ATTACHMENT B

Blue Line Improvements

Study of Grade Separations on the Los Angeles Metro Blue Line

Final Reports

Los Angeles County Metropolitan Transit Authority

July 24, 2018

Tasks

Task 1. – Draft Report with the proposed priority list formula explaining the approach used in developing the formula for all crossings (*)

Task 2. – Final Draft Report with Priority List of Grade Separations (*)

Task 3. – Final Detailed Report with Priority List of Grade Separations

Task 4. – Report recommending a package of recommended grade separations for each budget scenario with detailed reasoning and type of grade separations (**)

Task 5. – Rough order of magnitude cost estimates for each grade separation and each budget scenario (**)

Task 6. – Report of Milestone 1 and Milestone 2 analysis

(*) Draft and final draft reports with Priority List of Grade Separations integrated in final detailed report (task 3).

(**) Task 4 and Task 5 reports compiled in the same report.

TASK 3 – Final Detailed Report

Blue Line Improvements

Priority List of Grade Separations

Los Angeles County Metropolitan Transit Authority

July 19, 2018

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
01	5/8/2018	Incorporated Client Comments	✓	Vijay Khawani	Project Manager
02	5/16/2018	Incorporated Client Comments	✓	Vijay Khawani	Project Manager
03	7/19/2018	Final QAQC	✓	Vijay Khawani	Project Manager

Distribution List

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1. Introduction

The Metro Blue Line (MBL), opened in 1990, is a 22.0-mile light rail line running north-south between Downtown Los Angeles and Long Beach. Significant investments in safety measures over the past 28 years have been made to improve safety on the MBL and to reduce collisions with both vehicles and pedestrians along the alignment.

In an effort to continue enhancing safety on the MBL, AECOM recently completed the Wardlow Study to develop a prioritization formula which considered factors and data related to the 27 mid-corridor crossings along the MBL (See Zone 3 in **Figure 1** below). This formula was developed to assist in making priority decisions when considering grade separations as an investment option. In that study, collisions for a 10-year period (FY '07 – FY '17) were subcategorized to identify various correlations in the data and formulate discrete weighting factors from these trends. Other factors such as traffic volume, warning devices, intersection geometry, etc. were also evaluated.

Figure 1. – Project Overview Map.

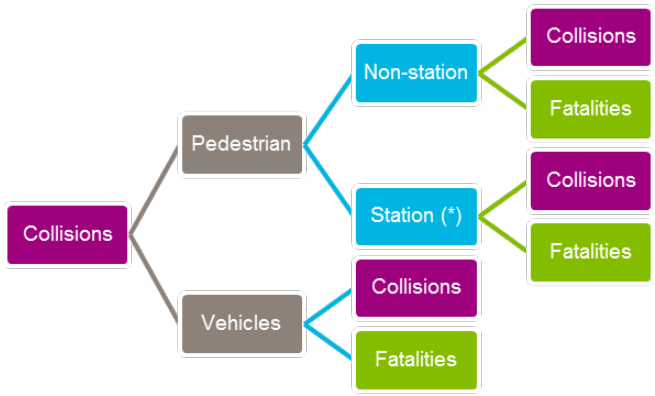
The scope of the current task order has now been expanded to develop a grade separation prioritization formula to include all 78 grade crossings along the MBL (see zones 1, 2, 4, and 5 in **Figure 1** above). As the previous formula was developed just for the 27 gated crossings, it was important to consider how previous factors are affected by the inclusion of non-gated crossings in the analysis set. Each of the prioritization factors identified in the previous study was evaluated in the context of the entire MBL and updated accordingly. Beyond this, we've considered additional factors to maximize benefits in terms of safety, operational efficiency, and improvements in cross traffic flows to formulate the revised version of the previous priority ranking formula.

Priority rankings will be analyzed for the full set of 78 grade crossings using both the previous formula as a baseline and the revised formula, modified to better reflect the characteristics of all 78 grade crossings along the MBL.

2. Previous MBL Safety Study for Wardlow Crossing

2.1 Collision Data

The foundation of the priority formula developed in the previous study was data obtained from 10-years (FY '07 – FY '17) of collision history for the MBL grade crossings.



(*) A station location is a crossing where there is a nearside or farside station located in immediate proximity of the vehicle-pedestrian at grade crossing.

Figure 2. – Collision Categorization.

Disaggregating the collisions, as shown above in **Figure 2** above, allowed for computation of potential weighting factors for all collisions vs. those resulting in fatalities as well as potential association of each type of collision with likely relevant factors such increased exposure (e.g., number of vehicles or pedestrian count). The categorizations were also used to identify trends in locations of collisions vs. fatalities to correlate them with specific conditions, such as time of day or unusual roadway geometries. As for the previous Wardlow study, suicides (e.g., "intentional deaths") were not considered for this analysis either. Also excluded were minor incidents at station platforms such as accidents where a train mirror may have grazed a patron standing too close the platform edge. The collision data reviewed was for public grade crossings only (excluding private driveways and dedicated station access crossings) to determine patterns in data including potential correlations with traffic volumes and pedestrian counts. The reason for the exclusions was based on the fact that such crossings are in close proximity to a public grade crossing, and grade separating the adjacent public crossing would inherently result in a grade separation of the dedicated station access or private crossing.

2.2 Prioritization Formula

The prioritization formula applicable to the mid-corridor crossings as presented in the previous study is as follows:

$$P = S_{SF} + V_P + f_{WD} \times V_V$$

The priority ranking score P reflects safety and mobility benefits resulting from grade separation:

- S_{SF}, the Safety Score, was established based upon an inferred association between site-specific factors positively correlated with locations where higher rates of collisions and fatalities were recorded – indeed, this term is higher in value at locations with higher collision rates.
- V_P, the Pedestrian Volume Score, also reflects potential safety benefits from the perspective that separation would reduce the exposure of pedestrians to crossing the rails which could reasonably be expected to reduce the number of resulting collisions even though the specific number of pedestrian collisions recorded did not directly correlate with pedestrian volumes.
- V_V, the Vehicular Volume Score, reflects the mobility benefit of grade separation because traffic delays are eliminated. To a degree, this term also reflects a safety benefit because exposure to potential collisions is

eliminated. However, since there were no fatalities associated with vehicular collisions recorded at the 27 gated crossings, the safety benefit for vehicles was much lower than the safety benefit for pedestrians.

- f_{WD}, the Warning Device factor, was added to distinguish between the different levels of risk at a 4-quadrant gated crossing compared to a 2-quadrant gated crossing.

The ranges assigned to each of the three primary factors were established so that the "safety" portion of the aggregate score would represent 50% of the weight, with the pedestrian volume and vehicular volumes each contributing 25% to the total score.

2.2.1 Safety Score

The safety component of the prioritization formula was developed by reviewing data at each of the potential grade crossing locations to determine correlations between candidate prioritization factors and the collision data. The weighting was established using an approach that takes into account the magnitude of correlation, resulting in the following formula.

$$S_{SF} = [F_{ST} \times ST + F_{SDR} \times SDR + F_{FR} \times FR + F_{ADJ} \times ADJ + F_{BS} \times BS + F_{SC} \times SC + AH]$$

As described above, the investigation into the prioritization factors completed as part of the previous study showed that the factors included in the safety score were highly correlated with the occurrence of collisions. The rest of the factors analyzed were excluded from the analysis due to the lack of correlation.

It is also important to mention that, as part of the previous study, the weighting coefficients used for each of the variables was based on the relative importance of the factor to predict collisions and fatalities.

The weighting factors used in the previous formula are as follows.

$$S_{SF} = 1.4 \times ST + 2.7 \times SDR + 1.6 \times FR + 1.3 \times ADJ + 1.2 \times BS + 1.0 \times SC + AH$$

$ST =$ Station located nearby the crossing

$SDR =$ Sight distance restriction

$FR =$ Freight (presence of freight tracks)

$ADJ =$ Adjacent signalized intersection

$BS =$ Bus Stops

$SC =$ Schools

$AH =$ Accident History (No. of Fatalities + 0.2 x No. of non-fatal collisions)

3. Baseline Results

To establish a baseline for any revisions to the formula, we applied the previous proposed formula to the full set of 78 grade crossings. Factor-by-factor results are detailed in the following sections, followed by the overall baseline priority rankings using that formula.

NOTE: Grade crossings are generally listed from North to South (Downtown Los Angeles to Long Beach) with gated crossings included in the previous study shaded green and newly analyzed, non-gated crossings shaded red.

Gated (Previous Study) **Non-gated**

3.1 Stations (ST)

The presence of a station adjacent to an at-grade crossing was found to correlate with higher collision rates compared to “non-station” crossings. Cross streets with station access pedestrian traffic require more pedestrian attention to avoid risky behavior at the grade crossing. Patrons concerned with transfers and/or station access/egress can become distracted while attempting to cross. In addition, there is the possibility of “another train coming” collision – a scenario where patrons observe a train that is berthed in a station and in their rush to board it, fail to observe or attempt to beat another train arriving into the station from the opposite direction. Grade crossings with adjacent stations are listed in **Table 1** below.

Crossings with Adjacent Stations	
Grand Ave.	Anaheim St.
Washington Blvd/Long Beach Ave.	6th St./LB Blvd.
Vernon Ave.	Broadway (Long Beach)
Florence Ave.	Long Beach Blvd./1st St.
103rd St.	Pine Ave./1st. St.
Compton Blvd.	Pacific Ave./1st. St.
Wardlow Rd.	4th St./Pacific Ave.
PCH	5th St./Pacific Ave.

Table 1. – Crossings with Adjacent Stations.

3.2 Sight Distance Restriction (SDR)

Crossings with restricted sight distance at one or both tracks may not allow a train operator to see an approaching vehicle or pedestrian until it is too late to bring the train to a stop. A correlation between higher collision frequency (for pedestrian – LRT collisions) was found at locations flagged with sight distance impairments in one or both approach quadrants. Because the particular type of sight distance impairment was varied and site-specific, this criteria was scored in a binary fashion – locations where sight distance restrictions where identified were scored as 1 vs 0 for locations with clear sight lines (500-800 feet up the track depending upon the train speed).

None of the crossings in the “street running” segments in Los Angeles and Long Beach have any sight distance restrictions because the LRT tracks are located within the roadway and approaching pedestrians and vehicles have a clear view up and down the rail line as they approach the track area. Grade crossings with sight distance restrictions are listed in Table 2 below.

Crossings with Sight Distance Restrictions
Gage Ave.
Florence Ave.
Century Blvd.
103rd St.
Wilmington Ave.

Table 2. – Crossings with Sight Distance Restrictions.

3.3 Freight (FR)

Grade crossings with adjacent freight tracks were found to have higher average collision rates compared to crossings with only LRT tracks. The presence of freight tracks requires pedestrians to negotiate multiple track crossings to traverse the crossing or use the station and are another source of “another train coming” type of collisions.

There is no freight track at any of the crossings along the “street running” segments in Los Angeles and Long Beach. However, all of the crossings in the “mid corridor” segment between 41st Street and Manville Road operate in a “shared corridor” with UPRR freight track(s).

Grade crossings with parallel freight tracks are listed in **Table 3** below.

Crossings with Adjacent Freight Tracks		
41st St.	Century Blvd.	Stockwell St.
Vernon Ave.	103rd St.	Elm St.
48th Pl.	108th St.	Compton Blvd.
55th St.	Wilmington Ave.	Myrrh St.
Gage Ave.	119th St.	Alondra Blvd.
Florence Ave.	124th St.	Greenleaf Blvd.
Nadeau St.	El Segundo Blvd.	Manville Rd.
92nd St.	130th St.	-

Table 3. – Crossings with Adjacent Freight Tracks.

3.4 Adjacent Signalized Intersections (ADJ)

Crossings that have adjacent signalized intersections could potentially result in vehicles queuing on the tracks or motorists on parallel streets driving under/around crossing gates to traverse the intersection.

There are signalized intersections immediately adjacent to many of the “mid-corridor” grade crossings where there are closely spaced parallel frontage roads on one or both sides of the rail corridor. However, there are no “adjacent” intersections in any of the street-running segments because the LRT tracks are included within the roadway intersections.

Grade crossings with adjacent signalized intersections are listed in **Table 4** below.

Crossings with Adjacent Signalized Intersections	
20th St.	124th St.
24th St.	El Segundo Blvd.
41st St.	130th St.
Vernon Ave.	Stockwell St.
48th Pl.	Compton Blvd.
Century Blvd.	Myrrh St.

Crossings with Adjacent Signalized Intersections	
103rd St.	Alondra Blvd.
119th St.	Wardlow Rd.

Table 4. – Crossings with Adjacent Signalized Intersections.

3.5 Proximity to Bus Stops (BS)

Bus stops adjacent to the LRT could be associated with higher collision rates in the event patrons attempting to make a transfer are distracted while crossing the track or exhibit risky behavior such as attempting to beat a train arriving into a station.

Along the street-running segments where stations are present, nearby bus stops are located far enough away from the platform ramp that patrons use to access and egress from the platform. As such, there is less likelihood that patrons could dart across the tracks attempting to make a transfer. Furthermore, in most cases, patrons have to risk illegally crossing multiple lanes of traffic before crossing the tracks to board trains in the street running sections of the alignment, making this risk unlikely.

Grade crossings with adjacent bus stops are listed in **Table 5** below.

Crossings with Adjacent Bus Stops		
41st St.	103rd St.	Elm St.
Vernon Ave.	Wilmington Ave.	Compton Blvd.
48th Pl.	119th St.	Myrrh St.
55th St.	124th St.	Alondra Blvd.
Florence Ave.	El Segundo Blvd.	Greenleaf Blvd.
Nadeau St.	130th St.	Wardlow Rd.
92nd St.	Stockwell St.	Spring St.
Century Blvd.	-	-

Table 5. – Crossings with Adjacent Bus Stops.

3.6 Schools (SC)

Crossings within in 0.25 miles of schools were given higher priority due to higher pedestrian volumes of school-age children utilizing the crossing.

The “Schools” factor is intended to represent use of the crossing for access to nearby schools by children and has not been applied in the vicinity of high schools or colleges. For example, the street running section along Washington Boulevard is adjacent to the Los Angeles Trade-Technical College and Frida Kahlo High School. As these schools are attended by young adults and not children, they have not been considered for this factor. However, further east along Washington Blvd., crossings within 0.25 miles of the Santee Education Complex and San Pedro Street Elementary School have been included as school-aged children may use these crossings to access the nearby facilities.

Grade crossings in close proximity to schools are listed in **Table 6** below.

Crossings with Nearby Schools	
55th St.	Wilmington Ave.
Florence Ave.	Stockwell St.
Nadeau St.	Myrrh St.
92nd St.	Alondra Blvd.
Century Blvd.	103rd St.
Wardlow Rd.	108th St.

Crossings with Nearby Schools	
San Pedro St.	Trinity St.
Los Angeles St.	Maple St.

Table 6. – Crossings with Nearby Schools.

3.7 Accident History Factor (AH)

Collisions and fatalities were tabulated in the AH term of the Safety Score. The primary collision data considered in the previous study was pedestrian fatalities (excluding suicides) with non-fatal collisions as a secondary consideration. As there were no vehicular collisions resulting in fatalities at any of the 27 gated crossings initially studied and there were far fewer vehicular collisions compared to pedestrian collisions (15 vs. 47), the previous prioritization formula did not consider vehicular collisions. However, as there were 4 vehicular fatalities and 142 vehicular collisions recorded in the non-gated sections over the same period, we included vehicular collision data in the baseline results. The number of total fatalities at each crossing plus 20% of the total pedestrian and vehicular non-fatal collisions was used as the final factor for the safety portion of the baseline formula. AH factors are listed in **Table 7** below.

Crossing Name	AH
18th St.	3.80
Gage Ave.	3.40
Vernon Ave.	3.20
103rd St.	2.80
Maple St.	2.80
Wilmington Ave.	2.20
Century Blvd.	2.20
Central Ave.	2.00
I-10 Freeway on-ramp	2.00
Burnett St.	1.60
Venice Blvd.	1.60
Nadeau St.	1.60
Los Angeles St.	1.40
Wardlow Rd.	1.40
119th St.	1.40
Main St.	1.40
7th St./Pacific Ave.	1.20
Pico Blvd.	1.20
3rd St./LB Blvd.	1.20
Stockwell St.	1.20
130th St.	1.20
El Segundo Blvd.	1.20
48th Pl.	1.20
Hill St.	1.20
PCH	1.00
Elm St.	1.00
124th St.	1.00
92nd St.	1.00

Crossing Name	AH
Alondra Blvd.	0.60
Florence Ave.	0.60
Washington Blvd/Long Beach Ave.	0.60
Naomi Ave.	0.60
Grand Ave.	0.60
Pine Ave./1st. St.	0.40
6th St./LB Blvd.	0.40
10th St.	0.40
Anaheim St.	0.40
20th St. (Long Beach)	0.40
Hill St. (Long Beach)	0.40
55th St.	0.40
Hooper Ave.	0.40
San Pedro St.	0.40
Washington Blvd/Flower St.	0.40
Broadway (Long Beach)	0.20
4th St./LB Blvd.	0.20
Spring St.	0.20
20th St.	0.20
Griffith Ave.	0.20
Trinity St.	0.20
Broadway	0.20
Long Beach Blvd./8th St. (duplicated)	0
Locust Ave. /8th St.	0
Pine Ave./8th St.	0
6th St./Pacific Ave.	0
Broadway/Pacific Ave.	0
Pacific Ave./1st. St.	0

Crossing Name	AH
41st St.	1.00
24th St.	1.00
4th St./Pacific Ave.	0.80
3rd St./Pacific Ave.	0.80
16th St.	0.80
19th St.	0.80
Olive St.	0.80
8th St./Pacific Ave. (Pacific Ave at 8th St (NB))	0.60
5th St./Pacific Ave.	0.60
7th St./LB Blvd.	0.60
14th St.	0.60

Crossing Name	AH
Locust Ave. (Promenade)1st St.	0
Long Beach Blvd./1st St.	0
8th St./LB Blvd. (Long Beach Blvd at 8th St (SB))	0
Willow St.	0
Long Beach Blvd.	0
Manville Rd.	0
Greenleaf Blvd.	0
Myrrh St.	0
Compton Blvd.	0
108th St.	0
12th St.	0

Table 7. – Baseline AH Factor Scores.

3.8 Safety Score (S_{SF})

The combined total of each of the safety factors (listed in **Sections 3.1 through 3.7** above) scaled by the respective weighting factors (as presented **Section 2.2.1**) makes up the Safety Score term for each crossing. This score is formulated to represent 50% of the weight of the overall priority ranking score, with the other 50% comprised of pedestrian and vehicular traffic volumes. Safety scores for each of the crossings are listed in **Table 8** below.

Crossing Name	SSF
103rd St.	11.9
Century Blvd.	10.0
Vernon Ave.	8.7
Wilmington Ave.	8.6
Florence Ave.	8.4
Gage Ave.	7.7
Stockwell St.	6.3
Wardlow Rd.	6.2
Alondra Blvd.	5.7
119th St.	5.5
Compton Blvd.	5.5
Nadeau St.	5.4
130th St.	5.3
El Segundo Blvd.	5.3
48th Pl.	5.3
124th St.	5.1
41st St.	5.1
Myrrh St.	5.1
92nd St.	4.8
55th St.	4.2
18th St.	3.8
Elm St.	3.8

Crossing Name	SSF
Venice Blvd.	1.6
Broadway (Long Beach)	1.6
20th St.	1.5
Main St.	1.4
Pacific Ave./1st. St.	1.4
Long Beach Blvd./1st St.	1.4
San Pedro St.	1.4
Spring St.	1.4
7th St./Pacific Ave.	1.2
Pico Blvd.	1.2
3rd St./LB Blvd.	1.2
Hill St.	1.2
Trinity St.	1.2
3rd St./Pacific Ave.	0.8
16th St.	0.8
19th St.	0.8
Olive St.	0.8
8th St./Pacific Ave. (Pacific Ave at 8th St (NB))	0.6
7th St./LB Blvd.	0.6
14th St.	0.6
Naomi Ave.	0.6
10th St.	0.4

Crossing Name	SSF	Crossing Name	SSF
Maple St.	3.8	20th St. (Long Beach)	0.4
Greenleaf Blvd.	2.8	Hill St. (Long Beach)	0.4
108th St.	2.6	Hooper Ave.	0.4
PCH	2.4	Washington Blvd/Flower St.	0.4
Los Angeles St.	2.4	4th St./LB Blvd.	0.2
24th St.	2.3	Griffith Ave.	0.2
4th St./Pacific Ave.	2.2	Broadway	0.2
Central Ave.	2.0	Long Beach Blvd./8th St. (duplicated)	0
I-10 Freeway on-ramp	2.0	Locust Ave. /8th St.	0
5th St./Pacific Ave.	2.0	Pine Ave./8th St.	0
Washington Blvd/Long Beach Ave.	2.0	6th St./Pacific Ave.	0
Grand Ave.	2.0	Broadway/Pacific Ave.	0
Pine Ave./1st. St.	1.8	Locust Ave. (Promenade)1st St.	0
6th St./LB Blvd.	1.8	8th St./LB Blvd. (Long Beach Blvd at 8th St (SB))	0
Anaheim St.	1.8	Willow St.	0
Manville Rd.	1.6	Long Beach Blvd.	0
Burnett St.	1.6	12th St.	0

Table 8. – Baseline Safety Scores.

3.9 Pedestrian Volumes (V_P)

The previous analysis considered the pedestrian traffic through the crossing area. Counts were tallied at crosswalks for the adjacent intersection(s) with adjustments to discount movements not made through the adjacent grade crossing. Raw data collection included both peak and off-peak pedestrian traffic. Adding the AM peak to the PM peak yields the most representative data set. The pedestrian volumes were ranked by determining six ranges with the highest volumes given a score of 6 and the lowest 1. **Table 9** shows the pedestrian volume ranges and **Table 10** shows the pedestrian volumes and scores for each crossing.

Maximum Pedestrian Volume		1,032
Minimum Pedestrian Volume		4
(Max-Min)		1,028
6	**Pedestrian Volume Range (Peak Hour)**	1000+
5		801 - 1,000
4		401 - 800
3		201 - 400
2		100 - 200
1		<100

Table 9. – Baseline Pedestrian Volume Ranges.

Crossing Name	Ped Vol	Score	Crossing Name	Ped Vol	Score	Crossing Name	Ped Vol	Score
Florence Ave.	1032	6	7th St./LB Blvd.	193	2	Griffith Ave.	99	1
San Pedro St.	793	4	3rd St./LB Blvd.	189	2	Nadeau St.	99	1
Vernon Ave.	776	4	12th St.	184	2	8th St./Pacific Ave.	96	1
Pico Blvd.	647	4	Central Ave.	178	2	Main St.	88	1
Pine/1st. St.	637	4	4th St./LB Blvd.	171	2	130th St.	82	1
PCH	561	4	3rd St./Pacific Ave.	170	2	108th St.	79	1
16th St.	549	4	Maple St.	169	2	Alondra Blvd.	79	1
Wash Blvd/Long Beach Ave.	541	4	Venice Blvd.	151	2	El Segundo Blvd.	73	1
Grand Ave.	513	4	7th St./Pacific Ave.	149	2	55th St.	70	1
Anaheim St.	459	4	20th St. (Long Beach)	144	2	119th St.	67	1
103rd St.	430	4	Wilmington Ave.	140	2	48th Pl.	64	1
Long Beach Blvd./1st St.	391	3	Century Blvd.	135	2	Burnett St.	64	1
Locust Ave. (Promenade)	313	3	Long Beach Blvd./8th St.	135	2	41st St.	60	1
Pacific Ave./1st. St.	299	3	Long Beach Blvd./8th St.	135	2	124th St.	59	1
Compton Blvd.	273	3	Elm St.	130	2	Wardlow Rd.	59	1
Broadway (Long Beach)	266	3	Hill St. (Long Beach)	129	2	Stockwell St.	54	1
6th St./LB Blvd.	258	3	Broadway/Pacific Ave.	128	2	Naomi Ave.	44	1
4th St./Pacific Ave.	257	3	6th St./Pacific Ave.	127	2	Gage Ave.	43	1
Broadway	247	3	Olive St.	125	2	18th St.	41	1
Locust/8th St.	238	3	Long Beach Blvd.	121	2	Myrrh St.	41	1
Trinity St.	234	3	92nd St.	117	2	Spring St.	40	1
Hill St.	232	3	Los Angeles St.	115	2	Greenleaf Blvd.	36	1
5th St./Pacific Ave.	231	3	Wash. Blvd/Flower St.	107	2	19th St.	30	1
Willow St.	222	3	14th St.	105	2	Hooper Ave.	23	1
10th St.	215	3				24th St.	20	1
Pine/8th St.	212	3				20th St.	17	1
						Manville Rd.	4	1
						I-10 Freeway on-ramp	0	1

Table 10. – Baseline Pedestrian Volumes and Scores.

3.10 Vehicular Volumes (Vv)

Crossings with higher traffic volume are subject to higher vehicular delays. Grade separations at locations with higher volumes would benefit more road users compared to locations with lower traffic levels. To maintain consistency with the approach used in the *LA Metro Grade Crossing Safety Policy,* the analysis considered the highest directional per-lane peak hour volume at each location. (Peak hour volumes were found to be closely correlated with the total Average Daily Traffic (ADT) which was also collected.) The vehicular volumes were calculated by dividing the peak hour directional volume by the number of lanes across the train tracks.

The volumes were ranked by determining six equal ranges with the highest volumes given a score of 6 and the lowest 1. **Table 11** shows the vehicular volume ranges and **Table 12** shows the vehicular volumes and scores for each crossing.

Max peak volume per lane		957
Min peak volume per lane		138
(Max-Min)		819
6	**Vehicular Volume Range (Peak Hour)**	700+
5		601-700
4		501-600
3		401-500
2		200-400
1		<200

Table 11. – Baseline Vehicular Volume Ranges.

Crossing Name	Veh Vol	Score	Crossing Name	Veh Vol	Score	Crossing Name	Veh Vol	Score
Greenleaf Blvd.	957	6	Pico Blvd.	399	2	18th St.	183	1
Wilmington	829	6	I-10 Fwy on ramp	398	2	4th St./LB Blvd.	172	1
Spring St.	780	6	Central Ave.	385	2	Hill St.	171	1
Gage Ave.	640	5	10th St.	384	2	16th St.	169	1
Hooper Ave.	636	5	Manville Rd.	382	2	Pine/8th St.	166	1
Wardlow Rd.	616	5	Naomi Ave.	376	2	20th St. (LB)	161	1
Nadeau St.	612	5	Main St.	373	2	20th St.	151	1
Wash/Flower	579	4	Willow St.	372	2	130th St.	138	1
Alondra Blvd.	576	4	Hill St.	340	2	4th/Pacific Ave.	133	1
El Segundo	541	4	San Pedro St.	338	2	Long Beach/1st	129	1
Broadway (LB)	534	4	7th St./Pacific	332	2	14th St.	85	1
Compton Blvd.	531	4	24th St.	326	2	Burnett St.	79	1
119th St.	527	4	108th St.	320	2	Locust/8th St.	58	1
Florence Ave.	510	4	Broadway	313	2	12th St.	23	1
Grand Ave.	502	4	103rd St.	311	2	5th/Pacific Ave.	19	1
6th St./LB Blvd.	488	3	Century Blvd.	302	2	19th St.	16	1
6th/Pacific Ave.	486	3	8th St./Pacific	298	2			
Long Beach Bd.	478	3	Trinity St.	295	2			

Crossing Name	Veh Vol	Score	Crossing Name	Veh Vol	Score	Crossing Name	Veh Vol	Score
Griffith Ave.	472	3	Los Angeles St.	293	2			
3rd St./LB Blvd.	471	3	55th St.	290	2			
92nd St.	467	3	Maple St.	268	2			
Broadway/Pac.	458	3	Olive St.	254	2			
Anaheim St.	454	3	Elm St.	252	2			
7th St./LB Blvd.	443	3	Pine/1st. St.	245	2			
3rd St./Pacific	441	3	48th Pl.	243	2			
41st St.	428	3	Stockwell St.	235	2			
PCH	424	3	Venice Blvd.	235	2			
Wash/LB Blvd	413	3	124th St.	217	2			
Vernon Ave.	404	3	8th St./LB Blvd	213	2			
Myrrh St.	403	3	Pacific/1st. St.	210	2			

Table 12. – Baseline Vehicular Volumes and Scores.

3.11 Warning Device Factor (f_{WD})

Crossings where four-quadrant crossing gates have been installed did not have any vehicular collisions in the ten-year accident history (there are six such locations). Should these locations be grade-separated, road users would benefit with a reduction in traffic delay and congestion but may not receive significant safety benefits. Accordingly, a "warning devices" factor was included in the priority formula to take into account the reduced total benefit of providing a grade separation at these locations.

To account for presence of warning devices which have a proven effect, a "warning device factor" f_{wd} was included. A factor of 1.0 represents "nominal" warning devices (e.g., no especial treatment present). Certain mid-corridor locations include four quadrant gates which have a proven effectiveness in eliminating crossing gate "drive around" incidents.

At the street running crossings, the nominal warning device factor of 1.0 was used for locations where traffic signals are present and are used to control conflicting traffic movements at the grade crossing (as this is the usual device used.) However, there is a left-turn crossing gate located at the I-10 freeway on-ramp so a factor of 0.5 was used for this location only to reflect the presence of this additional safety measure.

Table 13 shows the warning device factors considered at each location.

Crossing Name	f_{WD}	Crossing Name	f_{WD}	Crossing Name	f_{WD}
12th St.	1.0	Gage Ave.	1.0	19th St.	1.0
Pico Blvd.	1.0	Florence Ave.	1.0	PCH	1.0
Venice Blvd.	1.0	Nadeau St.	1.0	16th St.	1.0
I-10 fwy on ramp	**0.5**	92nd St.	1.0	14th St.	1.0
18th St.	1.0	Century Blvd.	1.0	Anaheim St.	1.0
Wash/Flower St.	1.0	103rd St.	1.0	10th St.	1.0
Grand Ave.	1.0	108th St.	1.0	8th St./LB Blvd	1.0
Olive St.	1.0	Wilmington Ave.	1.0	7th St./LB Blvd.	1.0
Hill St.	1.0	119th St.	1.0	6th St./LB Blvd.	1.0
Broadway	1.0	124th St.	**0.5**	4th St./LB Blvd.	1.0
Main St.	1.0	El Segundo Blvd.	1.0	3rd St./LB Blvd.	1.0

Crossing Name	f_{WD}	Crossing Name	f_{WD}	Crossing Name	f_{WD}
Los Angeles St.	1.0	130th St.	1.0	Broadway (LB)	1.0
Maple St.	1.0	Stockwell St.	1.0	LB Blvd./1st St.	1.0
Trinity St.	1.0	Elm St.	**0.5**	(Promenade)1st St.	1.0
San Pedro St.	1.0	Compton Blvd.	**0.5**	Pine Ave./1st. St.	1.0
Griffith Ave.	1.0	Myrrh St.	**0.5**	Pacific Ave./1st. St.	1.0
Central Ave.	1.0	Alondra Blvd.	**0.5**	Broadway/Pacific Ave.	1.0
Naomi Ave.	1.0	Greenleaf Blvd.	**0.5**	3rd St./Pacific Ave.	1.0
Hooper Ave.	1.0	Manville Rd.	1.0	4th St./Pacific Ave.	1.0
Wash/Long Beach Ave.	1.0	Wardlow Rd.	1.0	5th St./Pacific Ave.	1.0
20th St.	1.0	Spring St.	1.0	6th St./Pacific Ave.	1.0
24th St.	1.0	Long Beach Blvd.	1.0	7th St./Pacific Ave.	1.0
41st St.	1.0	Willow St.	1.0	8th St./Pacific Ave.	1.0
Vernon Ave.	1.0	Burnett St.	1.0	Pine Ave./8th St.	1.0
48th Pl.	1.0	Hill St. (LB)	1.0	Locust Ave. /8th St.	1.0
55th St.	1.0	20th St. (LB)	1.0		

Table 13. – Baseline Warning Device Factors.

3.12 Baseline Prioritization Rankings

The resulting priority ranking scores for the full set of grade crossings along the MBL using the previous formula are shown in **Table 14** below.

#	Crossing Name	S_{SF}	V_P	f_{WD}	V_V	P
1	Florence Ave.	**8.4**	**6.0**	**1.0**	**4.0**	**18.4**
2	103rd St.	**11.9**	**4**	1.0	**2**	**17.9**
3	Wilmington Ave.	**8.6**	**2**	1.0	**6**	**16.6**
4	Vernon Ave.	**8.7**	**4**	1.0	**3**	**15.7**
5	Century Blvd.	**10.0**	**2**	1.0	**2**	**14.0**
6	Gage Ave.	**7.7**	**1**	1.0	**5**	**13.7**
7	Wardlow Rd.	**6.2**	**1**	1.0	**5**	**12.2**
8	Nadeau St.	**5.4**	**1**	1.0	**5**	**11.4**
9	119th St.	**5.5**	**1**	1.0	**4**	**10.5**
10	Compton Blvd.	**5.5**	**3**	0.5	**4**	**10.5**
11	El Segundo Blvd.	**5.3**	**1**	1.0	**4**	**10.3**
12	Grand Ave.	**2.0**	**4**	1.0	**4**	**10.0**
13	92nd St.	**4.8**	**2**	1.0	**3**	**9.8**
14	PCH	**2.4**	**4**	1.0	**3**	**9.4**
15	Stockwell St.	**6.3**	**1**	1.0	**2**	**9.3**
16	41st St.	**5.1**	**1**	1.0	**3**	**9.1**
17	Washington Blvd/Long Beach Ave.	**2.0**	**4**	1.0	**3**	**9.0**
18	Anaheim St.	**1.8**	**4**	1.0	**3**	**8.8**
19	Alondra Blvd.	**5.7**	**1**	0.5	**4**	**8.7**
20	Broadway (Long Beach)	**1.6**	**3**	1.0	**4**	**8.6**

#	Crossing Name	S_{SF}	V_P	f_{WD}	V_V	P
40	4th St./Pacific Ave.	**2.2**	**3**	1.0	**1**	**6.2**
41	Trinity St.	**1.2**	**3**	1.0	**2**	**6.2**
42	Central Ave.	**2.0**	**2**	1.0	**2**	**6.0**
43	5th St./Pacific Ave.	**2.0**	**3**	1.0	**1**	**6.0**
44	18th St.	**3.8**	**1**	1.0	**1**	**5.8**
45	3rd St./Pacific Ave.	**0.8**	**2**	1.0	**3**	**5.8**
46	16th St.	**0.8**	**4**	1.0	**1**	**5.8**
47	108th St.	**2.6**	**1**	1.0	**2**	**5.6**
48	Venice Blvd.	**1.6**	**2**	1.0	**2**	**5.6**
49	7th St./LB Blvd.	**0.6**	**2**	1.0	**3**	**5.6**
50	10th St.	**0.4**	**3**	1.0	**2**	**5.4**
51	Long Beach Blvd./1st St.	**1.4**	**3**	1.0	**1**	**5.4**
52	24th St.	**2.3**	**1**	1.0	**2**	**5.3**
53	7th St./Pacific Ave.	**1.2**	**2**	1.0	**2**	**5.2**
54	Broadway	**0.2**	**3**	1.0	**2**	**5.2**
55	6th St./Pacific Ave.	**0.0**	**2**	1.0	**3**	**5.0**
56	Broadway/Pacific Ave.	**0.0**	**2**	1.0	**3**	**5.0**
57	Willow St.	**0.0**	**3**	1.0	**2**	**5.0**
58	Long Beach Blvd.	**0.0**	**2**	1.0	**3**	**5.0**
59	Olive St.	**0.8**	**2**	1.0	**2**	**4.8**

#	Crossing Name	S_{SF}	V_P	f_{WD}	V_V	*P*
21	Spring St.	**1.4**	**1**	1.0	**6**	**8.4**
22	48th Pl.	**5.3**	**1**	1.0	**2**	**8.3**
23	Pine Ave./1st. St.	**1.8**	**4**	1.0	**2**	**7.8**
24	6th St./LB Blvd.	**1.8**	**3**	1.0	**3**	**7.8**
25	Maple St.	**3.8**	**2**	1.0	**2**	**7.8**
26	Myrrh St.	**5.1**	**1**	0.5	**3**	**7.6**
27	San Pedro St.	**1.4**	**4**	1.0	**2**	**7.4**
28	130th St.	**5.3**	**1**	1.0	**1**	**7.3**
29	Pico Blvd.	**1.2**	**4**	1.0	**2**	**7.2**
30	55th St.	**4.2**	**1**	1.0	**2**	**7.2**
31	124th St.	**5.1**	**1**	0.5	**2**	**7.1**
32	Elm St.	**3.8**	**2**	0.5	**2**	**6.8**
33	Greenleaf Blvd.	**2.8**	**1**	0.5	**6**	**6.8**
34	Hooper Ave.	**0.4**	**1**	1.0	**5**	**6.4**
35	Washington Blvd/Flower St.	**0.4**	**2**	1.0	**4**	**6.4**
36	Pacific Ave./1st. St.	**1.4**	**3**	1.0	**2**	**6.4**
37	Los Angeles St.	**2.4**	**2**	1.0	**2**	**6.4**
38	3rd St./LB Blvd.	**1.2**	**2**	1.0	**3**	**6.2**
39	Hill St.	**1.2**	**3**	1.0	**2**	**6.2**
60	Manville Rd.	**1.6**	**1**	1.0	**2**	**4.6**
61	Main St.	**1.4**	**1**	1.0	**2**	**4.4**
62	Griffith Ave.	**0.2**	**1**	1.0	**3**	**4.2**
63	I-10 Freeway on-ramp	**2.0**	**1**	0.5	**2**	**4.0**
64	Long Beach Blvd./8th St. (duplicated)	**0.0**	**2**	1.0	**2**	**4.0**
65	Locust Ave. /8th St.	**0.0**	**3**	1.0	**1**	**4.0**
66	Pine Ave./8th St.	**0.0**	**3**	1.0	**1**	**4.0**
67	8th St./LB Blvd. (Long Beach Blvd at 8th St (SB))	**0.0**	**2**	1.0	**2**	**4.0**
68	Burnett St.	**1.6**	**1**	1.0	**1**	**3.6**
69	8th St./Pacific Ave. (Pacific Ave at 8th St (NB))	**0.6**	**1**	1.0	**2**	**3.6**
70	14th St.	**0.6**	**2**	1.0	**1**	**3.6**
71	Naomi Ave.	**0.6**	**1**	1.0	**2**	**3.6**
72	20th St.	**1.5**	**1**	1.0	**1**	**3.5**
73	20th St. (Long Beach)	**0.4**	**2**	1.0	**1**	**3.4**
74	Hill St. (Long Beach)	**0.4**	**2**	1.0	**1**	**3.4**
75	4th St./LB Blvd.	**0.2**	**2**	1.0	**1**	**3.2**
76	Locust Ave. (Promenade)1st St.	**0.0**	**3**	1.0	**0**	**3.0**
77	12th St.	**0**	**2**	1.0	**1**	**3**
78	19th St.	**0.8**	**1**	1.0	**1**	**2.8**

Table 14. – Baseline Grade Separation Prioritization Rankings.

The baseline priority rankings are similar to the previous study, with the top 11 crossings remaining unchanged from the previous study. Florence Ave., 103rd, Wilmington Ave., and Vernon Ave are the top four locations recommended for grade separation from the baseline rankings.

As the baseline rankings do not address factors specific to the non-gated crossings, it was necessary to revise the priority ranking formula, and analyze each factor in the context of the entire MBL.

4. Revised Formula

In the analysis of all 78 MBL grade crossings, the formula was adapted to consider non-gated crossings, controlled by traffic signals for motorists and train 'bar' type signals for trains, in addition to the gated mid-corridor crossings. This required re-analysis of certain safety factors to consider the type, frequency and severity of collisions at non-gated crossings.

In addition, the ranges previously used for pedestrian and vehicular volumes were reconsidered to reflect the full range of Blue Line grade crossings. The same ten year collision period (FY-07-FY17) that was used for the previous study of the 27 gated crossings was used for this study of all crossings. Potential updates were analyzed for each factor. If no revisions were necessary, the factor was applied in the same way as in the baseline rankings outlined above. Any revised factors are detailed in the following sections.

4.1 Accident History Term

Comparison of the collision histories of the mid-corridor gated crossings versus the street-running ungated crossings reveals that the type, frequency, and severity are substantially different between the two crossing types: The mid-corridor crossings recorded more pedestrian collisions than vehicular collisions, and a higher percentage of the collisions resulted in pedestrian fatalities. In fact, there were no fatalities associated with vehicular collisions in the mid-corridor crossings. In contrast, there was only one pedestrian fatality in the non-gated sections (one which was identified as a trespass incident presumably did not occur at a grade crossing), but there were four vehicular fatalities resulting from collisions in street-running sections all of which were due to "left-hand turn" incidents. Therefore, the computation of the Accident History term needed to be revised to reflect these differences, as further explained below.

For the baseline rankings, we counted all fatalities and applied the same 20% factor to all non-fatal collisions, pedestrian or vehicular. It was immediately clear that the 146 non-fatal vehicular collisions observed within the non-gated sections were weighted too heavily compared to fatalities and pedestrian collisions. Vehicular fatalities and collision data for the additional non-gated crossings were more accurately incorporated by expanding the Accident History term (AH) to consider vehicular collisions and fatalities separately as such:

$$AH = F_{veh} \times a + C_{veh} \times b + F_{ped} \times c + C_{ped} \times d$$

Where:

F_{veh} = Number of vehicular fatalities

C_{veh} = Number of vehicular collisions

F_{ped} = Number of pedestrian fatalities

C_{ped} = Number of pedestrian collisions

a = Weighting factor for vehicular fatalities

b = Weighting factor for vehicular collisions

c = Weighting factor for pedestrian fatalities

d = Weighting factor for pedestrian collisions

Our approach was as follows:

- The weighting factors for vehicular fatalities (a) and pedestrian fatalities (c) should equal **1.0** in all cases as our methodology considers collision weighting factors in reference to the value of a life.
- The weighting factor for pedestrian collisions (d) should remain as **0.2** considering per the logic applied in the baseline formula.
- The weighting factor for vehicular collisions (b) considers the likelihood of both pedestrian and vehicular collisions resulting in a fatalities. 24/53 (45%) of total pedestrian collisions resulted in a fatality while only 4/146 (2%) of total vehicular collisions resulted in a fatality. The ratio of these likelihoods (2%/45%) was multiplied by the established weighting factor for pedestrian collisions (0.2) to yield a weighting factor for vehicular collisions of **0.01**.

See **Table 15** below for the revised AH factors.

Crossing Name	AH (Baseline)	AH (Revised)
18th St.	3.80	1.14
Gage Ave.	3.40	3.22
Vernon Ave.	3.20	3.20

Crossing Name	AH (Baseline)	AH (Revised)
Alondra Blvd.	0.60	0.60
Florence Ave.	0.60	0.42
Washington Blvd/Long Beach Ave.	0.60	0.03

Crossing Name	AH (Baseline)	AH (Revised)
103rd St.	2.80	2.44
Maple St.	2.80	2.04
Wilmington Ave.	2.20	2.02
Century Blvd.	2.20	2.20
Central Ave.	2.00	0.10
I-10 Freeway on-ramp	2.00	0.10
Burnett St.	1.60	1.03
Venice Blvd.	1.60	0.08
Nadeau St.	1.60	1.42
Los Angeles St.	1.40	0.07
Wardlow Rd.	1.40	1.40
119th St.	1.40	1.04
Main St.	1.40	0.45
7th St./Pacific Ave.	1.20	0.06
Pico Blvd.	1.20	0.06
3rd St./LB Blvd.	1.20	1.01
Stockwell St.	1.20	1.20
130th St.	1.20	1.02
El Segundo Blvd.	1.20	1.20
48th Pl.	1.20	1.20
Hill St.	1.20	1.01
PCH	1.00	0.05
Elm St.	1.00	1.00
124th St.	1.00	1.00
92nd St.	1.00	1.00
41st St.	1.00	0.28
24th St.	1.00	1.00
4th St./Pacific Ave.	0.80	0.04
3rd St./Pacific Ave.	0.80	0.04
16th St.	0.80	0.04
19th St.	0.80	0.04
Olive St.	0.80	0.04
8th St./Pacific Ave. (Pacific Ave at 8th St (NB))	0.60	0.03
5th St./Pacific Ave.	0.60	0.22
7th St./LB Blvd.	0.60	0.03
14th St.	0.60	0.03

Crossing Name	AH (Baseline)	AH (Revised)
Naomi Ave.	0.60	0.03
Grand Ave.	0.60	0.22
Pine Ave./1st. St.	0.40	0.02
6th St./LB Blvd.	0.40	0.02
10th St.	0.40	0.02
Anaheim St.	0.40	0.02
20th St. (Long Beach)	0.40	0.02
Hill St. (Long Beach)	0.40	0.02
55th St.	0.40	0.22
Hooper Ave.	0.40	0.02
San Pedro St.	0.40	0.02
Washington Blvd/Flower St.	0.40	0.02
Broadway (Long Beach)	0.20	0.01
4th St./LB Blvd.	0.20	0.01
Spring St.	0.20	0.02
20th St.	0.20	0.20
Griffith Ave.	0.20	0.01
Trinity St.	0.20	0.01
Broadway	0.20	0.01
Long Beach Blvd./8th St. (duplicated)	0	0.00
Locust Ave. /8th St.	0	0.00
Pine Ave./8th St.	0	0.00
6th St./Pacific Ave.	0	0.00
Broadway/Pacific Ave.	0	0.00
Pacific Ave./1st. St.	0	0.00
Locust Ave. (Promenade)1st St.	0	0.00
Long Beach Blvd./1st St.	0	0.00
8th St./LB Blvd. (Long Beach Blvd at 8th St (SB))	0	0.00
Willow St.	0	0.00
Long Beach Blvd.	0	0.00
Manville Rd.	0	0.00
Greenleaf Blvd.	0	0.00
Myrrh St.	0	0.00
Compton Blvd.	0	0.00
108th St.	0	0.00
12th St.	0	0.00

Table 15. – Revised AH Factors.

While many of the AH terms remained the same or saw only minor changes, there were a few notable changes that resulted. Where 18th St. had the top AH score of 3.8 using the baseline formula, the revised formula reduced the AH score to 1.14. Maple St., while still one of the top 5 highest AH scores, shifted below Century Blvd.

Effectively, the revised formula accounts for the disproportionately high weighting of non-fatal vehicular collisions over non-fatal pedestrian collisions seen in the baseline formula by more accurately reflecting the probability of any given collision resulting in a fatality, which is much greater in the case of pedestrian collisions.

4.2 Vehicular Volumes

In the initial study of the 27 gated crossings, the vehicular volumes were calculated by dividing the peak hour directional volume by the number of lanes crossing the train tracks. These peak vehicular volumes per lane crossing the tracks were ranked by determining six equal ranges with the highest volumes given a score of 6 and the lowest 1. As intersections with LOS A and B do not experience significant traffic delays, safety benefits from grade separation at these intersections are similarly minimal. For this reason, we have combined vehicular volumes less than 560 vehicle/lane (LOS A and B) into the lowest category (1) and subsequently grouped the remaining intersections into 4 groups with Vehicular Volume scores ranging from 3 to 6 per **Table 16** with the revised scores for each crossing listed in **Table 17**.

Max peak volume per lane		957
Min peak volume per lane		16
(Max-Min)		941
6	**Vehicular Volume Range (Peak Hour)**	800+
5		720-800
4		640-720
3		560-640
1		<560

Table 16. – Revised Vehicular Volume Ranges.

Crossing Name	Veh Vol	Score	Crossing Name	Veh Vol	Score	Crossing Name	Veh Vol	Score
Greenleaf Blvd.	957	6	PCH	424	1	Elm St.	252	1
Wilmington Ave.	829	6	Wash/Long Beach Ave.	413	1	Pine Ave./1st. St.	245	1
Spring St.	780	5	Vernon Ave.	404	1	48th Pl.	243	1
Gage Ave.	640	4	Myrrh St.	403	1	Stockwell St.	235	1
Hooper Ave.	636	3	Pico Blvd.	399	1	Venice Blvd.	235	1
Wardlow Rd.	616	3	I-10 Freeway on-ramp	398	1	124th St.	217	1
Nadeau St.	612	3	Central Ave.	385	1	8th St./LB Blvd.	213	1
Washington Blvd/Flower St.	579	3	10th St.	384	1	Pacific Ave./1st. St.	210	1
Alondra Blvd.	576	3	Manville Rd.	382	1	18th St.	183	1
El Segundo Blvd.	541	1	Naomi Ave.	376	1	4th St./LB Blvd.	172	1
Broadway (Long Beach)	534	1	Main St.	373	1	Hill St. (Long Beach)	171	1
Compton Blvd.	531	1	Willow St.	372	1	16th St.	169	1
119th St.	527	1	Hill St.	340	1	Pine Ave./8th St.	166	1
Florence Ave.	510	1	San Pedro St.	338	1	20th St. (Long Beach)	161	1

Crossing Name	Veh Vol	Score	Crossing Name	Veh Vol	Score	Crossing Name	Veh Vol	Score
Grand Ave.	502	1	7th St./Pacific Ave.	332	1	20th St.	151	1
6th St./LB Blvd.	488	1	24th St.	326	1	130th St.	138	1
6th St./Pacific Ave.	486	1	108th St.	320	1	4th St./Pacific Ave.	133	1
Long Beach Blvd.	478	1	Broadway	313	1	Long Beach Blvd./1st St.	129	1
Griffith Ave.	472	1	103rd St.	311	1	14th St.	85	1
3rd St./LB Blvd.	471	1	Century Blvd.	302	1	Burnett St.	79	1
92nd St.	467	1	8th St./Pacific Ave	298	1	Locust Ave. /8th St.	58	1
Broadway/Pacific Ave.	458	1	Trinity St.	295	1	12th St.	23	1
Anaheim St.	454	1	Los Angeles St.	293	1	5th St./Pacific Ave.	19	1
7th St./LB Blvd.	443	1	55th St.	290	1	19th St.	16	1
3rd St./Pacific Ave.	441	1	Maple St.	268	1	(Promenade)1st St.	0	N/A
41st St.	428	1	Olive St.	254	1			

Table 17. – Revised Vehicular Volume Scores.

4.3 Revised Priority Rankings

The priority ranking scores for the full set of grade crossings along the MBL using the revised formula are shown in **Table 18** below.

#	Crossing Name	S_{SF}	V_P	f_{WD}	V_V	*P*
1	103rd St.	**11.6**	**4**	1.0	**1**	**16.6**
2	Wilmington Ave.	**8.5**	**2**	1.0	**6**	**16.5**
3	Florence Ave.	**8.2**	**6**	1.0	**1**	**15.2**
4	Vernon Ave.	**8.7**	**4**	1.0	**1**	**13.7**
5	Century Blvd.	**10.0**	**2**	1.0	**1**	**13.0**
6	Gage Ave.	**7.5**	**1**	1.0	**4**	**12.5**
7	Wardlow Rd.	**6.2**	**1**	1.0	**3**	**10.2**
8	Nadeau St.	**5.2**	**1**	1.0	**3**	**9.2**
9	Compton Blvd.	**5.5**	**3**	0.5	**1**	**9.0**
10	Stockwell St.	**6.3**	**1**	1.0	**1**	**8.3**
11	Alondra Blvd.	**5.7**	**1**	0.5	**3**	**8.2**
12	92nd St.	**4.8**	**2**	1.0	**1**	**7.8**
13	El Segundo Blvd.	**5.3**	**1**	1.0	**1**	**7.3**
14	48th Pl.	**5.3**	**1**	1.0	**1**	**7.3**
15	Spring St.	**1.2**	**1**	1.0	**5**	**7.2**
16	119th St.	**5.2**	**1**	1.0	**1**	**7.2**
17	130th St.	**5.1**	**1**	1.0	**1**	**7.1**
18	Greenleaf Blvd.	**2.8**	**1**	0.5	**6**	**6.8**

#	Crossing Name	S_{SF}	V_P	f_{WD}	V_V	*P*
39	Washington Blvd/Flower St.	**0.0**	**2**	1.0	**3**	**5.0**
40	Hill St.	**1.0**	**3**	1.0	**1**	**5.0**
41	Trinity St.	**1.0**	**3**	1.0	**1**	**5.0**
42	108th St.	**2.6**	**1**	1.0	**1**	**4.6**
43	24th St.	**2.3**	**1**	1.0	**1**	**4.3**
44	Los Angeles St.	**1.0**	**2**	1.0	**1**	**4.0**
45	10th St.	**0.0**	**3**	1.0	**1**	**4.0**
46	Hooper Ave.	**0.0**	**1**	1.0	**3**	**4.0**
47	3rd St./LB Blvd.	**1.0**	**2**	1.0	**1**	**4.0**
48	Broadway	**0.0**	**3**	1.0	**1**	**4.0**
49	Locust Ave. /8th St.	**0.0**	**3**	1.0	**1**	**4.0**
50	Pine Ave./8th St.	**0.0**	**3**	1.0	**1**	**4.0**
51	Willow St.	**0.0**	**3**	1.0	**1**	**4.0**
52	Manville Rd.	**1.6**	**1**	1.0	**1**	**3.6**
53	20th St.	**1.5**	**1**	1.0	**1**	**3.5**
54	18th St.	**1.1**	**1**	1.0	**1**	**3.1**
55	Central Ave.	**0.1**	**2**	1.0	**1**	**3.1**
56	Venice Blvd.	**0.1**	**2**	1.0	**1**	**3.1**

#	Crossing Name	S_{SF}	V_P	f_{WD}	V_V	*P*
19	124th St.	**5.1**	**1**	0.5	**1**	**6.6**
20	Myrrh St.	**5.1**	**1**	0.5	**1**	**6.6**
21	Grand Ave.	**1.6**	**4**	1.0	**1**	**6.6**
22	PCH	**1.4**	**4**	1.0	**1**	**6.4**
23	41st St.	**4.4**	**1**	1.0	**1**	**6.4**
24	Washington Blvd/Long Beach Ave.	**1.4**	**4**	1.0	**1**	**6.4**
25	Pine Ave./1st. St.	**1.4**	**4**	1.0	**1**	**6.4**
26	Anaheim St.	**1.4**	**4**	1.0	**1**	**6.4**
27	Elm St.	**3.8**	**2**	0.5	**1**	**6.3**
28	Maple St.	**3.0**	**2**	1.0	**1**	**6.0**
29	San Pedro St.	**1.0**	**4**	1.0	**1**	**6.0**
30	55th St.	**4.0**	**1**	1.0	**1**	**6.0**
31	5th St./Pacific Ave.	**1.6**	**3**	1.0	**1**	**5.6**
32	4th St./Pacific Ave.	**1.4**	**3**	1.0	**1**	**5.4**
33	6th St./LB Blvd.	**1.4**	**3**	1.0	**1**	**5.4**
34	Broadway (Long Beach)	**1.4**	**3**	1.0	**1**	**5.4**
35	Pacific Ave./1st. St.	**1.4**	**3**	1.0	**1**	**5.4**
36	Long Beach Blvd./1st St.	**1.4**	**3**	1.0	**1**	**5.4**
37	Pico Blvd.	**0.1**	**4**	1.0	**1**	**5.1**
38	16th St.	**0.0**	**4**	1.0	**1**	**5.0**

#	Crossing Name	S_{SF}	V_P	f_{WD}	V_V	*P*
57	7th St./Pacific Ave.	**0.1**	**2**	1.0	**1**	**3.1**
58	3rd St./Pacific Ave.	**0.0**	**2**	1.0	**1**	**3.0**
59	Olive St.	**0.0**	**2**	1.0	**1**	**3.0**
60	Burnett St.	**1.0**	**1**	1.0	**1**	**3.0**
61	7th St./LB Blvd.	**0.0**	**2**	1.0	**1**	**3.0**
62	14th St.	**0.0**	**2**	1.0	**1**	**3.0**
63	20th St. (Long Beach)	**0.0**	**2**	1.0	**1**	**3.0**
64	Hill St. (Long Beach)	**0.0**	**2**	1.0	**1**	**3.0**
65	4th St./LB Blvd.	**0.0**	**2**	1.0	**1**	**3.0**
66	Long Beach Blvd./8th St. (duplicated)	**0.0**	**2**	1.0	**1**	**3.0**
67	6th St./Pacific Ave.	**0.0**	**2**	1.0	**1**	**3.0**
68	Broadway/Pacific Ave.	**0.0**	**2**	1.0	**1**	**3.0**
69	Locust Ave. (Promenade)1st St.	**0.0**	**3**	1.0	**0**	**3.0**
70	8th St./LB Blvd. (Long Beach Blvd at 8th St (SB))	**0.0**	**2**	1.0	**1**	**3.0**
71	Long Beach Blvd.	**0.0**	**2**	1.0	**1**	**3.0**
73	12th St.	**0.0**	**2**	1.0	**1**	**3.0**
74	Main St.	**0.5**	**1**	1.0	**1**	**2.5**
75	19th St.	**0.0**	**1**	1.0	**1**	**2.0**
76	8th St./Pacific Ave. (Pacific Ave at 8th St (NB))	**0.0**	**1**	1.0	**1**	**2.0**
77	Naomi Ave.	**0.0**	**1**	1.0	**1**	**2.0**
78	Griffith Ave.	**0.01**	**1**	1.0	**1**	**2.0**

Table 18. – Revised Grade Separation Prioritization Rankings.

5. Conclusions

It is clear from the final scoring of the crossings that there are 3 crossings at the top of the list with similar scores, and a second group of relatively higher scores comprised of 6 additional crossings. All the remaining crossings had scores that were less than half of the value of the top ranked 103rd St.

Highest Benefits

- 103rd St.
- Wilmington Ave.
- Florence Ave.

Moderate Benefits

- Vernon Ave.
- Century Blvd.
- Gage Ave.
- Wardlow Rd.
- Nadeau St.
- Compton Blvd.

Minimal Benefits

- Remaining (68 crossings)

Figure 3. – Groups of crossings with High, Moderate & Low Scores.

From this initial priority ranking list, we have started looking at preliminary grade separation concepts for the top 10 crossings and establishing grade separation groupings. For example, if 103rd St. is to be grade separated, it will be necessary to also grade separate Century Blvd as part of the same project. Using these concepts, we will then estimate costs for each alternative and begin analysis of the 3 budget scenarios: $250M, $500M, $750M.

Appendix A. – Master Spreadsheet

Item No.	Location description	Gated (Yes/No)	Xings Ped Collision excluding Suicides	Station Ped Collisions exluding Suicides	Total Observed Ped Collisions (*)	Xings Ped Fatalities	Station Ped Fatalities	Total Observed Ped Fatalities (*)	Xings Veh Collisions excluding Suicides	Station Veh Collisions	Total Observed Vehicular Collisions (*)	Xings Veh Fatalities	Station Veh Fatalities	Total Vehicular Fatalities (*)
1	Long Beach Blvd./8th St. (duplicated)	No	0	0	0	0	0	0	0	0	0	0	0	0
2	Locust ave. /8th St.	No	0		0	0		0	0		0	0		0
3	Pine Ave./8th St.	No	0		0	0		0	0		0	0		0
4	8th St./Pacific Ave. (Pacific Ave at 8th St (NB))	No	0		0	0		0	3		3	0		0
5	7th St./Pacific Ave.	No	0		0	0		0	6		6	0		0
6	6th St./Pacific Ave.	No	0		0	0		0	0		0	0		0
7	5th St./Pacific Ave.	No	1		1	0		0	2		2	0		0
8	4th St./Pacific Ave.	No	0		0	0		0	4		4	0		0
9	3rd St./Pacific Ave.	No	0		0	0		0	4		4	0		0
10	Broadway/Pacific Ave.	No	0		0	0		0	0		0	0		0
11	Pacific Ave./1st. St.	No	0		0	0		0	0		0	0		0
12	Pine Ave./1st. St.	No	0		0	0		0	2		2	0		0
13	Locust Ave. (Promenade)1st St.	No	0		0	0		0	0		0	0		0
14	Long Beach Blvd./1st St.	No	0	0	0	0	0	0	0	0	0	0	0	0
15	Broadway (Long Beach)	No	0		0	0		0	1		1	0		0
16	3rd St./LB Blvd.	No	0		0	0		0	2		2	1		1
17	4th St./LB Blvd.	No	0		0	0		0	1		1	0		0
18	6th St./LB Blvd.	No	0		0	0		0	2		2	0		0
19	7th St./LB Blvd.	No	0		0	0		0	3		3	0		0
20	8th St./LB Blvd. (Long Beach Blvd at 8th St (SB))	No	0		0	0		0	0		0	0		0
21	10th St.	No	0		0	0		0	2		2	0		0
22	Anaheim St.	No	0		0	0		0	2		2	0		0
23	14th St.	No	0		0	0		0	3		3	0		0
24	16th St.	No	0		0	0		0	4		4	0		0
25	PCH	No	0	0	0	0	0	0	5	0	5	0	0	0
26	19th St.	No	0		0	0		0	4		4	0		0
27	20th St. (Long Beach)	No	0		0	0		0	2		2	0		0
28	Hill St. (Long Beach)	No	0		0	0		0	2		2	0		0
29	Burnett St.	No	0		0	0		0	4		4	1		1
30	Willow St.	No	0		0	0		0	0		0	0		0
31	Long Beach Blvd.	No	0		0	0		0	0		0	0		0
32	Spring St.	Yes	0		0	0		0	1		1	0		0
33	Wardlow Rd.	Yes	0	3	3	0	1	1	0	0	0	0	0	0
34	Manville Rd.	Yes	0		0	0		0	0		0	0		0
35	Greenleaf Blvd.	Yes	0		0	0		0	0		0	0		0
36	Alondra Blvd.	Yes	3		3	0		0	0		0	0		0
37	Myrrh St.	Yes	0		0	0		0	0		0	0		0
38	Compton Blvd.	Yes	0		0	0		0	0		0	0		0
39	Elm St.	Yes	1		1	1		1	0		0	0		0
40	Stockwell St.	Yes	2		2	1		1	0		0	0		0
41	130th St.	Yes	1		1	1		1	1		1	0		0
42	El Segundo Blvd.	Yes	2		2	1		1	0		0	0		0
43	124th St.	Yes	1		1	1		1	0		0	0		0
44	119th St.	Yes	1		1	1		1	2		2	0		0
45	Wilmington Ave.	Yes	6		6	1		1	1		1	0		0
46	108th St.	Yes	0		0	0		0	0		0	0		0
47	103rd St.	Yes	4		4	2		2	2		2	0		0

Item No.	Location description	Gated (Yes/No)	Xings Ped Collision excluding Suicides	Station Ped Collisions exluding Suicides	Total Observed Ped Collisions (*)	Xings Ped Fatalities	Station Ped Fatalities	Total Observed Ped Fatalities (*)	Xings Veh Collisions excluding Suicides	Station Veh Collisions	Total Observed Vehicular Collisions (*)	Xings Veh Fatalities	Station Veh Fatalities	Total Vehicular Fatalities (*)
48	Century Blvd.	Yes	3		3	2		2	0		0	0		0
49	92nd St.	Yes	1		1	1		1	0		0	0		0
50	Nadeau St.	Yes	3		3	1		1	1		1	0		0
51	Florence Ave.	Yes	0	2	2	0	0	0	0	1	1	0	0	0
52	Gage Ave.	Yes	4		4	3		3	1		1	0		0
53	55th St.	Yes	1		1	0		0	1		1	0		0
54	48th Pl.	Yes	2		2	1		1	0		0	0		0
55	Vernon Ave.	Yes	1	3	4	1	2	3	0	0	0	0	0	0
56	41st St.	Yes	1		1	0		0	4		4	0		0
57	24th St.	Yes	1		1	1		1	0		0	0		0
58	20th St.	Yes	1		1	0		0	0		0	0		0
59	Washington Blvd/Long Beach Ave.	No	0		0	0		0	3		3	0		0
60	Hooper Ave.	No	0		0	0		0	2		2	0		0
61	Naomi Ave.	No	0		0	0		0	3		3	0		0
62	Central Ave.	No	0		0	0		0	10		10	0		0
63	Griffith Ave.	No	0		0	0		0	1		1	0		0
64	San Pedro St.	No	0	0	0	0	0	0	2	0	2	0	0	0
65	Trinity St.	No	0		0	0		0	1		1	0		0
66	Maple St.	No	0		0	0		0	6		6	2		2
67	Los Angeles St.	No	0		0	0		0	7		7	0		0
68	Main St.	No	2		2	0		0	5		5	0		0
69	Broadway	No	0		0	0		0	1		1	0		0
70	Hill St.	No	1		1	1		1	1		1	0		0
71	Olive St.	No	0		0	0		0	4		4	0		0
72	Grand Ave.	No	1	0	1	0	0	0	1	1	2	0	0	0
73	Washington Blvd/Flower St.	No	0		0	0		0	2		2	0		0
74	18th St.	No	1		1	1		1	14		14	0		0
75	I-10 Freeway on-ramp	No	0		0	0		0	10		10	0		0
76	Venice Blvd.	No	0		0	0		0	8		8	0		0
77	Pico Blvd.	No	0	0	0	0	0	0	6	0	6	0	0	0
78	12th St.	No	0		0	0		0	0		0	0		0
			45	**8**	**53**	**21**	**3**	**24**		**2**	**161**	**4**	**0**	**4**

Item No.	Location description	Total Collisions (*)	AHrev	AH	Sight Distance Restriction (0- no 1- yes)	Freight track (Yes/No)	Adj. Signalized intersection (Yes/No)	Peak hour (AM+PM) Ped Volume	Max Peak hour (AM/PM) Ped Volume	Bus Stop (0- Stops no adj to Station 1- Stops adj station 2- Transfer Center)	Schools within 0.25mile	Stations nearby (0-no 1-yes)	Number of Lanes	
													EB/NB	WB/SB
1	Long Beach Blvd./8th St. (duplicated)	0	0	0	0	No	No	135	72	0	No	0	N/A	2
2	Locust ave. /8th St.	0	0	0	0	No	No	238	178	0	No	0	1	1
3	Pine Ave./8th St.	0	0	0	0	No	No	212	114	0	No	0	1	1
4	8th St./Pacific Ave. (Pacific Ave at 8th St (NB))	3	0.03	0.6	0	No	No	96	48	0	No	0	2	N/A
5	7th St./Pacific Ave.	6	0.06	1.2	0	No	No	149	80	0	No	0	N/A	3
6	6th St./Pacific Ave.	0	0	0	0	No	No	127	75	0	No	0	3	N/A
7	5th St./Pacific Ave.	3	0.22	0.6	0	No	No	231	122	0	No	1	1	1
8	4th St./Pacific Ave.	4	0.04	0.8	0	No	No	257	163	0	No	1	1	1
9	3rd St./Pacific Ave.	4	0.04	0.8	0	No	No	170	93	0	No	0	N/A	2
10	Broadway/Pacific Ave.	0	0	0	0	No	No	128	69	0	No	0	2	N/A
11	Pacific Ave./1st. St.	0	0	0	0	No	No	299	166	0	No	1	2	N/A
12	Pine Ave./1st. St.	2	0.02	0.4	0	No	No	637	437	0	No	1	1	1
13	Locust Ave. (Promenade)1st St.	0	0	0	0	No	No	313	199	0	No	0	N/A	N/A
14	Long Beach Blvd./1st St.	0	0	0	0	No	No	391	232	0	No	1	N/A	2
15	Broadway (Long Beach)	1	0.01	0.2	0	No	No	266	188	0	No	1	2	N/A
16	3rd St./LB Blvd.	2	1.01	1.2	0	No	No	189	130	0	No	0	N/A	2
17	4th St./LB Blvd.	1	0.01	0.2	0	No	No	171	108	0	No	0	1	1
18	6th St./LB Blvd.	2	0.02	0.4	0	No	No	258	137	0	No	1	3	N/A
19	7th St./LB Blvd.	3	0.03	0.6	0	No	No	193	97	0	No	0	N/A	3
20	8th St./LB Blvd. (Long Beach Blvd at 8th St (SB))	0	0	0	0	No	No	135	72	0	No	0	N/A	2
21	10th St.	2	0.02	0.4	0	No	No	215	140	0	No	0	1	1
22	Anaheim St.	2	0.02	0.4	0	No	No	459	244	0	No	1	3	3
23	14th St.	3	0.03	0.6	0	No	No	105	72	0	No	0	N/A	1
24	16th St.	4	0.04	0.8	0	No	No	549	462	0	No	0	1	1
25	PCH	5	0.05	1	0	No	No	561	304	0	No	1	3	3
26	19th St.	4	0.04	0.8	0	No	No	30	17	0	No	0	1	1
27	20th St. (Long Beach)	2	0.02	0.4	0	No	No	144	92	0	No	0	1	1
28	Hill St. (Long Beach)	2	0.02	0.4	0	No	No	129	71	0	No	0	1	1
29	Burnett St.	4	1.03	1.6	0	No	No	64	37	0	No	0	1	1
30	Willow St.	0	0	0	0	No	No	222	124	0	No	0	3	3
31	Long Beach Blvd.	0	0	0	0	No	No	121	70	0	No	0	N/A	2
32	Spring St.	1	0.02	0.2	0	No	No	40	21	1	Yes	0	1	1
33	Wardlow Rd.	3	1.4	1.4	0	No	Yes	59	30	1	Yes	1	2	2
34	Manville Rd.	0	0	0	0	Yes	No	4	3	0	No	0	2	2
35	Greenleaf Blvd.	0	0	0	0	Yes	No	36	21	1	No	0	1	1
36	Alondra Blvd.	3	0.6	0.6	0	Yes	Yes	79	46	1	Yes	0	2	2
37	Myrrh St.	0	0	0	0	Yes	Yes	41	21	1	Yes	0	1	1
38	Compton Blvd.	0	0	0	0	Yes	Yes	273	151	1	No	1	2	2
39	Elm St.	1	1	1	0	Yes	No	130	81	1	No	0	1	1
40	Stockwell St.	2	1.2	1.2	0	Yes	Yes	54	44	1	Yes	0	1	1
41	130th St.	2	1.02	1.2	0	Yes	Yes	82	72	1	No	0	1	1
42	El Segundo Blvd.	2	1.2	1.2	0	Yes	Yes	73	39	1	No	0	2	2
43	124th St.	1	1	1	0	Yes	Yes	59	32	1	No	0	1	1
44	119th St.	3	1.04	1.4	0	Yes	Yes	67	36	1	No	0	1	1
45	Wilmington Ave.	7	2.02	2.2	1	Yes	No	140	76	1	Yes	0	1	1
46	108th St.	0	0	0	0	Yes	No	79	54	0	Yes	0	1	1
47	103rd St.	6	2.44	2.8	1	Yes	Yes	430	226	1	Yes	1	2	2

Item No.	Location description	Total Collisions (*)	AHrev	AH	Sight Distance Restriction (0- no 1- yes)	Freight track (Yes/No)	Adj. Signalized intersection (Yes/No)	Peak hour (AM+PM) Ped Volume	Max Peak hour (AM/PM) Ped Volume	Bus Stop (0- Stops no adj to Station 1- Stops adj station 2- Transfer Center)	Schools within 0.25mile	Stations nearby (0-no 1-yes)	Number of Lanes	
													EB/NB	WB/SB
48	Century Blvd.	3	2.2	2.2	1	Yes	Yes	135	70	1	Yes	0	2	2
49	92nd St.	1	1	1	0	Yes	No	117	60	1	Yes	0	2	2
50	Nadeau St.	4	1.42	1.6	0	Yes	No	99	52	1	Yes	0	2	2
51	Florence Ave.	3	0.42	0.6	1	Yes	No	1032	558	1	Yes	1	2	2
52	Gage Ave.	5	3.22	3.4	1	Yes	No	43	24	0	No	0	2	2
53	55th St.	2	0.22	0.4	0	Yes	No	70	35	1	Yes	0	1	1
54	48th Pl.	2	1.2	1.2	0	Yes	Yes	64	48	1	No	0	1	1
55	Vernon Ave.	4	3.2	3.2	0	Yes	Yes	776	417	1	No	1	2	2
56	41st St.	5	0.28	1	0	Yes	Yes	60	34	1	No	0	1	1
57	24th St.	1	1	1	0	No	Yes	20	10	0	No	0	1	1
58	20th St.	1	0.2	0.2	0	No	Yes	17	11	0	No	0	1	1
59	Washington Blvd/Long Beach Ave.	3	0.03	0.6	0	No	No	541	275	0	No	1	3	N/A
60	Hooper Ave.	2	0.02	0.4	0	No	No	23	12	0	No	0	1	1
61	Naomi Ave.	3	0.03	0.6	0	No	No	44	27	0	No	0	1	1
62	Central Ave.	10	0.1	2	0	No	No	178	95	0	No	0	2	2
63	Griffith Ave.	1	0.01	0.2	0	No	No	99	51	0	No	0	2	1
64	San Pedro St.	2	0.02	0.4	0	No	No	793	630	0	Yes	0	2	2
65	Trinity St.	1	0.01	0.2	0	No	No	234	201	0	Yes	0	1	1
66	Maple St.	6	2.04	2.8	0	No	No	169	90	0	Yes	0	1	1
67	Los Angeles St.	7	0.07	1.4	0	No	No	115	60	0	Yes	0	2	2
68	Main St.	7	0.45	1.4	0	No	No	88	54	0	No	0	2	2
69	Broadway	1	0.01	0.2	0	No	No	247	127	0	No	0	2	2
70	Hill St.	2	1.01	1.2	0	No	No	232	134	0	No	0	2	2
71	Olive St.	4	0.04	0.8	0	No	No	125	85	0	No	0	3	N/A
72	Grand Ave.	3	0.22	0.6	0	No	No	513	257	0	No	1	1	1
73	Washington Blvd/Flower St.	2	0.02	0.4	0	No	No	107	60	0	No	0	N/A	2
74	18th St.	15	1.14	3.8	0	No	No	41	22	0	No	0	2	N/A
75	I-10 Freeway on-ramp	10	0.1	2	0	No	No	0	0	0	No	0	N/A	1
76	Venice Blvd.	8	0.08	1.6	0	No	No	151	76	0	No	0	2	2
77	Pico Blvd.	6	0.06	1.2	0	No	No	647	363	0	No	0	2	2
78	12th St.	0	0	0	0	No	No	184	151	0	No	0	2	N/A
		214												

Item No.	Location description	Highest AM Peak Hour Volume		Highest PM Peak Hour Volume		Highest Peak Hour Volume		Peak Vol per lane on xing	Warning Device Elements (0.5-4QG 1-2G and 1.5-WD)
		EB/NB	WB/SB	EB/NB	WB/SB	EB/NB	WB/SB		
1	Long Beach Blvd./8th St. (duplicated)	N/A	399	N/A	426	N/A	426	213	1.00
2	Locust ave. /8th St.	58	12	32	19	58	19	58	1.00
3	Pine Ave./8th St.	87	112	166	108	166	112	166	1.00
4	8th St./Pacific Ave. (Pacific Ave at 8th St (NB))	286	N/A	596	N/A	596	N/A	298	1.00
5	7th St./Pacific Ave.	N/A	995	N/A	617	N/A	995	332	1.00
6	6th St./Pacific Ave.	779	N/A	1458	N/A	1458	N/A	486	1.00
7	5th St./Pacific Ave.	17	10	18	19	18	19	19	1.00
8	4th St./Pacific Ave.	74	88	133	87	133	88	133	1.00
9	3rd St./Pacific Ave.	N/A	882	N/A	429	N/A	882	441	1.00
10	Broadway/Pacific Ave.	517	N/A	915	N/A	915	N/A	458	1.00
11	Pacific Ave./1st. St.	181	N/A	419	N/A	419	N/A	210	1.00
12	Pine Ave./1st. St.	108	171	245	209	245	209	245	1.00
13	Locust Ave. (Promenade)1st St.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.00
14	Long Beach Blvd./1st St.	N/A	258	N/A	238	N/A	258	129	1.00
15	Broadway (Long Beach)	316	N/A	1067	N/A	1067	N/A	534	1.00
16	3rd St./LB Blvd.	N/A	941	N/A	396	N/A	941	471	1.00
17	4th St./LB Blvd.	78	156	172	143	172	156	172	1.00
18	6th St./LB Blvd.	523	N/A	1465	N/A	1465	N/A	488	1.00
19	7th St./LB Blvd.	N/A	1328	N/A	635	N/A	1328	443	1.00
20	8th St./LB Blvd. (Long Beach Blvd at 8th St (SB))	N/A	399	N/A	426	N/A	426	213	1.00
21	10th St.	265	156	384	150	384	156	384	1.00
22	Anaheim St.	847	1040	1362	658	1362	1040	454	1.00
23	14th St.	N/A	85	N/A	59	N/A	85	85	1.00
24	16th St.	169	155	125	43	169	155	169	1.00
25	PCH	961	1271	1202	810	1202	1271	424	1.00
26	19th St.	0	16	2	14	2	16	16	1.00
27	20th St. (Long Beach)	109	118	161	148	161	148	161	1.00
28	Hill St. (Long Beach)	103	127	171	100	171	127	171	1.00
29	Burnett St.	45	66	79	57	79	66	79	1.00
30	Willow St.	917	978	1117	1045	1117	1045	372	1.00
31	Long Beach Blvd.	N/A	848	N/A	955	N/A	955	478	1.00
32	Spring St.	728	636	780	647	780	647	780	1.0
33	Wardlow Rd.	841	842	1231	776	1231	842	616	1.0
34	Manville Rd.	207	546	763	305	763	546	382	1.0
35	Greenleaf Blvd.	504	678	957	549	957	678	957	0.5
36	Alondra Blvd.	704	934	1152	672	1152	934	576	0.5
37	Myrrh St.	247	403	398	249	398	403	403	0.5
38	Compton Blvd.	691	768	1062	773	1062	773	531	0.5
39	Elm St.	213	168	252	202	252	202	252	0.5
40	Stockwell St.	235	211	202	210	235	211	235	1.0
41	130th St.	138	136	120	119	138	136	138	1.0
42	El Segundo Blvd.	609	736	1081	509	1081	736	541	1.0
43	124th St.	168	217	191	134	191	217	217	0.5
44	119th St.	306	527	484	408	484	527	527	1.0
45	Wilmington Ave.	763	829	819	661	819	829	829	1.0
46	108th St.	164	320	232	209	232	320	320	1.0
47	103rd St.	357	622	498	460	498	622	311	1.0

Item No.	Location description	Highest AM Peak Hour Volume		Highest PM Peak Hour Volume		Highest Peak Hour Volume		Peak Vol per lane on xing	Warning Device Elements (0.5-4QG 1-2G and 1.5-WD)
		EB/NB	WB/SB	EB/NB	WB/SB	EB/NB	WB/SB		
48	Century Blvd.	423	554	604	394	604	554	302	1.0
49	92nd St.	786	856	934	686	934	856	467	1.0
50	Nadeau St.	896	1031	1223	887	1223	1031	612	1.0
51	Florence Ave.	852	800	970	1020	970	1020	510	1.0
52	Gage Ave.	1115	1125	1280	1096	1280	1125	640	1.0
53	55th St.	290	224	269	268	290	268	290	1.0
54	48th Pl.	243	84	168	218	243	218	243	1.0
55	Vernon Ave.	572	581	570	808	572	808	404	1.0
56	41st St.	413	296	315	428	413	428	428	1.0
57	24th St.	183	206	193	326	193	326	326	1.0
58	20th St.	143	68	94	151	143	151	151	1.0
59	Washington Blvd/Long Beach Ave.	938	N/A	1238	N/A	1238	N/A	413	1.00
60	Hooper Ave.	636	286	280	562	636	562	636	1.00
61	Naomi Ave.	319	246	269	376	319	376	376	1.00
62	Central Ave.	712	545	688	769	712	769	385	1.00
63	Griffith Ave.	407	227	172	472	407	472	472	1.00
64	San Pedro St.	636	442	676	601	676	601	338	1.00
65	Trinity St.	282	102	107	295	282	295	295	1.00
66	Maple St.	259	193	211	268	259	268	268	1.00
67	Los Angeles St.	586	113	426	398	586	398	293	1.00
68	Main St.	729	418	591	745	729	745	373	1.00
69	Broadway	625	252	506	580	625	580	313	1.00
70	Hill St.	680	417	547	655	680	655	340	1.00
71	Olive St.	761	N/A	411	N/A	761	N/A	254	1.00
72	Grand Ave.	339	238	264	502	339	502	502	1.00
73	Washington Blvd/Flower St.	N/A	1021	N/A	1158	N/A	1158	579	1.00
74	18th St.	264	N/A	365	N/A	365	N/A	183	1.00
75	I-10 Freeway on-ramp	N/A	398	N/A	357	N/A	398	398	0.50
76	Venice Blvd.	433	318	362	469	433	469	235	1.00
77	Pico Blvd.	630	440	719	798	719	798	399	1.00
78	12th St.	17	N/A	45	N/A	45	N/A	23	1.00

TASK 4 & 5 – Recommendation of Grade Separation Packages for Each Budget Scenario

Blue Line Improvements

Los Angeles County Metropolitan Transit Authority

July 20, 2018

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
Draft Report	June 22, 2018	Updated (Incorporates Metro Comments)	NA	NA	NA
Final Report	July 20, 2018	Updated (Incorporates Metro Comments)	NA	NA	NA

Distribution List

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Appendix D – Evaluation of Road-over-Rail Alternative.

1. Introduction

The Metro Blue Line (MBL), opened in 1990, is a 22.0-mile light rail line running north-south between Downtown Los Angeles and Long Beach. Significant investments in safety measures over the past 28 years have been made to improve safety on the MBL and to reduce collisions with both vehicles and pedestrians along the alignment.

In an effort to continue enhancing safety on the MBL, AECOM recently completed (June 2017) the *Metro Blue Line Safety Improvement Study for Wardlow Crossing* to develop a prioritization formula which considered factors and data related to the 27 gated mid-corridor crossings along the MBL. That formula was developed to assist in making priority decisions when considering grade separations as an investment option. In that study, collisions for a 10-year period (FY '07 – FY '17) were subcategorized to identify various correlations in the data and formulate discrete weighting factors from these trends. Other factors such as traffic volume, warning devices, intersection geometry, etc. were also evaluated.

The current report, as part of the *Metro Blue Line improvements* Safety Study, expands that effort to prioritize all 78 gated and non-gated at-grade crossings along the MBL. Furthermore, using the results of that prioritization, this study identifies which grade crossings to separate under three different budget assumptions, as specified in the scope of work that will yield the greatest improvement in safety and operations.

For each scenario below, the report identifies the type of separation that would be most feasible for each location and explains the reasons leading to the recommendations.

- **Budget Scenario 1**: Group of crossings that should be considered for grade separation with an available budget of $250M.
- **Budget Scenario 2**: Group of crossings that should be considered for grade separation with an available budget of $500M.
- **Budget Scenario 3**: Group of crossings that should be considered for grade separation with an available budget of $750M.

The crossings and stations listed in **Figure 1** and **Figure 2** below have been analyzed as part of the current study.

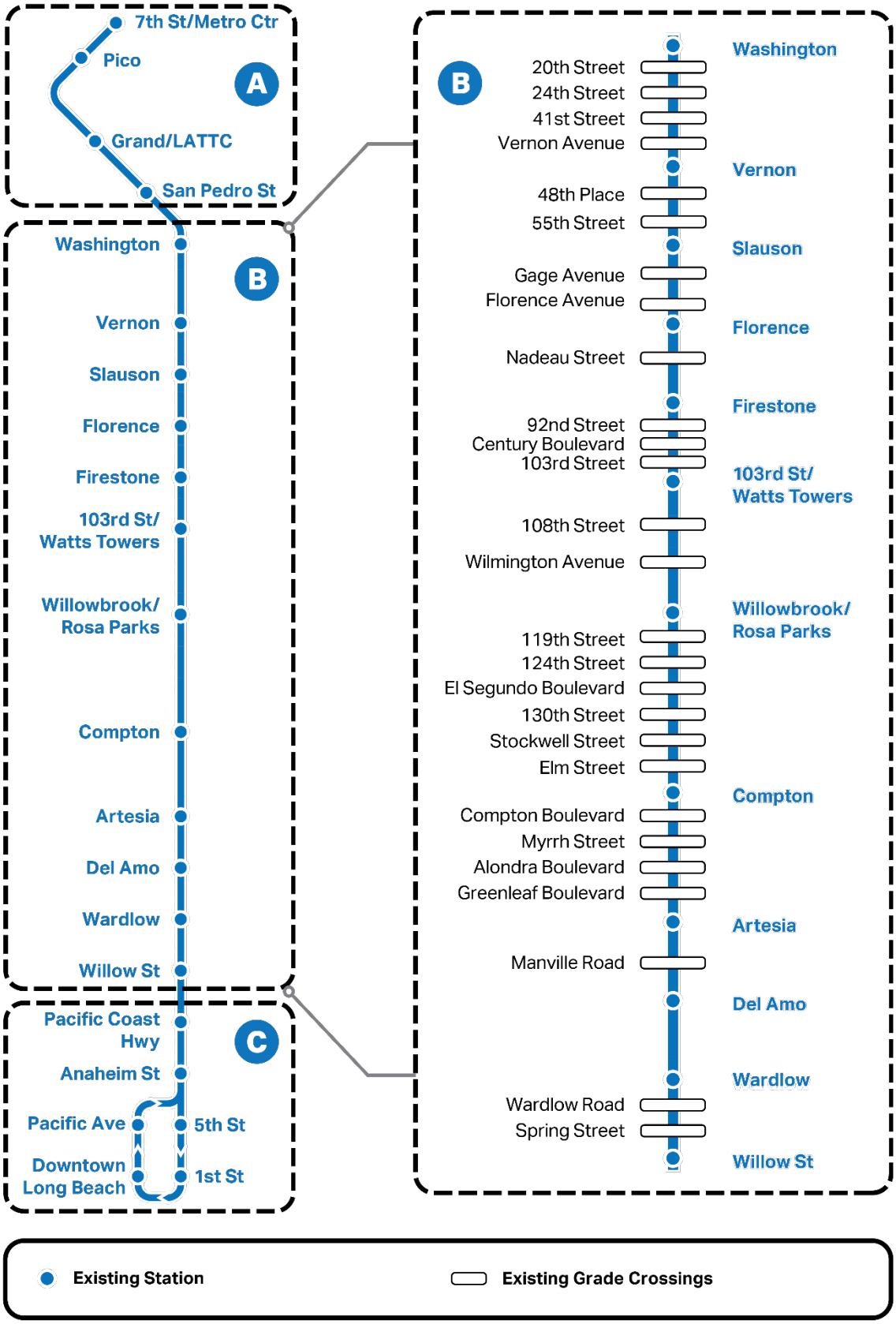


Figure 1. – MBL Overview and Mid-corridor crossings Maps.

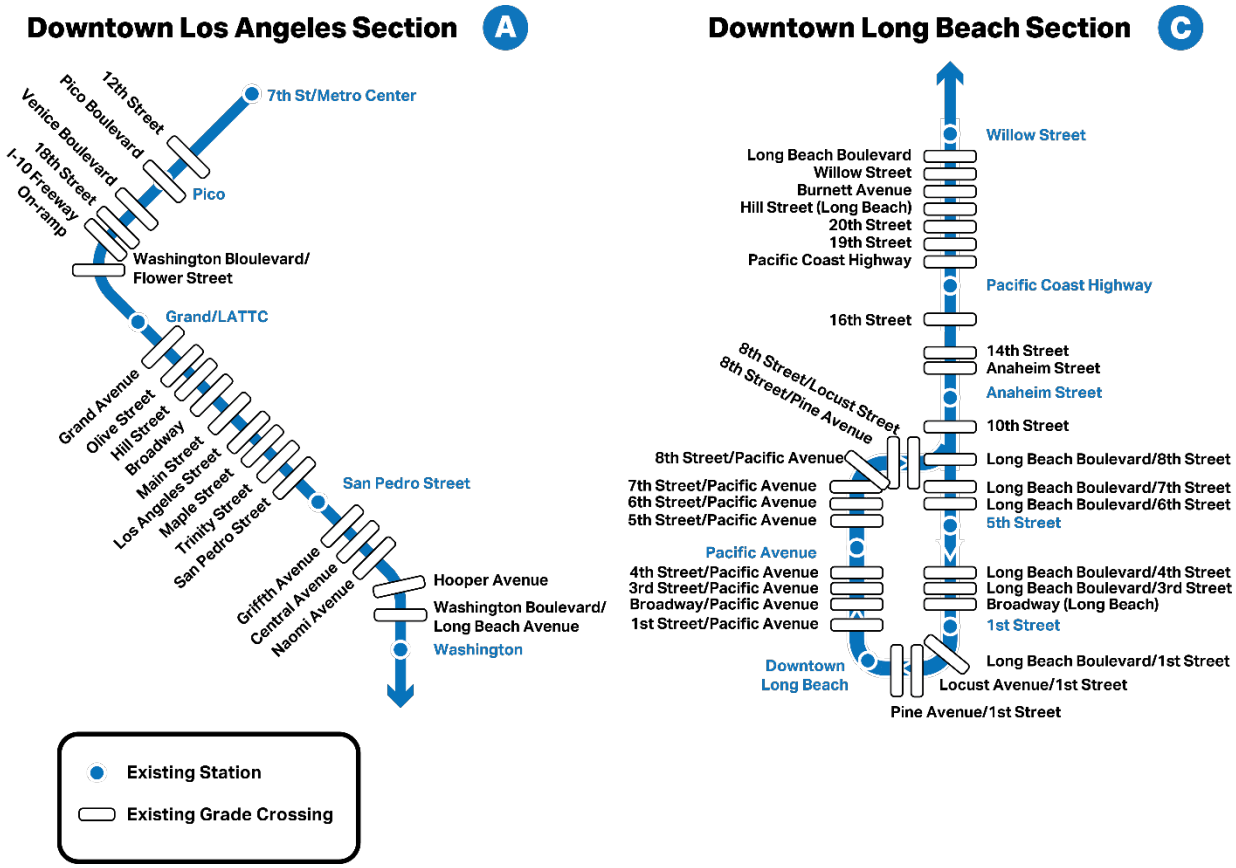


Figure 2. – Downtown and Long Beach Sections of the MBL.

2. Priority Ranking Formula

2.1 Methodology

In the analysis of all 78 MBL grade crossings, the formula developed for the previous study that analyzed only the 27 gated crossings, was modified to consider non-gated crossings which are controlled by traffic signals for motorists and train 'bar' type signals for trains, in addition to the gated mid-corridor crossings. This required re-analysis of certain safety factors to consider the type, frequency and severity of collisions at non-gated crossings.

In addition, the ranges previously used for pedestrian and vehicular volumes were reconsidered to reflect the full range of Blue Line grade crossings. The same ten year collision period (FY-07-FY17) that was used for the *Wardlow Study* of the 27 gated crossings was used for the current study of all crossings. Potential updates were analyzed for each factor.

As mentioned in the previous study, there is no industry formula or guideline that can be used by rail transit agencies to prioritize grade separations for existing at-grade crossings on a light rail system. The formula developed for both the previous study and this study are applicable only for the MBL since the elements of the formula are based on MBL-specific accident data and experience. The resulting prioritization formula applicable to all MBL crossings is as follows:

$$P = S_{SF} + V_P + f_{WD} \times V_V$$

The priority ranking score P reflects safety and mobility benefits resulting from grade separation:

- S_{SF}, the Safety Score, was established based upon an inferred association between site-specific factors positively correlated with locations where higher rates of collisions and fatalities were recorded – indeed, this term is higher in value at locations with higher collision rates.
- V_P, the Pedestrian Volume Score, also reflects potential safety benefits from the perspective that separation would reduce the exposure of pedestrians to crossing the rails which could reasonably be expected to reduce the number of resulting collisions even though the specific number of pedestrian collisions recorded did not directly correlate with pedestrian volumes.
- V_V, the Vehicular Volume Score, reflects the mobility benefit of grade separation because traffic delays are eliminated. To a degree, this term also reflects a safety benefit because exposure to potential collisions is eliminated.
- f_{WD}, the Warning Device factor, was added to account for presence of warning devices which have a proven effect.

The ranges assigned to each of the three primary factors were established so that the “safety” portion of the aggregate score would represent 50% of the weight, with the pedestrian volume and vehicular volumes each contributing 25% to the total score.

$$S_{SF} = 1.4 \times ST + 2.7 \times SDR + 1.6 \times FR + 1.3 \times ADJ + 1.2 \times BS + 1.0 \times SC + AH$$

$ST =$ Station located nearby the crossing

$SDR =$ Sight distance restriction

$FR =$ Freight (presence of freight tracks)

$ADJ =$ Adjacent signalized intersection

$BS =$ Bus Stops

$SC =$ Schools

$AH =$ Accident History

$$AH = F_{veh} \times 1.0 + C_{veh} \times 0.01 + F_{ped} \times 1.0 + C_{ped} \times 0.2$$

F_{veh} = Number of vehicular fatalities

C_{veh} = Number of vehicular collisions

F_{ped} = Number of pedestrian fatalities

C_{ped} = Number of pedestrian collisions

The detailed explanation about the calculation of each of these factors considered in the formula are included in the *Task 3 – Priority List of Grade Separation Report*.

2.2 Results

Using the formula described in Section 2.1, the priority ranking scores for the Top-10 at-grade crossings that could be potentially grade separated along the MBL are shown in **Table 1** below. All these crossings are gated and included in the mid-corridor segment of the MBL.

#	Crossing Name	S_{SF}	V_P	f_{WD}	V_V	P
1	103rd St.	**11.6**	**4**	1.0	**1**	**16.6**
2	Wilmington Ave.	**8.5**	**2**	1.0	**6**	**16.5**
3	Florence Ave.	**8.2**	**6**	1.0	**1**	**15.2**
4	Vernon Ave.	**8.7**	**4**	1.0	**1**	**13.7**
5	Century Blvd.	**10.0**	**2**	1.0	**1**	**13.0**
6	Gage Ave.	**7.5**	**1**	1.0	**4**	**12.5**
7	Wardlow Rd.	**6.2**	**1**	1.0	**3**	**10.2**
8	Nadeau St.	**5.2**	**1**	1.0	**3**	**9.2**
9	Compton Blvd.	**5.5**	**3**	0.5	**1**	**9.0**
10	Stockwell St.	**6.3**	**1**	1.0	**1**	**8.3**

Table 1. – Top-10 crossings for grade separation.

3. Grade Separation Concepts

3.1 Assumptions and Criteria

The final results of the priority ranking formula, as presented in **Table 1**, serves as a guide for the order in which each grade crossing should be evaluated for possible grade separation.

Each crossing was individually assessed to determine the most promising solutions for a grade separation. As rail-over-road and road-over-rail alternatives offer similar benefits and cost significantly less than any alternative requiring cut-and-cover or tunneling, underground alternatives were considered only if there were no credible aerial options, which was not the case in any of the top 10 crossings analyzed. **Appendix D** includes a general evaluation of road-over-rail alternatives, as well as a sketch footprint of 103rd St. road/over/rail grade separation.

Recognizing that construction of the rail-over-road solution will require temporary relocation and/or re-routing of both the LRT tracks as well as UPRR freight trackage, and would require negotiation of a construction and maintenance agreement with the UPRR, this option nevertheless will have a vastly reduced “footprint” (and therefore less direct land use impact) as well as reduced circulation impacts compared to solutions which utilize roadway overpasses. Principal reasons for not considering the road over rail option include:

- For road-over-rail options, use of elevated structures over the LRT and UP tracks, will require 23.5’ vertical clearance over top of rails, thus resulting in approach ramps more than 500 feet long and 60 to 70 feet wide (to provide four lanes with shoulders and parapet walls).
- To preserve access to parcels within the approach ramp zones, frontage roadways would need to be developed by widening the approach roadway on each side of the cross-street provide a minimum 20-foot wide lane (which would be required by the fire department for emergency access).
- Additional property takes will most likely be required to provide temporary roadway access and a temporary grade crossing to accommodate a traffic detour (or the cross street would need to be closed for the duration of the construction period.)
- When completed, the overcrossing would “fly over” the existing adjacent frontage roadways resulting permanent changes to local traffic circulation.
- The noted land use impacts would substantially increase the construction cost; in addition, the short and long-term impacts might make it impossible to gain environmental clearance for overpass solutions.

Therefore, the second option of a rail-over-road configuration for the ten highest-ranked crossings was evaluated further. The next step was to analyze which of these locations would require additional adjacent crossings to be grade separated as part of the same project due to track geometric constraints.

Based on Metro’s design criteria, we assumed a maximum transition grade of 5%, a minimum vertical clearance of the rail bridge from the roadway of 16.5’, and a structure depth of 6.5’. From this analysis, crossings within 900’ of one another must be considered as a group of crossings that will need to be grade separated in order to maintain the maximum grade transition. Crossings outside of this threshold generally could be considered separately, although limiting the ‘roller-coaster effect’ from multiple grade separation transitions in close proximity was also considered. In all cases, stations directly adjacent to a crossing being analyzed for grade separation were included as part of the grade separation of the crossing itself.

As there are UP freight tracks running parallel to the MBL tracks through most of the mid corridor, one of the biggest areas of uncertainty at this level of design is how UP right-of-way (ROW) may or may not be utilized for potential shoofly track (a shoofly track, which is a temporary track, would need to be constructed to avoid disruption in service for an extended period on the MBL while a particular grade separation structure is being constructed) alternatives which can affect the overall cost of any given grade separation concept significantly.

Impacts on UP ROW might include affecting UP track and/or operations. For each grade crossing separation where UP ROW is impacted, METRO and UP will have to sign an agreement including the specific temporary impacts on UP tracks and operations, and the requirements and compensation that UP will demand to keep their system in operation during construction.

The report presents various options for construction of the shoofly track. In locations where the UP ROW will be used to install a LRT shoofly track, the impacted UP track will have to be removed or relocated and a new temporary LRT track will be installed including OCS and signal system. When the existing UP ROW is used to accommodate an LRT shoofly track, and there is another UP track in operation side by side, a fence will need to be installed between the LRT shoofly track and the UP track to ensure that both operations are completely independent. Upon completion of the grade separation the LRT shoofly track will be removed as well as the OCS, signal system, and fence, and a new UP track will be reconstructed or relocated.

We have developed multiple shoofly configurations for each of the the top 10 crossings of the priority ranking list where possible, especially with considerations of how to best minimize impacts to UP operations during construction. Every configuration accommodates at least a single shoofly track to assure the MBL will also remain operational, albeit at a reduced level of service. Additionally, it should be noted that any construction adjacent to UP tracks will require close coordination with the freight railroad, and may require UP flaggers to be present during the duration of construction. These measures, if required, will increase the costs of grade separation, and because of their uncertainty at this time have not been included in the cost estimates presented in this report. For this reason, eliminating all impacts to UP operations will not be possible regardless of whether the UP ROW needs to be utilized for a shoofly configuration.

Generally, the optimal engineering geometry was developed, without considering impacts to freight operations or ROW impacts, to first determine potential locations of a temporary station. Once the optimal geometry was determined, possible shoofly configurations were analyzed in regards to both operations impacts and cost to determine the final preferred options. In order to minimize the operational impacts, double-track shoofly options were considered for each grouping, however, due to the highly constrained space along the corridor, a double-track shoofly alternative was proposed only for the 103rd/Century grouping. #14 switches were used for each shoofly alternative, which can support a max speed of 35 mph.

See **Appendix A** for more details of the grade separation concepts for each of the crossings in the top-10 priority ranking, as well as **Appendix B** where the cost estimate assumptions are described and specifically to the UP impacts and potential compensations.

3.2 Groupings

Considering the top-10 priority ranking of at-grade crossings to be potentially grade separated, the report sorts them into the following three major categories:

1) Crossings that could be grade separated with no impacts to other adjacent crossings or stations. These are:
   - **#2 – Wilmington Ave.**
   - **#8 – Nadeau St.**
   - **#10 – Stockwell St.**

2) Crossings where the crossing grade separations would also require the separation of the adjacent station. These are grouped as follows:
   - **Group 1: #3 – Florence Avenue (plus Florence Station)**
   - **Group 2: #4 – Vernon Avenue (plus Vernon Station)**
   - **Group 3: #7 – Wardlow Road (plus Wardlow Station)**
   - **Group 4: #9 – Compton Boulevard (plus Compton Station)**

3) Crossings where the grade separations would also require the separation of the adjacent station and adjacent crossing due to either reduced distance between those crossings (less than 900 ft) or to avoid the 'roller coaster effect' when two contiguous crossings are proposed to be grade separated. These are grouped as follows:
   - **Group 5: #1 – 103rd St. (plus 103rd Station) and #5 Century Blvd.**

Considering the rail-over-road solution as the optimal solution for grade separation for both 103rd St and Century Blvd, and the distance between both at-grade crossings (less than 900 ft), these two crossings will have to be grade separated together including 103rd Station.

- **Group 6: #3 – Florence Ave. (plus Florence Station) and #6 Gage Ave.**

  Considering the rail-over-road solution as the optimal solution for grade separation for both Florence Ave and Gage Ave and the distance between both at-grade crossings (about 2,600 ft), in order to avoid the 'roller coaster effect', it might not make sense to grade separate Gage Ave without grade separating Florence Ave concurrently.

- **Group 7: #3 – Florence Ave. (plus Florence Station), #6 Gage Ave. and #8 Nadeau St.**

  Considering the rail-over-road solution as the optimal solution for grade separation of these three crossings, and the distance between Florence Ave. and Nadeau St. at-grade crossings (about 2,600 ft), in order to avoid the 'roller coaster effect', it might make sense to grade separate these three crossings all together to maximize benefits while minimize the overall costs.

The **Figure 3** below shows the location of the potential grade separation groupings.

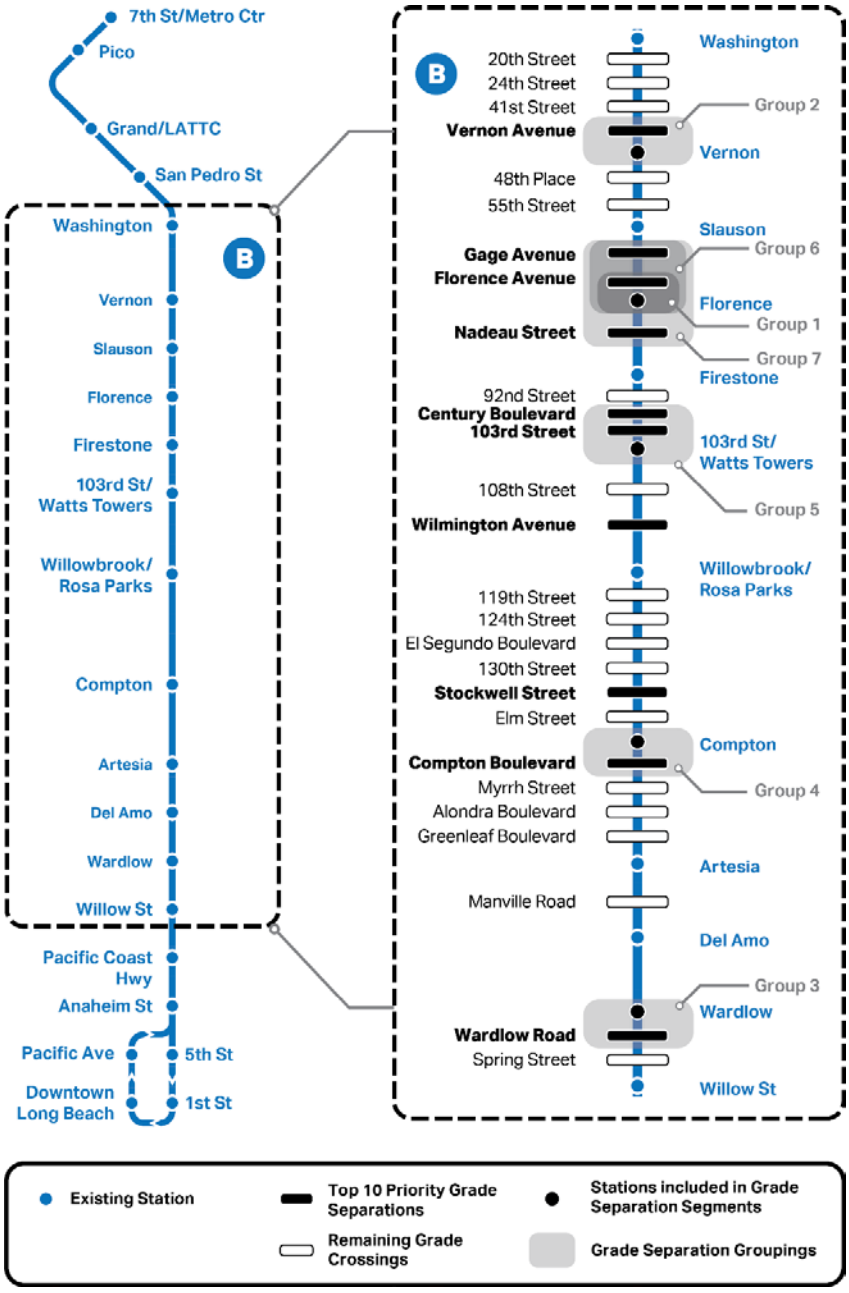


Figure 3. – Top-10 priority grade separations and groupings.

3.3 Group 5 – 103rd St (plus 103rd St Station) and Century Blvd

#1 on the priority ranking list is 103rd St. As there is insufficient room for an at-grade/aerial transition between 103rd St and Century Blvd, it was determined that any aerial structure over 103rd St. would also need to span Century Blvd, which happened to be #5 on the priority ranking list. The same conclusion is applicable to Century Blvd that in case for it to be grade separated, it would need to also span 103rd St., grade separating 103rd St.

Three different options for grade separation have been analyzed, having in common the same rail-over-road solution. The main difference is the proposed solution for the shoofly track during the construction stage:

- Option 1 – Single track shoofly to the east of the existing tracks
- Option 2 – Double track shoofly to the east of the existing tracks

- Option 3 – Single track shoofly to the west of the existing tracks

Options 1 and 2 are similar, each utilizing available public ROW to the east of the existing tracks for the proposed shoofly, with the main difference being single vs double track shoofly for option 1 and 2 respectively. While both options would have some impact to Graham Ave, the impact would be greater in the case of option 2 with the additional width requirement to maintain existing double track operation throughout the construction life cycle. Options 1 and 2 would also impact an existing LADWP Watts Customer Service Center adjacent to the existing 103rd St/Watts Tower Station, although it is assumed that this building could be removed and replaced at the original location.

Option 3 would utilize the adjacent Union Pacific (UP) ROW to the west of the existing MBL tracks for a single track shoofly. As the freight tracks in this area currently transition from double to single track near the existing 103rd Station, this may be a viable option with minimal impact to existing freight operations as we would propose temporarily shifting this transition north 2000'. Meanwhile this solution wouldn't impact the LADWP Watts Customer Service Center, it would have impacts to the intersection between Grandee Ave and 103rd St. and to the 103rd St/Watts Towers Station Parking lot.

The existing pedestrian bridge that crosses over the tracks immediately south of 103rd St would be impacted by any of the three proposed shoofly options, although it is assumed that this pedestrian bridge could be temporarily deconstructed and reassembled in the same location once construction of the aerial structure is completed.

3.4 Wilmington Ave

Wilmington Ave at-grade crossing came in at #2 on the priority ranking list.

The Imperial Highway overpass immediately to the south of the Wilmington grade crossing constrains the transition limits of an aerial structure separation to immediately north of the overpass. Using the maximum grade of 5%, it is feasible to grade separate the Wilmington Ave crossing while maintaining the required clearances at the Imperial Highway overpass, although design speed would be permanently limited to 45 mph.

The existing Willowbrook/Rosa Parks Station can stay in place, but would need to be temporarily extended to accommodate the temporary shoofly switches. There are two potential shoofly options for this grade separation alternative.

Option 1 avoids any impact to the adjacent freight tracks by utilizing available public ROW to the east of the existing MBL tracks for the single track shoofly. This would result in potential impacts to sidewalks, parking and traffic lanes along Willowbrook Ave.

Option 2 avoids any impact to adjacent roadways, but would temporarily shift freight operation to a newly constructed run of single track to the west and using the existing freight single track as a shoofly for MBL operation.

3.5 Group 1 – Florence St (plus Florence Station)

Florence Ave is #3 on the priority ranking list. Florence Ave is a unique case as it is located between two other grade crossings that were also within the top 10 on the priority ranking list, Gage Ave to the north and Nadeau St to the south. However, as each of these adjacent crossings are not within the threshold of 500' requiring grade separation grouping, these could be considered as separate alternatives with the option to group them in the same aerial structure for improved operations and construction cost savings.

The Florence Ave grade separation structure would also include a new aerial station straddling the Florence Ave intersection. As the rail corridor north of Florence Ave is closely lined on both sides by residential housing, it was necessary to utilize one of the two existing freight tracks for a shoofly in both options. In each option, the existing freight double track configuration would transition to single track operation north of Florence Ave, with the easternmost freight track being utilized for the shoofly.

The main differences between the options are concerning the potential location of the temporary station. Option 1 proposes a temporary station adjacent to the existing station, directly to the west of the easternmost UP track. This

option would require the western UP track be shifted to accommodate the temporary platform, which would impact commercial buildings along the corridor.

Option 2 avoids any impacts to adjacent buildings by proposing the temporary station to the east of existing MBL tracks instead. However, this option would push the temporary station 1500' south of the existing station.

3.6 Group 2 – Vernon Ave (plus Vernon Station)

Vernon Ave came in #4 on the priority ranking list.

The ROW along the west side of the rail corridor is extremely constrained due to the presence of Long Beach Ave adjacent to the railroad, with insufficient room to fit a temporary station without impacting the adjacent residential properties. For this reason, only one shoofly option is proposed to build the Vernon Ave grade separation.

Utilizing the westernmost UP ROW for temporary single track operation of the MBL, the easternmost track would be shifted further east to accommodate the width of a temporary platform with minor ROW impacts to the Long Beach Ave and impacts to the existing signal house.

3.7 Group 6 – Gage Ave + Florence St (plus Florence Station)

Next on the priority ranking list is Gage Ave at #6.

This is also a unique situation as immediately to the north of Gage Ave is an existing viaduct, transitioning down to cross Gage at grade. Therefore, it will be necessary to tie into and rebuild at least a portion of the viaduct to achieve the proper clearance over Gage Ave. To avoid a 'roller coaster' effect of closely spaced crest-sag-crest curve transitions, we are proposing to tie into the existing tangent directly north of the existing crest curve near E 60th St.

As we must maintain connection to the aerial structure north of Gage Ave during construction, a phased construction approach is necessary. During the first construction phase, the single track shoofly would operate along the existing SB track, while the NB portion of the proposed aerial structure is completed. This will require a more detailed structural analysis to ensure that the load of the SB side of the structure is supported during demolition of the NB side of the structure. Once this first phase of construction is completed, the shoofly would be switched to the newly completed NB track while the SB track and remaining portion of the aerial structure are constructed.

Grade separating Gave Ave alone without Florence St was also considered. However, as Florence is #3 on the priority ranking list, any standalone Gage Ave grade separation configuration but would create a similarly undesirable 'roller coaster' effect due to the proximity to Florence St. For this reason, the Gage Ave grade separation concept has been considered as a single grouping including Florence Ave and Florence Station.

The shoofly alternatives for the combined Gage Ave, Florence St and Florence Station grade separation are similar to the two options for the Florence St and Florence Station grade separation detailed in **Section 3.5**.

3.8 Group 3 – Wardlow Rd (plus Wardlow Station)

Wardlow Rd was next on the priority ranking list at #7. There are no adjacent freight tracks in this section of the corridor, unlike in most other areas.

Aerial transitions for Wardlow Rd are bounded by with the I-405 overpass to the north and the Spring St. grade crossing to the south, although there is sufficient distance to optimize the transitions for design speed, station location, and transition footprint.

There is enough room to build a single shoofly track along the west side of the existing tracks as in option 1. However, minor impacts to the adjacent parking lot and encroachment on the nearby Traction Power Substation (TPSS) might have potential concerns.

Option 2 proposes a slight realignment of the track towards the east to ensure any conflict with the TPSS is avoided. However, even with this shift, the temporary station would still impact the adjacent parking lot.

3.9 Nadeau St

Nadeau St is #8 on the priority ranking list. The Nadeau St grade crossing is immediately south of Florence Ave., but not within the threshold of necessary inclusion with any Florence Ave grade separation. For this reason, we have analyzed Nadeau St. grade separation as a standalone alternative detailed in this section but also included it as a combined alternative with the Florence Ave and Gage St alternatives in the next section.

The ROW along the east side of the LRT tracks is constrained by commercial properties south of Nadeau St. For this reason, we have proposed the UP ROW to the west of the LRT alignment be utilized for the shoofly. This requires the freight track to transition to a single track for the length of the proposed grade separation. Impacts to UP tracks are minimized with most of the existing freight tracks to remain in place aside from new special trackwork tie ins.

3.10 Group 7 – Gage Ave + Florence St (plus Florence Station) + Nadeau St

While Nadeau St can be grade separated independently, including it with the Florence St grade separation and combining it offers some benefits, primarily avoiding an undesirable ‘roller coaster’ effect resulting from two separate aerial transitions spaced less than 500’ apart.

As this option serves as an extension of the combined Gage Ave + Florence St option, there are potential cost savings in a combined aerial structure that we are currently analyzing. However, because trains would need to stop at Florence Station, major operational benefits due to grade separation are not expected.

There is a single option for the shoofly configuration in this combined alternative due to ROW constraints along the east side of the track south of Nadeau St. A 2-phase construction approach would be utilized to connect to the existing aerial structure north of Gage Ave as detailed in **Section 3.7**. South of Gage St, the Option 1 shoofly detailed in the Florence Ave grade separation alternative would be matched, utilizing the easternmost freight track for the single track shoofly and shifting the westernmost freight track to accommodate a temporary platform.

In this combined alternative, the freight track configuration south of the temporary station at Florence could accommodate a single track MBL shoofly as-is through Nadeau St., with special trackwork tie-ins south of the grade separation footprint to transition the MBL and freight back to normal double track configuration.

3.11 Group 4 – Compton Blvd (plus Compton Station)

#9 on the priority ranking list is Compton Blvd. The existing station is located 600’ north of the Compton St. intersection. We have proposed the new aerial station to be just north of the intersection to minimize the grade separation footprint while also effectively connecting with existing station access streets and sidewalks. There are two proposed options for the shoofly.

Option 1 utilizes the existing Metro ROW to the east of the existing tracks for temporary shoofly and platform. This option would not affect UP tracks, but would require the TPSS on site be moved north to avoid any conflict with the shoofly. Option 2 avoids impacts to the TPSS, but requires transitioning freight operations to the west to utilize the existing freight ROW for a temporary shoofly. As the freight operates with a single track currently along this section of the corridor, this option should only minimally impact freight operations.

3.12 Stockwell St

Finally, Stockwell St. came in at #10 on the priority ranking list.

Immediately south of Stockwell St., the LRT transitions to an aerial structure over Rosecrans Ave. Our proposed profile would tie into the existing viaduct to avoid the ‘roller coaster’ effect of closely spaced aerial transitions.

The most viable shoofly option requires a phased approach, operating the MBL on a single track on the existing viaduct structure and reconstructing the east and west side of the new viaduct in two phases. This would also require a new shoofly track be built at-grade to cross Stockwell St. while the grade separation is constructed.

4. Budget Scenarios

Cost estimates were prepared for each of the grade separation grouping alternatives detailed in **Section 3** above. **Table 2** summarizes the results per option and alternative.

Appendix B includes criteria, assumptions and guidelines considered to develop the capital cost estimates, as well as the detailed tables including unit prices and quantities per each of the options for grade separation described in **Section 3**.

#	Alternatives	Option 1 (M$)	Option 2 (M$)	Option 3 (M$)
1	103rd (+103rd station) + Century	206.4	214.4	189.8
2	Wilmington	84.2	119.2	-
3	Florence St (+Florence Station)	188.8	162.5	-
4	Vernon (+Vernon Station)	186.0	-	-
5	Gage + Florence St (+Florence Station)	328.6	324.8	-
6	Wardlow (+Wardlow Station)	162.8	145.8	-
7	Nadeau	106.8	-	-
8	Gage + Florence St (+Florence Station) + Nadeau	428.8	-	-
9	Compton (+Compton Station)	164.3	163.7	-
10	Stockwell St	125.3	-	-

Table 2. – Grade Separation Project Options

Estimates were prepared in the FTA Standard Cost Category (SCC) format and account for all elements related to the delivery of the proposed aerial guideway improvements including Construction, Temporary Shoofly during Construction, ROW and Adjacent Facility Impacts, Professional Services, and Contingencies.

The purpose of the priority ranking formula was to prioritize existing grade crossings for grade separation based on projected safety and operational improvements. As such, the final ranking list of crossings as presented in **Section 2.2** should generally be prioritized for grade separation from top to bottom.

However, since there are multiple options for some of the grade separation alternatives with variations in cost, impact to public right-of-way, and impact to adjacent Union Pacific (UP) operations, it is useful to break down each budget scenario into multiple combinations to weigh project-specific priorities against the associated costs.

The proposed priority combinations for each scenario are as follows:

- **Combination A**: Minimum Impacts to UP
- **Combination B**: Minimum Public ROW Impacts
- **Combination C**: Minimum Cost
- **Combination D**: Maximum Stations Included

While we have proposed these four combination possibilities for each budget scenario with varying project-specific priorities, it should be noted that there are many potential ways to combine the proposed grade separation groupings under each budget scenario and other possible combinations should be considered.

4.1 Scenario 1 – $250 M

As the 103rd (+103rd Station) and Century grouping is #1 on the priority ranking list and includes a proposed aerial station, each of the $250 M Scenario combinations included one of the 103rd/Century options.

As the options ranged from $189.8 M to $ 214.4 M with an available $250 M, 103rd/Century is typically the only grade separation project possible under the budget constraints of Scenario 1. Each of the three options impacted the

existing pedestrian bridge to the south of the existing station with other various impacts based on the configuration of the shoofly.

Combination A – Minimum Impacts to UP	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 2	214.4
Total Cost	**214.4**

Combination B – Minimum Public ROW Impacts	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 3	185.9
Wilmington - Option 2	119.2
Total Cost	**309.0**

Combination C - Minimum Cost	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 3	189.8
Wilmington - Option 1	84.2
Total Cost	**274.0**

Combination D - Maximum Stations Included	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 2	214.4
Total Cost	**214.4**

Table 3. – Scenario 1 ($250 M) Combinations

For Combination A, 103rd/Century Option 1 was considered first since this is the lowest cost option with minimal impact to UP operations. Option 1 would utilize the available public right-of-way along the east side of the tracks for the temporary station and single-track shoofly, with minor impacts during construction to the adjacent park, Graham Ave. and the existing building on the SE corner of 103rd St. As the cost of this option is $206.4 M and it would not be possible to include another grade separation alternative with the remaining $43.6 M, it makes sense to instead propose Option 2 for Combination A. Option 2 has similar public right-of-way impacts to Option 1 with slightly greater impact to Graham Ave. but with the added benefit of a double track shoofly which will allow operations to continue with minimal delays during construction. The cost of Option 2 is only $8.0 M greater than Option 1 at $ 214.4 M so still well within the budget threshold for Scenario 1.

For Combination B, 103rd/Century Option 3 was chosen. Option 3 would minimize public right-of-way impacts by utilizing the existing UP tracks along the west side of the rail corridor for a temporary shoofly and station. This option would require shifting UP operations to a new temporary single track to the west to accommodate the proper clearance for the temporary station with minor impacts the 103rd St intersection for a new temporary grade crossing. Choosing 103rd/Century Option 3 at $189.8 M also opens up the possibility of adding Wilmington Ave Option 21 at an additional cost of $119.2 M for a total of $309.0. While this combination is not technically within the $250 M threshold, it should be considered at this early planning stage.

For Combination C, 103rd/Century Option 3 was chosen since the projected cost of $189.8 M was the lowest. As in Combination B, utilizing 103rd/Century Option 3 opens up the possibility of adding Wilmington Ave Option 1 for a total cost just over the budget threshold at $274.0 M total. While this combination is not technically within the $250 M threshold, it should be considered at this early planning stage.

For Combination D, Option 2 for 103rd/Century was chosen as it this is the highest ranked alternative which includes an aerial station with the added operational benefits during construction due to the double-track shoofly. While Wilmington Option 1 could feasibly be added as in Combinations B and C if 103rd/Century Option 3 was chosen instead, this was not prioritized in Combination D as the Wilmington grade separation does not include a new aerial station.

4.2 Scenario 2 – $500 M

The $500 M Scenario allows us to include two additional crossings to the 103rd (+103rd Station) and Century #1 grouping and Wilmington #2 grouping considered in Scenario 1; Florence Ave (+ Florence Station) at #3 and Vernon Ave (+Vernon Station) at #4. Each potential Wilmington option would continue to utilize the existing at-grade station

south of Glen Anderson Freeway during construction with a temporary platform extension required in both cases due to geometric constraints. Both Florence (+ Florence Station) options would have some unavoidable impacts to UP operations with the major differences being the location of the temporary station. There is only one feasible option for Vernon (+Vernon Station) with the temporary MBL shoofly utilizing UP tracks along the east side of the corridor and shifting UP operations further east onto temporary tracks to accommodate a temporary station. The west side of the corridor was too constrained to accommodate a temporary station without full closure of Long Beach Ave which provides access to residential driveways lining the street. With the criteria we have specified, Florence (+ Florence Station) Option 1 was not preferred in any of the combinations due to its higher cost and greater impacts to both UP and public ROW. The 103rd/Century options and chosen for each Combination in Scenario 2 are the same as in Scenario 1 for the reasons described in **Section 4.1** except where specifically noted.

Combination A – Minimum Impacts to UP	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 2	214.4
Wilmington - Option 1	84.2
Florence St (+Florence Station) - Option 2	162.5
Total Cost	**461.1**

Combination C - Minimum Cost	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 3	189.8
Wilmington - Option 1	84.2
Florence St (+Florence Station) - Option 2	162.5
Total Cost	**436.5**

Combination B – Minimum Public ROW Impacts	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 3	189.8
Wilmington - Option 2	119.2
Florence St (+Florence Station) - Option 2	162.5
Total Cost	**471.4**

Combination D - Maximum Stations Included	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 3	189.8
Florence St (+Florence Station) - Option 2	162.5
Vernon (+Vernon Station) - Option 1	186.0
Total Cost	**538.2**

Table 4. – Scenario 2 ($500 M) Combinations

For Combination A, Wilmington Option 1 ($84.2 M) and Florence (+ Florence Station) Option 2 ($162.5 M) could be included in addition to 103rd/Century Option 2 as in Scenario 1 at a total cost of $461.1 M. Wilmington Option 1 minimizes impact to the existing UP operations as the public right-of-way to the east of the existing rail corridor would be utilized for the temporary shoofly with only minor impacts to a portion of the sidewalk along Willowbrook Ave. While Florence Option 2 minimizes impacts to UP operations south of Florence Ave, UP ROW along the west side would need to be used for a portion of the temporary shoofly due to the constrained nature of the corridor north of Florence Ave with the proximity of residential properties on both the east and west sides of the track. South of the grade separation footprint, the shoofly would cross over the existing tracks to meet a temporary station along the east side of existing track. While this option minimizes impacts to UP operations, the temporary impacts to the MBL due to the need for the temporary station to be constructed 1500’ south of the existing station pose definite operational concerns that would need to be evaluated.

While Wilmington Option 1 ($84.2 M) was included for Combination B in Scenario 1 due to the budget constraints, Wilmington Option 2 ($119.2 M) would actually have less public right-of-way impacts as there would be no impacts to existing sidewalks or streets in this alternative. Since Florence Option 1 would have major impacts to buildings and properties along the west side of the corridor, Florence Option 2 with no public right-of-way impacts was preferred in Combination B. This brings the total for Combination B to $471.4 M.

For Combination C, the additional $250 M allows us to include the lower cost Florence (+Florence Station) Option 2 bringing the total to $436.5 M. Unfortunately there are no additional projects we could include with the remaining $63.5 M so alternatives with less impacts may be considered with the remaining budget.

Considering that Wilmington and Florence Ave are #2 and #3 in the priority ranking list, Combinations A, B, and C each include these two crossings, as well as the Florence Station. If the priority would be to grade separate the highest ranked crossings which have also include adjacent stations (Combination D), Wilmington might be substituted by Vernon which is #4 in the priority ranking list and includes a new aerial station as part of the grade separation. This would bring the total for Combination D to $538.2 M, just over our budget threshold but within the realm of possibility.

4.3 Scenario 3 – $750 M

Finally, if we would have $750 M budget it will be feasible to add Gage Ave under combinations A to C, and potentially Wardlow and Compton including their nearby stations.

The 103rd/Century and Wilmington options chosen for each Combination in Scenario 3 are the same as in Scenario 2 for the reasons described in **Section 4.2** except where specifically noted. With the addition of Gage Ave at #6 on the priority ranking list, the combined Gage/Florence (+Florence Station) grouping is introduced which would replace the standalone Florence (+Florence Station) option.

Combination A – Minimum Impacts to UP	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 2	214.4
Wilmington - Option 1	84.2
Vernon (+Vernon Station) - Option 1	186.0
Gage + Florence St (+Florence Station) - Option 2	324.8
Total Cost	**809.4**

Combination B – Minimum Public ROW Impacts	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 3	189.8
Wilmington - Option 2	119.2
Vernon (+Vernon Station) - Option 1	186.0
Gage + Florence St (+Florence Station) - Option 2	324.8
Total Cost	**819.7**

Combination C - Minimum Cost	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 3	189.8
Wilmington - Option 1	84.2
Vernon (+Vernon Station) - Option 1	186.0
Gage + Florence St (+Florence Station) - Option 2	324.8
Total Cost	**784.8**

Combination D - Maximum Stations Included	
Groupings	**Cost (M$)**
103rd (+103rd station) + Century - Option 3	189.8
Florence St (+Florence Station) - Option 2	162.5
Vernon (+Vernon Station) - Option 1	186.0
Wardlow (+Wardlow Station) - Option 2	145.8
Compton (+Compton Station) – Option 2	163.7
Total Cost	**847.7**

Table 5. – Scenario 3 ($750 M) Combinations

For Combination A, Vernon (+Vernon Station) Option 1 could be included at an additional $186.0 M bringing the total cost to $647.1. Including Gage/Florence (+ Florence Station) Option 2 in lieu of Florence (+ Florence Station) Option 2 brings the total to $809.4, just over the budget threshold of $750 M. Gage/Florence Options 1 and 2 are similar for the portion of the proposed grade separation north of Florence Ave with the major differences seen in the location of the temporary station south of Florence Ave. As in the standalone Florence (+Florence Station) Option 2, the combined Gage/Florence Option 2 would push the temporary station 1500’ south of its existing location. However, this option is preferred in Combinations A through C as it would minimize impacts to UP tracks and public right-of-way at a lower cost due to the major impacts resulting from a temporary station on the more constrained west side of the corridor

For Combination B, Vernon (+Vernon Station) Option 1 could be included at an additional $186.0 M bringing the total cost to $657.4. As in Combination A, including Gage/Florence (+ Florence Station) Option 2 in lieu of Florence (+ Florence Station) Option 2 brings the total to $819.7, just over the budget threshold of $750 M.

For Combination C, going from top to bottom in the priority ranking list with the lowest cost alternatives from each crossing results in a total cost of $784.8 M to grade separate the same crossings as in Combinations A and B. While

Combination C proposes Vernon (+Vernon Station) Option 1 and Gage/Florence (+ Florence Station) Option 2 exactly as in Combinations A and B, choosing the lowest cost alternatives for 103rd/Century (Option 3) and Wilmington (Option 1) allows us to come in $34.8 M over the required budget threshold of $750 M at $784.8 M. Since taking the lowest cost alternatives would not allow us to add any additional crossings from Combinations A or B anyway, potential impacts should be considered for each option.

For Combination D, Wilmington at #2, Gage at #6, and Nadeau at #8 would not be considered since these crossings do not have adjacent stations. Maximizing the number of stations included would allow for 4-5 new aerial stations. Adding Wardlow (+ Wardlow Station) Option 2 to Combination D from Scenario 2 would bring the total to $684.0 M. While the remaining $66.0 M is not quite enough to add Compton (+ Compton Station), we have included Compton (+ Compton Station) Option 2 at $163.7 for consideration bringing the projected total to $847.7 M which is around 13% greater than the $750 M budget threshold and within the realm of possibility.

5. Operational and Traffic Benefits

In addition to the safety benefit, the potential benefits in terms of operational efficiency and improvements in cross traffic flows was analyzed in prioritizing the at-grade crossings along the MBL for grade separation.

This section analyzes those potential benefits for each of the crossings in the top-10 ranking included in Section 2.2 and for each of the budget scenarios described in **Section 4**.

5.1 Railroad Operational Improvements

While safety improvements resulting from potential grade separation were the main priority of this study, railroad operational improvements were also evaluated.

A runtime analysis of the Metro Blue Line (MBL) was conducted in order to assess the potential time savings associated with converting at-grade crossings to grade-separated rail-over-road crossings. The runtime analysis was conducted using *RAILSIM* by Systra, an industry standard *Train Performance Calculation* (TPC) software package. The rolling stock modeled was a P3010 light rail car currently in use on the MBL. Data for the *RAILSIM* model was taken from the Metro P3010 Technical Specifications dated April 30, 2012, and from the P3010 Performance Calculation Report of Propulsion System.

The following assumptions were used in the model:

- Speed restriction of 25mph is in effect at "**far-side**" station stops meaning trains must decelerate to 25mph in the approach to any far-side, at-grade station stop.
- The gates **do not** descend as a train approaches a "**near-side**" platform stop. They remain in the vertical position until the train stops and the operator calls the gates manually from his/her operating console. Once the gates are fully lowered, the operator then proceeds. This is only true in the near-side direction. In the other direction, the gates activate normally upon approach of a train.
- The current maximum operating speed of the MBL is 55 mph within the gated section of the alignment.
    - The possibility to increase the speed to 65mph has been also considered, but the train control system would have to be modified to accept the higher speed code.
- LRT trains have a station dwell time of approximately 20 seconds.
- P3010 Train Specifications:
    - 3-unit train
    - Line voltage: 750V
    - Weight per car: 128,088 lbs (AW2)
    - Max. acceleration: 3.0 MPH/s
    - Max. deceleration: 3.5 MPH/s
    - Max. tractive effort per car: 19,500 lbs from 0 mph to 20 MPH, tapering to 3,750 lbs at 70 MPH

A sample portion of the MBL was simulated in order to determine the expected order of magnitude level of improvement for elevated crossings in general, and to support the analysis already conducted regarding potential runtime improvements. The simulation area chosen for this analysis was Wardlow Station, as shown in **Figure 4** with the following routes simulated:

- Northbound train departing Willow St Station, dwelling at Wardlow Station for 20 seconds, arriving at Del Amo Station.
- Southbound train departing Del Amo Station, dwelling at Wardlow Station for 20 seconds, arriving at Willow St Station

Figure 4. – Simulation Section

Three runtime scenarios were modeled for each direction:

- Existing track alignment (At-grade crossing at Wardlow Road) and 55 MPH track speed limit
- Potential elevated track alignment (Elevated rail-over-road crossing at Wardlow Rd) and 55 MPH track speed limit
- Potential elevated track alignment (Elevated rail-over-road crossing at Wardlow Rd) and 65 MPH track speed limit

A 25 MPH speed limit was assumed for at-grade road crossings before far-side stops. For the purpose of this analysis, this speed limit was applicable to the Northbound trains on the existing track alignment when crossing Wardlow Road and entering Wardlow Station.

The grades and horizontal curves were modeled for the simulated area between Willow St Station and Del Amo Station from the Metro's provided track charts dated March 31, 1992, and from the proposed track alignment drawing for the Wardlow Rd grade separation included in **Appendix A**. It was assumed for the purpose of this analysis that all curves on the alignment can be safely traversed at 65 MPH. However, the spirals of some or all of the horizontal curves may require adjustment in order to allow for the higher speed limit.

The results of the simulation are tabulated in **Table 6**. The results show a minor improvement in runtime for the elevated 55 MPH case. The largest improvement in this case was for Northbound trains, which turned out a 2 second decrease in runtime, largely due to the removal of the 25 MPH speed limit in the elevated case. Improvements were much greater for the elevated 65 MPH case, which turned out approximately 7.8% better runtimes in both the northbound and southbound case as compared to the at-grade case.

Direction	Runtime [mm:ss.s]	Time Savings	
		[s]	[%]
Northbound			
At-Grade (55 MPH)	04:25.8	-	-
Elevated (55 MPH)	04:23.8	2.0	0.75%
Elevated (65 MPH)	04:05.0	20.8	7.83%
Southbound			
At-Grade (55 MPH)	04:26.0	-	-
Elevated (55 MPH)	04:25.4	0.6	0.23%
Elevated (65 MPH)	04:05.1	20.9	7.86%

Table 6. – Wardlow Station Runtime Analysis Results.

The speed profiles for the northbound and southbound trains are shown in **Figure 5** and Error! Reference source not found., respectively. **Figure 5** clearly shows the slow-down in the at-grade case approaching Wardlow Station for the 25 MPH speed limit. However, it can be seen from the speed profiles that the savings are marginal, as the LRT is only decelerating slightly early than is required to stop at the station. **Figure 5** and Error! Reference source not found. also show a slight improvement for the elevated case when departing Wardlow Station due to the gravity assist from the downhill slope after the station.

Figure 5 and Error! Reference source not found. also clearly show the speed increase in the 65 MPH case. There is a significant distance of roughly 10,000 feet between Wardlow Station and Del Amo Station over which the train is able to maintain a speed of 65 MPH, therefore decreasing the runtime significantly.

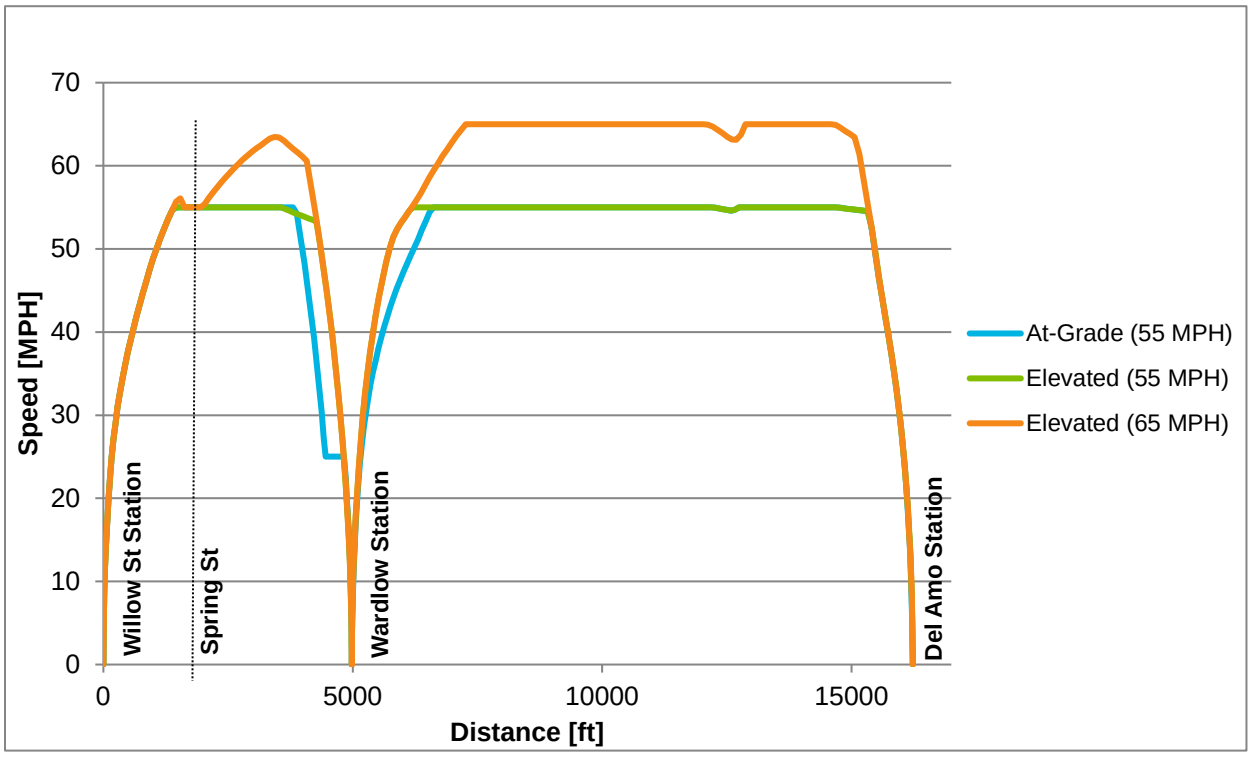


Figure 5. – Northbound Speed Profiles

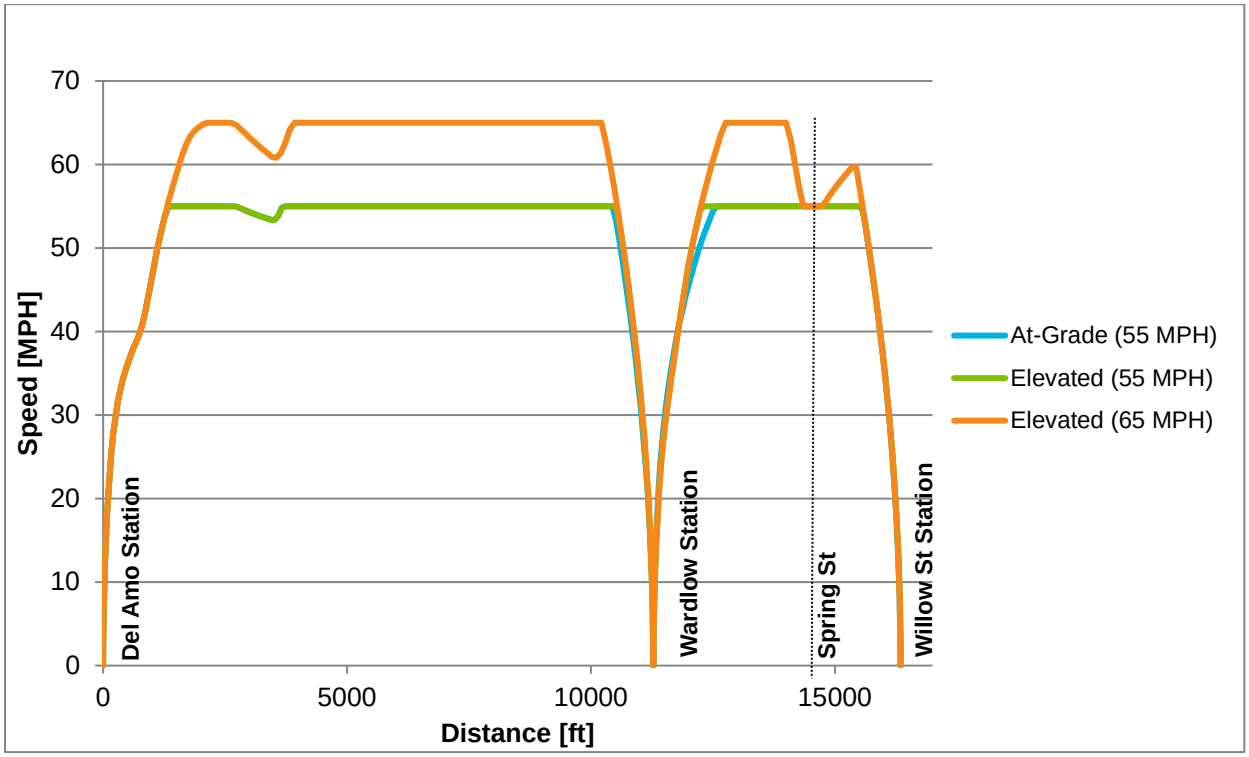


Figure 6. – Southbound Speed Profiles

Based on the rail simulation conclusions of the MBL sample between Del Amo Station and Willow Station, even assuming the possibility to increase the MBL speed limit up to 65 MPH, no significant improvement in runtime is expected due to the grade separation of any of the proposed groupings.

Additionally, the developed analysis has been extrapolated to the Group 7 [Gage Ave + Florence St (plus Florence Station) + Nadeau St] considering that this segment is expected to be the one that offers the major railroad operational benefits due to the proposed extension of the existing Slauson Ave. aerial structure for almost 2 miles. **Figure 7** shows the runtime savings per each scenario and the total savings are summarized in **Table 7**.

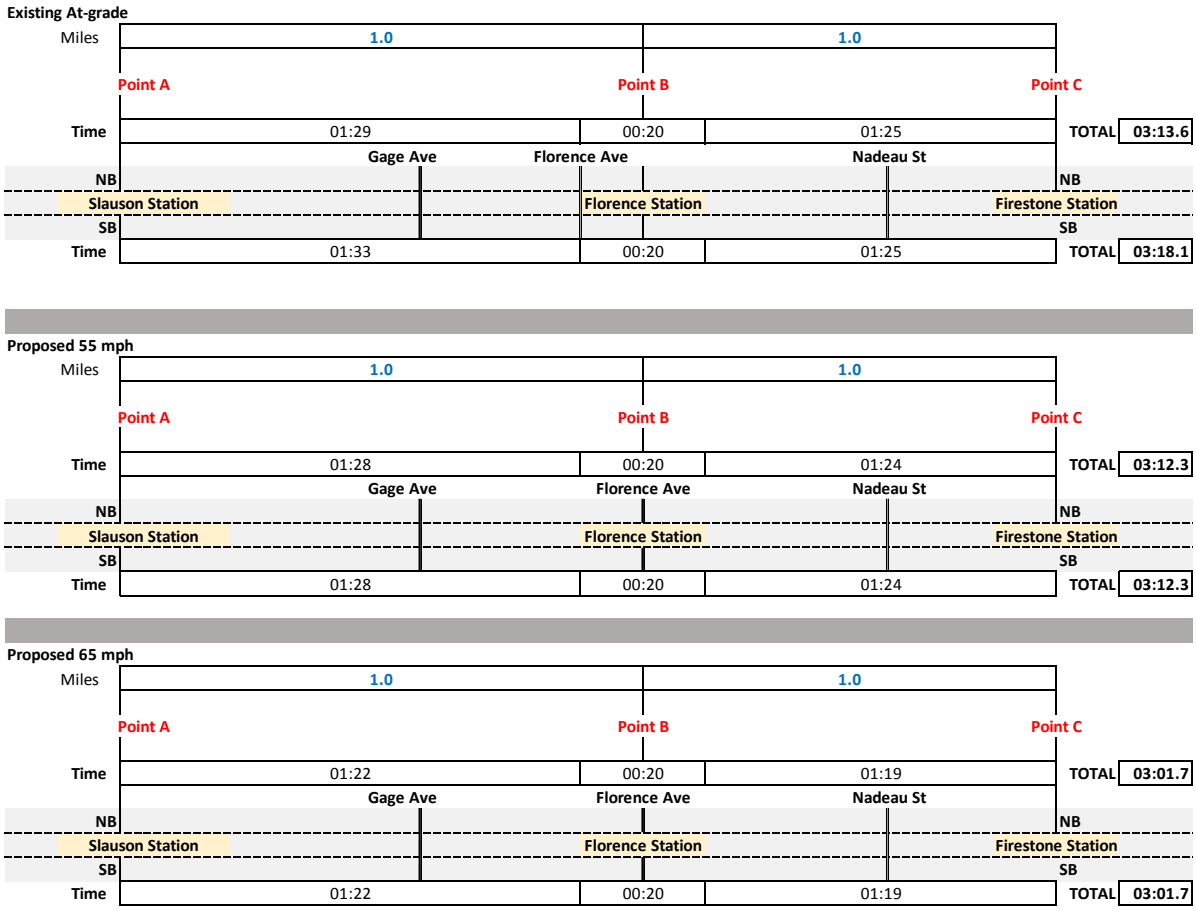


Figure 7. – Group 7 Runtime Analysis.

Direction	Runtime [mm:ss.s]	Time Savings	
		[s]	[%]
Northbound			
At-Grade (55 MPH)	03:13.6	-	-
Elevated (55 MPH)	03:12.3	1.3	0.69%
Elevated (65 MPH)	03:01.7	11.9	6.15%
Southbound			
At-Grade (55 MPH)	03:18.1	-	-
Elevated (55 MPH)	03:12.3	5.8	2.95%
Elevated (65 MPH)	03:01.7	16.4	8.28%

Table 7. – Group 7 Runtime Analysis Results.

Therefore, we can conclude that if we grade separate the three crossings included in Group 7, and even considering that the speed limit may be increased up to 65 MPH, the maximum runtime savings are below 20 sec and less than a 10% reduction of the existing runtimes with the railroad crossings at-grade.

Generally, the railroad operational improvements for grade separating most of the top 10 ranked crossings are limited due to the train needing to stop at one adjacent station, as it is the case of Florence Station located in the midpoint of the Group 7 grade separation section.

5.2 Traffic Improvements

The Metro Blue Line (MBL) trains run at 6-minute headways during the AM and PM peak periods (ten trains per hour per direction). Consequently, at any at-grade crossing along the MBL alignment, the crossing gates are activated a total of 20 times (gate down events) per hour during the AM and the PM peak periods. On average a train arrives from either direction at a crossing location every 3 minutes (180 seconds). However, after reviewing the published Metro Blue Line timetable, it was determined that, during a worst-case scenario, an interval between opposing train arrivals (one from each direction) can be as low as 90 seconds. This equates to a 90-second interval between two (2) consecutive activations of the crossing gates (gate down events). The gate down time is assumed to be approximately 45 seconds for each gate down event.

The objective of this traffic analysis is to evaluate operating conditions due to the proposed grade separations. During a gate down event, vehicular traffic stops for the train to pass through the at-grade rail crossing which in turn results in vehicular delays attributed to the activation of the crossing gates. Grade separating a rail crossing eliminates the need for a gate down event resulting in improved vehicular flow and the elimination of vehicular delays caused by the activation of the crossing gates (gate down events). **Appendix C** includes gate down event LOS worksheets.

A traffic operations evaluation was conducted at each of the proposed grade separation locations during the AM and PM peak hours to assess potential traffic flow benefits resulting from the elimination of the crossing gates (no gate down events). The results of the AM and PM peak hour before and after level of service analysis are summarized in **Table 8**.

ID	Grade Crossing Location	Track Location	AM Peak Hour				PM Peak Hour			
			No Gate Down Event		Gate Down Event		No Gate Down Event		Gate Down Event	
			Average Delay	LOS	Average Delay	LOS	Average Delay	LOS	Average Delay	LOS
148	Vernon Av	Adjacent	20.3	C	22.2	C	17.8	B	19.2	B
152	Gage Av	Mid-block	0	N/A*	22.5	C	0	N/A*	24.2	C
154	Florence Av	Mid-block	0	N/A*	18.1	B	0	N/A*	20.2	C
156	Nadeau St	Mid-block	0	N/A*	20.2	C	0	N/A*	22.0	C
159	Century Blvd	Adjacent	7.2	A	8.0	A	7.8	A	8.7	A
162	103rd St	Adjacent	10.3	B	11.5	B	11.3	B	11.7	B
163	Wilmington Ave	Mid-block	0	N/A*	31.5	C	0	N/A*	23.5	C
164	Stockwell St	Adjacent	10.5	B	11.2	B	10.5	B	10.6	B
165	Compton Blvd	Adjacent	13.5	B	14.3	B	12.8	B	13.5	B
108	Wardlow Rd	Adjacent	25.0	C	27.3	C	29.2	C	31.2	C

Table 8. – Results of the AM and PM peak hour before and after level of service analysis

N/A: Denotes that although the average delay at the grade crossing location is 0 seconds per vehicle, due to the grade separation of the crossing, there is no associated level of service because the roadway segment level of service at that location for a free flowing condition is calculated based on the volume to capacity ratio of the roadway segment.*

The level of service analysis was performed using the *Synchro 10* software, however, due to the limitation of the software several assumptions were made to evaluate the gate down event condition. For the mid-block locations at Gage Avenue, Florence Avenue, Nadeau Street, and Wilmington Avenue, potential delay caused by two consecutive gate down events is estimated by assuming the operation of a traffic signal with a 90-second cycle length to control vehicular traffic flow during the activation of the crossing gates. The proposed grade separation at each crossing location would eliminate the gate down event resulting in free and uninterrupted vehicular traffic flow along each roadway segment.

At the remaining six grade crossing locations, the rail tracks are adjacent to a signalized intersection. During the activation of the crossing gates (gate down events), some or all vehicular movements at the intersection will be stopped resulting in additional delay from normal intersection operations. The proposed grade separation at each crossing location would eliminate the gate down event resulting in normal signalized intersection operations. The assumptions made at each intersection location during a gate down event are presented in the following list.

Vernon Avenue

The rail tracks run through the middle of the intersection with Long Beach Avenue. During a gate down event, the north/south through and right turn movements along Long Beach Avenue operate in parallel with the activation of the crossing gates. The north/south left turns and all east/west movements along Vernon Avenue will be stopped.

Century Boulevard

The rail tracks run adjacent and on the eastside of the intersection with Grandee Avenue. During a gate down event, all north/south and east/west traffic movements will be stopped. The north/south lane configuration consists of one lane in each direction and there is no room available for a through vehicle to bypass a stopped turning vehicle waiting during the gate down event.

103rd Street

The rail tracks run adjacent and on the eastside of the intersection with Grandee Avenue. During a gate down event, the north/south through and turn movements away from the tracks along Grandee Avenue operate in parallel with the activation of the crossing gates. The north/south lane configuration consists of one wide lane in each direction and there is adequate width for a through vehicle to bypass a stopped turning vehicle waiting to cross the tracks during the gate down event. The northbound right turns and the southbound left turns and all east/west movements along 103rd Street will be stopped.

Stockwell Street

The rail tracks run in the middle between the Willowbrook Avenue East and Willowbrook Avenue West intersections. During a gate down event, the north/south turns crossing the tracks will be stopped and through and turn movements away from the tracks operate in parallel with the activation of the crossing gates. In addition, all east/west movements along Stockwell Street will be stopped.

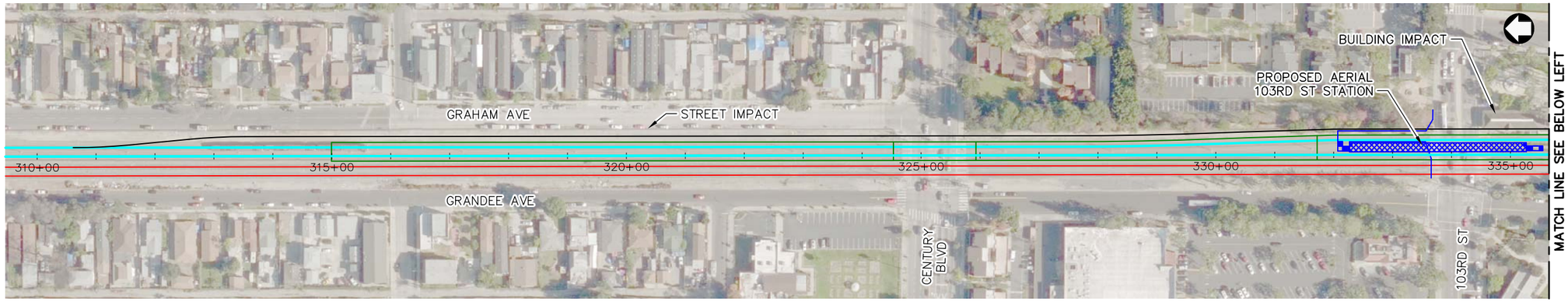
Compton Boulevard

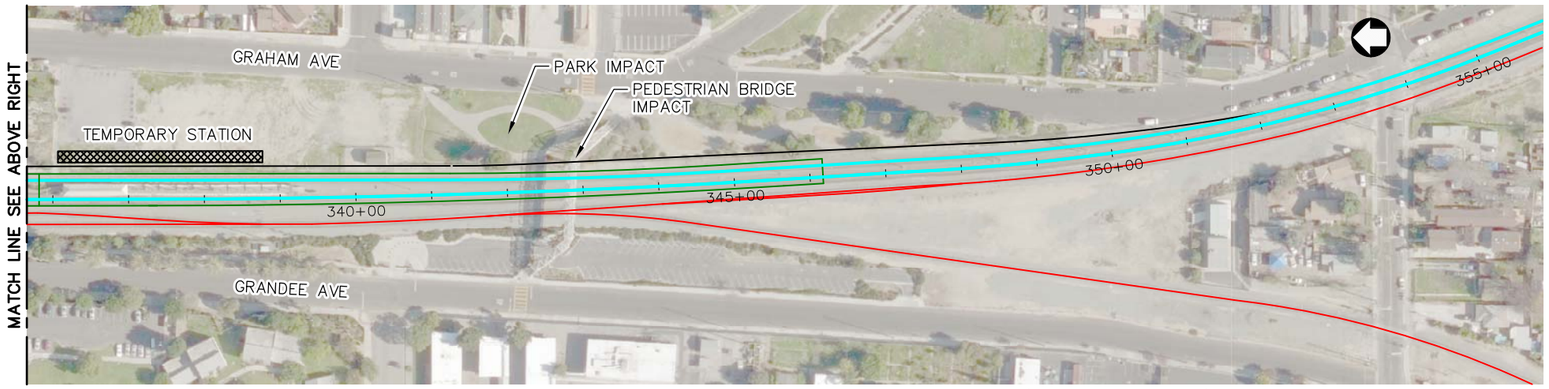
The rail tracks run in the middle between the Willowbrook Avenue East and Willowbrook Avenue West intersections. The northbound left turn movement from Willowbrook Avenue East and the southbound left turn movement from Willowbrook Avenue West are prohibited. During a gate down event, the north/south right turns crossing the tracks will be stopped and the through and turn movements away from the tracks operate in parallel with the activation of the crossing gates. In addition, all east/west movements along Compton Boulevard will be stopped.

Wardlow Road

The rail tracks run adjacent and on the eastside of the intersection with Pacific Place. During a gate down event, the north/south through and turn movements away from the tracks along Pacific Place operate in parallel with the activation of the crossing gates. The northbound right turns and the southbound left turns and all east/west movements along Wardlow Road will be stopped.

Appendix A. – Grade Separation Exhibits.





ASSUMPTIONS:

- NO IMPACT TO UP TRACKS
- STREET IMPACT
- PARK IMPACT
- PEDESTRIAN BRIDGE IMPACT
- RELOCATION OF BUILDING

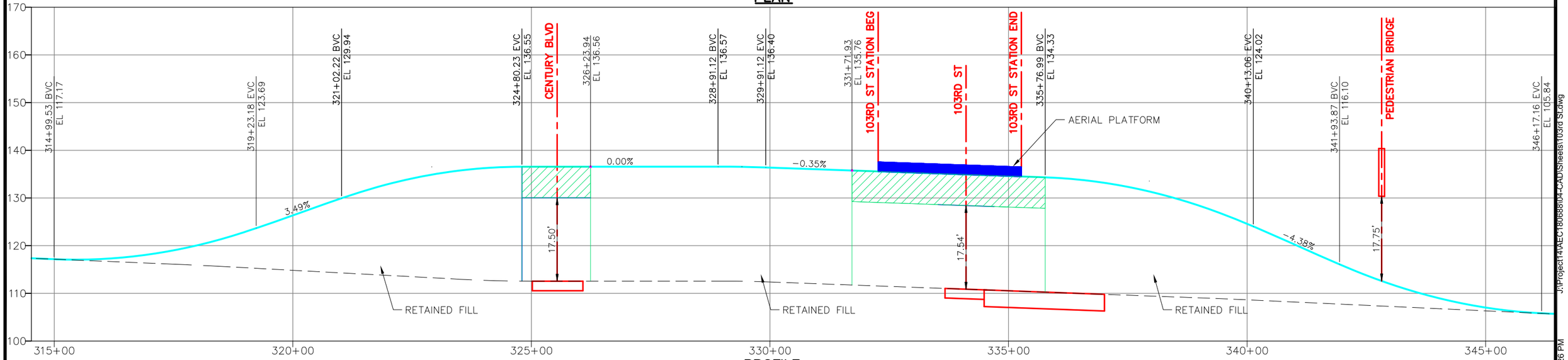
LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK EAST)
PLAN



PROFILE

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METRO BLUE LINE

103RD ST/CENTURY BLVD
GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK EAST)

CONTRACT NO
DRAWING NO A-1
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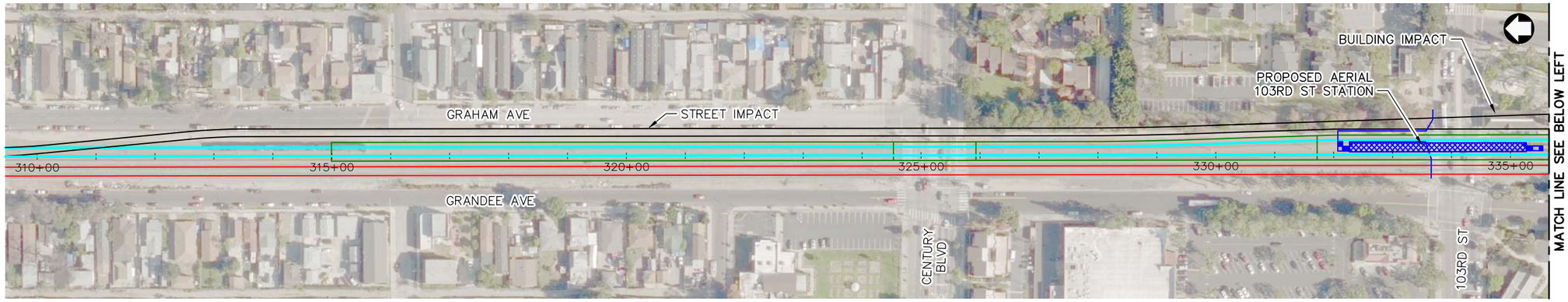
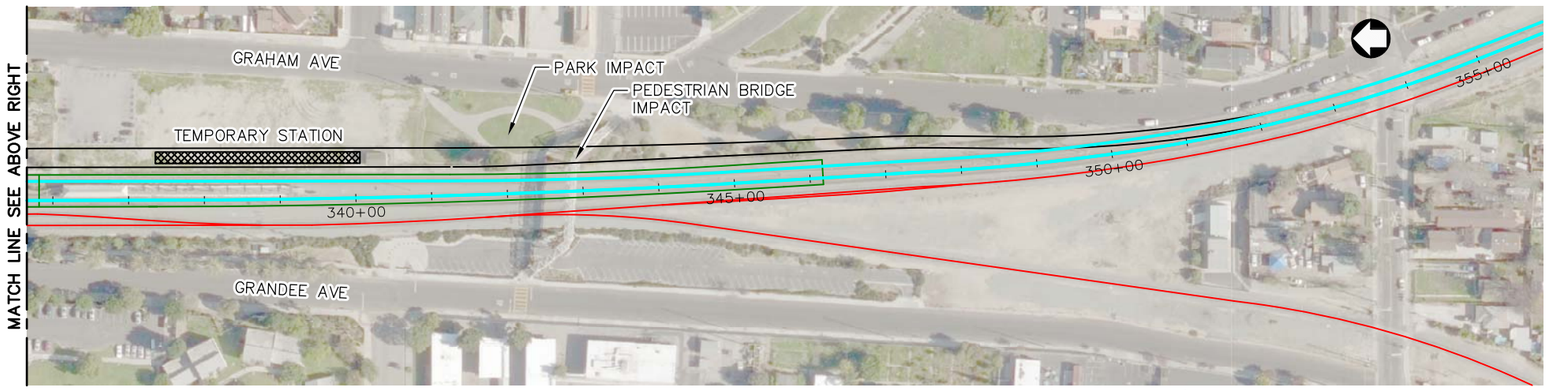




ASSUMPTIONS:

- NO IMPACT TO UP TRACKS
- STREET IMPACT
- PARK IMPACT
- PEDESTRIAN BRIDGE IMPACT
- RELOCATION OF BUILDING

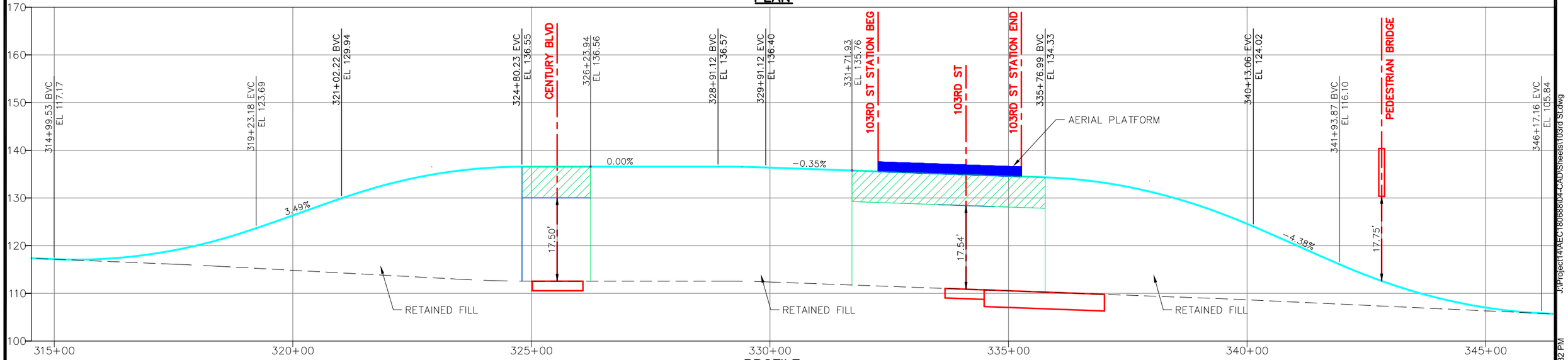
LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 2 (DOUBLE TRACK)
PLAN



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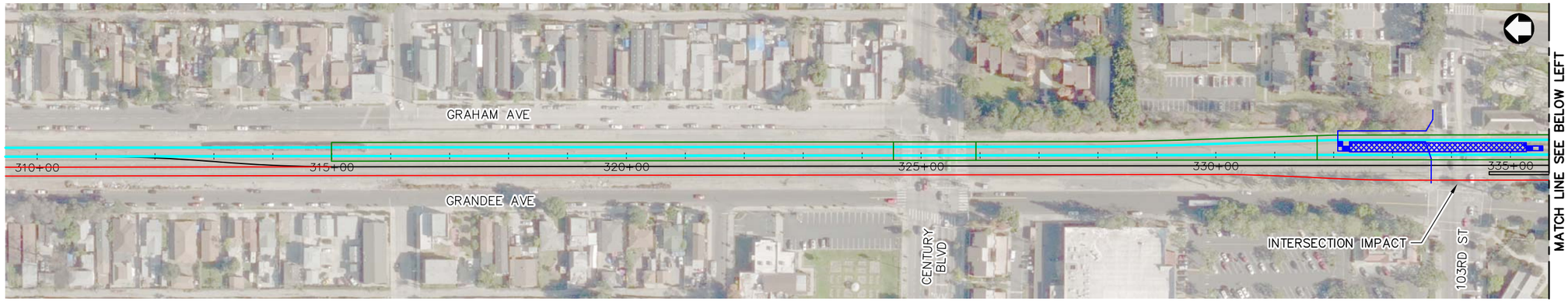

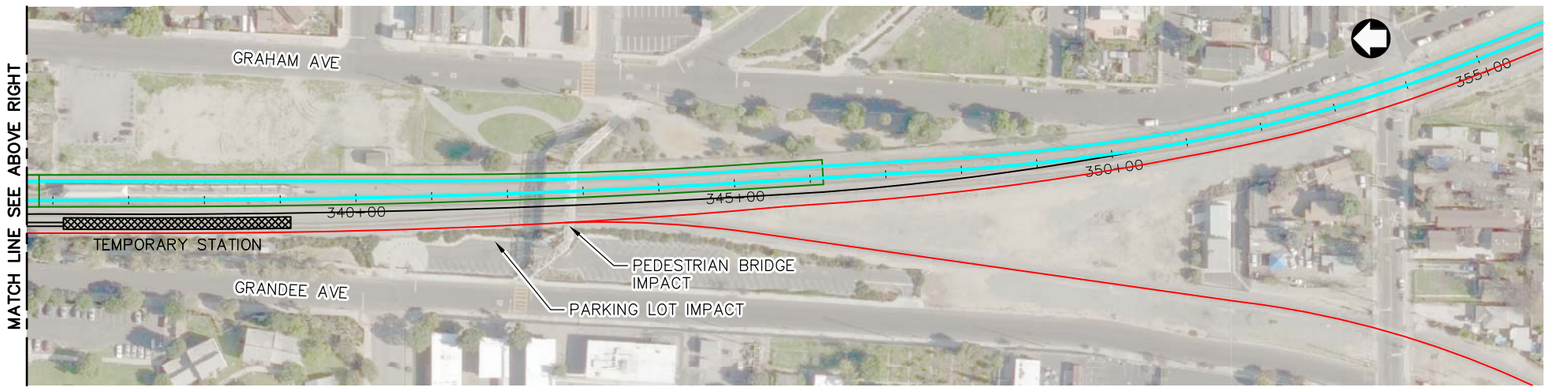

ASSUMPTIONS:

- UP TRACKS IMPACT
- UP SHIFTED TRACK CLOSE TO ROADWAY INTERSECTION
- PARKING LOT IMPACT
- PEDESTRIAN BRIDGE IMPACT

LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

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VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 3 (SINGLE TRACK WEST)
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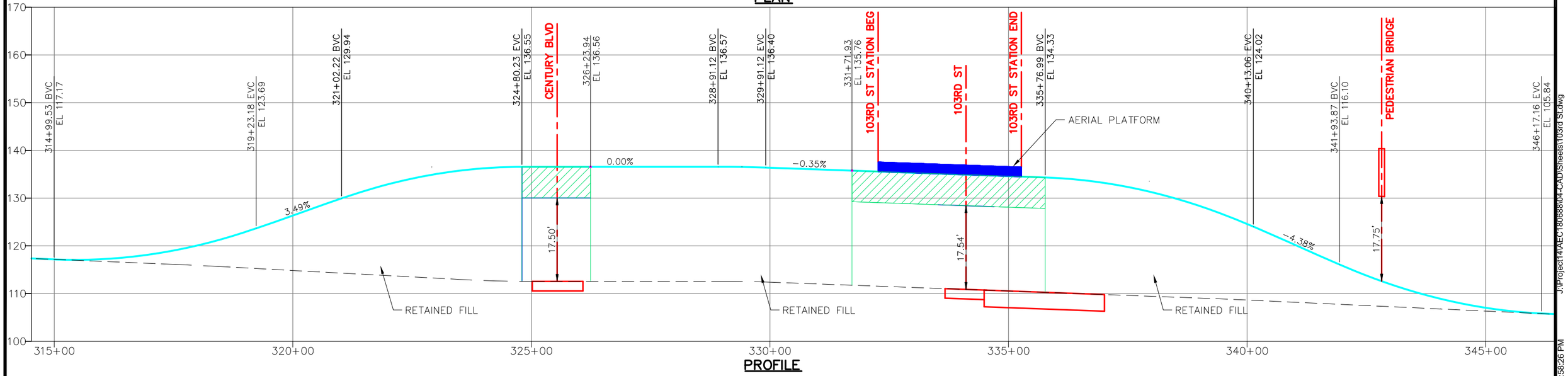

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103RD ST/CENTURY BLVD
GRADE SEPARATION
SHOOFLY ALTERNATIVE 3 (SINGLE TRACK WEST)

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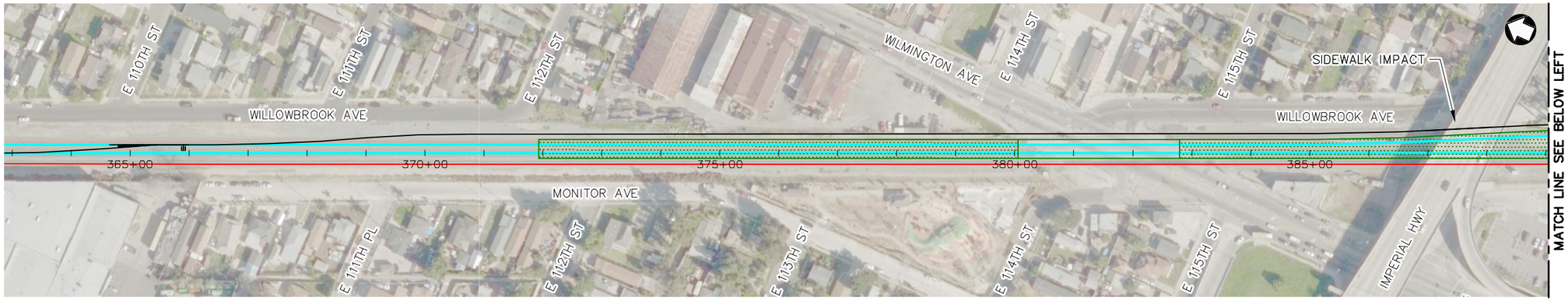

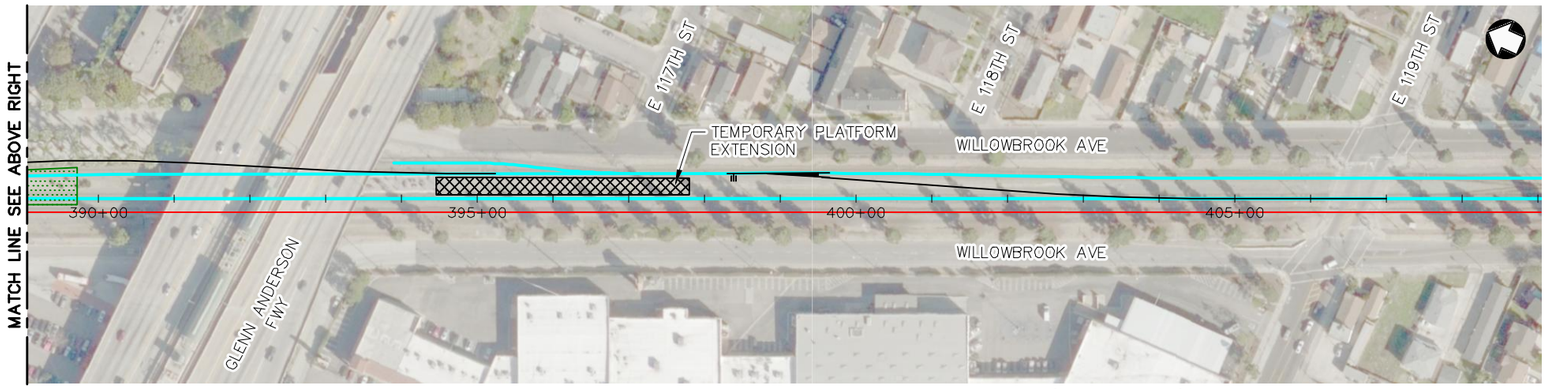

ASSUMPTIONS:

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- SIDEWALK IMPACT
- BRIDGE ON VERTICAL CURVE
- TCE AT NE QUADRANT OF GRADE CROSSING
- NEW SWITCHES AT NORTH AND SOUTH FOR SINGLE TRACK SHOOFLY
- PERMANENT PROFILE AT SPEED OF 45MPH

LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
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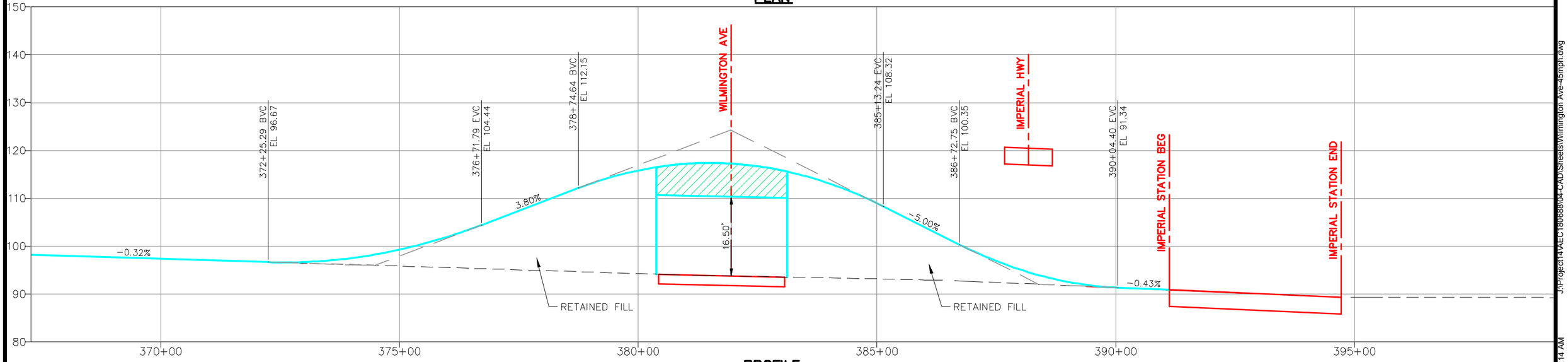

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METRO BLUE LINE

WILMINGTON AVE-45MPH
GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK EAST)

CONTRACT NO
DRAWING NO: A-4
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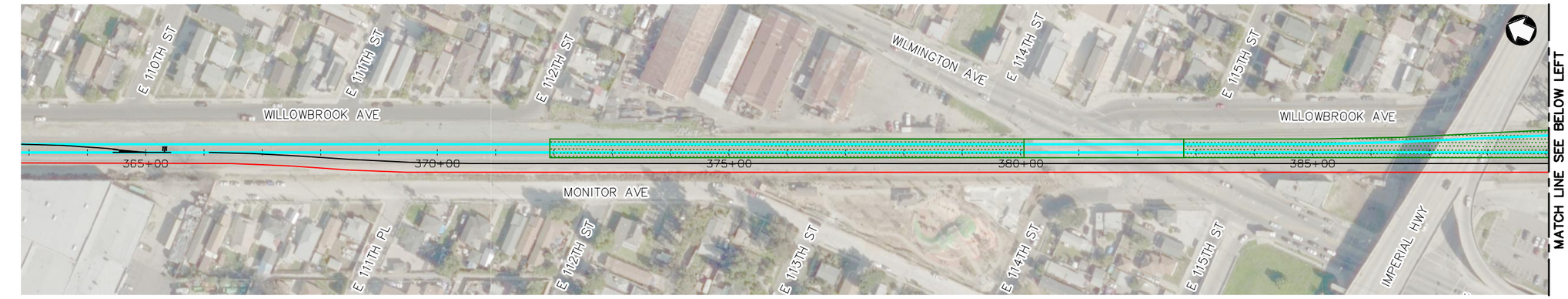

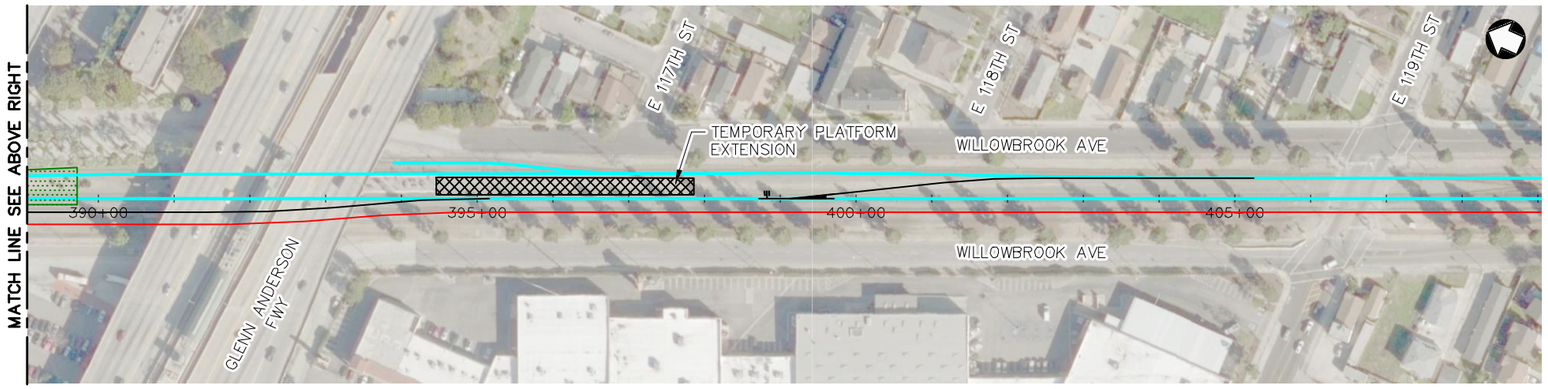

ASSUMPTIONS:

- IMPACT TO UP TRACKS
- NO SIDEWALK IMPACT
- BRIDGE ON VERTICAL CURVE
- TCE AT NE QUADRANT OF GRADE CROSSING
- NEW SWITCHES AT NORTH AND SOUTH FOR SINGLE TRACK SHOOFLY
- PERMANENT PROFILE AT SPEED OF 45MPH

LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

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VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
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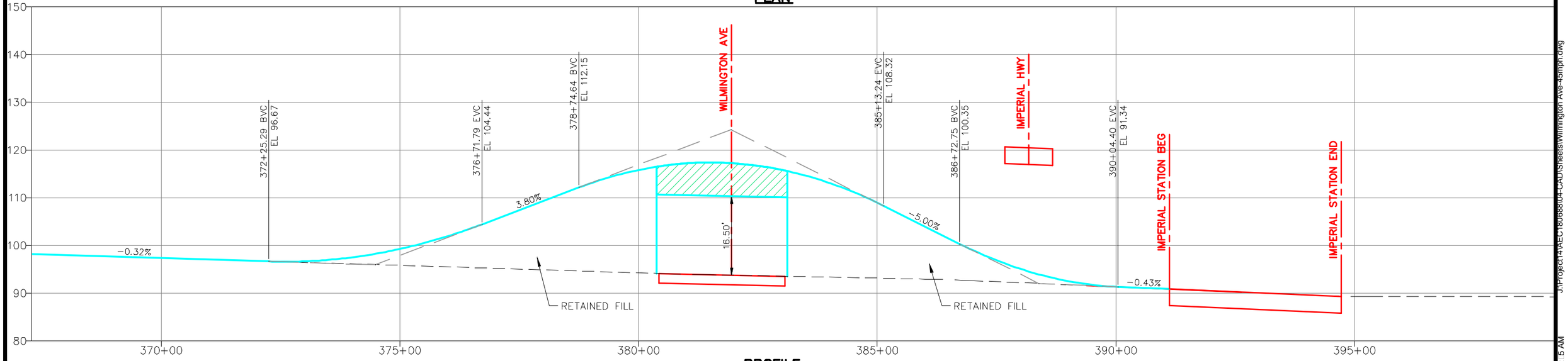

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WILMINGTON AVE-45MPH
GRADE SEPARATION
SHOOFLY ALTERNATIVE 2 (SINGLE TRACK WEST)

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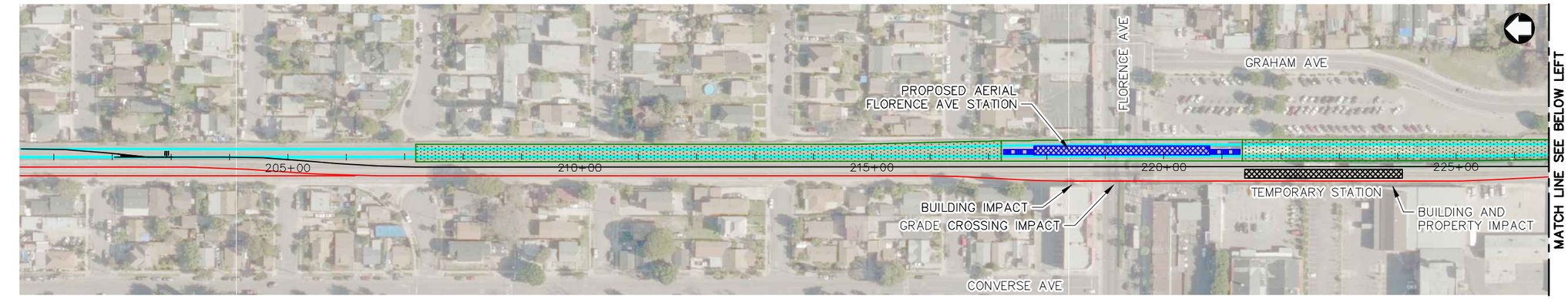
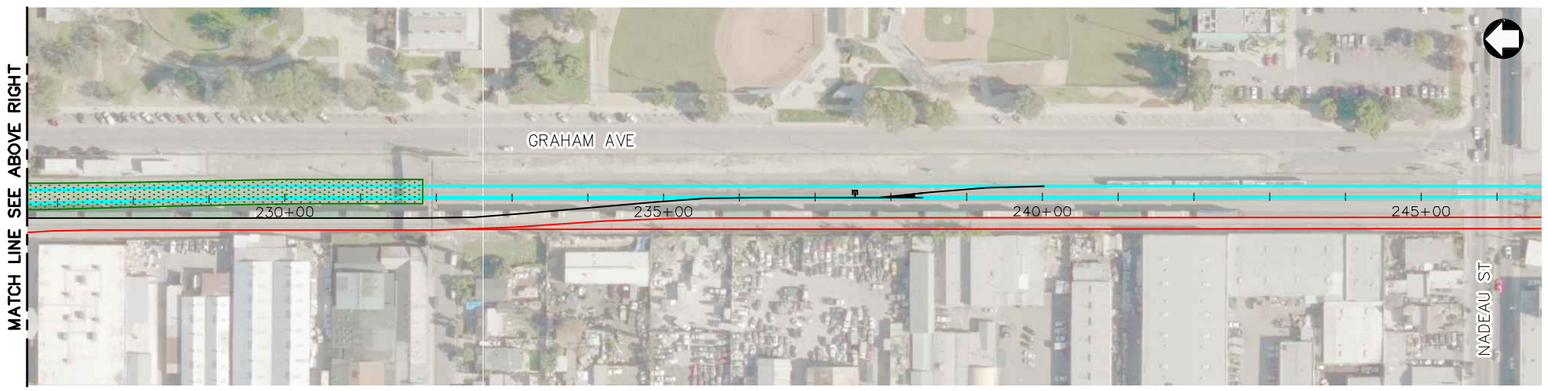




ASSUMPTIONS:

- IMPACT TO UP TRACKS
- BUILDING AND PROPERTY IMPACT
- GRADE CROSSING IMPACT
- NEW SWITCHES FOR UP & SHOOFLY AT BOTH NORTH & SOUTH

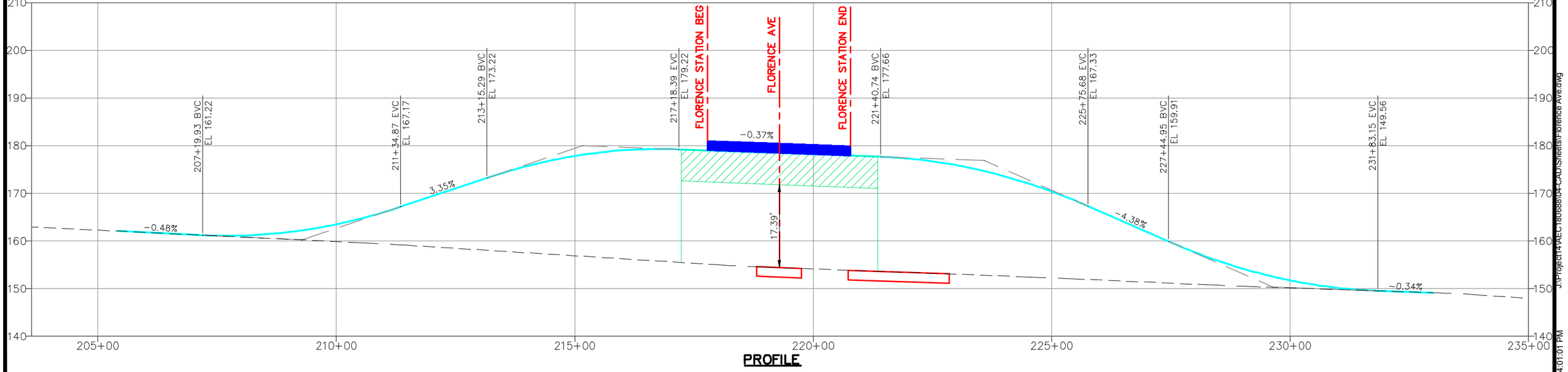
LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
PLAN



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY JC
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IN CHARGE
DATE 04-26-18

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METRO BLUE LINE

FLORENCE AVE
GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK WEST)

CONTRACT NO
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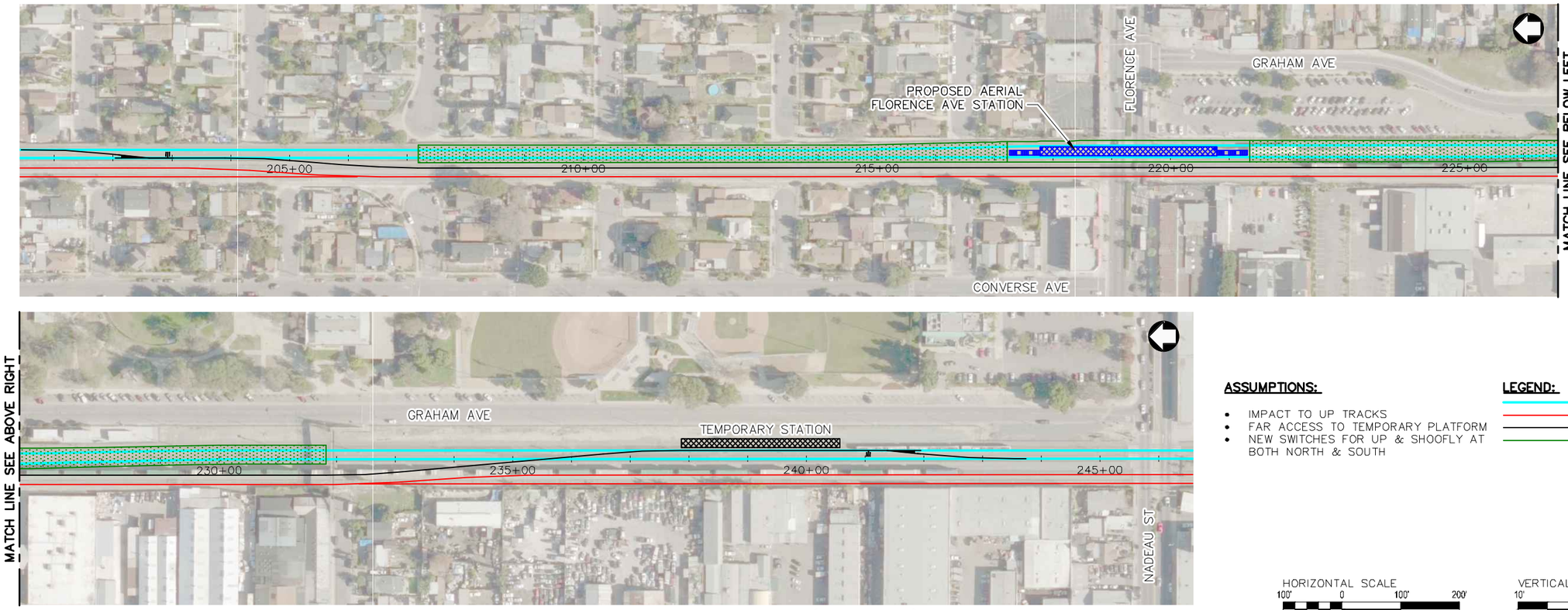

ASSUMPTIONS:

- IMPACT TO UP TRACKS
- FAR ACCESS TO TEMPORARY PLATFORM
- NEW SWITCHES FOR UP & SHOOFLY AT BOTH NORTH & SOUTH

LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
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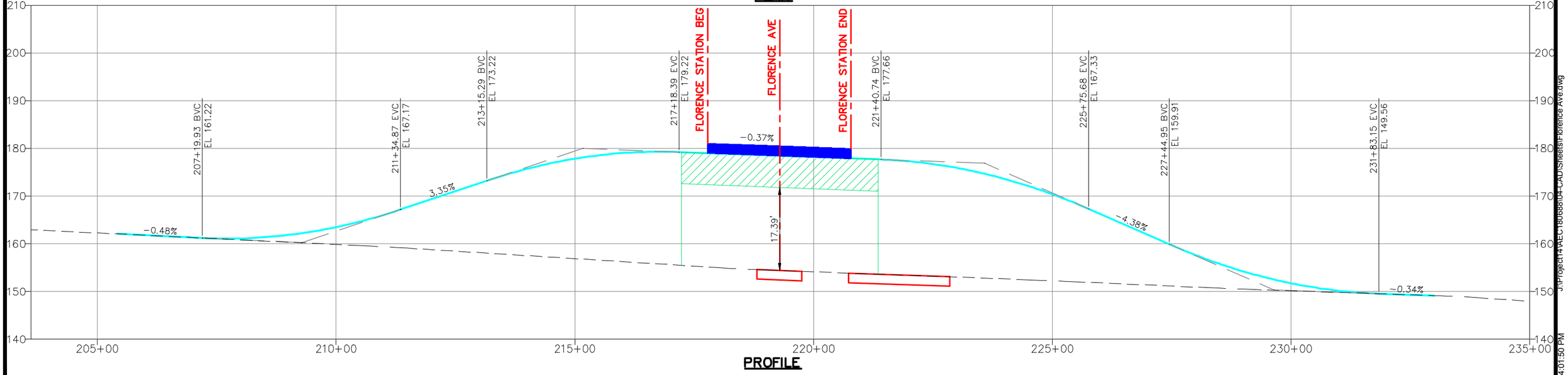

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METRO BLUE LINE

FLORENCE AVE
GRADE SEPARATION
SHOOFLY ALTERNATIVE 2 (SINGLE TRACK WEST)

CONTRACT NO
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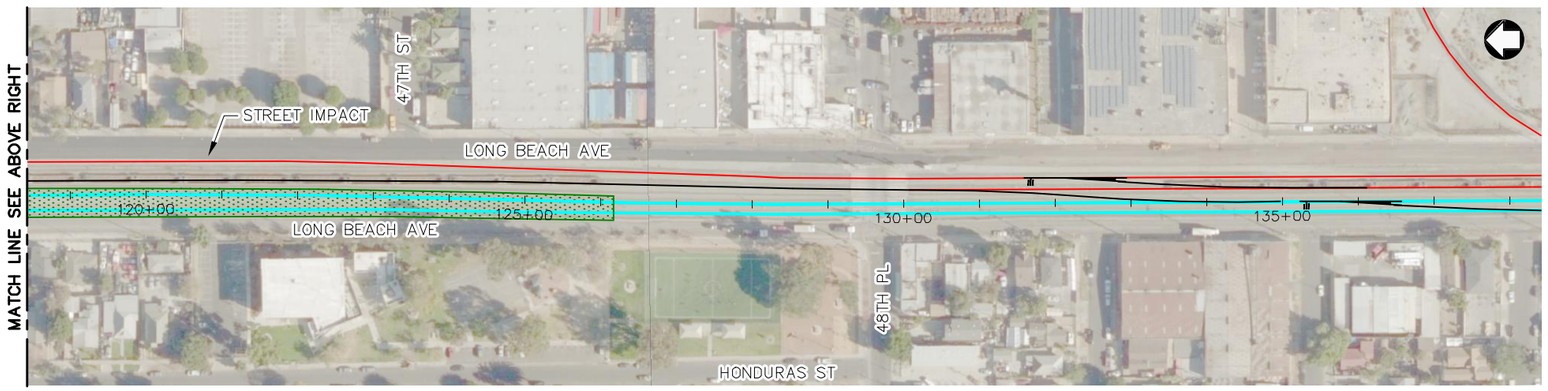


ASSUMPTIONS:

- IMPACT TO UP TRACKS
- GRADE CROSSING IMPACT
- STREET IMPACT
- SIGNAL HOUSE IMPACT

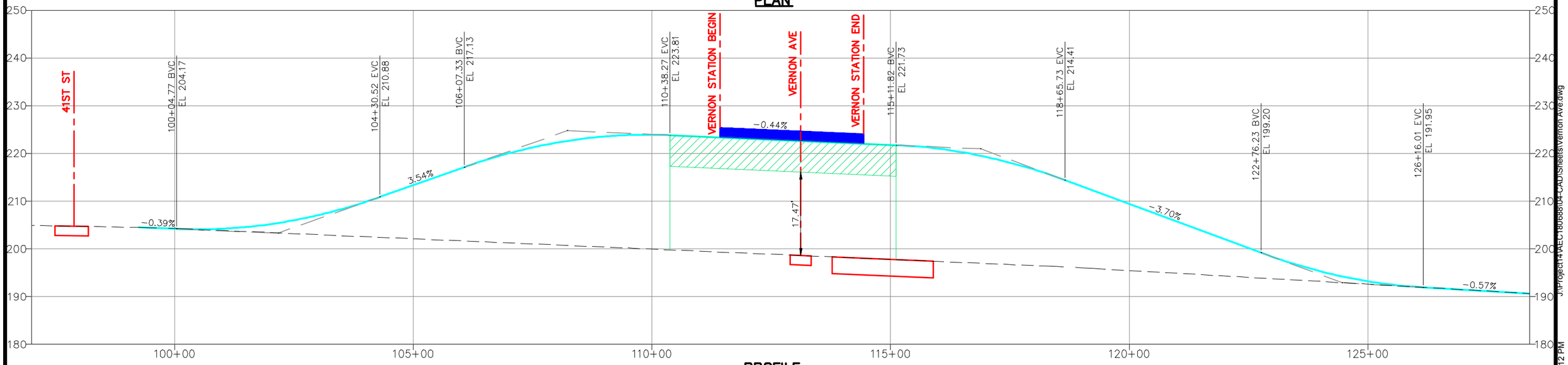
LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
PLAN



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY JC
DRAWN BY CC
CHECKED BY JC
IN CHARGE
DATE 05-01-18

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1875 Old County Road
Belmont, CA 94002
www.rseinc.com

METRO BLUE LINE

VERNON AVE
GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK EAST)

CONTRACT NO
DRAWING NO A-8
REV
SCALE H:1"=100'; V: 1"=10'
SHEET NO

J:\Projects\4\AEC-18\DB&B\04-CAD\Sheets\Vernon Ave.dwg
Tuesday, May 01, 2018 5:48:12 PM

ASSUMPTIONS:

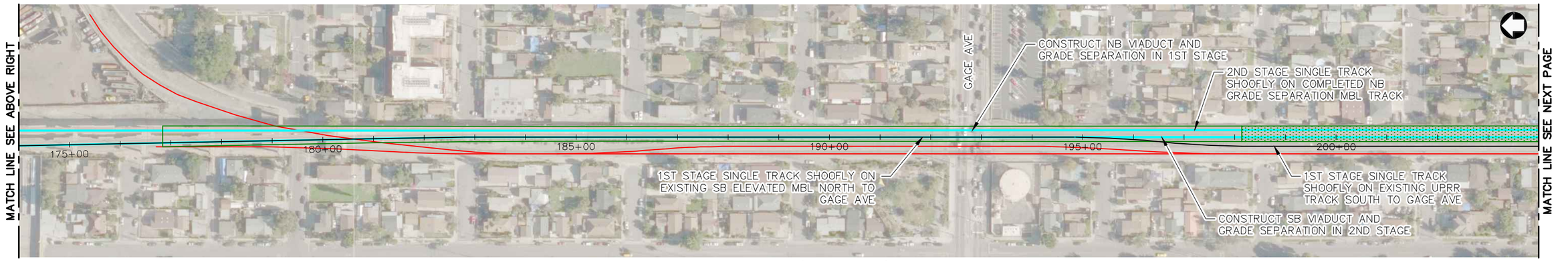
- IMPACT TO UP TRACKS
- NEW SWITCHES FOR UP & SHOOFLY AT BOTH NORTH & SOUTH

LEGEND:

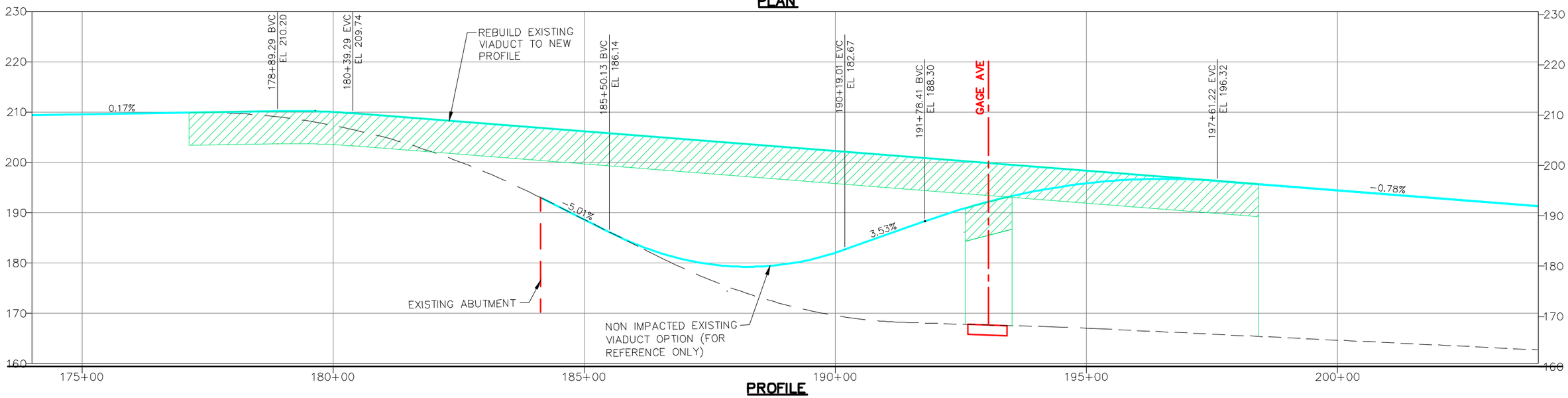
- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'



SHOOFLY ALTERNATIVE 1 (SINGLE TRACK) PLAN



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY JC
DRAWN BY CC
CHECKED BY JC
IN CHARGE
DATE 05-23-18

Metro
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1875 Old County Road
Belmont, CA 94002
www.rseinc.com

METRO BLUE LINE

GAGE AVE/FLORENCE AVE GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK WEST)

CONTRACT NO
DRAWING NO A-9
REV
SCALE H:1"=100'; V: 1"=10'
SHEET NO 1

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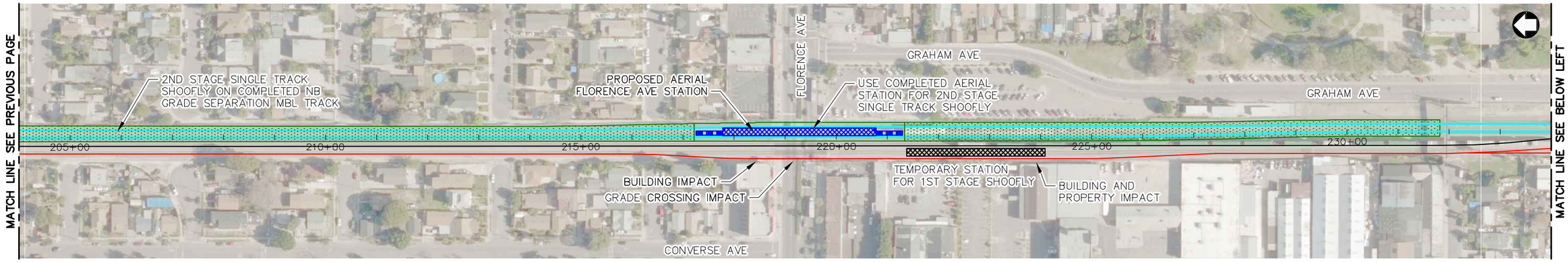
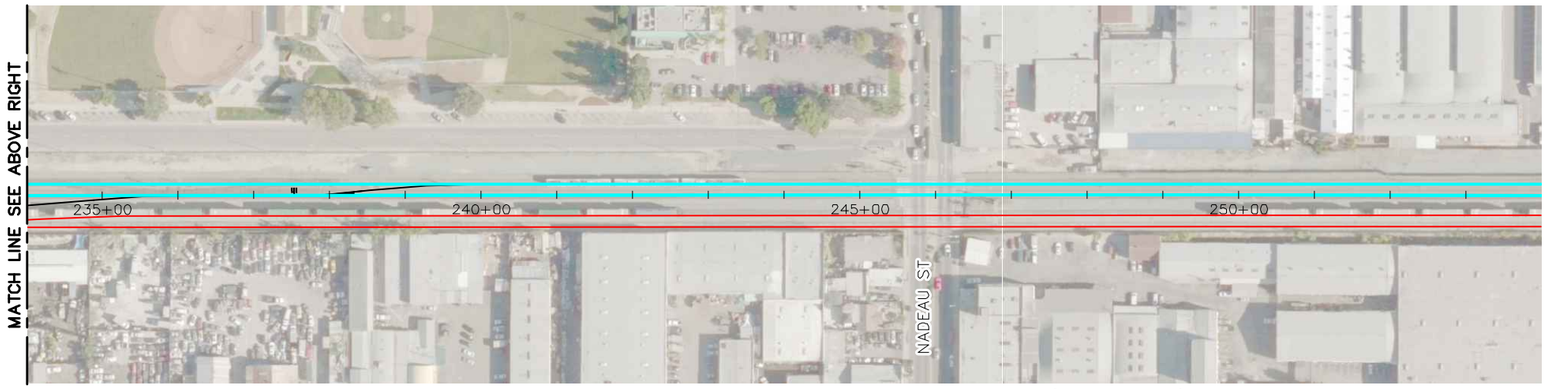




ASSUMPTIONS:

- IMPACT TO UP TRACKS
- BUILDING AND PROPERTY IMPACT
- GRADE CROSSING IMPACT
- NEW SWITCHES FOR UP & SHOOFLY AT BOTH NORTH & SOUTH

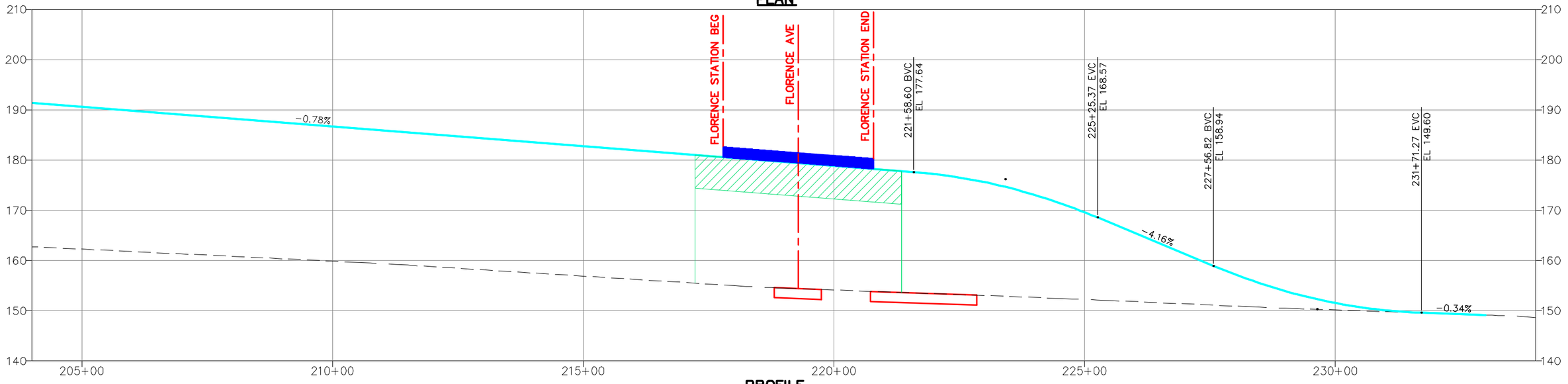
LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
PLAN



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY JC
DRAWN BY CC
CHECKED BY JC
IN CHARGE
DATE 05-23-18

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1875 Old County Road
Belmont, CA 94002
www.rseinc.com

METRO BLUE LINE

GAGE AVE/FLORENCE AVE
GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK WEST)

CONTRACT NO
DRAWING NO A-10
REV
SCALE H:1"=100'; V: 1"=10'
SHEET NO 2

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Wednesday, May 23, 2018 - 01:01 PM

MATCH LINE SEE BELOW LEFT

ASSUMPTIONS:

- IMPACT TO UP TRACKS
- FAR ACCESS TO TEMPORARY PLATFORM
- NEW SWITCHES FOR UP & SHOOFLY AT BOTH NORTH & SOUTH

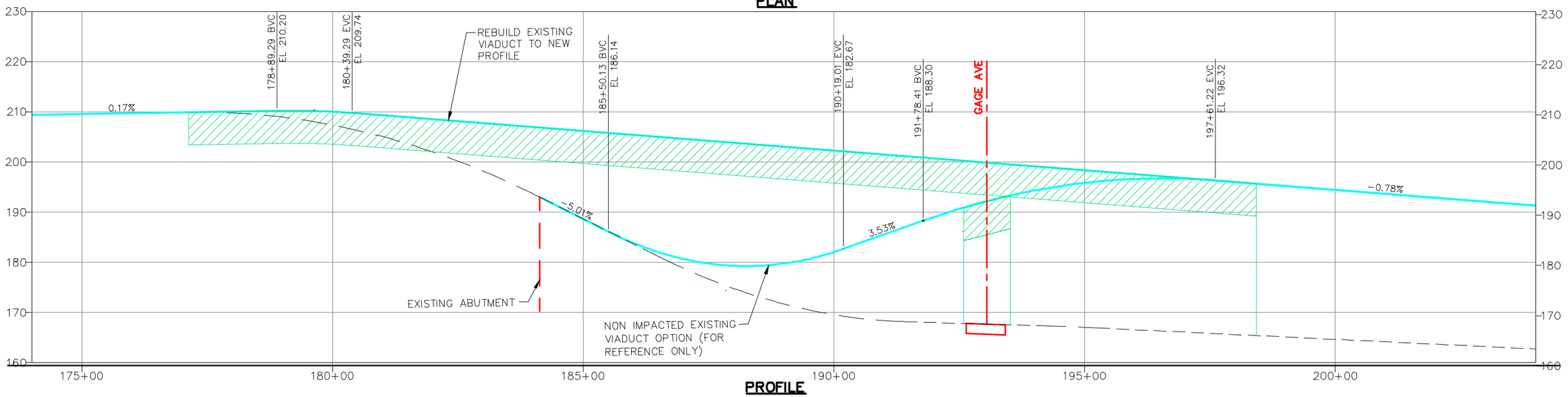
LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE
100' 0 100' 200'

VERTICAL SCALE
10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK) PLAN



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY JC
DRAWN BY CC
CHECKED BY JC
IN CHARGE
DATE 05-23-18

Metro
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1075 Old County Road
Belmont, CA 94002
www.rseinc.com

METRO BLUE LINE

GAGE AVE/FLORENCE AVE GRADE SEPARATION
SHOOFLY ALTERNATIVE 2 (SINGLE TRACK WEST)

CONTRACT NO
DRAWING NO A-11
REV
SCALE H:1"=100'; V: 1"=10'
SHEET NO 1

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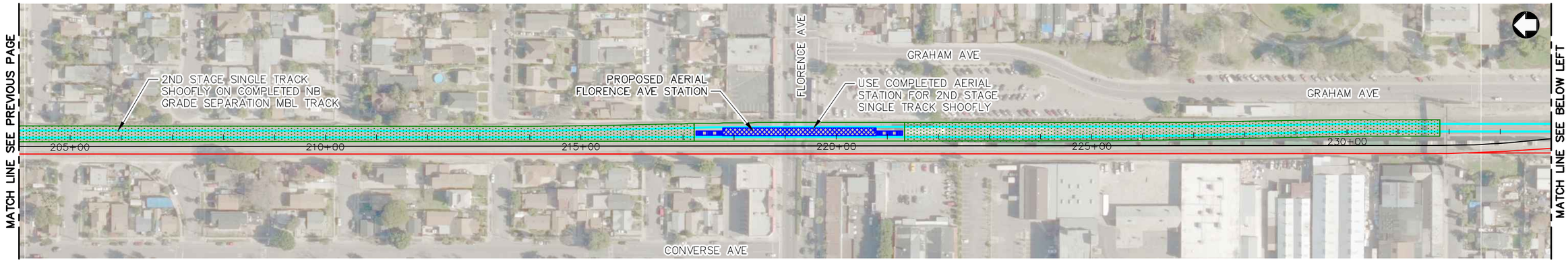
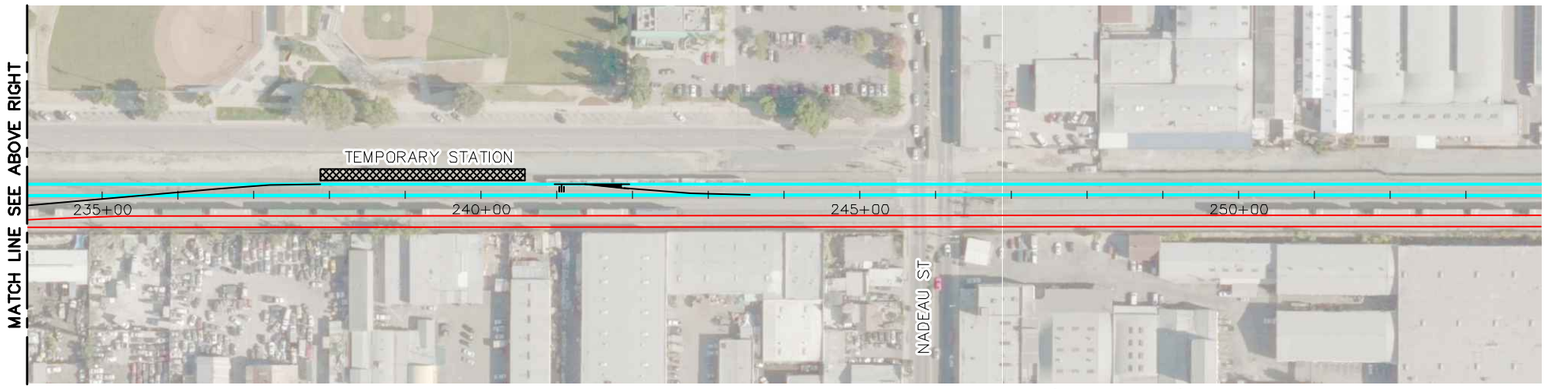




ASSUMPTIONS:

- IMPACT TO UP TRACKS
- FAR ACCESS TO TEMPORARY PLATFORM
- NEW SWITCHES FOR UP & SHOOFLY AT BOTH NORTH & SOUTH

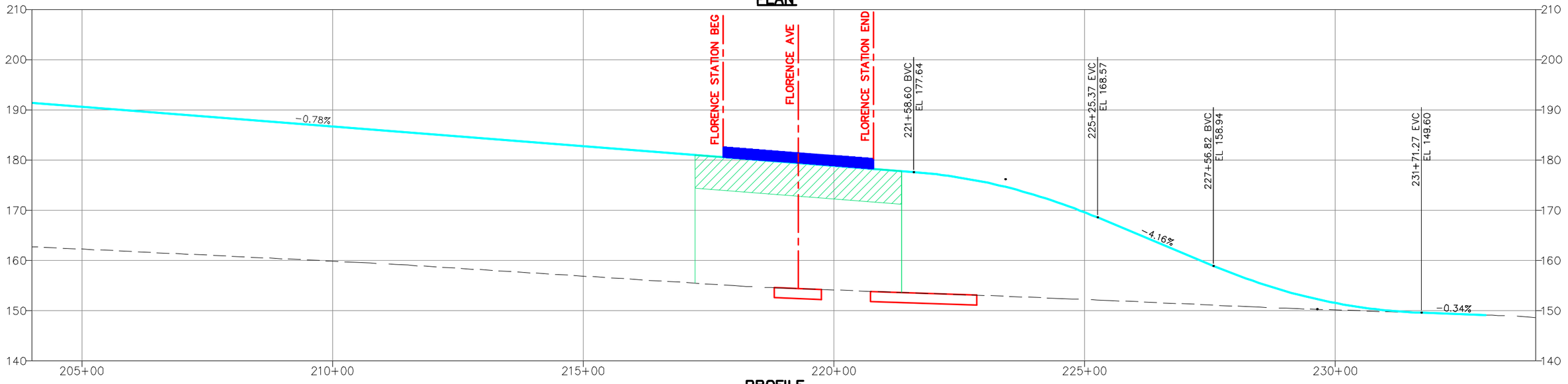
LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
PLAN



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY JC
DRAWN BY CC
CHECKED BY JC
IN CHARGE
DATE 05-23-18

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1575 OLD COUNTY ROAD
BELMONT, CA 94002
WWW.RSEINC.COM

METRO BLUE LINE

GAGE AVE/FLORENCE AVE
GRADE SEPARATION
SHOOFLY ALTERNATIVE 2 (SINGLE TRACK WEST)

CONTRACT NO
DRAWING NO A-12
REV
SCALE H:1"=100'; V: 1"=10'
SHEET NO 2

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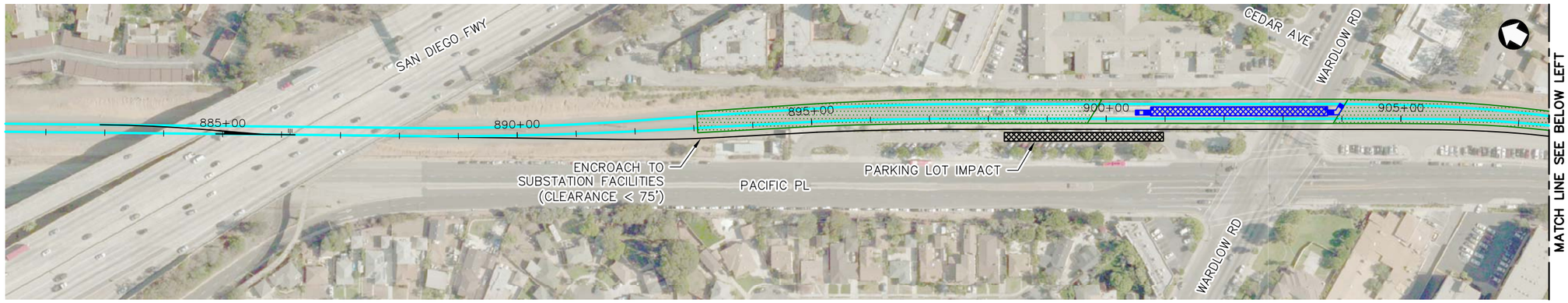
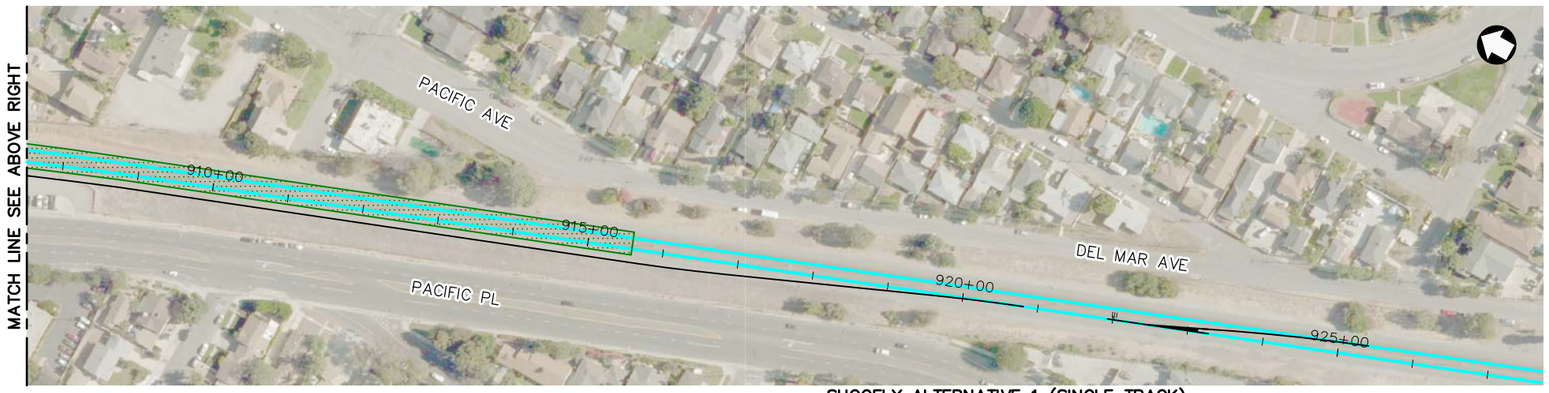




ASSUMPTIONS:

- ENCROACHING TO EXISTING SUBSTATION
- PARKING LOT IMPACT
- SINGLE TRACK SHOOFLY

LEGEND:

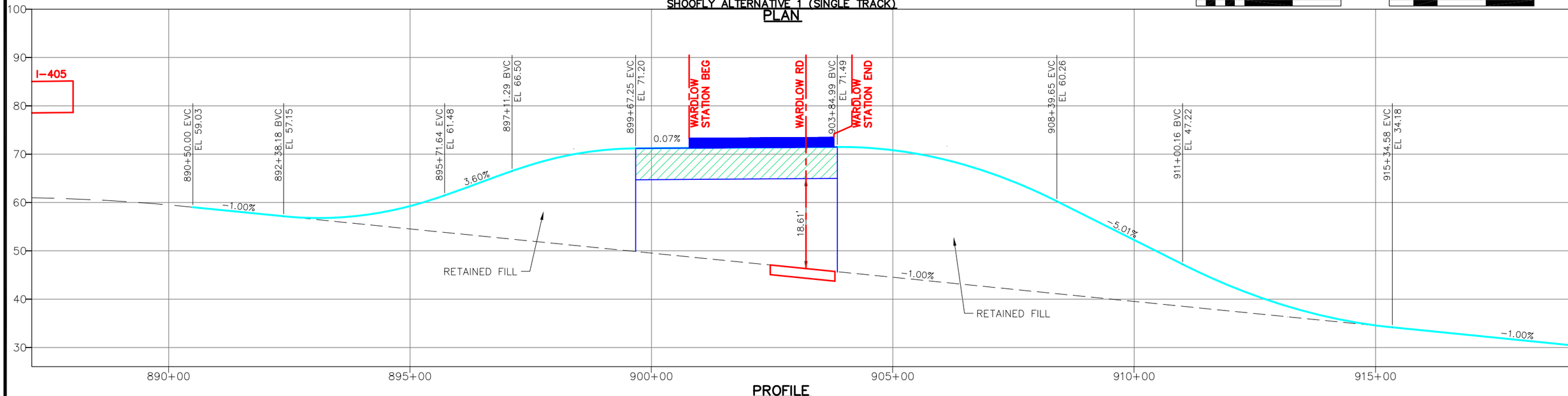
- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)

PLAN



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY JC
DRAWN BY CC
CHECKED BY JC
IN CHARGE
DATE 04-23-18

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1075 Old County Road
Belmont, CA 94002
www.rserail.com

METRO BLUE LINE

WARDLOW RD/SPRING ST
GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK WEST)

CONTRACT NO
DRAWING NO A-13
REV
SCALE H:1"=100'; V: 1"=10'
SHEET NO

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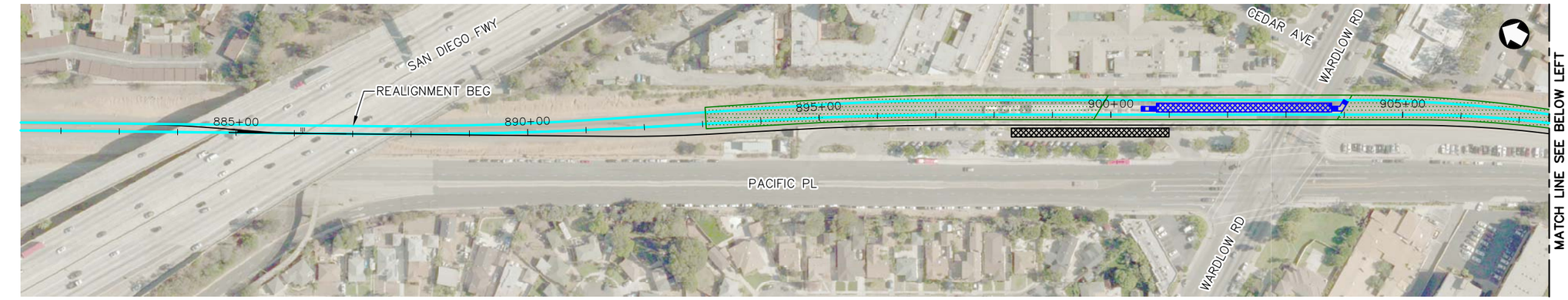


ASSUMPTIONS:

- REALIGNMENT TOWARD EAST
- PARKING LOT IMPACT
- SINGLE TRACK SHOOFLY

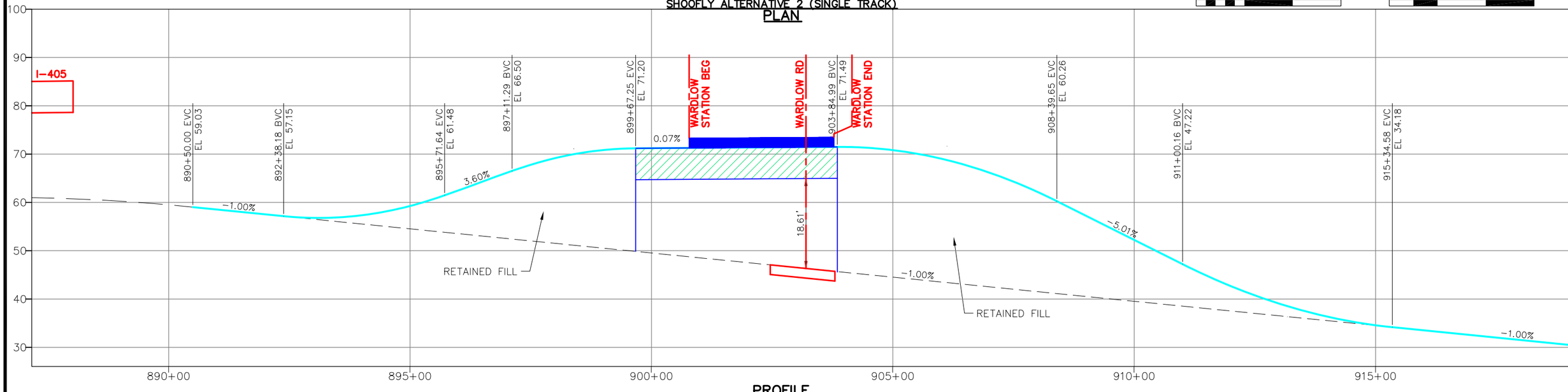
LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 2 (SINGLE TRACK)
PLAN



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY JC
DRAWN BY CC
CHECKED BY JC
IN CHARGE
DATE 04-23-18

Metro
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1075 Old County Road
Belmont, CA 94002
www.rserail.com

METRO BLUE LINE

WARDLOW RD/SPRING ST
GRADE SEPARATION
SHOOFLY ALTERNATIVE 2 (SINGLE TRACK WEST)

CONTRACT NO
DRAWING NO A-14
REV
SCALE H:1"=100'; V: 1"=10'
SHEET NO

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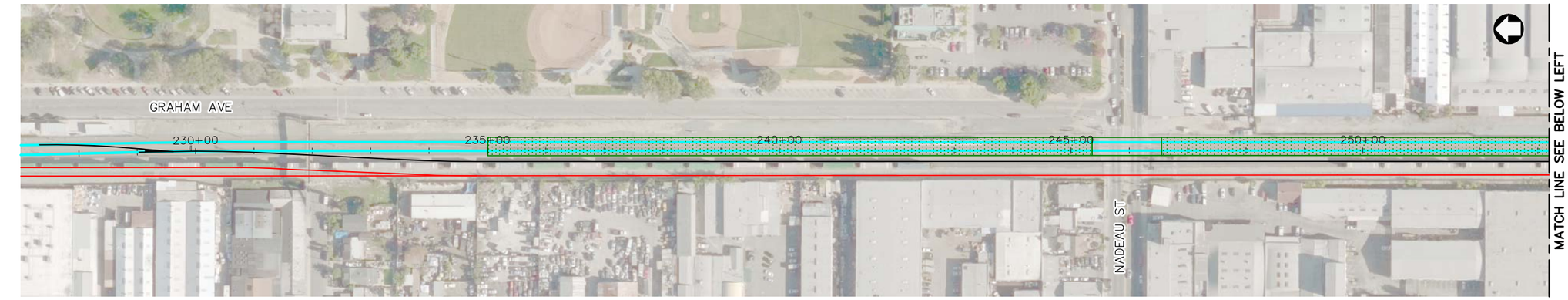
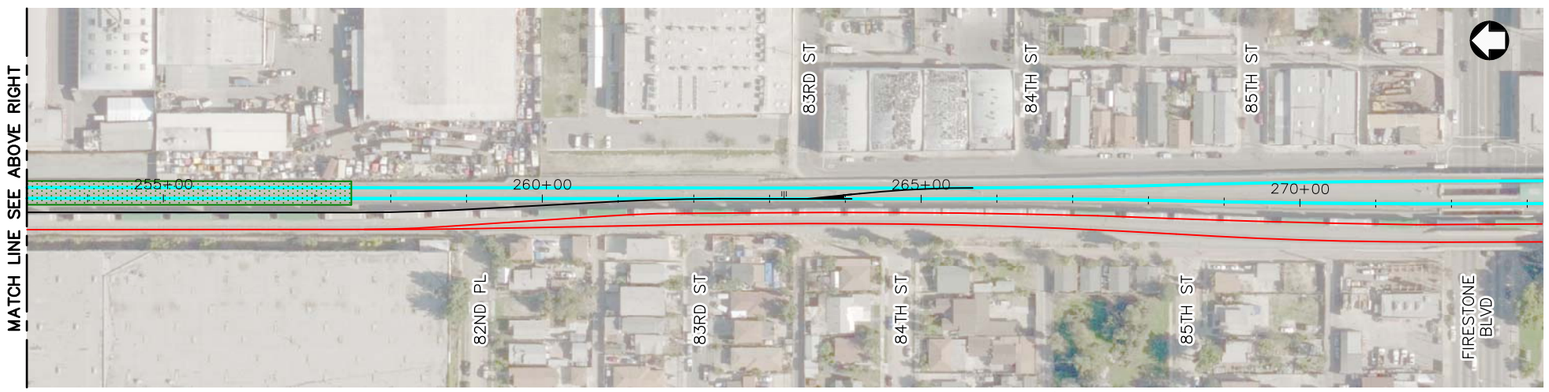




ASSUMPTIONS:

- IMPACT TO UP TRACKS
- NEW SWITCHES FOR UP & SHOOFLY AT BOTH NORTH & SOUTH

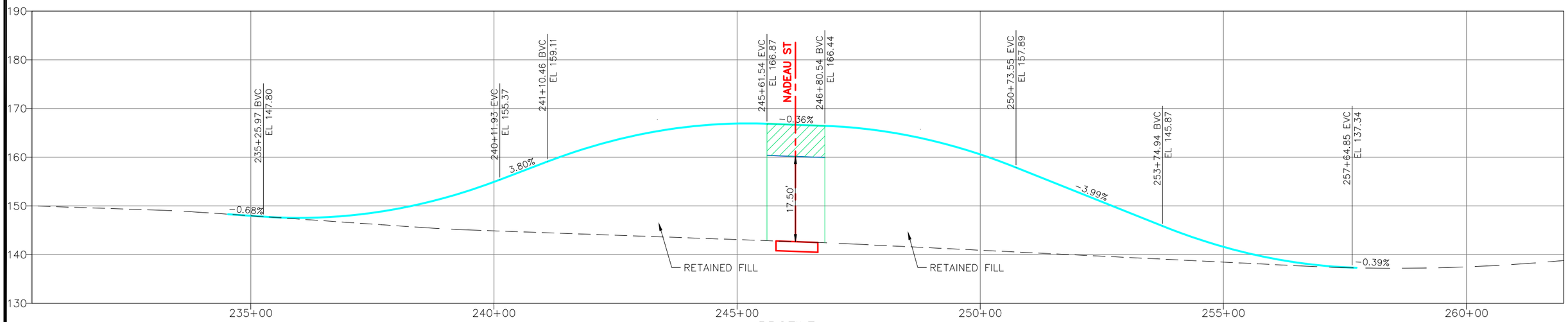
LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
PLAN



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY JC
DRAWN BY CC
CHECKED BY JC
IN CHARGE
DATE 05-21-18

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1075 Old County Road
Belmont, CA 94002
www.rseeail.com

METRO BLUE LINE

NADEAU ST
GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK EAST)

CONTRACT NO
DRAWING NO A-15
REV
SCALE H:1"=100'; V: 1"=10'
SHEET NO

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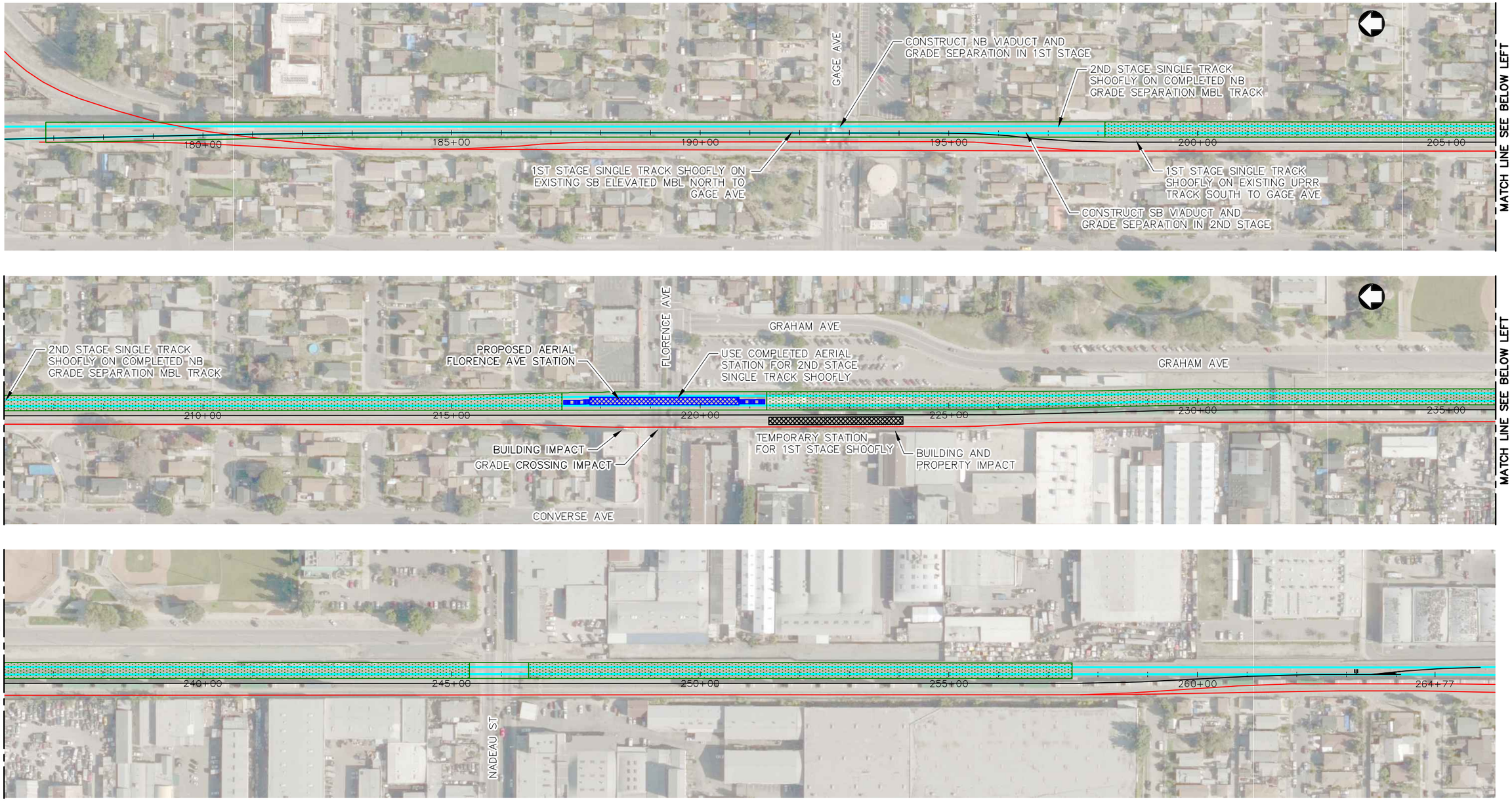

ASSUMPTIONS:

- IMPACT TO UP TRACKS
- BUILDING AND PROPERTY IMPACT
- GRADE CROSSING IMPACT
- NEW SWITCHES FOR UP & SHOOFLY AT BOTH NORTH & SOUTH

LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
PLAN

HORIZONTAL SCALE
100' 0 100' 200'

VERTICAL SCALE
10' 0 10' 20'

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY: JC
DRAWN BY: CC
CHECKED BY: JC
IN CHARGE:
DATE: 05-23-18

Metro
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1875 Old County Road
Belmont, CA 94002
www.rseinc.com

METRO BLUE LINE

GAGE AVE/FLORENCE AVE/NADEAU ST GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK WEST)

CONTRACT NO:
DRAWING NO: A-16
REV:
SCALE: H:1"=100'; V: 1"=10'
SHEET NO: 1

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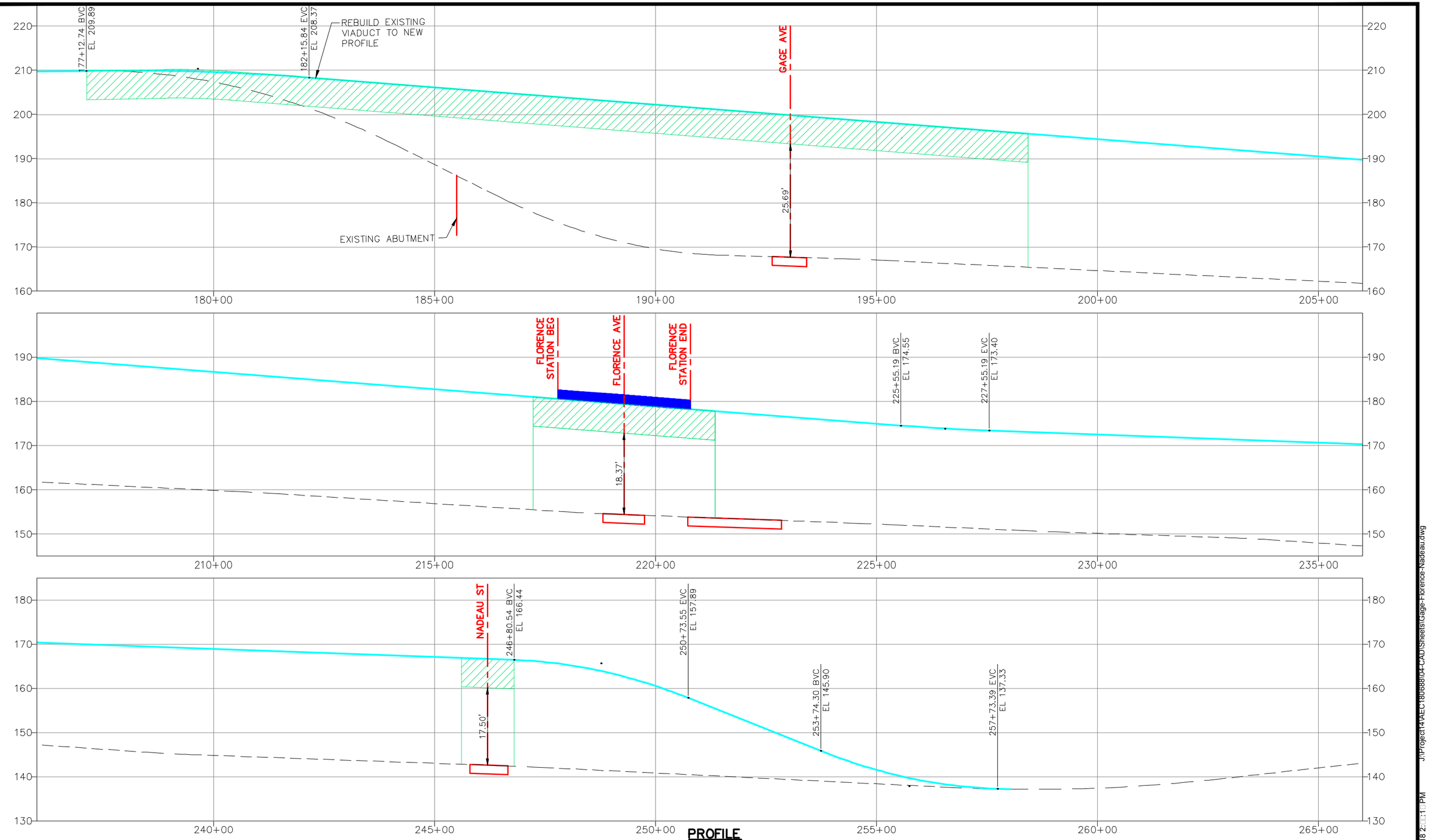

PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY: JC
DRAWN BY: CC
CHECKED BY: JC
IN CHARGE:
DATE: 05-23-18

Metro

LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1075 Old County Road
Belmont, CA 94002
www.rseinc.com

METRO BLUE LINE

GAGE AVE/FLORENCE AVE/NADEAU ST
GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK WEST)

CONTRACT NO
DRAWING NO: A-17
REV
SCALE: H:1"=100'; V: 1"=10'
SHEET NO: 2

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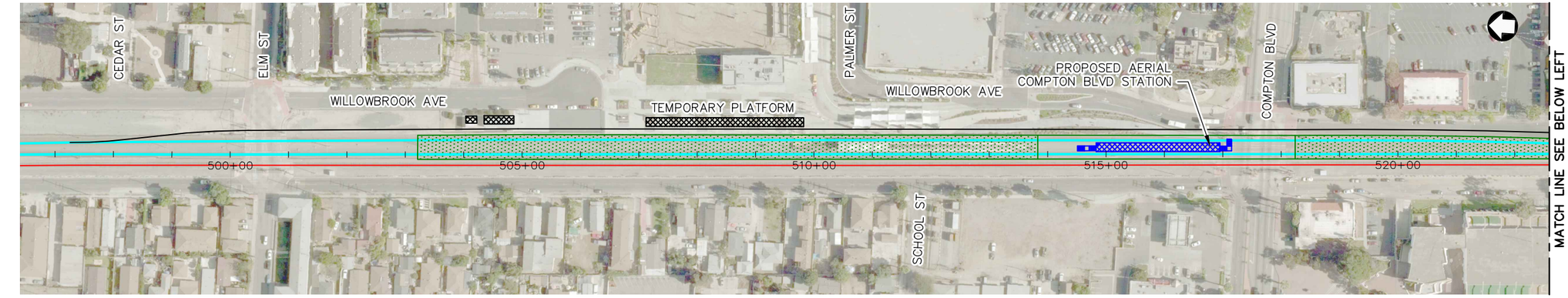
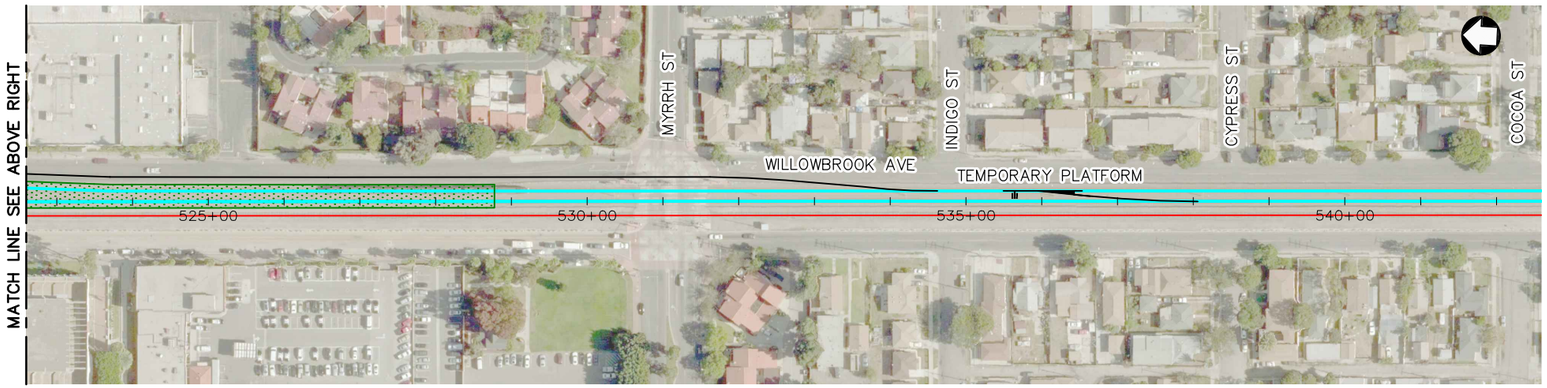




ASSUMPTIONS:

- SHOOFLY POTENTIAL ENCROACHMENT TO EXISTING SUBSTATION. RELOCATION COST IS ESTIMATED FOR PLANNING PURPOSE. SUBJECT TO FUTURE CLARIFICATION DURING ENGINEERING DESIGN.
- PARKING LOT IMPACT
- SINGLE TRACK SHOOFLY
- IMPACT TO WILLOWBROOK AVE ON EAST SIDE
- INSTALL SWITCH NORTH TO ROSECRANS GRADE SEPARATION FOR SINGLE TRACK SHOOFLY

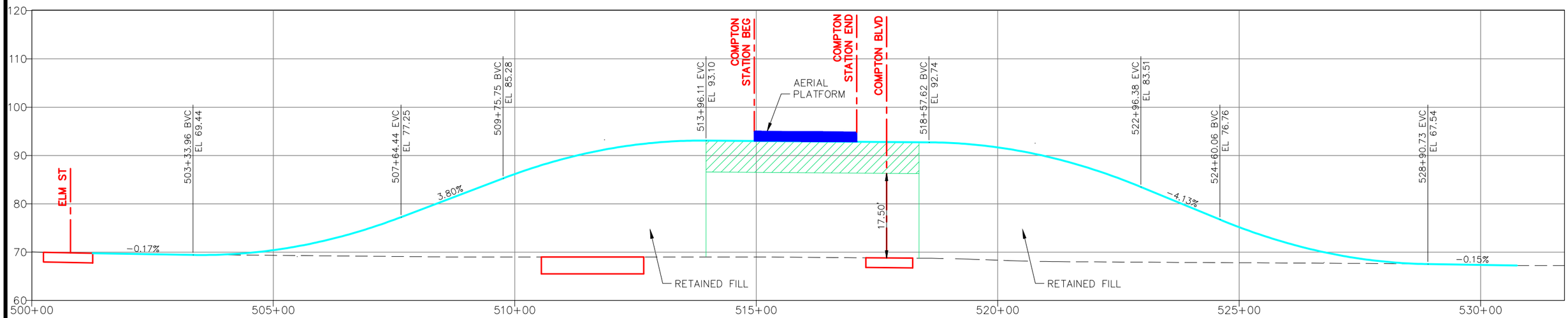
LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE 100' 0 100' 200'

VERTICAL SCALE 10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
PLAN



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY JC
DRAWN BY CC
CHECKED BY JC
IN CHARGE
DATE 05-18-18

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1075 Old County Road
Belmont, CA 94002
www.rserail.com

METRO BLUE LINE

COMPTON BLVD
GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK EAST)

CONTRACT NO
DRAWING NO A-18 REV
SCALE H:1"=100'; V: 1"=10'
SHEET NO

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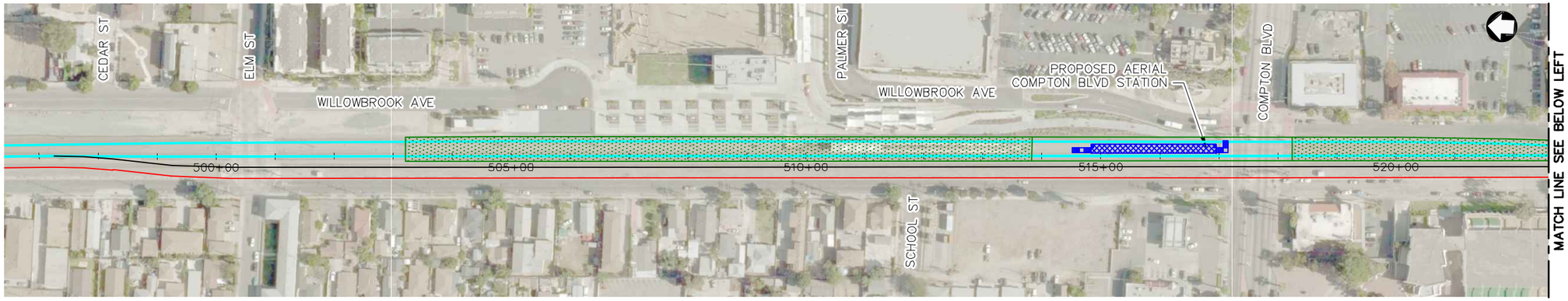
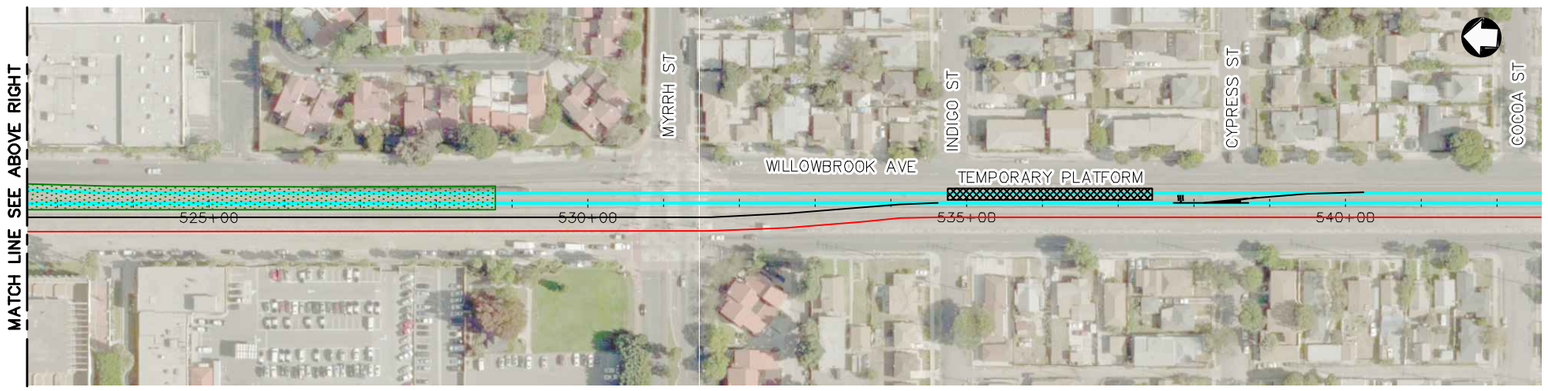




ASSUMPTIONS:

- IMPACT TO UP TRACKS
- SINGLE TRACK SHOOFLY
- IMPACT TO WILLOWBROOK AVE ON WEST SIDE
- INSTALL SWITCH NORTH TO ROSECRANS GRADE SEPARATION FOR SINGLE TRACK SHOOFLY
- TEMPORARY STATION AT 2000' SOUTH TO EXISTING STATION
- WEEKEND SHUTDOWN FOR TEMPORARY STATION REMOVAL AND FINAL TRACK REINSTALLATION

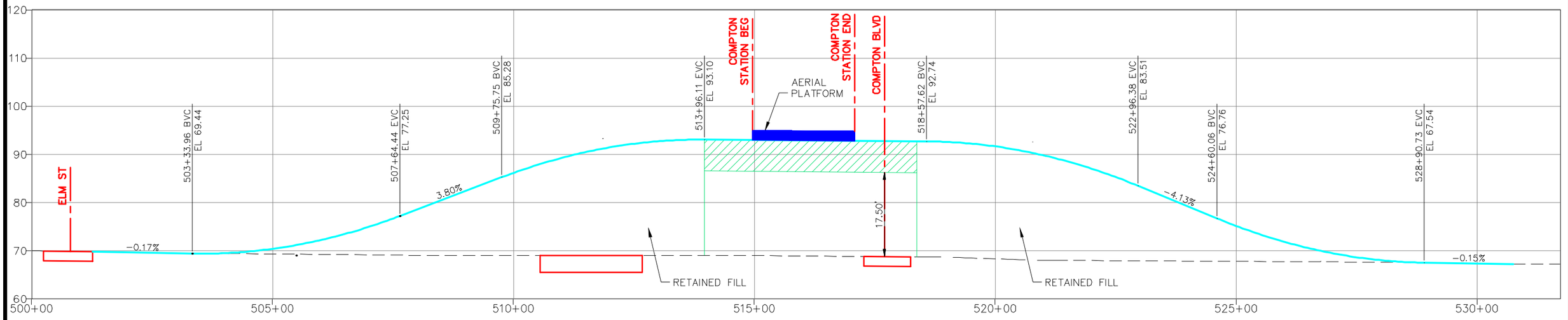
LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE
100' 0 100' 200'

VERTICAL SCALE
10' 0 10' 20'

SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
PLAN



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY: JC
DRAWN BY: CC
CHECKED BY: JC
IN CHARGE:
DATE: 05-18-18

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

RSE, Inc.
1875 Old County Road
Belmont, CA 94002
www.rseinc.com

METRO BLUE LINE

COMPTON BLVD
GRADE SEPARATION
SHOOFLY ALTERNATIVE 2 (SINGLE TRACK WEST)

CONTRACT NO:
DRAWING NO: A-19
REV:
SCALE: H:1"=100'; V: 1"=10'
SHEET NO:

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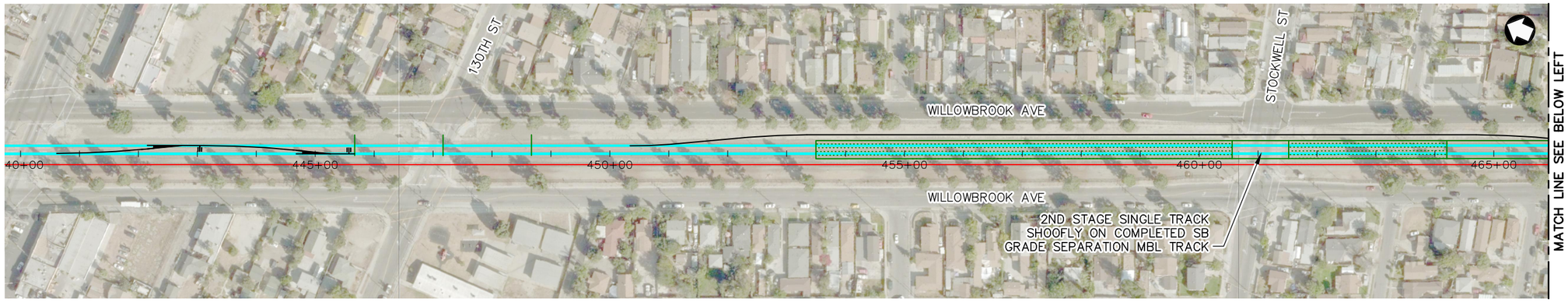
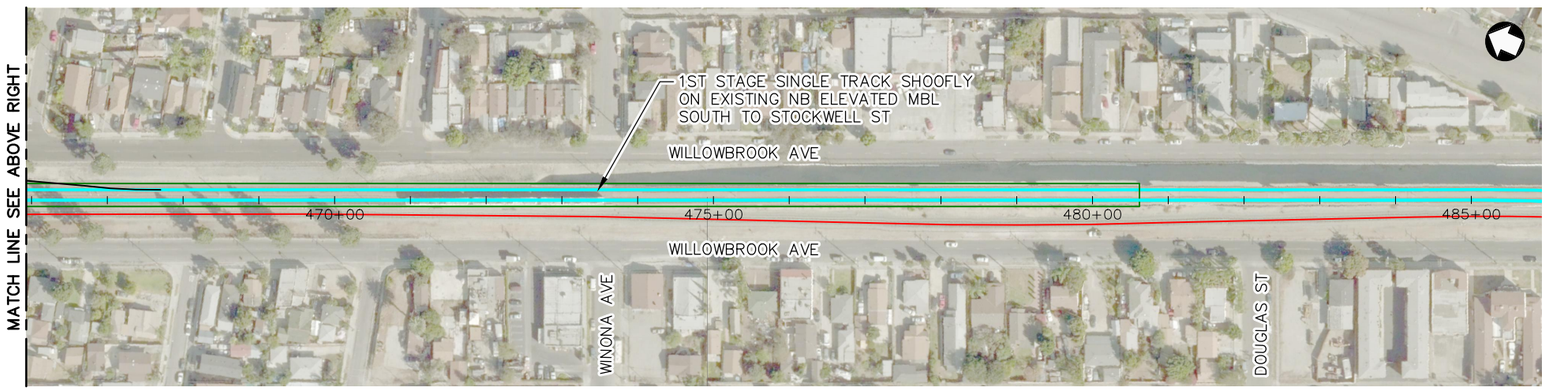
Friday, May 18, 2018 - 6:18 PM





SHOOFLY ALTERNATIVE 1 (SINGLE TRACK)
PLAN

ASSUMPTIONS:

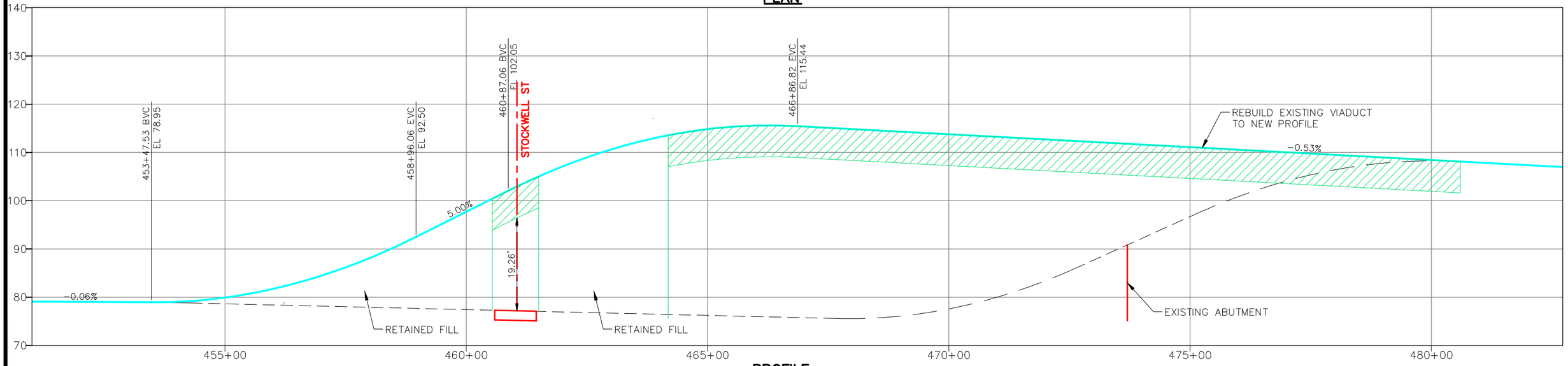
- NO IMPACT TO UP TRACKS
- BRIDGE ON VERTICAL CURVE
- NEW DOUBLE SWITCHES AT NORTH AND SOUTH FOR SINGLE TRACK SHOOFLY FOR TWO STAGE CONSTRUCTION

LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- RETAINING WALL

HORIZONTAL SCALE
100' 0 100' 200'

VERTICAL SCALE
10' 0 10' 20'



PROFILE

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY: JC
DRAWN BY: CC
CHECKED BY: JC
IN CHARGE:
DATE: 06-01-18

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1075 Old County Road
Belmont, CA 94002
www.rserail.com

METRO BLUE LINE

STOCKWELL ST
GRADE SEPARATION
SHOOFLY ALTERNATIVE 1 (SINGLE TRACK EAST)

CONTRACT NO:
DRAWING NO: A-20
REV:
SCALE: H:1"=100'; V: 1"=10'
SHEET NO:

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Appendix B. – Grade Separation Cost Estimates.

PROJECT NARRATIVE

The following is the 1-5% Design Cost Estimate for the Metro Blue Line Improvements Grade Separations Project. The purpose of this report is to prepare the capital cost estimate for various grade separations and multiple options.

Scope

The scope of these estimates covers the construction cost of various alternatives/options that provide additional safety features for the Metro Blue Line.

The proposed LRT Grade Separations alternatives/options are as follows:

- 103rd-Century-Grade Separation Option 1
- 103rd-Century-Grade Separation Option 2
- 103rd-Century-Grade Separation Option 3
- Compton Grade Separation Alternate 1
- Compton Grade Separation Alternate 2
- Florence-Grade Separation Option 1
- Florence-Grade Separation Option 2
- Gage-Florence Grade Separation Option 1
- Gage-Florence Grade Separation Option 2
- Gage-Florence- Nadeau Grade Separation Option 1
- Nadeau Grade Separation Option 1
- Stockwell Grade Separation Alternate 1
- Vernon Grade Separation Option 1
- Wardlow Grade Separation Alternate 1
- Wardlow Grade Separation Alternate 2
- Wilmington Grade Separation Option 1
- Wilmington Grade Separation Option 2

1.1. Cost Estimate Criteria and Assumptions

Estimates for the conceptual phase are based on the following assumptions:

- The estimates will be prepared utilizing current year dollars.
- No premium time on labor costs will be assumed.
- Adequate experience craft labor will be available.
- Compatible trade agreements exist in the region.
- No unusual labor pacts or agreements will be negotiated.
- There will be sufficient experienced contractors to complete the work.
- There will be no unusual weather conditions.
- The design is at 5% design level.

1.2. Estimates Format

FTA requires the use of standardized cost categories (SCC), which summarize budget baselines in a consistent framework. This report is developed by FTA guidelines. The guidelines require cost estimates to be prepared and reported using the latest version of the SCC. Within the estimates, cost components for the various alternatives are developed and summarized into the SCC format. These cost categories form the basis for the format and structure that is used for the capital cost detail and summary sheets developed for this project.

These estimates are prepared in an estimating format, appropriate to this 5% Design stage of project development. The comparison of each alternative is illustrated in Appendix A.

The SCC consists of the following categories:

- Guideway: At-Grade, Aerial, Tunnel, Cut and Cover
- Stations: At-Grade, Aerial, and Underground
- Support Facilities
- Sitework and Special Conditions
- Systems
- Right-of-Way, Land, Existing Improvements
- Vehicles
- Professional Services (costs to be provided by Metro)
- Contingency
- Finance Charges

1.3. Quantities

In the areas where the level of design does not support quantity measurements, parametric estimating techniques were utilized.

1.4. Unit Price, Mark-Ups, Contingency

All prices have been developed by using parametric historical project data that was escalated to 2018. The prices are based on the Expo Phases 1 & 2 and Crenshaw/LAX light rail projects. The unit costs received were adjusted to reflect current market value pricing in the Southern California area.

The unit costs shown in the cost estimate include all direct cost, associated project mark-ups, including subcontractor overhead and profit, general contractor overhead and profit, taxes, insurances, and bonds.

The cost estimates include all design contingency (expected design development) and construction contingency (expected change orders).

1.5. Escalation

Escalation is not included. The escalation will be added at the later stage of the project causing an increase in the overall cost of the project.

1.6. Estimate Limitation

The uncertainty exists at the early stages of engineering completion to the extent of the level that work scope has been defined. Estimates that support the Environmental Study are based on documents that are developed to an approximate 10% to 15% level of engineering completion. The uncertainty inherent in the project at this stage may include:

- Scope and Quantity Definition
- Commodity Pricing
- Unforeseen Problems

1.7. UPRR Tracks & ROW Assumptions

Assume all options for LRT shooflies will include OCS and Train Control Relocation and Restoration after demolition

Below is a description of interferences with UPRR tracks per each option:

- 103rd-Century-Grade Separation Option 1

  Realign/ Shift east track by 1ft to provide additional spacing to retaining wall face during construction. Reconstruct at-grade crossings at Century and 103rd. Restore track to the original configuration after shoofly demolition.

- 103rd-Century-Grade Separation Option 2

  Realign/ Shift east track by 1ft to provide additional spacing to retaining wall face during construction. Reconstruct at-grade crossings at Century and 103rd. Restore track to the original configuration after shoofly demolition.

- 103rd-Century-Grade Separation Option 3

  Be single tracked onto West UPRR track to provide room for single track LRT shoofly. Remove east track to create 18ft of additional spacing for single track shoofly. Reconstruct at-grade crossings at Century and 103rd. Restore track to the original configuration after shoofly demolition.

- Compton Grade Separation Alternate 1

  No UPRR Adjuscent to LRT

- Compton Grade Separation Alternate 2

- Florence-Grade Separation Option 1

  East Tack - Realign/ Shift 1ft to provide additional spacing for single track LRT shoofly. Reconstruct at-grade crossing at Florence. Restore track to the original configuration after shoofly demolition.

  Be single tracked onto West Tack - Realign/ Shift 2.5ft to provide additional spacing for LRT shoofly OCS. Reconstruct at-grade crossing at Florence. Restore track to the original configuration after shoofly demolition.

- Florence-Grade Separation Option 2

  East Tack - Realign/ Shift 1ft to provide additional spacing for single track LRT shoofly. Reconstruct at-grade crossing at Florence. Restore track to the original configuration after shoofly demolition.

  Be single tracked onto West Tack - Realign/ Shift 2.5ft to provide additional spacing for LRT shoofly OCS. Reconstruct at-grade crossing at Florence. Restore track to the original configuration after shoofly demolition.

- Gage-Florence Grade Separation Option 1

  East Tack - Realign/ Shift 1ft to provide additional spacing for single track LRT shoofly. Reconstruct at-grade crossings at Florence and Gage. Restore track to the original configuration after shoofly demolition.

  Be single tracked onto West Tack - Realign/ Shift 2.5ft to provide additional spacing for LRT shoofly OCS. Reconstruct at-grade crossings at Florence and Gage. Restore track to the original configuration after shoofly demolition.

- Gage-Florence Grade Separation Option 2

  East Tack - Realign/ Shift 1ft to provide additional spacing for single track LRT shoofly. Reconstruct at-grade crossings at Florence and Gage. Restore track to the original configuration after shoofly demolition.

  Be single tracked onto West Tack - Realign/ Shift 2.5ft to provide additional spacing for LRT shoofly OCS. Reconstruct at-grade crossings at Florence and Gage. Restore track to the original configuration after shoofly demolition.

- Gage-Florence- Nadeau Grade Separation Option 1

East Tack - Realign/ Shift 1ft to provide additional spacing for single track LRT shoofly. Reconstruct at-grade crossings at Florence, Gage, and Nadeau. Restore track to the original configuration after shoofly demolition.

Be single tracked onto West Tack - Realign/ Shift 2.5ft to provide additional spacing for LRT shoofly OCS. Reconstruct at-grade crossings at Florence, Gage, and Nadeau. Restore track to the original configuration after shoofly demolition.

- Nadeau Grade Separation Option 1

  East Tack - Realign/ Shift 1ft to provide additional spacing for single track LRT shoofly. Reconstruct at-grade crossing at Nadeau. Restore track to the original configuration after shoofly demolition.

  Be single tracked onto West Tack - Realign/ Shift 2.5ft to provide additional spacing for LRT shoofly OCS. Reconstruct at-grade crossing at Nadeau. Restore track to the original configuration after shoofly demolition.

- Vernon Grade Separation Option 1

  Be single tracked onto East Tack - Realign/ Shift 2.5ft to provide additional spacing for single track LRT shoofly and OCS. Reconstruct at-grade crossing at Vernon. Restore track to the original configuration after shoofly demolition.

  West Tack – Remove track to provide additional spacing for LRT shoofly. Reconstruct at-grade crossing at Vernon. Restore track to the original configuration after shoofly demolition.

- Wardlow Grade Separation Alternate 1

  No UPRR Adjuscent to LRT.

- Wardlow Grade Separation Alternate 2

  No UPRR Adjuscent to LRT

- Wilmington Grade Separation Option 1

  Realign/ Shift track by 1.5 ft to provide additional spacing to retaining wall face during construction. Reconstruct at-grade crossing at Wilmington. Restore track to the original configuration after shoofly demolition.

- Wilmington Grade Separation Option 2

  Remove UPRR track. Install new track 18ft from existing location to provide room for single track LRT shoofly. Reconstruct at-grade crossing at Wilmington. Restore track to the original configuration after shoofly demolition.

- Stockwell Grade Separation Alternate 1

  No UPRR Adjuscent to LRT

1.8. UPRR Tracks & ROW Exclusions

Excluded from all options cost estimates any potential UPRR unknown compensations that might be required such as loss of use for ROW, single tracking impediment for train traffic, the inability of using some tracks as storage tracks, etc.

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
103rd Street/Century Blvd. Grade Separation
Alternate #1 - Single Track East

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**3,118**	**0.59**	**$ 41,300,000**
10.01 Guideway: At-grade exclusive right-of-way		7,850		$ 3,600,000
				$ -
Install & Remove Temp Shoofly at grade separation between Station 352+00.00 to 310+50.00 - Allow	RF	4,150	$ 700	$ 2,905,000
Realign Temp East Freight Track at grade separation between Station 312+00 to 349+00 - Allow	TF	3,700	$ 200	$ 740,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		660		$ 1,000,000
Shoefly At grade crossings At 103rd St.	RF	100	$ 1,520	$ 152,000
Shoefly At grade crossings At Century Blvd.	RF	120	$ 1,520	$ 182,400
Temporary East Freight Track At grade crossings	RF	220	$ 1,520	$ 334,400
Restore East Freight Track At grade crossings	RF	220	$ 1,520	$ 334,400
10.04 Guideway: Aerial structure		549		$ 10,100,000
Aerial Guideway Structure, Station 'from 324+80.23 to 326+23.94	RF	144	$ 18,432	$ 2,654,208
Aerial Guideway Structure, Station 'from 335+76.99 to 331+71.93	RF	405	$ 18,432	$ 7,464,960
10.05 Guideway: Built-up fill		2,569		$ 19,500,000
MSE Buit-up Fill, Station 314+99.53 to 324+80.23	RF	981	$ 7,600	$ 7,455,600
MSE Buit-up Fill, Station 326+23.94 to331+71.93	RF	548	$ 7,600	$ 4,164,800
MSE Buit-up Fill, Station 335+76.99 to 346+17.16	RF	1,040	$ 7,600	$ 7,904,000
10.09 Track: Direct fixation		549		$ 500,000
Aerial Guideway Structure, Station 'from 324+80.23 to 326+23.94	RF	144	$ 900	$ 129,600
Aerial Guideway Structure, Station 'from 335+76.99 to 331+71.93		405	$ 900	$ 364,500
10.11 Track: Ballasted		14,119		$ 4,400,000
Ballasted Track at MSE Buit-up Fill, Station 314+99.53 to 324+80.23	RF	981	$ 670	$ 657,270
Ballasted Track at MSE Buit-up Fill, Station 326+23.94 to331+71.93	RF	548	$ 670	$ 367,160
Ballasted Track at MSE Buit-up Fill, Station 335+76.99 to 346+17.16	RF	1,040	$ 670	$ 696,800
Temporary Shoefly (Single Track)	TF	4150.00	$ 335	$ 1,390,250
Temporary Shift 1ft Ballasted East Freight Track , Station 312+00.00 to 349+00.00 - Allowance	TF	3,700	$ 175	$ 647,500
Restore, Shift 1ft back Ballasted East Freight Track, Station 312+00.00 to 349+00.00 - Allowance	TF	3,700	$ 175	$ 647,500
10.12 Track: Special (switches, turnouts)				$ 2,200,000
No. 14 Turnout - Allow For Shoefly	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Shoefly	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000.00**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - 103rd Street	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
40 SITEWORK & SPECIAL CONDITIONS	RF	3,118		$ 28,613,000
40.01 Demolition, Clearing, Earthwork				$ 1,400,000
Exisitng Trackwork Allowance	RF	3,118	$ 300	$ 935,400
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
40.02 Site Utilities, Utility Relocation		7,268		$ 2,544,000
Utilities Relocation Allow	RF	7,268	$ 350	$ 2,543,800
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks				$ 1,500,000
Restore Park and All Amenities After Shoefly Demolition	SF	49,520	$ 30	$ 1,485,600
40.05 Site structures including retaining walls, sound walls				$ 3,200,000
RECONSTRUCT PEDESTRIAN BRIDGE (265LF x 12LF = 3180SF)	SF	3,180	$ 800	$ 2,544,000
Relocate and Reinstall Exisiting Historical Building (Station)	SF	3,210	$ 200	$ 642,000

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
103rd Street/Century Blvd. Grade Separation
Alternate #1 - Single Track East

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
40.06 Pedestrian / bike access and accommodation, landscaping				$ 2,100,000
Landscaping, Street Scape, Urban Design Features	RF	3,118	$ 480	$ 1,496,640
Restore Street After Shoefly Demolition	RF	1,300	$ 480	$ 624,000
40.07 Automobile, bus, van accessways including roads, parking lots				$ 500,000
Restore Parking and All Amenities	SF	11,300	$ 40	$ 452,000
40.08 Temporary Facilities and other indirect costs during construction				$ 17,369,000
General Conditions - Allow		20%	$ 86,844,000	$ 17,368,800
50 SYSTEMS	RF	7,268		**$ 16,000,000**
50.01 Train control and signals				$ 2,800,000
New Alignment	RF	3,118	$ 540	$ 1,683,720
Shoefly Temporary Train Control	RF	4,150	$ 270	$ 1,120,500
50.02 Traffic signals and crossing protection				$ 600,000
Traffic Signals: Grade Crossings Restoration Allow (103rd St.)	EA	1	$ 297,000	$ 297,000
				$ -
50.04 Traction power distribution: catenary and third rail				$ 5,700,000
Catenary OCS Pole	RF	7,268	$ 560	$ 4,070,080
Ductbank Pullboxes	RF	7,268	$ 150	$ 1,090,200
OCS Poles Foundations	RF	7,268	$ 70	$ 508,760
50.05 Communications				$ 4,900,000
Communications Equipment Installation	RF	7,268	$ 520	$ 3,779,360
Ductbank & Pullboxes	RF	7,268	$ 150	$ 1,090,200
				$ -
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
				$ -
Construction Subtotal (10 - 50)	RF	3,118	$ 32,880	**$ 104,213,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ 11,200,000
60.01 Purchase or lease of real estate				$ 11,200,000
ROW	ACRE	2.48	$ 4,500,000	$ 11,160,000
(Allowance for 2.48 acres)				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		3,118		**$ 34,390,000**
80.01 Preliminary Engineering	4,168,520	4% 10-50		$ 4,168,520
80.02 Final Design	9,379,170	9% 10-50		$ 9,379,170
80.03 Project Management for Design and Construction	10,421,300	10% 10-50		$ 10,421,300
80.04 Construction Administration & Management	5,210,650	5% 10-50		$ 5,210,650
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	1,042,130	1% 10-50		$ 1,042,130
80.07 Surveys, Testing, Investigation, Inspection	2,084,260	2% 10-50		$ 2,084,260
80.08 Start up	2,084,260	2% 10-50		$ 2,084,260
				$ 149,803,000

*** All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #1 - Single Track East

103rd Street/Century Blvd. Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.59**	41,300	9,665	**50,965**	**39%**	**25%**
10.01 Guideway: At-grade exclusive right-of-way		3,600	900	4,500		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		1,000	250	1,250		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.10	10,100	2,525	12,625		
10.05 Guideway: Built-up fill	0.49	19,500	4,875	24,375		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		500	125	625		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		4,400	660	5,060		
10.12 Track: Special (switches, turnouts)		2,200	330	2,530		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**17%**	**11%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.59	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.59	28,613	8,584	**37,197**	**28%**	**18%**
40.01 Demolition, Clearing, Earthwork		1,400	420	1,820		
40.02 Site Utilities, Utility Relocation		2,544	763	3,307		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		1,500	450	1,950		
40.05 Site structures including retaining walls, sound walls		3,200	960	4,160		
40.06 Pedestrian / bike access and accommodation, landscaping		2,100	630	2,730		
40.07 Automobile, bus, van accessways including roads, parking lots		500	150	650		
40.08 Temporary Facilities and other indirect costs during construction		17,369	5,211	22,580		
50 SYSTEMS	0.59	16,000	4,800	**20,800**	**16%**	**10%**
50.01 Train control and signals		2,800	840	3,640		
50.02 Traffic signals and crossing protection		600	180	780		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		5,700	1,710	7,410		
50.05 Communications		4,900	1,470	6,370		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.59	104,213	27,624	**131,837**	**100%**	**64%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.59	11,200	3,360	**14,560**		**7%**
60.01 Purchase or lease of real estate		11,200	3,360	14,560		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail	0	0	0	0		
70.02 Heavy Rail	0	0	0	0		
70.03 Commuter Rail	0	0	0	0		
70.04 Bus	0	0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.59	34,390	6,878	**41,268**	**31%**	**20%**
80.01 Project Development		4,169	834	5,002		
80.02 Engineering		9,379	1,876	11,255		
80.03 Project Management for Design and Construction		10,421	2,084	12,506		
80.04 Construction Administration & Management		5,211	1,042	6,253		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		1,042	208	1,251		
80.07 Surveys, Testing, Investigation, Inspection		2,084	417	2,501		
80.08 Start up		2,084	417	2,501		
Subtotal (10 - 80)	0.59	149,803	37,862	**187,665**		**91%**
90 UNALLOCATED CONTINGENCY				**18,767**		**9%**
Subtotal (10 - 90)	0.59			**206,432**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.59			**206,432**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				25.27%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.53%		
Total Contingency as % of Base Yr Dollars w/o Contingency				37.80%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
103rd Street/Century Blvd. Grade Separation
Alternate #2 - Double Track East

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**3,118**	**0.59**	$ 45,200,000
10.01 Guideway: At-grade exclusive right-of-way		8,050		$ 3,800,000
Install & Remove Temp Shoofly at grade separation between Station 352+00.00 to 308+50.00 - Allow	RF	4,350	$ 700	$ 3,045,000
Realign Temp East Freight Track at grade separation between Station 312+00 to 349+00 - Allow	TF	3,700	$ 200	$ 740,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		660		$ 1,000,000
Shoefly At grade crossings At 103rd St.	RF	100	$ 1,520	$ 152,000
Shoefly At grade crossings At Century Blvd.	RF	120	$ 1,520	$ 182,400
Temporary East Freight Track At grade crossings	RF	220	$ 1,520	$ 334,400
Restore East Freight Track At grade crossings	RF	220	$ 1,520	$ 334,400
10.04 Guideway: Aerial structure		549		$ 10,100,000
Aerial Guideway Structure, Station 'from 324+80.23 to 326+23.94	RF	144	$ 18,432	$ 2,654,208
Aerial Guideway Structure, Station 'from 335+76.99 to 331+71.93	RF	405	$ 18,432	$ 7,464,960
10.05 Guideway: Built-up fill		2,569		$ 19,500,000
MSE Buit-up Fill, Station 314+99.53 to 324+80.23	RF	981	$ 7,600	$ 7,455,600
MSE Buit-up Fill, Station 326+23.94 to331+71.93	RF	548	$ 7,600	$ 4,164,800
MSE Buit-up Fill, Station 335+76.99 to 346+17.16	RF	1,040	$ 7,600	$ 7,904,000
				$ -
10.09 Track: Direct fixation		549		$ 500,000
Aerial Guideway Structure, Station 'from 324+80.23 to 326+23.94	RF	144	$ 900	$ 129,600
Aerial Guideway Structure, Station 'from 335+76.99 to 331+71.93		405	$ 900	$ 364,500
10.11 Track: Ballasted		14,319		$ 5,900,000
Ballasted Track at MSE Buit-up Fill, Station 314+99.53 to 324+80.23	RF	981	$ 670	$ 657,270
Ballasted Track at MSE Buit-up Fill, Station 326+23.94 to331+71.93	RF	548	$ 670	$ 367,160
Ballasted Track at MSE Buit-up Fill, Station 335+76.99 to 346+17.16	RF	1,040	$ 670	$ 696,800
Temporary Shoefly (Single Track)	TF	4350.00	$ 670	$ 2,914,500
Temporary Shift 1ft Ballasted East Freight Track , Station 312+00.00 to 349+00.00 - Allowance	TF	3,700	$ 175	$ 647,500
Restore, Shift 1ft back Ballasted East Freight Track, Station 312+00.00 to 349+00.00 - Allowance	TF	3,700	$ 175	$ 647,500
10.12 Track: Special (switches, turnouts)				$ 4,400,000
No. 14 Turnout - Allow For Shoefly	EA	8.00	$ 547,400	$ 4,379,200
No. 10 Turnout - Allow	EA	0.00	$ 476,000	$ -
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000.00**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - 103rd Street	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	3,118		**$ 28,937,000**
40.01 Demolition, Clearing, Earthwork				$ 1,400,000
Existing Trackwork Allowance	RF	3,118	$ 300	$ 935,400
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
				$ -
40.02 Site Utilities, Utility Relocation		7,468		$ 2,614,000
Utilities Relocation Allow	RF	7,468	$ 350	$ 2,613,800
				$ -
				$ -
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks				$ 1,500,000
Restore Park and All Amenities After Shoefly Demolition	SF	49,520	$ 30	$ 1,485,600
40.05 Site structures including retaining walls, sound walls				$ 3,200,000
RECONSTRUCT PEDESTRIAN BRIDGE (265LF x 12LF = 3180SF)	SF	3,180	$ 800	$ 2,544,000
Relocate and Reinstall Exisiting Historical Building (Station)	SF	3,210	$ 200	$ 642,000

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
103rd Street/Century Blvd. Grade Separation
Alternate #2 - Double Track East

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
40.06 Pedestrian / bike access and accommodation, landscaping				$ 2,100,000
Landscaping, Street Scape, Urban Design Features	RF	3,118	$ 480	$ 1,496,640
Restore Street After Shoefly Demolition	RF	1,300	$ 480	$ 624,000
40.07 Automobile, bus, van accessways including roads, parking lots				$ -
Restore Parking and All Amenities	SF		$ 40	$ -
40.08 Temporary Facilities and other indirect costs during construction				$ 18,123,000
General Conditions - Allow		20%	$ 90,614,000	$ 18,122,800
50 SYSTEMS	RF	7,468		**$ 16,300,000**
50.01 Train control and signals				$ 2,900,000
New Alignment	RF	3,118	$ 540	$ 1,683,720
Shoefly Temporary Train Control	RF	4,350	$ 270	$ 1,174,500
50.02 Traffic signals and crossing protection				$ 600,000
Traffic Signals: Grade Crossings Restoration Allow (Century)	EA	1	$ 297,000	$ 297,000
Traffic Signals: Grade Crossings Restoration Allow (103rd St.)	EA	1	$ 297,000	$ 297,000
50.04 Traction power distribution: catenary and third rail				$ 5,800,000
Catenary OCS Pole	RF	7,468	$ 560	$ 4,182,080
Ductbank Pullboxes	RF	7,468	$ 150	$ 1,120,200
OCS Poles Foundations	RF	7,468	$ 70	$ 522,760
50.05 Communications				$ 5,000,000
Communications Equipment Installation	RF	7,468	$ 520	$ 3,883,360
Ductbank & Pullboxes	RF	7,468	$ 150	$ 1,120,200
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
Construction Subtotal (10 - 50)	RF	3,118	$ 34,176	**$ 108,737,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ 11,300,000
60.01 Purchase or lease of real estate				$ 11,300,000
ROW	ACRE	2.50	$ 4,500,000	$ 11,250,000
(Allowance for 2.5 acres)				
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		3,118		$ 35,883,000
80.01 Preliminary Engineering	4,349,480	4% 10-50		$ 4,349,480
80.02 Final Design	9,786,330	9% 10-50		$ 9,786,330
80.03 Project Management for Design and Construction	10,873,700	10% 10-50		$ 10,873,700
80.04 Construction Administration & Management	5,436,850	5% 10-50		$ 5,436,850
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	1,087,370	1% 10-50		$ 1,087,370
80.07 Surveys, Testing, Investigation, Inspection	2,174,740	2% 10-50		$ 2,174,740
80.08 Start up	2,174,740	2% 10-50		$ 2,174,740
				$ 155,920,000

*** All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #2 - Double Track East

103rd Street/Century Blvd. Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.59**	45,200	10,270	**55,470**	**40%**	**26%**
10.01 Guideway: At-grade exclusive right-of-way		3,800	950	4,750		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		1,000	250	1,250		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.10	10,100	2,525	12,625		
10.05 Guideway: Built-up fill	0.49	19,500	4,875	24,375		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		500	125	625		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		5,900	885	6,785		
10.12 Track: Special (switches, turnouts)		4,400	660	5,060		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**17%**	**11%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.59	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.59	28,937	8,681	**37,618**	**27%**	**18%**
40.01 Demolition, Clearing, Earthwork		1,400	420	1,820		
40.02 Site Utilities, Utility Relocation		2,614	784	3,398		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		1,500	450	1,950		
40.05 Site structures including retaining walls, sound walls		3,200	960	4,160		
40.06 Pedestrian / bike access and accommodation, landscaping		2,100	630	2,730		
40.07 Automobile, bus, van accessways including roads, parking lots		0	0	0		
40.08 Temporary Facilities and other indirect costs during construction		18,123	5,437	23,560		
50 SYSTEMS	0.59	16,300	4,890	**21,190**	**15%**	**10%**
50.01 Train control and signals		2,900	870	3,770		
50.02 Traffic signals and crossing protection		600	180	780		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		5,800	1,740	7,540		
50.05 Communications		5,000	1,500	6,500		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.59	108,737	28,416	**137,153**	**100%**	**64%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.59	11,300	3,390	**14,690**		**7%**
60.01 Purchase or lease of real estate		11,300	3,390	14,690		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail	0	0	0	0		
70.02 Heavy Rail	0	0	0	0		
70.03 Commuter Rail	0	0	0	0		
70.04 Bus	0	0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.59	35,883	7,177	**43,060**	**31%**	**20%**
80.01 Project Development		4,349	870	5,219		
80.02 Engineering		9,786	1,957	11,744		
80.03 Project Management for Design and Construction		10,874	2,175	13,048		
80.04 Construction Administration & Management		5,437	1,087	6,524		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		1,087	217	1,305		
80.07 Surveys, Testing, Investigation, Inspection		2,175	435	2,610		
80.08 Start up		2,175	435	2,610		
Subtotal (10 - 80)	0.59	155,920	38,983	**194,903**		**91%**
90 UNALLOCATED CONTINGENCY				**19,490**		**9%**
Subtotal (10 - 90)	0.59			**214,393**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.59			**214,393**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				25.00%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.50%		
Total Contingency as % of Base Yr Dollars w/o Contingency				37.50%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

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Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
103rd Street/Century Blvd. Grade Separation
Alternate #3 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**3,118**	**0.59**	$ 44,200,000
10.01 Guideway: At-grade exclusive right-of-way		7,275		$ 3,400,000
				$ -
Install & Remove Temp Shoofly at grade separation between Station 350+25.00 to 311+50.00 - Allow	RF	3,875	$ 700	$ 2,712,500
Install & Remove East Freight Tracks at grade separation between Station 312+00 to 338+00 and 343+40 to 351+00 on existing track bed - Allow	RF	3,400	$ 200	$ 680,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		440		$ 700,000
Shoefly At grade crossings At 103rd St.	RF	100	$ 1,520	$ 152,000
Shoefly At grade crossings At Century Blvd.	RF	120	$ 1,520	$ 182,400
Freight Tracks At grade crossings	RF	220	$ 1,520	$ 334,400
10.04 Guideway: Aerial structure		549		$ 10,100,000
Aerial Guideway Structure, Station 'from 324+80.23 to 326+23.94	RF	144	$ 18,432	$ 2,654,208
Aerial Guideway Structure, Station 'from 335+76.99 to 331+71.93	RF	405	$ 18,432	$ 7,464,960
10.05 Guideway: Built-up fill		2,569		$ 19,500,000
MSE Buit-up Fill, Station 314+99.53 to 324+80.23	RF	981	$ 7,600	$ 7,455,600
MSE Buit-up Fill, Station 326+23.94 to331+71.93	RF	548	$ 7,600	$ 4,164,800
MSE Buit-up Fill, Station 335+76.99 to 346+17.16	RF	1,040	$ 7,600	$ 7,904,000
10.09 Track: Direct fixation		549		$ 500,000
Aerial Guideway Structure, Station 'from 324+80.23 to 326+23.94	RF	144	$ 900	$ 129,600
Aerial Guideway Structure, Station 'from 335+76.99 to 331+71.93		405	$ 900	$ 364,500
10.11 Track: Ballasted		10,644		$ 4,400,000
Ballasted Track at MSE Buit-up Fill, Station 314+99.53 to 324+80.23	RF	981	$ 670	$ 657,270
Ballasted Track at MSE Buit-up Fill, Station 326+23.94 to331+71.93	RF	548	$ 670	$ 367,160
Ballasted Track at MSE Buit-up Fill, Station 335+76.99 to 346+17.16	RF	1,040	$ 670	$ 696,800
Temporary Shoefly (Single Track)	TF	3875	$ 335	$ 1,298,125
Temporary Ballasted Single Freight Track, Station 351+00.00 to 343+00.00	TF	800	$ 335	$ 268,000
Restore Ballasted East Freight Tracks at grade separation between Station 312+00 to 338+00 and 343+40 to 351+00	TF	3,400	$ 335	$ 1,139,000
10.12 Track: Special (switches, turnouts)				$ 5,600,000
No. 14 Turnout - Allow For Shoefly	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Shoefly	EA	2.00	$ 28,720	$ 57,440
No. 14 Turnout - Allow For Tempory Freight Track Configuration	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Temp & Permanent Freight Track	EA	2.00	$ 28,720	$ 57,440
No. 14 Turnout - Allow For Restoration of East Freight Track	EA	2.00	$ 547,400	$ 1,094,800
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000.00**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - 103rd Street	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	3,118		**$ 26,143,000**
40.01 Demolition, Clearing, Earthwork				$ 2,500,000
Exisitng Trackwork Allowance	RF	3,118	$ 300	$ 935,400
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
Freight Trackwork Allowance	RF	3,400	$ 300	$ 1,020,000
40.02 Site Utilities, Utility Relocation		10,393		$ 1,819,000
Utilities Relocation Allow	TF	10,393	$ 175	$ 1,818,775
40.05 Site structures including retaining walls, sound walls				$ 2,500,000
RECONSTRUCT PEDESTRIAN BRIDGE (265LF x 12LF = 3180SF)	SF	3,180	$ 800	$ 2,544,000
40.06 Pedestrian / bike access and accommodation, landscaping				$ 1,500,000
Landscaping, Street Scape, Urban Design Features	RF	3,118	$ 480	$ 1,496,640

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
103rd Street/Century Blvd. Grade Separation
Alternate #3 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
40.07 Automobile, bus, van accessways including roads, parking lots				$ 500,000
Restore Parking and All Amenities	SF	11,300	$ 40	$ 452,000
40.08 Temporary Facilities and other indirect costs during construction				$ 17,324,000
General Conditions - Allow		20%	$ 86,619,000	$ 17,323,800
50 SYSTEMS	RF	6,993		**$ 15,500,000**
50.01 Train control and signals				$ 2,700,000
New Alignment	RF	3,118	$ 540	$ 1,683,720
Shoefly Temporary Train Control	RF	3,875	$ 270	$ 1,046,250
50.02 Traffic signals and crossing protection				$ 600,000
Traffic Signals: Grade Crossings Restoration Allow (Century)	EA	1	$ 297,000	$ 297,000
Traffic Signals: Grade Crossings Restoration Allow (103rd St.)	EA	1	$ 297,000	$ 297,000
50.04 Traction power distribution: catenary and third rail				$ 5,500,000
Catenary OCS Pole	RF	6,993	$ 560	$ 3,916,080
Ductbank Pullboxes	RF	6,993	$ 150	$ 1,048,950
OCS Poles Foundations	RF	6,993	$ 70	$ 489,510
50.05 Communications				$ 4,700,000
Communications Equipment Installation	RF	6,993	$ 520	$ 3,636,360
Ductbank & Pullboxes	RF	6,993	$ 150	$ 1,048,950
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
				$ -
Construction Subtotal (10 - 50)	RF	3,118	$ 33,060	**$ 104,143,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		3,118		$ 34,367,000
80.01 Preliminary Engineering	4,165,720	4% 10-50		$ 4,165,720
80.02 Final Design	9,372,870	9% 10-50		$ 9,372,870
80.03 Project Management for Design and Construction	10,414,300	10% 10-50		$ 10,414,300
80.04 Construction Administration & Management	5,207,150	5% 10-50		$ 5,207,150
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	1,041,430	1% 10-50		$ 1,041,430
80.07 Surveys, Testing, Investigation, Inspection	2,082,860	2% 10-50		$ 2,082,860
80.08 Start up	2,082,860	2% 10-50		$ 2,082,860
				$ 138,510,000

* **All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #3 - Single Track West

103rd Street/Century Blvd. Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.59**	44,200	10,050	**54,250**	**41%**	**29%**
10.01 Guideway: At-grade exclusive right-of-way		3,400	850	4,250		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		700	175	875		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.10	10,100	2,525	12,625		
10.05 Guideway: Built-up fill	0.49	19,500	4,875	24,375		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		500	125	625		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		4,400	660	5,060		
10.12 Track: Special (switches, turnouts)		5,600	840	6,440		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**17%**	**12%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.59	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.59	26,143	7,843	**33,986**	**26%**	**18%**
40.01 Demolition, Clearing, Earthwork		2,500	750	3,250		
40.02 Site Utilities, Utility Relocation		1,819	546	2,365		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		2,500	750	3,250		
40.06 Pedestrian / bike access and accommodation, landscaping		1,500	450	1,950		
40.07 Automobile, bus, van accessways including roads, parking lots		500	150	650		
40.08 Temporary Facilities and other indirect costs during construction		17,324	5,197	22,521		
50 SYSTEMS	0.59	15,500	4,650	**20,150**	**15%**	**11%**
50.01 Train control and signals		2,700	810	3,510		
50.02 Traffic signals and crossing protection		600	180	780		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		5,500	1,650	7,150		
50.05 Communications		4,700	1,410	6,110		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.59	104,143	27,118	**131,261**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.59	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail	0	0	0	0		
70.02 Heavy Rail	0	0	0	0		
70.03 Commuter Rail	0	0	0	0		
70.04 Bus	0	0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.59	34,367	6,873	**41,241**	**31%**	**22%**
80.01 Project Development		4,166	833	4,999		
80.02 Engineering		9,373	1,875	11,247		
80.03 Project Management for Design and Construction		10,414	2,083	12,497		
80.04 Construction Administration & Management		5,207	1,041	6,249		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		1,041	208	1,250		
80.07 Surveys, Testing, Investigation, Inspection		2,083	417	2,499		
80.08 Start up		2,083	417	2,499		
Subtotal (10 - 80)	0.59	138,510	33,991	**172,502**		**91%**
90 UNALLOCATED CONTINGENCY				**17,250**		**9%**
Subtotal (10 - 90)	0.59			**189,752**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.59			**189,752**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				24.54%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.45%		
Total Contingency as % of Base Yr Dollars w/o Contingency				36.99%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Compton Blvd. Grade Separation
Alternate #1 - Single Track East

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**2,557**	**0.48**	**$ 32,900,000**
10.01 Guideway: At-grade exclusive right-of-way		4,075		$ 2,900,000
				$ -
Install & Remove Temp Shoofly at grade separation between Station 497+25 to 538+00 - Allow	RF	4,075	$ 700	$ 2,852,500
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		400		$ 600,000
Shoofly At grade crossing At Elm St.	RF	115	$ 1,520	$ 174,800
Shoofly At grade crossing At Compton Blvd.	RF	140	$ 1,520	$ 212,800
Shoofly At grade crossing At Myrrh St.	RF	145	$ 1,520	$ 220,400
10.04 Guideway: Aerial structure		441		$ 8,100,000
Aerial Guideway Structure, Station from 513+96 to 518+37	RF	441	$ 18,432	$ 8,128,512
10.05 Guideway: Built-up fill		2,116		$ 16,100,000
MSE Buit-up Fill, Station 503+34 to 513+96	RF	1,062	$ 7,600	$ 8,071,200
MSE Buit-up Fill, Station 518+37 to 528+91	RF	1,054	$ 7,600	$ 8,010,400
10.09 Track: Direct fixation		441		$ 400,000
Aerial Guideway Structure, Station from 513+96 to 518+37	RF	441	$ 900	$ 396,900
10.11 Track: Ballasted		6,191		$ 2,800,000
Ballasted Track at MSE Buit-up Fill, Station 503+34 to 513+96	RF	1,062	$ 670	$ 711,540
Ballasted Track at MSE Buit-up Fill, Station 518+37 to 528+91	RF	1,054	$ 670	$ 706,180
Temporary Shoofly (Single Track)	TF	4,075	$ 335	$ 1,365,125
				$ -
10.12 Track: Special (switches, turnouts)				$ 2,000,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 476,000	$ 1,904,000
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
				$ -
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - Compton Blvd.	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	2,557		**$ 19,880,000**
40.01 Demolition, Clearing, Earthwork				$ 1,300,000
Exisitng Trackwork Allowance	RF	2,557	$ 300	$ 767,100
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
Demo Exisitng TPSS, Recycle Equipment For Spare Parts	EA	1	$ 44,000	$ 44,000
40.02 Site Utilities, Utility Relocation		6,632		$ 2,300,000
Utilities Relocation Allow	RF	6,632	$ 350	$ 2,321,200
				$ -
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks				$ 1,300,000
Restore Park After Temp Station & Shoofly Demolition (Including Hardscape and Amenities)	SF	37,540	$ 35	$ 1,313,900
40.06 Pedestrian / bike access and accommodation, landscaping				$ -
Landscaping, Street Scape, Urban Design Features - USE Exist ROW	RF	0	$ 480	$ -
Restore Street After Shoofly Demolition	RF		$ 480	$ -
40.08 Temporary Facilities and other indirect costs during construction				$ 14,980,000
General Conditions - Allow		20%	$ 74,900,000	$ 14,980,000
50 SYSTEMS	RF	6,632		**$ 18,800,000**
50.01 Train control and signals				$ 2,500,000
New Alignment	RF	2,557	$ 540	$ 1,380,780
Shoofly Temporary Train Control	RF	4,075	$ 270	$ 1,100,250
50.02 Traffic signals and crossing protection				$ 300,000
Traffic Signals: Grade Crossings Restoration Allow (Wardlow)	EA	1	$ 297,000	$ 297,000

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Compton Blvd. Grade Separation
Alternate #1 - Single Track East

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
50.03 Traction power supply: substations				$ 7,100,000
New TPSS to Replace Exisitng	EA	1	$ 7,109,000	$ 7,109,000
(Grading, Concrete, Drainage, Grounding, Equipment and All Feeders)				
50.04 Traction power distribution: catenary and third rail				$ 5,200,000
Catenary OCS Pole	RF	6,632	$ 560	$ 3,713,920
Ductbank Pullboxes	RF	6,632	$ 150	$ 994,800
OCS Poles Foundations	RF	6,632	$ 70	$ 464,240
50.05 Communications				$ 1,700,000
Communications Equipment Installation	RF	2,557	$ 520	$ 1,329,640
Ductbank & Pullboxes	RF	2,557	$ 150	$ 383,550
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
Construction Subtotal (10 - 50)	RF	2,557	$ 34,494	**$ 89,880,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		2,557		$ 29,660,000
80.01 Preliminary Engineering	3,595,200	4% 10-50		$ 3,595,200
80.02 Final Design	8,089,200	9% 10-50		$ 8,089,200
80.03 Project Management for Design and Construction	8,988,000	10% 10-50		$ 8,988,000
80.04 Construction Administration & Management	4,494,000	5% 10-50		$ 4,494,000
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	898,800	1% 10-50		$ 898,800
80.07 Surveys, Testing, Investigation, Inspection	1,797,600	2% 10-50		$ 1,797,600
80.08 Start up	1,797,600	2% 10-50		$ 1,797,600
				$ 119,540,000

* **All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #1 - Single Track East

Compton Blvd. Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.48**	32,900	7,745	**40,645**	**36%**	**25%**
10.01 Guideway: At-grade exclusive right-of-way		2,900	725	3,625		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		600	150	750		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.08	8,100	2,025	10,125		
10.05 Guideway: Built-up fill	0.40	16,100	4,025	20,125		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		400	100	500		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		2,800	420	3,220		
10.12 Track: Special (switches, turnouts)		2,000	300	2,300		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**20%**	**14%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.48	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.48	19,880	5,964	**25,844**	**23%**	**16%**
40.01 Demolition, Clearing, Earthwork		1,300	390	1,690		
40.02 Site Utilities, Utility Relocation		2,300	690	2,990		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		1,300	390	1,690		
40.05 Site structures including retaining walls, sound walls		0	0	0		
40.06 Pedestrian / bike access and accommodation, landscaping		0	0	0		
40.07 Automobile, bus, van accessways including roads, parking lots		0	0	0		
40.08 Temporary Facilities and other indirect costs during construction		14,980	4,494	19,474		
50 SYSTEMS	0.48	18,800	5,640	**24,440**	**21%**	**15%**
50.01 Train control and signals		2,500	750	3,250		
50.02 Traffic signals and crossing protection		300	90	390		
50.03 Traction power supply: substations		7,100	2,130	9,230		
50.04 Traction power distribution: catenary and third rail		5,200	1,560	6,760		
50.05 Communications		1,700	510	2,210		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.48	89,880	23,924	**113,804**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.48	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail	0	0	0	0		
70.02 Heavy Rail	0	0	0	0		
70.03 Commuter Rail	0	0	0	0		
70.04 Bus	0	0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.48	29,660	5,932	**35,592**	**31%**	**22%**
80.01 Project Development		3,595	719	4,314		
80.02 Engineering		8,089	1,618	9,707		
80.03 Project Management for Design and Construction		8,988	1,798	10,786		
80.04 Construction Administration & Management		4,494	899	5,393		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		899	180	1,079		
80.07 Surveys, Testing, Investigation, Inspection		1,798	360	2,157		
80.08 Start up		1,798	360	2,157		
Subtotal (10 - 80)	0.48	119,540	29,856	**149,396**		**91%**
90 UNALLOCATED CONTINGENCY				**14,940**		**9%**
Subtotal (10 - 90)	0.48			**164,336**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.48			**164,336**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				24.98%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.50%		
Total Contingency as % of Base Yr Dollars w/o Contingency				37.47%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Compton Blvd. Grade Separation
Alternate #1 - Single Track East

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**2,557**	**0.48**	**$ 37,000,000**
10.01 Guideway: At-grade exclusive right-of-way		8,075		$ 5,700,000
Install & Remove Temp Shoofly at grade separation between Station 497+25 to 540+00 - Allow	RF	4,275	$ 700	$ 2,992,500
Install Sole Freight Track at grade separation between Station 497+00 to 535+00 - Allow	RF	3,800	$ 720	$ 2,736,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		400		$ 600,000
Shoofly At grade crossing At Elm St.	RF	115	$ 1,520	$ 174,800
Shoofly At grade crossing At Compton Blvd.	RF	140	$ 1,520	$ 212,800
Shoofly At grade crossing At Myrrh St.	RF	145	$ 1,520	$ 220,400
10.04 Guideway: Aerial structure		441		$ 8,100,000
Aerial Guideway Structure, Station from 513+96 to 518+37	RF	441	$ 18,432	$ 8,128,512
10.05 Guideway: Built-up fill		2,116		$ 16,100,000
MSE Buit-up Fill, Station 503+34 to 513+96	RF	1,062	$ 7,600	$ 8,071,200
MSE Buit-up Fill, Station 518+37 to 528+91	RF	1,054	$ 7,600	$ 8,010,400
10.09 Track: Direct fixation		441		$ 400,000
Aerial Guideway Structure, Station from 513+96 to 518+37	RF	441	$ 900	$ 396,900
10.11 Track: Ballasted		10,191		$ 4,100,000
Ballasted Track at MSE Buit-up Fill, Station 503+34 to 513+96	RF	1,062	$ 670	$ 711,540
Ballasted Track at MSE Buit-up Fill, Station 518+37 to 528+91	RF	1,054	$ 670	$ 706,180
Temporary Shoofly (Single Track)	TF	4275	$ 335	$ 1,432,125
Restore Sole Freight Track at grade separation between Station 497+00 to 535+00 - Allow	RF	3,800	$ 335	$ 1,273,000
10.12 Track: Special (switches, turnouts)				$ 2,000,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 476,000	$ 1,904,000
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - Compton Blvd.	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	2,557		**$ 22,660,000**
40.01 Demolition, Clearing, Earthwork				$ 2,400,000
Exisitng Trackwork Allowance	RF	2,557	$ 300	$ 767,100
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
Exisitng FreightTrackwork Allowance	RF	3,800	$ 300	$ 1,140,000
40.02 Site Utilities, Utility Relocation		10,632		$ 3,700,000
Utilities Relocation Allow	RF	10,632	$ 350	$ 3,721,200
40.06 Pedestrian / bike access and accommodation, landscaping				$ 1,600,000
Landscaping, Street Scape, Urban Design Features - USE Exist ROW	RF	0	$ 480	$ -
Restore Street After Shoofly Demolition from 499+00 to 533+00	RF	3,400	$ 480	$ 1,632,000
40.08 Temporary Facilities and other indirect costs during construction				$ 14,960,000
General Conditions - Allow		20%	$ 74,800,000	$ 14,960,000
50 SYSTEMS	RF	6,832		**$ 11,800,000**
50.01 Train control and signals				$ 2,500,000
New Alignment	RF	2,557	$ 540	$ 1,380,780
Shoofly Temporary Train Control	RF	4,275	$ 270	$ 1,154,250
50.02 Traffic signals and crossing protection				$ 300,000
Traffic Signals: Grade Crossings Restoration Allow (Wardlow)	EA	1	$ 297,000	$ 297,000

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Compton Blvd. Grade Separation
Alternate #1 - Single Track East

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
50.04 Traction power distribution: catenary and third rail				$ 5,300,000
Catenary OCS Pole	RF	6,832	$ 560	$ 3,825,920
Ductbank Pullboxes	RF	6,832	$ 150	$ 1,024,800
OCS Poles Foundations	RF	6,832	$ 70	$ 478,240
50.05 Communications				$ 1,700,000
Communications Equipment Installation	RF	2,557	$ 520	$ 1,329,640
Ductbank & Pullboxes	RF	2,557	$ 150	$ 383,550
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
Construction Subtotal (10 - 50)	RF	2,557	$ 33,273	**$ 89,760,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		2,557		$ 29,621,000
80.01 Preliminary Engineering	3,590,400	4% 10-50		$ 3,590,400
80.02 Final Design	8,078,400	9% 10-50		$ 8,078,400
80.03 Project Management for Design and Construction	8,976,000	10% 10-50		$ 8,976,000
80.04 Construction Administration & Management	4,488,000	5% 10-50		$ 4,488,000
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	897,600	1% 10-50		$ 897,600
80.07 Surveys, Testing, Investigation, Inspection	1,795,200	2% 10-50		$ 1,795,200
80.08 Start up	1,795,200	2% 10-50		$ 1,795,200
				$ 119,381,000

* **All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #1 - Single Track East

Compton Blvd. Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.48**	37,000	8,640	**45,640**	**40%**	**28%**
10.01 Guideway: At-grade exclusive right-of-way		5,700	1,425	7,125		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		600	150	750		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.08	8,100	2,025	10,125		
10.05 Guideway: Built-up fill	0.40	16,100	4,025	20,125		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		400	100	500		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		4,100	615	4,715		
10.12 Track: Special (switches, turnouts)		2,000	300	2,300		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**20%**	**14%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.48	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.48	22,660	6,798	**29,458**	**26%**	**18%**
40.01 Demolition, Clearing, Earthwork		2,400	720	3,120		
40.02 Site Utilities, Utility Relocation		3,700	1,110	4,810		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		0	0	0		
40.06 Pedestrian / bike access and accommodation, landscaping		1,600	480	2,080		
40.07 Automobile, bus, van accessways including roads, parking lots		0	0	0		
40.08 Temporary Facilities and other indirect costs during construction		14,960	4,488	19,448		
50 SYSTEMS	0.48	11,800	3,540	**15,340**	**14%**	**9%**
50.01 Train control and signals		2,500	750	3,250		
50.02 Traffic signals and crossing protection		300	90	390		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		5,300	1,590	6,890		
50.05 Communications		1,700	510	2,210		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.48	89,760	23,553	**113,313**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.48	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail	0	0	0	0		
70.02 Heavy Rail	0	0	0	0		
70.03 Commuter Rail	0	0	0	0		
70.04 Bus	0	0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.48	29,621	5,924	**35,545**	**31%**	**22%**
80.01 Project Development		3,590	718	4,308		
80.02 Engineering		8,078	1,616	9,694		
80.03 Project Management for Design and Construction		8,976	1,795	10,771		
80.04 Construction Administration & Management		4,488	898	5,386		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		898	180	1,077		
80.07 Surveys, Testing, Investigation, Inspection		1,795	359	2,154		
80.08 Start up		1,795	359	2,154		
Subtotal (10 - 80)	0.48	119,381	29,477	**148,858**		**91%**
90 UNALLOCATED CONTINGENCY				**14,886**		**9%**
Subtotal (10 - 90)	0.48			**163,744**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.48			**163,744**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				24.69%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.47%		
Total Contingency as % of Base Yr Dollars w/o Contingency				37.16%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Florence St. Grade Separation
Alternate #1 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**2,465**	**0.47**	**$ 41,500,000**
10.01 Guideway: At-grade exclusive right-of-way		10,558		$ 6,400,000
Install & Remove Temp Shoofly at grade separation between Station 200+42 to 240+00 - Allow	RF	3,958	$ 700	$ 2,770,600
Realign Temp East Freight Track at grade separation between Station 261+00 to 208+00 and 228+00 to 236+00 - Allow	TF	2,100	$ 200	$ 420,000
Install & Remove Temp Freight Tracks at grade separation between Station 203+00 to 236+00 and 216+00 to 228+00 - Allow	RF	4,500	$ 720	$ 3,240,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		330		$ 500,000
Shoofly At Florence grade crossing	RF	110	$ 1,520	$ 167,200
Temporary East Freight Track At grade crossings	RF	110	$ 1,520	$ 167,200
Restore East Freight Track At grade crossings	RF	110	$ 1,520	$ 167,200
				$ -
10.04 Guideway: Aerial structure		423		$ 7,800,000
Aerial Guideway Structure, Station 'from 217+18 to 221+41	RF	423	$ 18,432	$ 7,796,736
10.05 Guideway: Built-up fill		2,042		$ 15,500,000
MSE Buit-up Fill, Station 207+19 to 217+18	RF	999	$ 7,600	$ 7,592,400
MSE Buit-up Fill, Station 221+41 to 231+84	RF	1,043	$ 7,600	$ 7,926,800
10.09 Track: Direct fixation		423		$ 400,000
Aerial Guideway Structure, Station 'from 217+18 to 221+41	RF	423	$ 900	$ 380,700
10.11 Track: Ballasted		19,200		$ 6,400,000
Ballasted Track at MSE Buit-up Fill, Station 207+19 to 217+18	RF	999	$ 670	$ 669,330
Ballasted Track at MSE Buit-up Fill, Station 221+41 to 231+84	RF	1,043	$ 670	$ 698,810
Temporary Shoofly (Single Track)	TF	3958	$ 335	$ 1,325,930
Temporary Shift 2.5ft Ballasted West Freight Track , Station 208+00 to 216+00 and 228+00 to 236+00 - Allowance	TF	2,100	$ 175	$ 367,500
Restore, Shift 2.5ft Ballasted West Freight Track , Station 208+00 to 216+00 and 228+00 to 236+00 - Allowance	TF	2,100	$ 175	$ 367,500
Temporary Ballasted Freight Track, Station (East) 203+00 to 236+00 and (West) 216+00 to 228+00 - Allowance	TF	4,500	$ 335	$ 1,507,500
Restore Ballasted Freight Track, Station (East) 203+00 to 236+00 and (West) 216+00 to 228+00 - Allowance	TF	4,500	$ 335	$ 1,507,500
10.12 Track: Special (switches, turnouts)				$ 4,500,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
No. 14 Turnout - Allow For Temporary Freight Track	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Temporary Freight Track	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - 103rd Street	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	2,465		**$ 28,970,000**
40.01 Demolition, Clearing, Earthwork				$ 2,600,000
Exisiting Trackwork Allowance	RF	2,465	$ 300	$ 739,500
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
Freight Trackwork Allowance	RF	4,500	$ 300	$ 1,350,000
40.02 Site Utilities, Utility Relocation		10,923		$ 3,823,000
Utilities Relocation Allow	RF	10,923	$ 350	$ 3,823,050
40.05 Site structures including retaining walls, sound walls				$ 3,600,000
Reconstruct Exisitng 3850SF Bldg NW of Florence Ave. Intersection	SF	3,850	$ 300	$ 1,155,000
Reconstruct Exisitng 8000SF Bldg SW of Florence Ave. Intersection	SF	8,000	$ 300	$ 2,400,000

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Florence St. Grade Separation
Alternate #1 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
40.06 Pedestrian / bike access and accommodation, landscaping				$ 1,800,000
Landscaping, Street Scape, Urban Design Features	RF	2,465	$ 480	$ 1,183,200
Restore Street After Shoofly Demolition	RF	1,200	$ 480	$ 576,000
40.07 Automobile, bus, van accessways including roads, parking lots				$ 452,000
Restore Parking and All Amenities	SF	11,300	$ 40	$ 452,000
40.08 Temporary Facilities and other indirect costs during construction				$ 16,695,000
General Conditions - Allow		20%	$ 83,475,000	$ 16,695,000
50 SYSTEMS	RF	6,423		**$ 11,400,000**
50.01 Train control and signals				$ 2,400,000
New Alignment	RF	2,465	$ 540	$ 1,331,100
Shoofly Temporary Train Control	RF	3,958	$ 270	$ 1,068,660
50.02 Traffic signals and crossing protection				$ 300,000
Traffic Signals: Grade Crossings Restoration Allow	EA	1	$ 297,000	$ 297,000
50.04 Traction power distribution: catenary and third rail				$ 5,000,000
Catenary OCS Pole	RF	6,423	$ 560	$ 3,596,880
Ductbank Pullboxes	RF	6,423	$ 150	$ 963,450
OCS Poles Foundations	RF	6,423	$ 70	$ 449,610
50.05 Communications				$ 1,700,000
Communications Equipment Installation	RF	2,465	$ 520	$ 1,281,800
Ductbank & Pullboxes	RF	2,465	$ 150	$ 369,750
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
Construction Subtotal (10 - 50)	RF	2,465	$ 39,043	**$ 100,170,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ 4,500,000
60.01 Purchase or lease of real estate				$ 4,500,000
ROW	ACRE	1.00	$ 4,500,000	$ 4,500,000
(Allowance for 1.00 acre)				
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		2,465		$ 33,056,000
80.01 Preliminary Engineering	4,006,800	4% 10-50		$ 4,006,800
80.02 Final Design	9,015,300	9% 10-50		$ 9,015,300
80.03 Project Management for Design and Construction	10,017,000	10% 10-50		$ 10,017,000
80.04 Construction Administration & Management	5,008,500	5% 10-50		$ 5,008,500
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	1,001,700	1% 10-50		$ 1,001,700
80.07 Surveys, Testing, Investigation, Inspection	2,003,400	2% 10-50		$ 2,003,400
80.08 Start up	2,003,400	2% 10-50		$ 2,003,400
				$ 137,726,000

*** All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #1 - Single Track West

Florence St. Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.47**	41,500	9,285	**50,785**	**40%**	**27%**
10.01 Guideway: At-grade exclusive right-of-way		6,400	1,600	8,000		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		500	125	625		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.08	7,800	1,950	9,750		
10.05 Guideway: Built-up fill	0.39	15,500	3,875	19,375		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		400	100	500		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		6,400	960	7,360		
10.12 Track: Special (switches, turnouts)		4,500	675	5,175		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**18%**	**12%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.47	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.47	28,970	8,691	**37,661**	**30%**	**20%**
40.01 Demolition, Clearing, Earthwork		2,600	780	3,380		
40.02 Site Utilities, Utility Relocation		3,823	1,147	4,970		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		3,600	1,080	4,680		
40.06 Pedestrian / bike access and accommodation, landscaping		1,800	540	2,340		
40.07 Automobile, bus, van accessways including roads, parking lots		452	136	588		
40.08 Temporary Facilities and other indirect costs during construction		16,695	5,009	21,704		
50 SYSTEMS	0.47	11,400	3,420	**14,820**	**12%**	**8%**
50.01 Train control and signals		2,400	720	3,120		
50.02 Traffic signals and crossing protection		300	90	390		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		5,000	1,500	6,500		
50.05 Communications		1,700	510	2,210		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.47	100,170	25,971	**126,141**	**100%**	**67%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.47	4,500	1,350	**5,850**		**3%**
60.01 Purchase or lease of real estate		4,500	1,350	5,850		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail		0	0	0		
70.02 Heavy Rail		0	0	0		
70.03 Commuter Rail		0	0	0		
70.04 Bus		0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.47	33,056	6,611	**39,667**	**31%**	**21%**
80.01 Project Development		4,007	801	4,808		
80.02 Engineering		9,015	1,803	10,818		
80.03 Project Management for Design and Construction		10,017	2,003	12,020		
80.04 Construction Administration & Management		5,009	1,002	6,010		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		1,002	200	1,202		
80.07 Surveys, Testing, Investigation, Inspection		2,003	401	2,404		
80.08 Start up		2,003	401	2,404		
Subtotal (10 - 80)	0.47	137,726	33,932	**171,658**		**91%**
90 UNALLOCATED CONTINGENCY				**17,166**		**9%**
Subtotal (10 - 90)	0.47			**188,824**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.47			**188,824**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				24.64%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.46%		
Total Contingency as % of Base Yr Dollars w/o Contingency				37.10%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Florence Ave. Grade separation
Alternate #2 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**2,465**	**0.47**	**$ 38,119,000**
10.01 Guideway: At-grade exclusive right-of-way		10,558		$ 5,800,000
Install & Remove Temp Shoofly at grade separation between Station 200+42 to 240+00 - Allow	RF	3,958	$ 700	$ 2,770,600
Realign Temp West Freight Track at grade separation between Station 203+00 to 236+00 - Allow	TF	3,300	$ 200	$ 660,000
Install & Remove Temp Freight Tracks at grade separation between Station 203+00 to 236+00 - Allow	RF	3,300	$ 720	$ 2,376,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		550		$ 800,000
Shoofly At Florence grade crossing	RF	110	$ 1,520	$ 167,200
Temporary West Freight Track At grade crossings	RF	110	$ 1,520	$ 167,200
Restore West Freight Track At grade crossings	RF	110	$ 1,520	$ 167,200
Temporary East Freight Track At grade crossings	RF	110	$ 1,520	$ 167,200
Restore East Freight Track At grade crossings	RF	110	$ 1,520	$ 167,200
10.04 Guideway: Aerial structure		423		$ 6,100,000
Aerial Guideway Structure, Station 'from 217+18 to 221+41	RF	423	$ 14,400	$ 6,091,200
	RF	0	$ 14,400	$ -
				$ -
10.05 Guideway: Built-up fill		2,042		$ 15,519,200
MSE Buit-up Fill, Station 207+19 to 217+18	RF	999	$ 7,600	$ 7,592,400
MSE Buit-up Fill, Station 221+41 to 231+84	RF	1,043	$ 7,600	$ 7,926,800
10.09 Track: Direct fixation		423		$ 400,000
Aerial Guideway Structure, Station 'from 217+18.39 to 221+40.74	RF	423	$ 900	$ 380,700
10.11 Track: Ballasted		15,900		$ 5,000,000
Ballasted Track at MSE Buit-up Fill, Station 207+19 to 217+18	RF	999	$ 670	$ 669,330
Ballasted Track at MSE Buit-up Fill, Station 221+41 to 231+84	RF	1,043	$ 670	$ 698,810
Temporary Shoofly (Single Track)	TF	3958	$ 335	$ 1,325,930
Temporary Shift 2.5ft West Freight Track at grade separation between Station 203+00 to 236+00 - Allowance	TF	3,300	$ 175	$ 577,500
Restore Shifted West Freight Track at grade separation between Station 203+00 to 236+00 - Allowance	TF	3,300	$ 175	$ 577,500
Restore Ballasted East Freight Track, Station 203+00 to 236+00 - Allowance	TF	3,300	$ 335	$ 1,105,500
10.12 Track: Special (switches, turnouts)				$ 4,500,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
No. 14 Turnout - Allow For Temporary Freight Track	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Temporary Freight Track	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - Florence	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
				$ -
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	2,465		**$ 22,324,000**
40.01 Demolition, Clearing, Earthwork				$ 2,200,000
Exisiting Trackwork Allowance	RF	2,465	$ 300	$ 739,500
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
Freight Trackwork Allowance	RF	3,300	$ 300	$ 990,000
40.02 Site Utilities, Utility Relocation		9,723		$ 3,400,000
Utilities Relocation Allow	RF	9,723	$ 350	$ 3,403,050
40.06 Pedestrian / bike access and accommodation, landscaping				$ 1,700,000
Landscaping, Street Scape, Urban Design Features	RF	2,465	$ 480	$ 1,183,200
Restore Street After Shoofly Demolition	RF	1,070	$ 480	$ 513,600
40.08 Temporary Facilities and other indirect costs during construction				$ 15,024,000
General Condition/Contingency - Allow		20%	$ 75,119,000	$ 15,023,800

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Florence Ave. Grade separation
Alternate #2 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
50 SYSTEMS	RF	6,423		**$ 11,400,000**
50.01 Train control and signals				$ 2,400,000
New Alignment	RF	2,465	$ 540	$ 1,331,100
Shoofly Temporary Train Control	RF	3,958	$ 270	$ 1,068,660
50.02 Traffic signals and crossing protection				$ 300,000
Traffic Signals: Grade Crossings Existing Allow	EA	1	$ 297,000	$ 297,000
50.04 Traction power distribution: catenary and third rail				$ 5,000,000
Catenary OCS Pole	RF	6,423	$ 560	$ 3,596,880
Ductbank Pullboxes	RF	6,423	$ 150	$ 963,450
OCS Poles Foundations	RF	6,423	$ 70	$ 449,610
50.05 Communications				$ 1,700,000
Communications Equipment Installation	RF	2,465	$ 520	$ 1,281,800
Ductbank & Pullboxes	RF	2,465	$ 150	$ 369,750
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
Construction Subtotal (10 - 50)	RF	2,465	$ 35,303	**$ 90,143,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		2,465		$ 29,747,000
80.01 Preliminary Engineering	3,605,720	4% 10-50		$ 3,605,720
80.02 Final Design	8,112,870	9% 10-50		$ 8,112,870
80.03 Project Management for Design and Construction	9,014,300	10% 10-50		$ 9,014,300
80.04 Construction Administration & Management	4,507,150	5% 10-50		$ 4,507,150
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	901,430	1% 10-50		$ 901,430
80.07 Surveys, Testing, Investigation, Inspection	1,802,860	2% 10-50		$ 1,802,860
80.08 Start up	1,802,860	2% 10-50		$ 1,802,860
				$ 119,890,000

*** All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #2 - Single Track West

Florence Ave. Grade separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.47**	38,119	7,203	**45,323**	**40%**	**28%**
10.01 Guideway: At-grade exclusive right-of-way		5,800	1,450	7,250		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		800	200	1,000		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.08	6,100	1,525	7,625		
10.05 Guideway: Built-up fill	0.39	15,519	3,880	19,399		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		400	6	406		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		5,000	75	5,075		
10.12 Track: Special (switches, turnouts)		4,500	68	4,568		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**20%**	**14%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.47	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.47	22,324	6,697	**29,021**	**26%**	**18%**
40.01 Demolition, Clearing, Earthwork		2,200	660	2,860		
40.02 Site Utilities, Utility Relocation		3,400	1,020	4,420		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		0	0	0		
40.06 Pedestrian / bike access and accommodation, landscaping		1,700	510	2,210		
40.07 Automobile, bus, van accessways including roads, parking lots		0	0	0		
40.08 Temporary Facilities and other indirect costs during construction		15,024	4,507	19,531		
50 SYSTEMS	0.47	11,400	3,420	**14,820**	**13%**	**9%**
50.01 Train control and signals		2,400	720	3,120		
50.02 Traffic signals and crossing protection		300	90	390		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		5,000	1,500	6,500		
50.05 Communications		1,700	510	2,210		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.47	90,143	21,896	**112,039**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.47	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail	0	0	0	0		
70.02 Heavy Rail	0	0	0	0		
70.03 Commuter Rail	0	0	0	0		
70.04 Bus	0	0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.47	29,747	5,949	**35,697**	**32%**	**22%**
80.01 Project Development		3,606	721	4,327		
80.02 Engineering		8,113	1,623	9,735		
80.03 Project Management for Design and Construction		9,014	1,803	10,817		
80.04 Construction Administration & Management		4,507	901	5,409		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		901	180	1,082		
80.07 Surveys, Testing, Investigation, Inspection		1,803	361	2,163		
80.08 Start up		1,803	361	2,163		
Subtotal (10 - 80)	0.47	119,890	27,845	**147,735**		**91%**
90 UNALLOCATED CONTINGENCY				**14,774**		**9%**
Subtotal (10 - 90)	0.47			**162,509**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.47			**162,509**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				23.23%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.32%		
Total Contingency as % of Base Yr Dollars w/o Contingency				35.55%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Gage / Florence / Nadeau Ave Grade Separation
Alternate #1 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**8,060**	**1.53**	**$ 124,100,000**
10.01 Guideway: At-grade exclusive right-of-way		25,037		$ 14,800,000
Install & Remove Temp Shoofly at grade separation between Station 154+00 to 264+77 - Allow	RF	11,077	$ 700	$ 7,753,900
Realign Temp West Freight Track at grade separation between Station 193+20 to 216+00 and 228+00 to 263+00 - Allow	TF	5,780	$ 200	$ 1,156,000
Install East Freight Tracks at grade separation between Station 193+20 to 263+00 - Allow	RF	6,980	$ 720	$ 5,025,600
Install West Freight Tracks at grade separation between Station 216+00 to 228+00 - Allow	RF	1,200	$ 720	$ 864,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		870		$ 1,300,000
Shoofly At Gage, Florence & Nadeau grade crossing	RF	290	$ 1,520	$ 440,800
Temporary West Freight Track At grade crossings	RF	290	$ 1,520	$ 440,800
Restore East & West Freight Track At grade crossings	RF	290	$ 1,520	$ 440,800
10.04 Guideway: Aerial structure		2,661		$ 49,000,000
Aerial Guideway Structure, Station from 177+13 to 198+43	RF	2,130	$ 18,432	$ 39,260,160
Aerial Guideway Structure, Station from 217+23 to 221+35	RF	412	$ 18,432	$ 7,593,984
Aerial Guideway Structure, Station from 245+61 to 246+80	RF	119	$ 18,432	$ 2,193,408
10.05 Guideway: Built-up fill		5,399		$ 41,000,000
MSE Buit-up Fill, Station 198+43 to 217+23	RF	1,880	$ 7,600	$ 14,288,000
MSE Buit-up Fill, Station 221+35 to 245+61	RF	2,426	$ 7,600	$ 18,437,600
MSE Buit-up Fill, Station 246+80 to 257+73	RF	1,093	$ 7,600	$ 8,306,800
10.09 Track: Direct fixation		2,661		$ 2,400,000
Aerial Guideway Structure, Station from 177+13 to 198+43	RF	2,130	$ 900	$ 1,917,000
Aerial Guideway Structure, Station from 217+23 to 221+35	RF	412	$ 900	$ 370,800
Aerial Guideway Structure, Station from 245+61 to 246+80	RF	119	$ 900	$ 107,100
10.11 Track: Ballasted		30,816		$ 11,100,000
Ballasted Track at MSE Buit-up Fill, Station 198+43 to 217+23	RF	1,880	$ 670	$ 1,259,600
Ballasted Track at MSE Buit-up Fill, Station 221+35 to 245+61	RF	2,426	$ 670	$ 1,625,420
Ballasted Track at MSE Buit-up Fill, Station 246+80 to 257+73	RF	1,093	$ 670	$ 732,310
Temporary Shoofly (Single Track)	TF	11077	$ 335	$ 3,710,795
Temporary Shift 2.5ft Ballasted West Freight Track , Station 193+20 to 216+00 and 228+00 to 236+00 - Allowance	TF	3,080	$ 175	$ 539,000
Restore, Shift 2.5ft Ballasted West Freight Track , Station 193+20 to 216+00 and 228+00 to 236+00 - Allowance	TF	3,080	$ 175	$ 539,000
Restore Ballasted Freight Track, East Station 193+20 to 263+00 and West Station 216+00 to 228+00 - Allowance	TF	8,180	$ 335	$ 2,740,300
10.12 Track: Special (switches, turnouts)				$ 4,500,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
No. 14 Turnout - Allow For Temporary Freight Track	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Temporary Freight Track	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - 103rd Street	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	8,060		**$ 62,180,000**
40.01 Demolition, Clearing, Earthwork				$ 5,400,000
Exisitng Trackwork Allowance	RF	8,060	$ 300	$ 2,418,000
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
Freight Trackwork Allowance	RF	8,180	$ 300	$ 2,454,000
40.02 Site Utilities, Utility Relocation		27,317		$ 9,600,000
Utilities Relocation Allow	RF	27,317	$ 350	$ 9,560,950

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Gage / Florence / Nadeau Ave Grade Separation
Alternate #1 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
40.05 Site structures including retaining walls, sound walls				$ 3,600,000
Reconstruct Exisitng 3850SF Bldg NW of Florence Ave. Intersection	SF	3,850	$ 300	$ 1,155,000
Reconstruct Exisitng 8000SF Bldg SW of Florence Ave. Intersection	SF	8,000	$ 300	$ 2,400,000
40.06 Pedestrian / bike access and accommodation, landscaping				$ 4,400,000
Landscaping, Street Scape, Urban Design Features	RF	8,060	$ 480	$ 3,868,800
Restore Street After Shoofly Demolition	RF	1,200	$ 480	$ 576,000
40.08 Temporary Facilities and other indirect costs during construction				$ 39,180,000
General Conditions - Allow		20%	$ 195,900,000	$ 39,180,000
50 SYSTEMS	RF	19,137		**$ 30,500,000**
50.01 Train control and signals				$ 7,300,000
New Alignment	RF	8,060	$ 540	$ 4,352,400
Shoofly Temporary Train Control	RF	11,077	$ 270	$ 2,990,790
50.02 Traffic signals and crossing protection				$ 900,000
Traffic Signals: Gage Grade Crossing Restoration Allow	EA	1	$ 297,000	$ 297,000
Traffic Signals: Florence Grade Crossing Restoration Allow	EA	1	$ 297,000	$ 297,000
Traffic Signals: Nadeau Grade Crossing Restoration Allow	EA	1	$ 297,000	$ 297,000
50.04 Traction power distribution: catenary and third rail				$ 14,900,000
Catenary OCS Pole	RF	19,137	$ 560	$ 10,716,720
Ductbank Pullboxes	RF	19,137	$ 150	$ 2,870,550
OCS Poles Foundations	RF	19,137	$ 70	$ 1,339,590
50.05 Communications				$ 5,400,000
Communications Equipment Installation	RF	8,060	$ 520	$ 4,191,200
Ductbank & Pullboxes	RF	8,060	$ 150	$ 1,209,000
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
				$ -
Construction Subtotal (10 - 50)	RF	8,060	$ 28,139	**$ 235,080,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		8,060		$ 77,576,000
80.01 Preliminary Engineering	9,403,200	4% 10-50		$ 9,403,200
80.02 Final Design	21,157,200	9% 10-50		$ 21,157,200
80.03 Project Management for Design and Construction	23,508,000	10% 10-50		$ 23,508,000
80.04 Construction Administration & Management	11,754,000	5% 10-50		$ 11,754,000
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	2,350,800	1% 10-50		$ 2,350,800
80.07 Surveys, Testing, Investigation, Inspection	4,701,600	2% 10-50		$ 4,701,600
80.08 Start up	4,701,600	2% 10-50		$ 4,701,600
				$ 312,656,000

*** All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #1 - Single Track West

Gage / Florence / Nadeau Ave Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**1.53**	124,100	29,225	**153,325**	**52%**	**36%**
10.01 Guideway: At-grade exclusive right-of-way		14,800	3,700	18,500		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		1,300	325	1,625		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.50	49,000	12,250	61,250		
10.05 Guideway: Built-up fill	1.02	41,000	10,250	51,250		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		2,400	360	2,760		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		11,100	1,665	12,765		
10.12 Track: Special (switches, turnouts)		4,500	675	5,175		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**8%**	**5%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	1.53	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	1.53	62,180	18,654	**80,834**	**27%**	**19%**
40.01 Demolition, Clearing, Earthwork		5,400	1,620	7,020		
40.02 Site Utilities, Utility Relocation		9,600	2,880	12,480		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		3,600	1,080	4,680		
40.06 Pedestrian / bike access and accommodation, landscaping		4,400	1,320	5,720		
40.07 Automobile, bus, van accessways including roads, parking lots		0	0	0		
40.08 Temporary Facilities and other indirect costs during construction		39,180	11,754	50,934		
50 SYSTEMS	1.53	30,500	9,150	**39,650**	**13%**	**9%**
50.01 Train control and signals		7,300	2,190	9,490		
50.02 Traffic signals and crossing protection		900	270	1,170		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		14,900	4,470	19,370		
50.05 Communications		5,400	1,620	7,020		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	1.53	235,080	61,604	**296,684**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	1.53	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail	0	0	0	0		
70.02 Heavy Rail	0	0	0	0		
70.03 Commuter Rail	0	0	0	0		
70.04 Bus	0	0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	1.53	77,576	15,515	**93,092**	**31%**	**22%**
80.01 Project Development		9,403	1,881	11,284		
80.02 Engineering		21,157	4,231	25,389		
80.03 Project Management for Design and Construction		23,508	4,702	28,210		
80.04 Construction Administration & Management		11,754	2,351	14,105		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		2,351	470	2,821		
80.07 Surveys, Testing, Investigation, Inspection		4,702	940	5,642		
80.08 Start up		4,702	940	5,642		
Subtotal (10 - 80)	1.53	312,656	77,119	**389,776**		**91%**
90 UNALLOCATED CONTINGENCY				**38,978**		**9%**
Subtotal (10 - 90)	1.53			**428,753**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	1.53			**428,753**		**100%**

Allocated Contingency as % of Base Yr Dollars w/o Contingency	24.67%
Unallocated Contingency as % of Base Yr Dollars w/o Contingency	12.47%
Total Contingency as % of Base Yr Dollars w/o Contingency	37.13%
Unallocated Contingency as % of Subtotal (10 - 80)	10.00%
YOE Construction Cost per Mile (X000)	
YOE Total Project Cost per Mile Not Including Vehicles (X000)	
YOE Total Project Cost per Mile (X000)	

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Gage Ave / Florence Ave Grade Separation
Alternate #1 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**5,458**	**1.03**	**$ 95,100,000**
10.01 Guideway: At-grade exclusive right-of-way		17,132		$ 10,600,000
Install & Remove Temp Shoofly at grade separation between Station 154+00 to 239+72 - Allow	RF	8,572	$ 700	$ 6,000,400
Realign Temp West Freight Track at grade separation between Station 193+20 to 216+00 and 228+00 to 236+00 - Allow	TF	3,080	$ 200	$ 616,000
Install East Freight Tracks at grade separation between Station 193+20 to 236+00 - Allow	RF	4,280	$ 720	$ 3,081,600
Install West Freight Tracks at grade separation between Station 216+00 to 228+00 - Allow	RF	1,200	$ 720	$ 864,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		600		$ 900,000
Shoofly At Gage & Florence grade crossing	RF	200	$ 1,520	$ 304,000
Temporary West Freight Track At grade crossings	RF	200	$ 1,520	$ 304,000
Restore East & West Freight Track At grade crossings	RF	200	$ 1,520	$ 304,000
10.04 Guideway: Aerial structure		2,542		$ 46,900,000
Aerial Guideway Structure, Station from 177+13 to 198+43	RF	2,130	$ 18,432	$ 39,260,160
Aerial Guideway Structure, Station from 217+23 to 221+35	RF	412	$ 18,432	$ 7,593,984
10.05 Guideway: Built-up fill		2,916		$ 22,200,000
MSE Buit-up Fill, Station 198+43 to 217+23	RF	1,880	$ 7,600	$ 14,288,000
MSE Buit-up Fill, Station 221+35 to 231+71	RF	1,036	$ 7,600	$ 7,873,600
10.09 Track: Direct fixation		2,542		$ 2,300,000
Aerial Guideway Structure, Station from 177+13 to 198+43	RF	2,130	$ 900	$ 1,917,000
Aerial Guideway Structure, Station from 217+23 to 221+35	RF	412	$ 900	$ 370,800
10.11 Track: Ballasted		23,128		$ 7,700,000
Ballasted Track at MSE Buit-up Fill, Station 198+43 to 217+23	RF	1,880	$ 670	$ 1,259,600
Ballasted Track at MSE Buit-up Fill, Station 221+35 to 231+71	RF	1,036	$ 670	$ 694,120
Temporary Shoofly (Single Track)	TF	8572	$ 335	$ 2,871,620
Temporary Shift 2.5ft Ballasted West Freight Track , Station 193+20 to 216+00 and 228+00 to 236+00 - Allowance	TF	3,080	$ 175	$ 539,000
Restore, Shift 2.5ft Ballasted West Freight Track , Station 193+20 to 216+00 and 228+00 to 236+00 - Allowance	TF	3,080	$ 175	$ 539,000
Restore Ballasted Freight Track, East Station 193+20 to 236+00 and West Station 216+00 to 228+00 - Allowance	TF	5,480	$ 335	$ 1,835,800
10.12 Track: Special (switches, turnouts)				$ 4,500,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
No. 14 Turnout - Allow For Temporary Freight Track	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Temporary Freight Track	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - 103rd Street	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	5,458		**$ 44,460,000**
40.01 Demolition, Clearing, Earthwork				$ 3,800,000
Existing Trackwork Allowance	RF	5,458	$ 300	$ 1,637,400
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
Freight Trackwork Allowance	RF	5,480	$ 300	$ 1,644,000
40.02 Site Utilities, Utility Relocation		10,938		$ 3,800,000
Utilities Relocation Allow	RF	10,938	$ 350	$ 3,828,300
40.05 Site structures including retaining walls, sound walls				$ 3,600,000
Reconstruct Exisitng 3850SF Bldg NW of Florence Ave. Intersection	SF	3,850	$ 300	$ 1,155,000
Reconstruct Exisitng 8000SF Bldg SW of Florence Ave. Intersection	SF	8,000	$ 300	$ 2,400,000

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Gage Ave / Florence Ave Grade Separation
Alternate #1 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
40.06 Pedestrian / bike access and accommodation, landscaping				$ 3,200,000
Landscaping, Street Scape, Urban Design Features	RF	5,458	$ 480	$ 2,619,840
Restore Street After Shoofly Demolition	RF	1,200	$ 480	$ 576,000
40.08 Temporary Facilities and other indirect costs during construction				$ 30,060,000
General Conditions - Allow		20%	$ 150,300,000	$ 30,060,000
50 SYSTEMS	RF	14,030		**$ 22,500,000**
50.01 Train control and signals				$ 5,300,000
New Alignment	RF	5,458	$ 540	$ 2,947,320
Shoofly Temporary Train Control	RF	8,572	$ 270	$ 2,314,440
50.02 Traffic signals and crossing protection				$ 600,000
Traffic Signals: Gage Grade Crossing Restoration Allow	EA	1	$ 297,000	$ 297,000
Traffic Signals: Florence Grade Crossing Restoration Allow	EA	1	$ 297,000	$ 297,000
50.04 Traction power distribution: catenary and third rail				$ 10,900,000
Catenary OCS Pole	RF	14,030	$ 560	$ 7,856,800
Ductbank Pullboxes	RF	14,030	$ 150	$ 2,104,500
OCS Poles Foundations	RF	14,030	$ 70	$ 982,100
50.05 Communications				$ 3,700,000
Communications Equipment Installation	RF	5,458	$ 520	$ 2,838,160
Ductbank & Pullboxes	RF	5,458	$ 150	$ 818,700
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
Construction Subtotal (10 - 50)	RF	5,458	$ 32,715	**$ 180,360,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		5,458		$ 59,519,000
80.01 Preliminary Engineering	7,214,400	4% 10-50		$ 7,214,400
80.02 Final Design	16,232,400	9% 10-50		$ 16,232,400
80.03 Project Management for Design and Construction	18,036,000	10% 10-50		$ 18,036,000
80.04 Construction Administration & Management	9,018,000	5% 10-50		$ 9,018,000
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	1,803,600	1% 10-50		$ 1,803,600
80.07 Surveys, Testing, Investigation, Inspection	3,607,200	2% 10-50		$ 3,607,200
80.08 Start up	3,607,200	2% 10-50		$ 3,607,200
				$ 239,879,000

*** All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #1 - Single Track West

Gage Ave / Florence Ave Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**1.03**	95,100	22,325	**117,425**	**52%**	**36%**
10.01 Guideway: At-grade exclusive right-of-way		10,600	2,650	13,250		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		900	225	1,125		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.48	46,900	11,725	58,625		
10.05 Guideway: Built-up fill	0.55	22,200	5,550	27,750		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		2,300	345	2,645		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		7,700	1,155	8,855		
10.12 Track: Special (switches, turnouts)		4,500	675	5,175		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**10%**	**7%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	1.03	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	1.03	44,460	13,338	**57,798**	**25%**	**18%**
40.01 Demolition, Clearing, Earthwork		3,800	1,140	4,940		
40.02 Site Utilities, Utility Relocation		3,800	1,140	4,940		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		3,600	1,080	4,680		
40.06 Pedestrian / bike access and accommodation, landscaping		3,200	960	4,160		
40.07 Automobile, bus, van accessways including roads, parking lots		0	0	0		
40.08 Temporary Facilities and other indirect costs during construction		30,060	9,018	39,078		
50 SYSTEMS	1.03	22,500	6,750	**29,250**	**13%**	**9%**
50.01 Train control and signals		5,300	1,590	6,890		
50.02 Traffic signals and crossing protection		600	180	780		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		10,900	3,270	14,170		
50.05 Communications		3,700	1,110	4,810		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	1.03	180,360	46,988	**227,348**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	1.03	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail	0	0	0	0		
70.02 Heavy Rail	0	0	0	0		
70.03 Commuter Rail	0	0	0	0		
70.04 Bus	0	0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	1.03	59,519	11,904	**71,423**	**31%**	**22%**
80.01 Project Development		7,214	1,443	8,657		
80.02 Engineering		16,232	3,246	19,479		
80.03 Project Management for Design and Construction		18,036	3,607	21,643		
80.04 Construction Administration & Management		9,018	1,804	10,822		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		1,804	361	2,164		
80.07 Surveys, Testing, Investigation, Inspection		3,607	721	4,329		
80.08 Start up		3,607	721	4,329		
Subtotal (10 - 80)	1.03	239,879	58,892	**298,771**		**91%**
90 UNALLOCATED CONTINGENCY				**29,877**		**9%**
Subtotal (10 - 90)	1.03			**328,648**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	1.03			**328,648**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				24.55%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.46%		
Total Contingency as % of Base Yr Dollars w/o Contingency				37.01%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Gage Ave / Florence Ave Grade Separation
Alternate #2 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**5,458**	**1.03**	**$ 94,900,000**
10.01 Guideway: At-grade exclusive right-of-way		17,510		$ 10,200,000
Install & Remove Temp Shoofly at grade separation between Station 154+00 to 243+50 - Allow	RF	8,950	$ 700	$ 6,265,000
Realign Temp West Freight Track at grade separation between Station 193+20 to 236+00 - Allow	TF	4,280	$ 200	$ 856,000
Install East Freight Tracks at grade separation between Station 193+20 to 236+00 - Allow	RF	4,280	$ 720	$ 3,081,600
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		600		$ 900,000
Shoofly At Gage & Florence grade crossing	RF	200	$ 1,520	$ 304,000
Temporary West Freight Track At grade crossings	RF	200	$ 1,520	$ 304,000
Restore East & West Freight Track At grade crossings	RF	200	$ 1,520	$ 304,000
10.04 Guideway: Aerial structure		2,542		$ 46,900,000
Aerial Guideway Structure, Station from 177+13 to 198+43	RF	2,130	$ 18,432	$ 39,260,160
Aerial Guideway Structure, Station from 217+23 to 221+35	RF	412	$ 18,432	$ 7,593,984
10.05 Guideway: Built-up fill		2,916		$ 22,200,000
MSE Buit-up Fill, Station 198+43 to 217+23	RF	1,880	$ 7,600	$ 14,288,000
MSE Buit-up Fill, Station 221+35 to 231+71	RF	1,036	$ 7,600	$ 7,873,600
10.09 Track: Direct fixation		2,542		$ 2,300,000
Aerial Guideway Structure, Station from 177+13 to 198+43	RF	2,130	$ 900	$ 1,917,000
Aerial Guideway Structure, Station from 217+23 to 221+35	RF	412	$ 900	$ 370,800
10.11 Track: Ballasted		24,706		$ 7,900,000
Ballasted Track at MSE Buit-up Fill, Station 198+43 to 217+23	RF	1,880	$ 670	$ 1,259,600
Ballasted Track at MSE Buit-up Fill, Station 221+35 to 231+71	RF	1,036	$ 670	$ 694,120
Temporary Shoofly (Single Track)	TF	8950	$ 335	$ 2,998,250
Temporary Shift 2.5ft Ballasted West Freight Track , Station 193+20 to 236+00 - Allowance	TF	4,280	$ 175	$ 749,000
Restore, Shift 2.5ft Ballasted West Freight Track , Station 193+20 to 236+00 - Allowance	TF	4,280	$ 175	$ 749,000
Restore Ballasted East Freight Track, Station 193+20 to 236+00 - Allowance	TF	4,280	$ 335	$ 1,433,800
10.12 Track: Special (switches, turnouts)				$ 4,500,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
No. 14 Turnout - Allow For Temporary Freight Track	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Temporary Freight Track	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
				$ -
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - 103rd Street	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	5,458		**$ 42,220,000**
40.01 Demolition, Clearing, Earthwork				$ 3,400,000
Existing Trackwork Allowance	RF	5,458	$ 300	$ 1,637,400
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
Freight Trackwork Allowance	RF	4,280	$ 300	$ 1,284,000
40.02 Site Utilities, Utility Relocation		18,688		$ 6,500,000
Utilities Relocation Allow	RF	18,688	$ 350	$ 6,540,800
40.06 Pedestrian / bike access and accommodation, landscaping				$ 2,600,000
Landscaping, Street Scape, Urban Design Features	RF	5,458	$ 480	$ 2,619,840
40.08 Temporary Facilities and other indirect costs during construction				$ 29,720,000
General Conditions - Allow		20%	$ 148,600,000	$ 29,720,000

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Gage Ave / Florence Ave Grade Separation
Alternate #2 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
50 SYSTEMS	RF	14,408		**$ 22,900,000**
50.01 Train control and signals				$ 5,400,000
New Alignment	RF	5,458	$ 540	$ 2,947,320
Shoofly Temporary Train Control	RF	8,950	$ 270	$ 2,416,500
50.02 Traffic signals and crossing protection				$ 600,000
Traffic Signals: Gage Grade Crossing Restoration Allow	EA	1	$ 297,000	$ 297,000
Traffic Signals: Florence Grade Crossing Restoration Allow	EA	1	$ 297,000	$ 297,000
50.04 Traction power distribution: catenary and third rail				$ 11,200,000
Catenary OCS Pole	RF	14,408	$ 560	$ 8,068,480
Ductbank Pullboxes	RF	14,408	$ 150	$ 2,161,200
OCS Poles Foundations	RF	14,408	$ 70	$ 1,008,560
50.05 Communications				$ 3,700,000
Communications Equipment Installation	RF	5,458	$ 520	$ 2,838,160
Ductbank & Pullboxes	RF	5,458	$ 150	$ 818,700
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
Construction Subtotal (10 - 50)	RF	5,458	$ 31,880	**$ 178,320,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		5,458		$ 58,846,000
80.01 Preliminary Engineering	7,132,800	4% 10-50		$ 7,132,800
80.02 Final Design	16,048,800	9% 10-50		$ 16,048,800
80.03 Project Management for Design and Construction	17,832,000	10% 10-50		$ 17,832,000
80.04 Construction Administration & Management	8,916,000	5% 10-50		$ 8,916,000
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	1,783,200	1% 10-50		$ 1,783,200
80.07 Surveys, Testing, Investigation, Inspection	3,566,400	2% 10-50		$ 3,566,400
80.08 Start up	3,566,400	2% 10-50		$ 3,566,400
				$ 237,166,000

***** **All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #2 - Single Track West

Gage Ave / Florence Ave Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**1.03**	94,900	22,255	**117,155**	**52%**	**36%**
10.01 Guideway: At-grade exclusive right-of-way		10,200	2,550	12,750		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		900	225	1,125		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.48	46,900	11,725	58,625		
10.05 Guideway: Built-up fill	0.55	22,200	5,550	27,750		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		2,300	345	2,645		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		7,900	1,185	9,085		
10.12 Track: Special (switches, turnouts)		4,500	675	5,175		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**10%**	**7%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	1.03	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	1.03	42,220	12,666	**54,886**	**24%**	**17%**
40.01 Demolition, Clearing, Earthwork		3,400	1,020	4,420		
40.02 Site Utilities, Utility Relocation		6,500	1,950	8,450		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		0	0	0		
40.06 Pedestrian / bike access and accommodation, landscaping		2,600	780	3,380		
40.07 Automobile, bus, van accessways including roads, parking lots		0	0	0		
40.08 Temporary Facilities and other indirect costs during construction		29,720	8,916	38,636		
50 SYSTEMS	1.03	22,900	6,870	**29,770**	**13%**	**9%**
50.01 Train control and signals		5,400	1,620	7,020		
50.02 Traffic signals and crossing protection		600	180	780		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		11,200	3,360	14,560		
50.05 Communications		3,700	1,110	4,810		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	1.03	178,320	46,366	**224,686**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	1.03	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail	0	0	0	0		
70.02 Heavy Rail	0	0	0	0		
70.03 Commuter Rail	0	0	0	0		
70.04 Bus	0	0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	1.03	58,846	11,769	**70,615**	**31%**	**22%**
80.01 Project Development		7,133	1,427	8,559		
80.02 Engineering		16,049	3,210	19,259		
80.03 Project Management for Design and Construction		17,832	3,566	21,398		
80.04 Construction Administration & Management		8,916	1,783	10,699		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		1,783	357	2,140		
80.07 Surveys, Testing, Investigation, Inspection		3,566	713	4,280		
80.08 Start up		3,566	713	4,280		
Subtotal (10 - 80)	1.03	237,166	58,135	**295,301**		**91%**
90 UNALLOCATED CONTINGENCY				**29,530**		**9%**
Subtotal (10 - 90)	1.03			**324,831**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	1.03			**324,831**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				24.51%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.45%		
Total Contingency as % of Base Yr Dollars w/o Contingency				36.96%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Nadeau Street Grade Separation
Alternate #1 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**2,239**	**0.42**	**$ 33,800,000**
10.01 Guideway: At-grade exclusive right-of-way		10,345		$ 5,600,000
Install & Remove Temp Shoofly at grade separation between Station 227+35 to 262+65 - Allow	RF	3,830	$ 700	$ 2,681,000
Realign Temp West Freight Track at grade separation between Station 230+00 to 262+50 - Allow	TF	3,265	$ 200	$ 653,000
Install East Freight Tracks at grade separation between Station 230+00 to 262+50 - Allow	RF	3,250	$ 700	$ 2,275,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		270		$ 400,000
Shoofly At Nadeau grade crossing	RF	90	$ 1,520	$ 136,800
Temporary West Freight Track At grade crossings	RF	90	$ 1,520	$ 136,800
Restore East & West Freight Track At grade crossings	RF	90	$ 1,520	$ 136,800
10.04 Guideway: Aerial structure		119		$ 2,200,000
Aerial Guideway Structure, Station from 245+61 to 246+80	RF	119	$ 18,432	$ 2,193,408
10.05 Guideway: Built-up fill		2,120		$ 16,100,000
MSE Buit-up Fill, Station 235+26 to 245+61	RF	1,035	$ 7,600	$ 7,866,000
MSE Buit-up Fill, Station 246+80 to 257+65	RF	1,085	$ 7,600	$ 8,246,000
10.09 Track: Direct fixation		119		$ 100,000
Aerial Guideway Structure, Station from 245+61 to 246+80	RF	119	$ 900	$ 107,100
10.11 Track: Ballasted		15,730		$ 4,900,000
Ballasted Track at MSE Buit-up Fill, Station 235+26 to 245+61	RF	1,035	$ 670	$ 693,450
Ballasted Track at MSE Buit-up Fill, Station 246+80 to 257+65	RF	1,085	$ 670	$ 726,950
Temporary Shoofly (Single Track)	TF	3830	$ 335	$ 1,283,050
Temporary Shift Ballasted West Freight Track at grade separation between Station 230+00 to 262+50 - Allow	TF	3,265	$ 175	$ 571,375
Restore, Shifted Ballasted West Freight Track , Station 230+00 to 262+50 - Allowance	TF	3,265	$ 175	$ 571,375
Restore Ballasted East Freight Track, Station 230+00 to 262+50 - Allowance	TF	3,250	$ 335	$ 1,088,750
10.12 Track: Special (switches, turnouts)				$ 4,500,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
No. 14 Turnout - Allow For Temporary Freight Track	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Temporary Freight Track	EA	2.00	$ 28,720	$ 57,440
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	2,239		**$ 16,300,000**
40.01 Demolition, Clearing, Earthwork				$ 2,100,000
Exisitng Trackwork Allowance	RF	2,239	$ 300	$ 671,700
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
Freight Trackwork Allowance	RF	3,250	$ 300	$ 975,000
40.02 Site Utilities, Utility Relocation		9,319		$ 3,300,000
Utilities Relocation Allow	RF	9,319	$ 350	$ 3,261,650
40.06 Pedestrian / bike access and accommodation, landscaping				$ 1,100,000
Landscaping, Street Scape, Urban Design Features	RF	2,239	$ 480	$ 1,074,720
40.08 Temporary Facilities and other indirect costs during construction				$ 9,800,000
General Conditions - Allow		20%	$ 49,000,000	$ 9,800,000
50 SYSTEMS	RF	6,069		**$ 8,700,000**
50.01 Train control and signals				$ 2,200,000
New Alignment	RF	2,239	$ 540	$ 1,209,060
Shoofly Temporary Train Control	RF	3,830	$ 270	$ 1,034,100
50.02 Traffic signals and crossing protection				$ 300,000
Traffic Signals: Nadeau Grade Crossing Restoration Allow	EA	1	$ 297,000	$ 297,000
50.04 Traction power distribution: catenary and third rail				$ 4,700,000
Catenary OCS Pole	RF	6,069	$ 560	$ 3,398,640
Ductbank Pullboxes	RF	6,069	$ 150	$ 910,350
OCS Poles Foundations	RF	6,069	$ 70	$ 424,830

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Nadeau Street Grade Separation
Alternate #1 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
50.05 Communications				$ 1,500,000
Communications Equipment Installation	RF	2,239	$ 520	$ 1,164,280
Ductbank & Pullboxes	RF	2,239	$ 150	$ 335,850
Construction Subtotal (10 - 50)	RF	2,239	$ 25,190	**$ 58,800,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		2,239		$ 19,404,000
80.01 Preliminary Engineering	2,352,000	4% 10-50		$ 2,352,000
80.02 Final Design	5,292,000	9% 10-50		$ 5,292,000
80.03 Project Management for Design and Construction	5,880,000	10% 10-50		$ 5,880,000
80.04 Construction Administration & Management	2,940,000	5% 10-50		$ 2,940,000
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	588,000	1% 10-50		$ 588,000
80.07 Surveys, Testing, Investigation, Inspection	1,176,000	2% 10-50		$ 1,176,000
80.08 Start up	1,176,000	2% 10-50		$ 1,176,000
				$ 78,204,000

***** **All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #1 - Single Track West

Nadeau Street Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.42**	33,800	7,500	**41,300**	**56%**	**39%**
10.01 Guideway: At-grade exclusive right-of-way		5,600	1,400	7,000		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		400	100	500		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.02	2,200	550	2,750		
10.05 Guideway: Built-up fill	0.40	16,100	4,025	20,125		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		100	15	115		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		4,900	735	5,635		
10.12 Track: Special (switches, turnouts)		4,500	675	5,175		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**0**	0	0	**0**	**0%**	**0%**
20.01 At-grade station, stop, shelter, mall, terminal, platform		0	0	0		
20.02 Aerial station, stop, shelter, mall, terminal, platform		0	0	0		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		0	0	0		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.42	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.42	16,300	4,890	**21,190**	**29%**	**20%**
40.01 Demolition, Clearing, Earthwork		2,100	630	2,730		
40.02 Site Utilities, Utility Relocation		3,300	990	4,290		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		0	0	0		
40.06 Pedestrian / bike access and accommodation, landscaping		1,100	330	1,430		
40.07 Automobile, bus, van accessways including roads, parking lots		0	0	0		
40.08 Temporary Facilities and other indirect costs during construction		9,800	2,940	12,740		
50 SYSTEMS	0.42	8,700	2,610	**11,310**	**15%**	**11%**
50.01 Train control and signals		2,200	660	2,860		
50.02 Traffic signals and crossing protection		300	90	390		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		4,700	1,410	6,110		
50.05 Communications		1,500	450	1,950		
50.06 Fare collection system and equipment		0	0	0		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.42	58,800	15,000	**73,800**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.42	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail		0	0	0		
70.02 Heavy Rail		0	0	0		
70.03 Commuter Rail		0	0	0		
70.04 Bus		0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.42	19,404	3,881	**23,285**	**32%**	**22%**
80.01 Project Development		2,352	470	2,822		
80.02 Engineering		5,292	1,058	6,350		
80.03 Project Management for Design and Construction		5,880	1,176	7,056		
80.04 Construction Administration & Management		2,940	588	3,528		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		588	118	706		
80.07 Surveys, Testing, Investigation, Inspection		1,176	235	1,411		
80.08 Start up		1,176	235	1,411		
Subtotal (10 - 80)	0.42	78,204	18,881	**97,085**		**91%**
90 UNALLOCATED CONTINGENCY				**9,708**		**9%**
Subtotal (10 - 90)	0.42			**106,793**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.42			**106,793**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				24.14%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.41%		
Total Contingency as % of Base Yr Dollars w/o Contingency				36.56%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Stockwell St. Grade Separation
Alternate #1 - Single Track East

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**2,712**	**0.51**	$ 46,100,000
10.01 Guideway: At-grade exclusive right-of-way		2,705		$ 1,900,000
Install & Remove Temp Shoofly at grade separation between Station 440+65 to 467+70 - Allow	RF	2,705	$ 700	$ 1,893,500
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		190		$ 300,000
Shoofly At grade crossing At 130th St.	RF	90	$ 1,520	$ 136,800
Shoofly At grade crossing At Stockwell St.	RF	100	$ 1,520	$ 152,000
10.04 Guideway: Aerial structure		1,738		$ 32,000,000
Aerial Guideway Structure, Station from 460+54 to 461+50	RF	96	$ 18,432	$ 1,769,472
Aerial Guideway Structure, Station from 464+18 to 480+60	RF	1,642	$ 18,432	$ 30,265,344
10.05 Guideway: Built-up fill		974		$ 7,400,000
MSE Buit-up Fill, Station 453+48 to 460+54	RF	706	$ 7,600	$ 5,365,600
MSE Buit-up Fill, Station 461+50 to 464+18	RF	268	$ 7,600	$ 2,036,800
10.09 Track: Direct fixation		974		$ 900,000
Aerial Guideway Structure, Station from 460+54 to 461+50	RF	706	$ 900	$ 635,400
Aerial Guideway Structure, Station from 464+18 to 480+60	RF	268	$ 900	$ 241,200
10.11 Track: Ballasted		3,679		$ 1,600,000
Ballasted Track at MSE Buit-up Fill, Station 453+48 to 460+54	RF	706	$ 670	$ 473,020
Ballasted Track at MSE Buit-up Fill, Station 461+50 to 464+18	RF	268	$ 670	$ 179,560
Temporary Shoofly (Single Track)	TF	2705	$ 335	$ 906,175
10.12 Track: Special (switches, turnouts)				$ 2,000,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 476,000	$ 1,904,000
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**0**		**$ -**
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	2,712		**$ 14,160,000**
40.01 Demolition, Clearing, Earthwork				$ 800,000
Exisitng Trackwork Allowance	RF	2,712	$ 300	$ 813,600
40.02 Site Utilities, Utility Relocation		5,417		$ 1,900,000
Utilities Relocation Allow	RF	5,417	$ 350	$ 1,895,950
40.08 Temporary Facilities and other indirect costs during construction				$ 11,460,000
General Conditions - Allow		20%	$ 57,300,000	$ 11,460,000
50 SYSTEMS	RF	5,417		**$ 8,500,000**
50.01 Train control and signals				$ 2,200,000
New Alignment	RF	2,712	$ 540	$ 1,464,480
Shoofly Temporary Train Control	RF	2,705	$ 270	$ 730,350
50.02 Traffic signals and crossing protection				$ 300,000
Traffic Signals: Grade Crossings Restoration Allow (Wardlow)	EA	1	$ 297,000	$ 297,000
50.03 Traction power supply: substations				$ -
New TPSS to Replace Exisitng	EA		$ 7,109,000	$ -
(Grading, Concrete, Drainage, Grounding, Equipment and All Feeders)				$ -
50.04 Traction power distribution: catenary and third rail				$ 4,200,000
Catenary OCS Pole	RF	5,417	$ 560	$ 3,033,520
Ductbank Pullboxes	RF	5,417	$ 150	$ 812,550
OCS Poles Foundations	RF	5,417	$ 70	$ 379,190
50.05 Communications				$ 1,800,000
Communications Equipment Installation	RF	2,712	$ 520	$ 1,410,240
Ductbank & Pullboxes	RF	2,712	$ 150	$ 406,800
Construction Subtotal (10 - 50)	RF	2,712	$ 24,912	**$ 68,760,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		2,712		$ 22,691,000
80.01 Preliminary Engineering	2,750,400	4% 10-50		$ 2,750,400
80.02 Final Design	6,188,400	9% 10-50		$ 6,188,400
80.03 Project Management for Design and Construction	6,876,000	10% 10-50		$ 6,876,000
80.04 Construction Administration & Management	3,438,000	5% 10-50		$ 3,438,000
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	687,600	1% 10-50		$ 687,600
80.07 Surveys, Testing, Investigation, Inspection	1,375,200	2% 10-50		$ 1,375,200
80.08 Start up	1,375,200	2% 10-50		$ 1,375,200
				$ 91,451,000

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS — Today's Date **6/22/18**

Conceptual Study Alternate #1 - Single Track East — Yr of Base Year $ 2018

Stockwell St. Grade Separation — Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.51**	46,100	11,165	**57,265**	**66%**	**46%**
10.01 Guideway: At-grade exclusive right-of-way		1,900	475	2,375		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		300	75	375		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.33	32,000	8,000	40,000		
10.05 Guideway: Built-up fill	0.18	7,400	1,850	9,250		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		900	225	1,125		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		1,600	240	1,840		
10.12 Track: Special (switches, turnouts)		2,000	300	2,300		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**0**	0	0	**0**	**0%**	**0%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	0	0	0	0		
20.02 Aerial station, stop, shelter, mall, terminal, platform	0	0	0	0		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		0	0	0		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.51	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.51	14,160	4,248	**18,408**	**21%**	**15%**
40.01 Demolition, Clearing, Earthwork		800	240	1,040		
40.02 Site Utilities, Utility Relocation		1,900	570	2,470		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		0	0	0		
40.06 Pedestrian / bike access and accommodation, landscaping		0	0	0		
40.07 Automobile, bus, van accessways including roads, parking lots		0	0	0		
40.08 Temporary Facilities and other indirect costs during construction		11,460	3,438	14,898		
50 SYSTEMS	0.51	8,500	2,550	**11,050**	**13%**	**9%**
50.01 Train control and signals		2,200	660	2,860		
50.02 Traffic signals and crossing protection		300	90	390		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		4,200	1,260	5,460		
50.05 Communications		1,800	540	2,340		
50.06 Fare collection system and equipment		0	0	0		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.51	68,760	17,963	**86,723**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.51	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail	0	0	0	0		
70.02 Heavy Rail	0	0	0	0		
70.03 Commuter Rail	0	0	0	0		
70.04 Bus	0	0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.51	22,691	4,538	**27,229**	**31%**	**22%**
80.01 Project Development		2,750	550	3,300		
80.02 Engineering		6,188	1,238	7,426		
80.03 Project Management for Design and Construction		6,876	1,375	8,251		
80.04 Construction Administration & Management		3,438	688	4,126		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		688	138	825		
80.07 Surveys, Testing, Investigation, Inspection		1,375	275	1,650		
80.08 Start up		1,375	275	1,650		
Subtotal (10 - 80)	0.51	91,451	22,501	**113,952**		**91%**
90 UNALLOCATED CONTINGENCY				**11,395**		**9%**
Subtotal (10 - 90)	0.51			**125,347**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.51			**125,347**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				24.60%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.46%		
Total Contingency as % of Base Yr Dollars w/o Contingency				37.07%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Vernon Ave. Grade Separation
Alternate #1 - Single Track East

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**2,559**	**0.48**	**$ 44,964,000**
10.01 Guideway: At-grade exclusive right-of-way		13,910		$ 8,600,000
Install & Remove Temp Shoofly at grade separation between Station 88+30 to 138+40 - Allow	RF	5,010	$ 700	$ 3,507,000
Realign Temp East Freight Track at grade separation between Stations 91+50 to 109+00 and 129+00 to 136+00 - Allow	TF	2,450	$ 200	$ 490,000
Install East Freight Tracks at grade separation between Station 109+00 to 129+00 - Allow	RF	2,000	$ 720	$ 1,440,000
Install West Freight Tracks at grade separation between Station 91+50 to 136+00 - Allow	RF	4,450	$ 720	$ 3,204,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		500		$ 800,000
Shoofly At grade crossings At Vernon Ave.	RF	100	$ 1,520	$ 152,000
Temporary East & West Freight Track At grade crossings	RF	200	$ 1,520	$ 304,000
Restore East & West Freight Track At grade crossings	RF	200	$ 1,520	$ 304,000
10.04 Guideway: Aerial structure		474		$ 8,737,000
Aerial Guideway Structure, Station 'from 115+12 to 110+38	RF	474	$ 18,432	$ 8,736,768
10.05 Guideway: Built-up fill		2,085		$ 15,800,000
MSE Buit-up Fill, Station 100+04 to 110+38	RF	981	$ 7,600	$ 7,455,600
MSE Buit-up Fill, Station 115+12 to 126+16	RF	1,104	$ 7,600	$ 8,390,400
10.09 Track: Direct fixation		474		$ 427,000
Aerial Guideway Structure, Station 'from 115+12 to 110+38	RF	474	$ 900	$ 426,600
10.11 Track: Ballasted		18,445		$ 6,100,000
Ballasted Track at MSE Buit-up Fill, Station 100+04 to 110+38	RF	981	$ 670	$ 657,270
Ballasted Track at MSE Buit-up Fill, Station 115+12 to 126+16	RF	1,104	$ 670	$ 739,680
Temporary Shoofly (Single Track)	TF	5,010	$ 335	$ 1,678,350
Temporary Shift 2.5ft Ballasted East Freight Track , Station 91+50 to 109+00 and 129+00 to 136+00 - Allowance	TF	2,450	$ 175	$ 428,750
Restore Shifted 2.5ft Ballasted East Freight Track , Station 91+50 to 109+00 and 129+00 to 136+00 - Allowance	TF	2,450	$ 175	$ 428,750
Restore, Ballasted East & West Freight Track, Station 109+00 to 129+00 and 91+50 to 136+00 - Allowance	TF	6,450	$ 335	$ 2,160,750
10.12 Track: Special (switches, turnouts)				$ 4,500,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
No. 14 Turnout - Allow For Temporary UPRR Track relocation	EA	4.00	$ 547,400	$ 2,189,600
Switch Assembly - Allow For Temporary UPRR Track relocation	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - Vernon Ave.	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	2,559		**$ 26,333,000**
40.01 Demolition, Clearing, Earthwork				$ 2,200,000
Exisitng Trackwork Allowance	RF	2,559	$ 300	$ 767,700
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
Demo Existing UPRR Tracks Allowance	TF	6,450	$ 150	$ 967,500
40.02 Site Utilities, Utility Relocation		14,019		$ 4,900,000
Utilities Relocation Allow	RF	14,019	$ 350	$ 4,906,650
40.06 Pedestrian / bike access and accommodation, landscaping				$ 2,200,000
Landscaping, Street Scape, Urban Design Features	RF	2,559	$ 480	$ 1,228,320
Restore Street After Shoofly Demolition	RF	2,000	$ 480	$ 960,000
40.08 Temporary Facilities and other indirect costs during construction				$ 17,033,000
General Conditions - Allow		20%	$ 85,164,000	$ 17,032,800

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Vernon Ave. Grade Separation
Alternate #1 - Single Track East

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
50 SYSTEMS	RF	7,569		**$ 12,600,000**
50.01 Train control and signals				$ 2,700,000
New Alignment	RF	2,559	$ 540	$ 1,381,860
Shoofly Temporary Train Control	RF	5,010	$ 270	$ 1,352,700
50.02 Traffic signals and crossing protection				$ 300,000
Traffic Signals: Grade Crossings Restoration Allow (Vernon)	EA	1	$ 297,000	$ 297,000
50.04 Traction power distribution: catenary and third rail				$ 5,900,000
Catenary OCS Pole	RF	7,569	$ 560	$ 4,238,640
Ductbank Pullboxes	RF	7,569	$ 150	$ 1,135,350
OCS Poles Foundations	RF	7,569	$ 70	$ 529,830
50.05 Communications				$ 1,700,000
Communications Equipment Installation	RF	2,559	$ 520	$ 1,330,680
Ductbank & Pullboxes	RF	2,559	$ 150	$ 383,850
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
Construction Subtotal (10 - 50)	RF	2,559	$ 35,933	**$ 102,197,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		2,559		$ 33,725,000
80.01 Preliminary Engineering	4,087,880	4% 10-50		$ 4,087,880
80.02 Final Design	9,197,730	9% 10-50		$ 9,197,730
80.03 Project Management for Design and Construction	10,219,700	10% 10-50		$ 10,219,700
80.04 Construction Administration & Management	5,109,850	5% 10-50		$ 5,109,850
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	1,021,970	1% 10-50		$ 1,021,970
80.07 Surveys, Testing, Investigation, Inspection	2,043,940	2% 10-50		$ 2,043,940
80.08 Start up	2,043,940	2% 10-50		$ 2,043,940
				$ 135,922,000

*** All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #1 - Single Track East

Vernon Ave. Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.48**	44,964	10,138	**55,102**	**43%**	**30%**
10.01 Guideway: At-grade exclusive right-of-way		8,600	2,150	10,750		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		800	200	1,000		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.09	8,737	2,184	10,921		
10.05 Guideway: Built-up fill	0.39	15,800	3,950	19,750		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		427	64	491		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		6,100	915	7,015		
10.12 Track: Special (switches, turnouts)		4,500	675	5,175		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**18%**	**12%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.48	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.48	26,333	7,900	**34,233**	**27%**	**18%**
40.01 Demolition, Clearing, Earthwork		2,200	660	2,860		
40.02 Site Utilities, Utility Relocation		4,900	1,470	6,370		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		0	0	0		
40.06 Pedestrian / bike access and accommodation, landscaping		2,200	660	2,860		
40.07 Automobile, bus, van accessways including roads, parking lots		0	0	0		
40.08 Temporary Facilities and other indirect costs during construction		17,033	5,110	22,143		
50 SYSTEMS	0.48	12,600	3,780	**16,380**	**13%**	**9%**
50.01 Train control and signals		2,700	810	3,510		
50.02 Traffic signals and crossing protection		300	90	390		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		5,900	1,770	7,670		
50.05 Communications		1,700	510	2,210		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.48	102,197	26,393	**128,590**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.48	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail		0	0	0		
70.02 Heavy Rail		0	0	0		
70.03 Commuter Rail		0	0	0		
70.04 Bus		0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.48	33,725	6,745	**40,470**	**31%**	**22%**
80.01 Project Development		4,088	818	4,905		
80.02 Engineering		9,198	1,840	11,037		
80.03 Project Management for Design and Construction		10,220	2,044	12,264		
80.04 Construction Administration & Management		5,110	1,022	6,132		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		1,022	204	1,226		
80.07 Surveys, Testing, Investigation, Inspection		2,044	409	2,453		
80.08 Start up		2,044	409	2,453		
Subtotal (10 - 80)	0.48	135,922	33,138	**169,060**		**91%**
90 UNALLOCATED CONTINGENCY				**16,906**		**9%**
Subtotal (10 - 90)	0.48			**185,966**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.48			**185,966**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				24.38%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.44%		
Total Contingency as % of Base Yr Dollars w/o Contingency				36.82%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Wardlow Road Grade Separation
Alternate #1 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**2,485**	**0.47**	**$ 31,800,000**
10.01 Guideway: At-grade exclusive right-of-way		4,250		$ 3,000,000
Install & Remove Temp Shoofly at grade separation between Station 822+90 to 925+40 - Allow	RF	4,250	$ 700	$ 2,975,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		140		$ 200,000
Shoofly At grade crossing At Wordlow Rd.	RF	140	$ 1,520	$ 212,800
10.04 Guideway: Aerial structure		418		$ 7,700,000
Aerial Guideway Structure, Station from 899+67 to 903+85	RF	418	$ 18,432	$ 7,704,576
10.05 Guideway: Built-up fill		2,067		$ 15,700,000
MSE Buit-up Fill, Station 890+50 to 899+67	RF	917	$ 7,600	$ 6,969,200
MSE Buit-up Fill, Station 903+85 to 915+35	RF	1,150	$ 7,600	$ 8,740,000
10.09 Track: Direct fixation		418		$ 400,000
Aerial Guideway Structure, Station from 899+67 to 903+85	RF	418	$ 900	$ 376,200
10.11 Track: Ballasted		6,317		$ 2,800,000
Ballasted Track at MSE Buit-up Fill, Station 890+50 to 899+67	RF	917	$ 670	$ 614,390
Ballasted Track at MSE Buit-up Fill, Station 903+85 to 915+35	RF	1,150	$ 670	$ 770,500
Temporary Shoofly (Single Track)	TF	4,250	$ 335	$ 1,423,750
10.12 Track: Special (switches, turnouts)				$ 2,000,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 476,000	$ 1,904,000
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - 103rd Street	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	2,485		**$ 20,040,000**
40.01 Demolition, Clearing, Earthwork				$ 1,300,000
Exisitng Trackwork Allowance	RF	2,485	$ 300	$ 745,500
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
Demo Exisitng TPSS, Recycle Equipment For Spare Parts	EA	1	$ 44,000	$ 44,000
40.02 Site Utilities, Utility Relocation		6,735		$ 2,400,000
Utilities Relocation Allow	RF	6,735	$ 350	$ 2,357,250
40.07 Automobile, bus, van accessways including roads, parking lots				$ 1,500,000
Restore Parking and Amenities After Shoofly Demolition	SF	37,250	$ 40	$ 1,490,000
40.08 Temporary Facilities and other indirect costs during construction				$ 14,840,000
General Conditions - Allow		20%	$ 74,200,000	$ 14,840,000
50 SYSTEMS	RF	6,735		**$ 18,900,000**
50.01 Train control and signals				$ 2,500,000
New Alignment	RF	2,485	$ 540	$ 1,341,900
Shoofly Temporary Train Control	RF	4,250	$ 270	$ 1,147,500
50.02 Traffic signals and crossing protection				$ 300,000
Traffic Signals: Grade Crossings Restoration Allow (Wardlow)	EA	1	$ 297,000	$ 297,000
50.03 Traction power supply: substations				$ 7,100,000
New TPSS to Replace Exisitng (Grading, Concrete, Drainage, Grounding, Equipment and All Feeders)	EA	1	$ 7,109,000	$ 7,109,000
50.04 Traction power distribution: catenary and third rail				$ 5,300,000
Catenary OCS Pole	RF	6,735	$ 560	$ 3,771,600
Ductbank Pullboxes	RF	6,735	$ 150	$ 1,010,250
OCS Poles Foundations	RF	6,735	$ 70	$ 471,450

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Wardlow Road Grade Separation
Alternate #1 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
50.05 Communications				$ 1,700,000
Communications Equipment Installation	RF	2,485	$ 520	$ 1,292,200
Ductbank & Pullboxes	RF	2,485	$ 150	$ 372,750
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
				$ -
Construction Subtotal (10 - 50)	RF	2,485	$ 34,720	**$ 89,040,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		2,485		$ 29,383,000
80.01 Preliminary Engineering	3,561,600	4% 10-50		$ 3,561,600
80.02 Final Design	8,013,600	9% 10-50		$ 8,013,600
80.03 Project Management for Design and Construction	8,904,000	10% 10-50		$ 8,904,000
80.04 Construction Administration & Management	4,452,000	5% 10-50		$ 4,452,000
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	890,400	1% 10-50		$ 890,400
80.07 Surveys, Testing, Investigation, Inspection	1,780,800	2% 10-50		$ 1,780,800
80.08 Start up	1,780,800	2% 10-50		$ 1,780,800
				$ 118,423,000

***** **All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS — Today's Date **6/22/18**

Conceptual Study Alternate #1 - Single Track West — Yr of Base Year $ 2018

Wardlow Road Grade Separation — Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.47**	31,800	7,470	**39,270**	**35%**	**24%**
10.01 Guideway: At-grade exclusive right-of-way		3,000	750	3,750		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		200	50	250		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.08	7,700	1,925	9,625		
10.05 Guideway: Built-up fill	0.39	15,700	3,925	19,625		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		400	100	500		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		2,800	420	3,220		
10.12 Track: Special (switches, turnouts)		2,000	300	2,300		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**20%**	**14%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.47	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.47	20,040	6,012	**26,052**	**23%**	**16%**
40.01 Demolition, Clearing, Earthwork		1,300	390	1,690		
40.02 Site Utilities, Utility Relocation		2,400	720	3,120		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		0	0	0		
40.06 Pedestrian / bike access and accommodation, landscaping		0	0	0		
40.07 Automobile, bus, van accessways including roads, parking lots		1,500	450	1,950		
40.08 Temporary Facilities and other indirect costs during construction		14,840	4,452	19,292		
50 SYSTEMS	0.47	18,900	5,670	**24,570**	**22%**	**15%**
50.01 Train control and signals		2,500	750	3,250		
50.02 Traffic signals and crossing protection		300	90	390		
50.03 Traction power supply: substations		7,100	2,130	9,230		
50.04 Traction power distribution: catenary and third rail		5,300	1,590	6,890		
50.05 Communications		1,700	510	2,210		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.47	89,040	23,727	**112,767**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.47	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail	0	0	0	0		
70.02 Heavy Rail	0	0	0	0		
70.03 Commuter Rail	0	0	0	0		
70.04 Bus	0	0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.47	29,383	5,877	**35,260**	**31%**	**22%**
80.01 Project Development		3,562	712	4,274		
80.02 Engineering		8,014	1,603	9,616		
80.03 Project Management for Design and Construction		8,904	1,781	10,685		
80.04 Construction Administration & Management		4,452	890	5,342		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		890	178	1,068		
80.07 Surveys, Testing, Investigation, Inspection		1,781	356	2,137		
80.08 Start up		1,781	356	2,137		
Subtotal (10 - 80)	0.47	118,423	29,604	**148,027**		**91%**
90 UNALLOCATED CONTINGENCY				**14,803**		**9%**
Subtotal (10 - 90)	0.47			**162,830**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.47			**162,830**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				25.00%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.50%		
Total Contingency as % of Base Yr Dollars w/o Contingency				37.50%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Wardlow Road Grade Separation
Alternate #2 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**2,485**	**0.47**	**$ 32,200,000**
10.01 Guideway: At-grade exclusive right-of-way		4,600		$ 3,200,000
Install & Remove Temp Shoofly at grade separation between Station 822+90 to 925+40 - Allow	RF	4,250	$ 700	$ 2,975,000
Realign Existing LRT Tracks at grade separation between Station 887+00 to 890+50 - Allow	RF	350	$ 700	$ 245,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		140		$ 200,000
Shoofly At grade crossing At Wordlow Rd.	RF	140	$ 1,520	$ 212,800
10.04 Guideway: Aerial structure		418		$ 7,700,000
Aerial Guideway Structure, Station from 899+67 to 903+85	RF	418	$ 18,432	$ 7,704,576
10.05 Guideway: Built-up fill		2,067		$ 15,700,000
MSE Buit-up Fill, Station 890+50 to 899+67	RF	917	$ 7,600	$ 6,969,200
MSE Buit-up Fill, Station 903+85 to 915+35	RF	1,150	$ 7,600	$ 8,740,000
10.09 Track: Direct fixation		418		$ 400,000
Aerial Guideway Structure, Station from 899+67 to 903+85	RF	418	$ 900	$ 376,200
10.11 Track: Ballasted		6,667		$ 3,000,000
Ballasted Track at MSE Buit-up Fill, Station 890+50 to 899+67	RF	917	$ 670	$ 614,390
Ballasted Track at MSE Buit-up Fill, Station 903+85 to 915+35	RF	1,150	$ 670	$ 770,500
Temporary Shoofly (Single Track)	TF	4,250	$ 335	$ 1,423,750
Realign Existing LRT Tracks at grade separation between Station 887+00 to 890+50 - Allow	RF	350	$ 670	$ 234,500
10.12 Track: Special (switches, turnouts)				$ 2,000,000
No. 14 Turnout - Allow For Shoofly	EA	4.00	$ 476,000	$ 1,904,000
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**2**		**$ 18,300,000**
20.01 At-grade station, stop, shelter, mall, terminal, platform		1		$ 2,000,000
Temporary at Grade Station	EA	1	$ 2,000,000	$ 2,000,000
20.02 Aerial station, stop, shelter, mall, terminal, platform		1		$ 13,900,000
AERIAL STATION - 103rd Street	EA	1	$ 13,917,500	$ 13,917,500
20.07 Elevators, escalators		3		$ 2,400,000
Assume 2 Elevator & 1 Escalators Per Aerial Station	EA	3	$ 793,000	$ 2,379,000
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	2,485		**$ 17,620,000**
40.01 Demolition, Clearing, Earthwork				$ 1,200,000
Exisitng Trackwork Allowance	RF	2,485	$ 300	$ 745,500
Demo Existing Station Allowance	EA	1	$ 500,000	$ 500,000
				$ -
40.02 Site Utilities, Utility Relocation		6,735		$ 2,400,000
Utilities Relocation Allow	RF	6,735	$ 350	$ 2,357,250
40.07 Automobile, bus, van accessways including roads, parking lots				$ 700,000
Restore Parking After Shoofly Demolition	SF	37,250	$ 20	$ 745,000
40.08 Temporary Facilities and other indirect costs during construction				$ 13,320,000
General Conditions - Allow		20%	$ 66,600,000	$ 13,320,000
50 SYSTEMS	RF	6,735		**$ 11,800,000**
50.01 Train control and signals				$ 2,500,000
New Alignment	RF	2,485	$ 540	$ 1,341,900
Shoofly Temporary Train Control	RF	4,250	$ 270	$ 1,147,500
50.02 Traffic signals and crossing protection				$ 300,000
Traffic Signals: Grade Crossings Restoration Allow (Wardlow)	EA	1	$ 297,000	$ 297,000
50.04 Traction power distribution: catenary and third rail				$ 5,300,000
Catenary OCS Pole	RF	6,735	$ 560	$ 3,771,600
Ductbank Pullboxes	RF	6,735	$ 150	$ 1,010,250
OCS Poles Foundations	RF	6,735	$ 70	$ 471,450

AECOM/Lenax

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Wardlow Road Grade Separation
Alternate #2 - Single Track West

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
50.05 Communications				$ 1,700,000
Communications Equipment Installation	RF	2,485	$ 520	$ 1,292,200
Ductbank & Pullboxes	RF	2,485	$ 150	$ 372,750
50.06 Fare collection system and equipment				$ 2,000,000
Ticket Vending Machines, per Station	EA	2	$ 1,023,000	$ 2,046,000
Construction Subtotal (10 - 50)	RF	2,485	$ 31,388	**$ 79,920,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		2,485		$ 26,374,000
80.01 Preliminary Engineering	3,196,800	4% 10-50		$ 3,196,800
80.02 Final Design	7,192,800	9% 10-50		$ 7,192,800
80.03 Project Management for Design and Construction	7,992,000	10% 10-50		$ 7,992,000
80.04 Construction Administration & Management	3,996,000	5% 10-50		$ 3,996,000
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	799,200	1% 10-50		$ 799,200
80.07 Surveys, Testing, Investigation, Inspection	1,598,400	2% 10-50		$ 1,598,400
80.08 Start up	1,598,400	2% 10-50		$ 1,598,400
				$ 106,294,000

***** **All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS — Today's Date **6/22/18**

Conceptual Study Alternate #2 - Single Track West — Yr of Base Year $ 2018

Alternate #2 - Single Track West — Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.47**	32,200	7,550	**39,750**	**39%**	**27%**
10.01 Guideway: At-grade exclusive right-of-way		3,200	800	4,000		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		200	50	250		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.08	7,700	1,925	9,625		
10.05 Guideway: Built-up fill	0.39	15,700	3,925	19,625		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		400	100	500		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		3,000	450	3,450		
10.12 Track: Special (switches, turnouts)		2,000	300	2,300		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**2**	18,300	4,575	**22,875**	**23%**	**16%**
20.01 At-grade station, stop, shelter, mall, terminal, platform	1	2,000	500	2,500		
20.02 Aerial station, stop, shelter, mall, terminal, platform	1	13,900	3,475	17,375		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		2,400	600	3,000		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.47	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.47	17,620	5,286	**22,906**	**23%**	**16%**
40.01 Demolition, Clearing, Earthwork		1,200	360	1,560		
40.02 Site Utilities, Utility Relocation		2,400	720	3,120		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		0	0	0		
40.06 Pedestrian / bike access and accommodation, landscaping		0	0	0		
40.07 Automobile, bus, van accessways including roads, parking lots		700	210	910		
40.08 Temporary Facilities and other indirect costs during construction		13,320	3,996	17,316		
50 SYSTEMS	0.47	11,800	3,540	**15,340**	**15%**	**11%**
50.01 Train control and signals		2,500	750	3,250		
50.02 Traffic signals and crossing protection		300	90	390		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		5,300	1,590	6,890		
50.05 Communications		1,700	510	2,210		
50.06 Fare collection system and equipment		2,000	600	2,600		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.47	79,920	20,951	**100,871**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.47	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail		0	0	0		
70.02 Heavy Rail		0	0	0		
70.03 Commuter Rail		0	0	0		
70.04 Bus		0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.47	26,374	5,275	**31,648**	**31%**	**22%**
80.01 Project Development		3,197	639	3,836		
80.02 Engineering		7,193	1,439	8,631		
80.03 Project Management for Design and Construction		7,992	1,598	9,590		
80.04 Construction Administration & Management		3,996	799	4,795		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		799	160	959		
80.07 Surveys, Testing, Investigation, Inspection		1,598	320	1,918		
80.08 Start up		1,598	320	1,918		
Subtotal (10 - 80)	0.47	106,294	26,226	**132,519**		**91%**
90 UNALLOCATED CONTINGENCY				**13,252**		**9%**
Subtotal (10 - 90)	0.47			**145,771**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.47			**145,771**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				24.67%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.47%		
Total Contingency as % of Base Yr Dollars w/o Contingency				37.14%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Willmington Ave. Grade Separation
Alternate #1 - Single Track East (45mph)

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**1,780**	**0.34**	**$ 27,846,000**
10.01 Guideway: At-grade exclusive right-of-way		6,550		$ 3,400,000
				$ -
Install & Remove Temp Shoofly at grade separation between Station 363+50.00 to 405+00.00 - Allow	RF	4,150	$ 700	$ 2,905,000
Realign Single Freight Track at grade separation between Station 369+00 to 393+00 - Allow	TF	2,400	$ 200	$ 480,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		780		$ 1,200,000
Shoofly At Wilmington grade crossings	RF	260	$ 1,520	$ 395,200
Temporary Freight Track At Wilmington grade crossings	RF	260	$ 1,520	$ 395,200
Restore Freight Track At Wilmington grade crossings	RF	260	$ 1,520	$ 395,200
				$ -
10.04 Guideway: Aerial structure		274		$ 5,100,000
Aerial Guideway Structure, Station 'from 380+38.00 to 383+12.00	RF	274	$ 18,432	$ 5,050,368
10.05 Guideway: Built-up fill		1,506		$ 11,445,600
MSE Buit-up Fill, Station 372+25.00 to 380+38.00	RF	813	$ 7,600	$ 6,178,800
MSE Buit-up Fill, Station 383+12.00 to 390+05.00	RF	693	$ 7,600	$ 5,266,800
10.09 Track: Direct fixation		274		$ 200,000
Aerial Guideway Structure, Station 'from 380+38.00 to 383+12.00	RF	274	$ 900	$ 246,600
10.11 Track: Ballasted		10,456		$ 3,200,000
Ballasted Track at MSE Buit-up Fill, Station 372+25.00 to 380+38.00	RF	813	$ 670	$ 544,710
Ballasted Track at MSE Buit-up Fill, Station 383+12.00 to 390+05.00	RF	693	$ 670	$ 464,310
Temporary Shoofly (Single Track)	TF	4150	$ 335	$ 1,390,250
Temporary Shift 1.5ft Ballasted Freight Track , Station 369+00 to 393+00 - Allowance	TF	2,400	$ 175	$ 420,000
Restore, Shift 1.5ft back Ballasted East Freight Track, Station 369+00 to 393+00 - Allowance	TF	2,400	$ 175	$ 420,000
10.12 Track: Special (switches, turnouts)				$ 3,300,000
No. 14 Turnout - Allow For Shoofly	EA	6.00	$ 547,400	$ 3,284,400
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**0**		**$ -**
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	1,780		**$ 10,848,000**
40.01 Demolition, Clearing, Earthwork				$ 534,000
Trackwork Allowance	RF	1,780	$ 300	$ 534,000
40.02 Site Utilities, Utility Relocation		5,930		$ 1,038,000
Utilities Relocation Allow 50%	RF	5,930	$ 175	$ 1,037,750
40.06 Pedestrian / bike access and accommodation, landscaping				$ 1,210,000
Landscaping, Street Scape, Urban Design Features	RF	1,780	$ 480	$ 854,400
Restore Street After Shoofly Demolition	RF	740	$ 480	$ 355,200
40.07 Automobile, bus, van accessways including roads, parking lots				$ 450,000
Restore Parking After Shoofly Demolition	SF	18,000	$ 25	$ 450,000
40.08 Temporary Facilities and other indirect costs during construction				$ 7,616,000
General Condition/Contingency - Allow		20%	$ 38,078,000	$ 7,616,000
50 SYSTEMS	RF	5,930		**$ 8,200,000**
50.01 Train control and signals				$ 2,100,000
New Alignment	RF	1,780	$ 540	$ 961,200
Shoofly Temporary Train Control	RF	4,150	$ 270	$ 1,120,500
50.02 Traffic signals and crossing protection				$ 300,000
Traffic Signals: Grade Crossings Existing Allow	EA	1	$ 297,000	$ 297,000
50.04 Traction power distribution: catenary and third rail				$ 4,600,000
Catenary OCS Pole	RF	5,930	$ 560	$ 3,320,800
Ductbank Pullboxes	RF	5,930	$ 150	$ 889,500
OCS Poles Foundations	RF	5,930	$ 70	$ 415,100

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Willmington Ave. Grade Separation
Alternate #1 - Single Track East (45mph)

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
50.05 Communications				$ 1,200,000
Communications Equipment Installation	RF	1,780	$ 520	$ 925,600
Ductbank & Pullboxes	RF	1,780	$ 150	$ 267,000
Construction Subtotal (10 - 50)	RF	1,780	$ 25,183	**$ 46,894,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ -
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		1,780		$ 15,475,000
80.01 Preliminary Engineering	1,875,760	4% 10-50		$ 1,875,760
80.02 Final Design	4,220,460	9% 10-50		$ 4,220,460
80.03 Project Management for Design and Construction	4,689,400	10% 10-50		$ 4,689,400
80.04 Construction Administration & Management	2,344,700	5% 10-50		$ 2,344,700
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	468,940	1% 10-50		$ 468,940
80.07 Surveys, Testing, Investigation, Inspection	937,880	2% 10-50		$ 937,880
80.08 Start up	937,880	2% 10-50		$ 937,880
				$ 62,369,000

***** **All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #1 - Single Track East (45mph)

Willmington Ave. Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.34**	27,846	5,387	**33,233**	**57%**	**39%**
10.01 Guideway: At-grade exclusive right-of-way		3,400	850	4,250		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		1,200	300	1,500		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.05	5,100	1,275	6,375		
10.05 Guideway: Built-up fill	0.29	11,446	2,861	14,307		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		200	3	203		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		3,200	48	3,248		
10.12 Track: Special (switches, turnouts)		3,300	50	3,350		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**0**	0	0	**0**	**0%**	**0%**
20.01 At-grade station, stop, shelter, mall, terminal, platform		0	0	0		
20.02 Aerial station, stop, shelter, mall, terminal, platform		0	0	0		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		0	0	0		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.34	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.34	10,848	3,254	**14,102**	**24%**	**17%**
40.01 Demolition, Clearing, Earthwork		534	160	694		
40.02 Site Utilities, Utility Relocation		1,038	311	1,349		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		0	0	0		
40.06 Pedestrian / bike access and accommodation, landscaping		1,210	363	1,573		
40.07 Automobile, bus, van accessways including roads, parking lots		450	135	585		
40.08 Temporary Facilities and other indirect costs during construction		7,616	2,285	9,901		
50 SYSTEMS	0.34	8,200	2,460	**10,660**	**18%**	**13%**
50.01 Train control and signals		2,100	630	2,730		
50.02 Traffic signals and crossing protection		300	90	390		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		4,600	1,380	5,980		
50.05 Communications		1,200	360	1,560		
50.06 Fare collection system and equipment		0	0	0		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.34	46,894	11,101	**57,995**	**100%**	**69%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.34	0	0	**0**		**0%**
60.01 Purchase or lease of real estate		0	0	0		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail		0	0	0		
70.02 Heavy Rail		0	0	0		
70.03 Commuter Rail		0	0	0		
70.04 Bus		0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.34	15,475	3,095	**18,570**	**32%**	**22%**
80.01 Project Development		1,876	375	2,251		
80.02 Engineering		4,220	844	5,065		
80.03 Project Management for Design and Construction		4,689	938	5,627		
80.04 Construction Administration & Management		2,345	469	2,814		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		469	94	563		
80.07 Surveys, Testing, Investigation, Inspection		938	188	1,125		
80.08 Start up		938	188	1,125		
Subtotal (10 - 80)	0.34	62,369	14,196	**76,565**		**91%**
90 UNALLOCATED CONTINGENCY				**7,656**		**9%**
Subtotal (10 - 90)	0.34			**84,221**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.34			**84,221**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				22.76%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.28%		
Total Contingency as % of Base Yr Dollars w/o Contingency				35.04%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Willmington Ave. Grade Separation
Alternate #2 - Single Track West (45mph)

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)		**1,780**	**0.34**	**$ 30,832,000**
10.01 Guideway: At-grade exclusive right-of-way		7,250		$ 5,100,000
Install & Remove Temp Shoofly at grade separation between Station 363+50.00 to 405+00.00 - Allow	RF	4,150	$ 700	$ 2,905,000
Install & Remove Freight Tracks at grade separation between Station 365+00 to 396+00 - Allow	TF	3,100	$ 720	$ 2,232,000
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		780		$ 1,186,000
Shoofly At Wilmington grade crossings	RF	260	$ 1,520	$ 395,200
Temporary Freight Track At Wilmington grade crossings	RF	260	$ 1,520	$ 395,200
Restore Freight Track At Wilmington grade crossings	RF	260	$ 1,520	$ 395,200
10.04 Guideway: Aerial structure		274		$ 5,100,000
Aerial Guideway Structure, Station 'from 380+38.00 to 383+12.00	RF	274	$ 18,432	$ 5,050,368
				$ -
10.05 Guideway: Built-up fill		1,506		$ 11,446,000
MSE Buit-up Fill, Station 372+25.00 to 380+38.00	RF	813	$ 7,600	$ 6,178,800
MSE Buit-up Fill, Station 383+12.00 to 390+05.00	RF	693	$ 7,600	$ 5,266,800
10.09 Track: Direct fixation		274		$ 200,000
Aerial Guideway Structure, Station 'from 380+38.00 to 383+12.00	RF	274	$ 900	$ 246,600
10.11 Track: Ballasted		11,856		$ 4,500,000
Ballasted Track at MSE Buit-up Fill, Station 372+25.00 to 380+38.00	RF	813	$ 670	$ 544,710
Ballasted Track at MSE Buit-up Fill, Station 383+12.00 to 390+05.00	RF	693	$ 670	$ 464,310
Temporary Shoofly (Single Track)	TF	4150	$ 335	$ 1,390,250
Temporary Shift 18ft Ballasted Freight Track , Station 365+00 to 396+00 - Allowance	TF	3,100	$ 335	$ 1,038,500
Restore, Shifted 18ft Ballasted Freight Track, Station 369+00 to 393+00 - Allowance	TF	3,100	$ 335	$ 1,038,500
10.12 Track: Special (switches, turnouts)				$ 3,300,000
No. 14 Turnout - Allow For Shoofly	EA	6.00	$ 547,400	$ 3,284,400
Switch Assembly - Allow For Shoofly	EA	2.00	$ 28,720	$ 57,440
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)		**0**		**$ -**
20.01 At-grade station, stop, shelter, mall, terminal, platform		0		$ -
Temporary at Grade Station	EA	0	$ 2,000,000	$ -
				$ -
20.02 Aerial station, stop, shelter, mall, terminal, platform		0		$ -
AERIAL STATION	EA	0	$ 13,917,500	$ -
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**
40 SITEWORK & SPECIAL CONDITIONS	RF	1,780		**$ 17,027,000**
40.01 Demolition, Clearing, Earthwork				$ 1,464,000
Trackwork Allowance	RF	1,780	$ 300	$ 534,000
Freight Trackwork Allowance	RF	3,100	$ 300	$ 930,000
40.02 Site Utilities, Utility Relocation		9,030		$ 3,200,000
Utilities Relocation Allow	RF	9,030	$ 350	$ 3,160,500
40.06 Pedestrian / bike access and accommodation, landscaping				$ 2,300,000
Landscaping, Street Scape, Urban Design Features	RF	1,780	$ 480	$ 854,400
Restore Street After Temporary Freight Track Demolition	RF	3,100	$ 480	$ 1,488,000
40.07 Automobile, bus, van accessways including roads, parking lots				$ 720,000
Restore Parking and Amenities After Shoofly Demolition	SF	18,000	$ 40	$ 720,000
40.08 Temporary Facilities and other indirect costs during construction				$ 9,343,000
General Condition/Contingency - Allow		20%	$ 46,716,000	$ 9,343,000
50 SYSTEMS	RF	5,930		**$ 8,200,000**
50.01 Train control and signals				$ 2,100,000
New Alignment	RF	1,780	$ 540	$ 961,200
Shoofly Temporary Train Control	RF	4,150	$ 270	$ 1,120,500
50.02 Traffic signals and crossing protection				$ 300,000
Traffic Signals: Grade Crossings Existing Allow	EA	1	$ 297,000	$ 297,000

Quantity and Cost Calculator

METRO BLUE LINE IMPROVEMENTS
Conceptual Study
Willmington Ave. Grade Separation
Alternate #2 - Single Track West (45mph)

	Unit	Quantity	Unit Cost	Base Year Dollars w/o Contingency (X000)
50.04 Traction power distribution: catenary and third rail				$ 4,600,000
Catenary OCS Pole	RF	5,930	$ 560	$ 3,320,800
Ductbank Pullboxes	RF	5,930	$ 150	$ 889,500
OCS Poles Foundations	RF	5,930	$ 70	$ 415,100
50.05 Communications				$ 1,200,000
Communications Equipment Installation	RF	1,780	$ 520	$ 925,600
Ductbank & Pullboxes	RF	1,780	$ 150	$ 267,000
Construction Subtotal (10 - 50)	RF	1,780	$ 28,824	**$ 56,059,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				$ 12,825,000
60.01 Purchase or lease of real estate				$ 12,825,000
ROW (allow 2.85 acres)	ACRE	3	$ 4,500,000	$ 12,825,000
70 VEHICLES (number)		**0**		$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		1,780		$ 18,499,000
80.01 Preliminary Engineering	2,242,360	4% 10-50		$ 2,242,360
80.02 Final Design	5,045,310	9% 10-50		$ 5,045,310
80.03 Project Management for Design and Construction	5,605,900	10% 10-50		$ 5,605,900
80.04 Construction Administration & Management	2,802,950	5% 10-50		$ 2,802,950
80.05 Professional Liability and other Non-Construction Insurance		0% 10-50		$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	560,590	1% 10-50		$ 560,590
80.07 Surveys, Testing, Investigation, Inspection	1,121,180	2% 10-50		$ 1,121,180
80.08 Start up	1,121,180	2% 10-50		$ 1,121,180
				$ 87,383,000

***** **All Unit Prices Taken From Crenshaw/LAX Bid Result & Expo Phase 2**

MAIN WORKSHEET - BUILD ALTERNATIVE

(Rev.19, June, 2017)

METRO BLUE LINE IMPROVEMENTS

Conceptual Study Alternate #2 - Single Track West (45mph)

Willmington Ave. Grade Separation

Today's Date **6/22/18**

Yr of Base Year $ 2018

Yr of Revenue Ops 2018

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**0.34**	30,832	5,828	**36,660**	**53%**	**31%**
10.01 Guideway: At-grade exclusive right-of-way		5,100	1,275	6,375		
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)		1,186	297	1,483		
10.03 Guideway: At-grade in mixed traffic		0	0	0		
10.04 Guideway: Aerial structure	0.05	5,100	1,275	6,375		
10.05 Guideway: Built-up fill	0.29	11,446	2,862	14,308		
10.06 Guideway: Underground cut & cover		0	0	0		
10.07 Guideway: Underground tunnel		0	0	0		
10.08 Guideway: Retained cut or fill		0	0	0		
10.09 Track: Direct fixation		200	3	203		
10.10 Track: Embedded		0	0	0		
10.11 Track: Ballasted		4,500	68	4,568		
10.12 Track: Special (switches, turnouts)		3,300	50	3,350		
10.13 Track: Vibration and noise dampening		0	0	0		
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**0**	0	0	**0**	**0%**	**0%**
20.01 At-grade station, stop, shelter, mall, terminal, platform		0	0	0		
20.02 Aerial station, stop, shelter, mall, terminal, platform		0	0	0		
20.03 Underground station, stop, shelter, mall, terminal, platform		0	0	0		
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.		0	0	0		
20.05 Joint development		0	0	0		
20.06 Automobile parking multi-story structure		0	0	0		
20.07 Elevators, escalators		0	0	0		
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	0.34	0	0	**0**	**0%**	**0%**
30.01 Administration Building: Office, sales, storage, revenue counting				0		
30.02 Light Maintenance Facility				0		
30.03 Heavy Maintenance Facility		0	0	0		
30.04 Storage or Maintenance of Way Building				0		
30.05 Yard and Yard Track				0		
40 SITEWORK & SPECIAL CONDITIONS	0.34	17,027	5,108	**22,135**	**32%**	**19%**
40.01 Demolition, Clearing, Earthwork		1,464	439	1,903		
40.02 Site Utilities, Utility Relocation		3,200	960	4,160		
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments		0	0	0		
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		0	0	0		
40.05 Site structures including retaining walls, sound walls		0	0	0		
40.06 Pedestrian / bike access and accommodation, landscaping		2,300	690	2,990		
40.07 Automobile, bus, van accessways including roads, parking lots		720	216	936		
40.08 Temporary Facilities and other indirect costs during construction		9,343	2,803	12,146		
50 SYSTEMS	0.34	8,200	2,460	**10,660**	**15%**	**9%**
50.01 Train control and signals		2,100	630	2,730		
50.02 Traffic signals and crossing protection		300	90	390		
50.03 Traction power supply: substations		0	0	0		
50.04 Traction power distribution: catenary and third rail		4,600	1,380	5,980		
50.05 Communications		1,200	360	1,560		
50.06 Fare collection system and equipment		0	0	0		
50.07 Central Control		0	0	0		
Construction Subtotal (10 - 50)	0.34	56,059	13,396	**69,455**	**100%**	**58%**
60 ROW, LAND, EXISTING IMPROVEMENTS	0.34	12,825	3,848	**16,673**		**14%**
60.01 Purchase or lease of real estate		12,825	3,848	16,673		
60.02 Relocation of existing households and businesses				0		
70 VEHICLES (number)	**0**	0	0	**0**		**0%**
70.01 Light Rail		0	0	0		
70.02 Heavy Rail		0	0	0		
70.03 Commuter Rail		0	0	0		
70.04 Bus		0	0	0		
70.05 Other				0		
70.06 Non-revenue vehicles				0		
70.07 Spare parts				0		
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	0.34	18,499	3,700	**22,199**	**32%**	**19%**
80.01 Project Development		2,242	448	2,691		
80.02 Engineering		5,045	1,009	6,054		
80.03 Project Management for Design and Construction		5,606	1,121	6,727		
80.04 Construction Administration & Management		2,803	561	3,364		
80.05 Professional Liability and other Non-Construction Insurance		0	0	0		
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		561	112	673		
80.07 Surveys, Testing, Investigation, Inspection		1,121	224	1,345		
80.08 Start up		1,121	224	1,345		
Subtotal (10 - 80)	0.34	87,383	20,943	**108,327**		**91%**
90 UNALLOCATED CONTINGENCY				**10,833**		**9%**
Subtotal (10 - 90)	0.34			**119,160**		**100%**
100 FINANCE CHARGES				**0**		**0%**
Total Project Cost (10 - 100)	0.34			**119,160**		**100%**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				23.97%		
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				12.40%		
Total Contingency as % of Base Yr Dollars w/o Contingency				36.36%		
Unallocated Contingency as % of Subtotal (10 - 80)				10.00%		
YOE Construction Cost per Mile (X000)						
YOE Total Project Cost per Mile Not Including Vehicles (X000)						
YOE Total Project Cost per Mile (X000)						

Appendix C – Gate Down Event LOS Worksheets.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	77	565	5	10	439	51	48	466	11	78	165	81
Future Volume (vph)	77	565	5	10	439	51	48	466	11	78	165	81
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4		4.0	4.7		4.0	4.7	4.7
Lane Util. Factor		0.95			0.95		1.00	1.00		1.00	1.00	1.00
Frt		1.00			0.98		1.00	1.00		1.00	1.00	0.85
Flt Protected		0.99			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		3514			3482		1770	1857		1770	1863	1583
Flt Permitted		0.79			0.94		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		2798			3269		1770	1857		1770	1863	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	80	589	5	10	457	53	50	485	11	81	172	84
RTOR Reduction (vph)	0	1	0	0	9	0	0	1	0	0	0	50
Lane Group Flow (vph)	0	673	0	0	511	0	50	495	0	81	172	34
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								6
Actuated Green, G (s)		19.8			19.8		3.1	23.6		5.1	25.6	25.6
Effective Green, g (s)		19.8			19.8		3.1	23.6		5.1	25.6	25.6
Actuated g/C Ratio		0.32			0.32		0.05	0.38		0.08	0.41	0.41
Clearance Time (s)		5.4			5.4		4.0	4.7		4.0	4.7	4.7
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		884			1033		87	700		144	761	647
v/s Ratio Prot							0.03	c0.27		c0.05	0.09	
v/s Ratio Perm		c0.24			0.16							0.02
v/c Ratio		0.76			0.49		0.57	0.71		0.56	0.23	0.05
Uniform Delay, d1		19.3			17.3		29.1	16.6		27.7	12.0	11.2
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		3.9			0.4		8.9	3.3		5.0	0.2	0.0
Delay (s)		23.2			17.7		38.0	19.8		32.6	12.2	11.2
Level of Service		C			B		D	B		C	B	B
Approach Delay (s)		23.2			17.7			21.5			16.9	
Approach LOS		C			B			C			B	

Intersection Summary			
HCM 2000 Control Delay	20.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	62.6	Sum of lost time (s)	19.5
Intersection Capacity Utilization	77.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	77	565	5	10	439	51	48	466	11	78	165	81
Future Volume (vph)	77	565	5	10	439	51	48	466	11	78	165	81
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4		4.0	5.0		4.0	5.0	5.0
Lane Util. Factor		0.95			0.95		1.00	1.00		1.00	1.00	1.00
Frt		1.00			0.98		1.00	1.00		1.00	1.00	0.85
Flt Protected		0.99			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		3514			3482		1770	1857		1770	1863	1583
Flt Permitted		0.78			0.94		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		2770			3271		1770	1857		1770	1863	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	80	589	5	10	457	53	50	485	11	81	172	84
RTOR Reduction (vph)	0	1	0	0	7	0	0	1	0	0	0	49
Lane Group Flow (vph)	0	673	0	0	513	0	50	495	0	81	172	35
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								6
Actuated Green, G (s)		24.0			24.0		4.0	27.5		6.9	30.4	30.4
Effective Green, g (s)		24.0			24.0		4.0	27.5		6.9	30.4	30.4
Actuated g/C Ratio		0.33			0.33		0.05	0.38		0.09	0.42	0.42
Clearance Time (s)		5.4			5.4		4.0	5.0		4.0	5.0	5.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		913			1078		97	701		167	777	661
v/s Ratio Prot							0.03	c0.27		c0.05	c0.09	
v/s Ratio Perm		c0.24			0.16							0.02
v/c Ratio		0.74			0.48		0.52	0.71		0.49	0.22	0.05
Uniform Delay, d1		21.6			19.4		33.5	19.2		31.3	13.6	12.6
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		3.1			0.3		4.6	3.3		2.2	0.1	0.0
Delay (s)		24.8			19.7		38.0	22.5		33.5	13.7	12.7
Level of Service		C			B		D	C		C	B	B
Approach Delay (s)		24.8			19.7			23.9			18.2	
Approach LOS		C			B			C			B	

Intersection Summary			
HCM 2000 Control Delay	22.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	72.8	Sum of lost time (s)	19.8
Intersection Capacity Utilization	78.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	43	503	9	17	603	23	81	320	22	88	354	130
Future Volume (vph)	43	503	9	17	603	23	81	320	22	88	354	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4		4.0	4.7		4.0	4.7	4.7
Lane Util. Factor		0.95			0.95		1.00	1.00		1.00	1.00	1.00
Frt		1.00			0.99		1.00	0.99		1.00	1.00	0.85
Flt Protected		1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		3517			3515		1770	1845		1770	1863	1583
Flt Permitted		0.85			0.93		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		3017			3275		1770	1845		1770	1863	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	45	524	9	18	628	24	84	333	23	92	369	135
RTOR Reduction (vph)	0	1	0	0	3	0	0	3	0	0	0	85
Lane Group Flow (vph)	0	577	0	0	667	0	84	353	0	92	369	50
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								6
Actuated Green, G (s)		18.3			18.3		5.7	17.7		6.2	18.2	18.2
Effective Green, g (s)		18.3			18.3		5.7	17.7		6.2	18.2	18.2
Actuated g/C Ratio		0.33			0.33		0.10	0.31		0.11	0.32	0.32
Clearance Time (s)		5.4			5.4		4.0	4.7		4.0	4.7	4.7
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		980			1064		179	580		194	602	511
v/s Ratio Prot							0.05	0.19		c0.05	c0.20	
v/s Ratio Perm		0.19			c0.20							0.03
v/c Ratio		0.59			0.63		0.47	0.61		0.47	0.61	0.10
Uniform Delay, d1		15.9			16.1		23.9	16.4		23.5	16.1	13.3
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.9			1.2		1.9	1.8		1.8	1.9	0.1
Delay (s)		16.8			17.3		25.8	18.2		25.3	17.9	13.4
Level of Service		B			B		C	B		C	B	B
Approach Delay (s)		16.8			17.3			19.6			18.0	
Approach LOS		B			B			B			B	

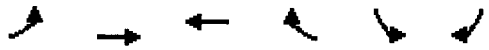
Intersection Summary			
HCM 2000 Control Delay	17.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	56.3	Sum of lost time (s)	19.5
Intersection Capacity Utilization	72.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	43	503	9	17	603	23	81	320	22	88	354	130
Future Volume (vph)	43	503	9	17	603	23	81	320	22	88	354	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4		4.0	4.7		4.0	4.7	4.7
Lane Util. Factor		0.95			0.95		1.00	1.00		1.00	1.00	1.00
Frt		1.00			0.99		1.00	0.99		1.00	1.00	0.85
Flt Protected		1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		3517			3515		1770	1845		1770	1863	1583
Flt Permitted		0.85			0.93		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		3009			3277		1770	1845		1770	1863	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	45	524	9	18	628	24	84	333	23	92	369	135
RTOR Reduction (vph)	0	1	0	0	2	0	0	2	0	0	0	91
Lane Group Flow (vph)	0	577	0	0	668	0	84	354	0	92	369	44
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								6
Actuated Green, G (s)		21.2			21.2		7.2	20.5		7.4	20.7	20.7
Effective Green, g (s)		21.2			21.2		7.2	20.5		7.4	20.7	20.7
Actuated g/C Ratio		0.34			0.34		0.11	0.32		0.12	0.33	0.33
Clearance Time (s)		5.4			5.4		4.0	4.7		4.0	4.7	4.7
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		1009			1099		201	598		207	610	518
v/s Ratio Prot							0.05	0.19		c0.05	c0.20	
v/s Ratio Perm		0.19			c0.20							0.03
v/c Ratio		0.57			0.61		0.42	0.59		0.44	0.60	0.09
Uniform Delay, d1		17.3			17.5		26.1	17.9		26.0	17.8	14.7
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.8			1.0		1.4	1.6		1.5	1.7	0.1
Delay (s)		18.1			18.5		27.5	19.4		27.5	19.5	14.8
Level of Service		B			B		C	B		C	B	B
Approach Delay (s)		18.1			18.5			21.0			19.7	
Approach LOS		B			B			C			B	

Intersection Summary			
HCM 2000 Control Delay	19.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	63.2	Sum of lost time (s)	19.5
Intersection Capacity Utilization	72.7%	ICU Level of Service	C
Analysis Period (min)	15		

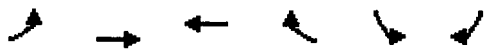
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			
Traffic Volume (vph)	0	1115	1125	0	0	0
Future Volume (vph)	0	1115	1125	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0	3.0			
Lane Util. Factor		0.95	0.95			
Frt		1.00	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		3539	3539			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		3539	3539			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1212	1223	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1212	1223	0	0	0
Turn Type		NA	NA			
Protected Phases		4	8			
Permitted Phases						
Actuated Green, G (s)		42.0	42.0			
Effective Green, g (s)		42.0	42.0			
Actuated g/C Ratio		0.47	0.47			
Clearance Time (s)		3.0	3.0			
Lane Grp Cap (vph)		1651	1651			
v/s Ratio Prot		0.34	c0.35			
v/s Ratio Perm						
v/c Ratio		0.73	0.74			
Uniform Delay, d1		19.5	19.6			
Progression Factor		1.00	1.00			
Incremental Delay, d2		2.9	3.0			
Delay (s)		22.4	22.6			
Level of Service		C	C			
Approach Delay (s)		22.4	22.6		0.0	
Approach LOS		C	C		A	

Intersection Summary			
HCM 2000 Control Delay	22.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	34.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			
Traffic Volume (vph)	0	1268	1096	0	0	0
Future Volume (vph)	0	1268	1096	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0	3.0			
Lane Util. Factor		0.95	0.95			
Frt		1.00	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		3539	3539			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		3539	3539			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1378	1191	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1378	1191	0	0	0
Turn Type		NA	NA			
Protected Phases		4	8			
Permitted Phases						
Actuated Green, G (s)		42.0	42.0			
Effective Green, g (s)		42.0	42.0			
Actuated g/C Ratio		0.47	0.47			
Clearance Time (s)		3.0	3.0			
Lane Grp Cap (vph)		1651	1651			
v/s Ratio Prot		c0.39	0.34			
v/s Ratio Perm						
v/c Ratio		0.83	0.72			
Uniform Delay, d1		21.0	19.3			
Progression Factor		1.00	1.00			
Incremental Delay, d2		5.1	2.8			
Delay (s)		26.1	22.1			
Level of Service		C	C			
Approach Delay (s)		26.1	22.1		0.0	
Approach LOS		C	C		A	

Intersection Summary			
HCM 2000 Control Delay	24.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	38.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			
Traffic Volume (vph)	0	852	706	0	0	0
Future Volume (vph)	0	852	706	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0	3.0			
Lane Util. Factor		0.95	0.95			
Frt		1.00	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		3539	3539			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		3539	3539			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	926	767	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	926	767	0	0	0
Turn Type		NA	NA			
Protected Phases		4	8			
Permitted Phases						
Actuated Green, G (s)		42.0	42.0			
Effective Green, g (s)		42.0	42.0			
Actuated g/C Ratio		0.47	0.47			
Clearance Time (s)		3.0	3.0			
Lane Grp Cap (vph)		1651	1651			
v/s Ratio Prot		c0.26	0.22			
v/s Ratio Perm						
v/c Ratio		0.56	0.46			
Uniform Delay, d1		17.3	16.3			
Progression Factor		1.00	1.00			
Incremental Delay, d2		1.4	0.9			
Delay (s)		18.7	17.3			
Level of Service		B	B			
Approach Delay (s)		18.7	17.3		0.0	
Approach LOS		B	B		A	

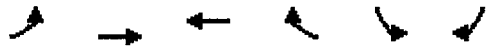
Intersection Summary			
HCM 2000 Control Delay	18.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	26.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			
Traffic Volume (vph)	0	913	1020	0	0	0
Future Volume (vph)	0	913	1020	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0	3.0			
Lane Util. Factor		0.95	0.95			
Frt		1.00	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		3539	3539			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		3539	3539			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	992	1109	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	992	1109	0	0	0
Turn Type		NA	NA			
Protected Phases		4	8			
Permitted Phases						
Actuated Green, G (s)		42.0	42.0			
Effective Green, g (s)		42.0	42.0			
Actuated g/C Ratio		0.47	0.47			
Clearance Time (s)		3.0	3.0			
Lane Grp Cap (vph)		1651	1651			
v/s Ratio Prot		0.28	c0.31			
v/s Ratio Perm						
v/c Ratio		0.60	0.67			
Uniform Delay, d1		17.8	18.6			
Progression Factor		1.00	1.00			
Incremental Delay, d2		1.6	2.2			
Delay (s)		19.4	20.8			
Level of Service		B	C			
Approach Delay (s)		19.4	20.8		0.0	
Approach LOS		B	C		A	

Intersection Summary			
HCM 2000 Control Delay	20.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	31.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			
Traffic Volume (vph)	0	895	1031	0	0	0
Future Volume (vph)	0	895	1031	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0	3.0			
Lane Util. Factor		0.95	0.95			
Frt		1.00	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		3539	3539			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		3539	3539			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	973	1121	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	973	1121	0	0	0
Turn Type		NA	NA			
Protected Phases		4	8			
Permitted Phases						
Actuated Green, G (s)		42.0	42.0			
Effective Green, g (s)		42.0	42.0			
Actuated g/C Ratio		0.47	0.47			
Clearance Time (s)		3.0	3.0			
Lane Grp Cap (vph)		1651	1651			
v/s Ratio Prot		0.27	c0.32			
v/s Ratio Perm						
v/c Ratio		0.59	0.68			
Uniform Delay, d1		17.7	18.7			
Progression Factor		1.00	1.00			
Incremental Delay, d2		1.6	2.3			
Delay (s)		19.2	21.0			
Level of Service		B	C			
Approach Delay (s)		19.2	21.0		0.0	
Approach LOS		B	C		A	

Intersection Summary			
HCM 2000 Control Delay	20.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	31.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			
Traffic Volume (vph)	0	1223	672	0	0	0
Future Volume (vph)	0	1223	672	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0	3.0			
Lane Util. Factor		0.95	0.95			
Frt		1.00	1.00			
Flt Protected		1.00	1.00			
Satd. Flow (prot)		3539	3539			
Flt Permitted		1.00	1.00			
Satd. Flow (perm)		3539	3539			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1329	730	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1329	730	0	0	0
Turn Type		NA	NA			
Protected Phases		4	8			
Permitted Phases						
Actuated Green, G (s)		42.0	42.0			
Effective Green, g (s)		42.0	42.0			
Actuated g/C Ratio		0.47	0.47			
Clearance Time (s)		3.0	3.0			
Lane Grp Cap (vph)		1651	1651			
v/s Ratio Prot		c0.38	0.21			
v/s Ratio Perm						
v/c Ratio		0.80	0.44			
Uniform Delay, d1		20.5	16.1			
Progression Factor		1.00	1.00			
Incremental Delay, d2		4.3	0.9			
Delay (s)		24.8	17.0			
Level of Service		C	B			
Approach Delay (s)		24.8	17.0		0.0	
Approach LOS		C	B		A	

Intersection Summary			
HCM 2000 Control Delay	22.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	37.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	7	367	73	60	494	9	34	14	44	23	30	4
Future Volume (vph)	7	367	73	60	494	9	34	14	44	23	30	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4		5.4	5.4		4.7			4.7	
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00		1.00			1.00	
Frt	1.00	1.00	0.85		1.00	0.85		0.94			0.99	
Flt Protected	0.95	1.00	1.00		0.99	1.00		0.98			0.98	
Satd. Flow (prot)	1770	3539	1583		3520	1583		1711			1809	
Flt Permitted	0.95	1.00	1.00		0.87	1.00		0.86			0.82	
Satd. Flow (perm)	1770	3539	1583		3091	1583		1490			1522	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	7	382	76	62	515	9	35	15	46	24	31	4
RTOR Reduction (vph)	0	0	29	0	0	5	0	40	0	0	3	0
Lane Group Flow (vph)	7	382	47	0	578	4	0	56	0	0	56	0
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4	8		8	2			6		
Actuated Green, G (s)	0.9	25.7	25.7		19.4	19.4		5.7			5.7	
Effective Green, g (s)	0.9	25.7	25.7		19.4	19.4		5.7			5.7	
Actuated g/C Ratio	0.02	0.62	0.62		0.47	0.47		0.14			0.14	
Clearance Time (s)	5.4	5.4	5.4		5.4	5.4		4.7			4.7	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)	38	2191	980		1444	740		204			209	
v/s Ratio Prot	0.00	c0.11										
v/s Ratio Perm			0.03		c0.19	0.00		c0.04			0.04	
v/c Ratio	0.18	0.17	0.05		0.40	0.01		0.28			0.27	
Uniform Delay, d1	19.9	3.4	3.1		7.2	5.9		16.1			16.0	
Progression Factor	1.00	1.00	1.00		1.00	1.00		1.00			1.00	
Incremental Delay, d2	2.3	0.0	0.0		0.2	0.0		0.7			0.7	
Delay (s)	22.3	3.4	3.1		7.4	5.9		16.8			16.7	
Level of Service	C	A	A		A	A		B			B	
Approach Delay (s)		3.6			7.4			16.8			16.7	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	7.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	41.5	Sum of lost time (s)	15.5
Intersection Capacity Utilization	46.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	7	367	73	60	494	9	34	14	44	23	30	4
Future Volume (vph)	7	367	73	60	494	9	34	14	44	23	30	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4		5.4	5.4		4.7			4.7	
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00		1.00			1.00	
Frt	1.00	1.00	0.85		1.00	0.85		0.94			0.99	
Flt Protected	0.95	1.00	1.00		0.99	1.00		0.98			0.98	
Satd. Flow (prot)	1770	3539	1583		3520	1583		1711			1809	
Flt Permitted	0.95	1.00	1.00		0.87	1.00		0.86			0.84	
Satd. Flow (perm)	1770	3539	1583		3082	1583		1496			1551	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	7	382	76	62	515	9	35	15	46	24	31	4
RTOR Reduction (vph)	0	0	32	0	0	5	0	28	0	0	2	0
Lane Group Flow (vph)	7	382	44	0	578	4	0	68	0	0	57	0
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4	8		8	2			6		
Actuated Green, G (s)	0.8	24.3	24.3		18.1	18.1		8.0			8.0	
Effective Green, g (s)	0.8	24.3	24.3		18.1	18.1		8.0			8.0	
Actuated g/C Ratio	0.02	0.57	0.57		0.43	0.43		0.19			0.19	
Clearance Time (s)	5.4	5.4	5.4		5.4	5.4		4.7			4.7	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)	33	2028	907		1315	675		282			292	
v/s Ratio Prot	0.00	c0.11										
v/s Ratio Perm			0.03		c0.19	0.00		c0.05			0.04	
v/c Ratio	0.21	0.19	0.05		0.44	0.01		0.24			0.19	
Uniform Delay, d1	20.5	4.3	4.0		8.6	7.0		14.6			14.5	
Progression Factor	1.00	1.00	1.00		1.00	1.00		1.00			1.00	
Incremental Delay, d2	3.2	0.0	0.0		0.2	0.0		0.4			0.3	
Delay (s)	23.7	4.4	4.0		8.8	7.0		15.1			14.8	
Level of Service	C	A	A		A	A		B			B	
Approach Delay (s)		4.6			8.8			15.1			14.8	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	8.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	42.4	Sum of lost time (s)	20.5
Intersection Capacity Utilization	46.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	526	88	50	303	20	23	34	89	21	26	6
Future Volume (vph)	14	526	88	50	303	20	23	34	89	21	26	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4		5.4	5.4		4.7			4.7	
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00		1.00			1.00	
Frt	1.00	1.00	0.85		1.00	0.85		0.92			0.99	
Flt Protected	0.95	1.00	1.00		0.99	1.00		0.99			0.98	
Satd. Flow (prot)	1770	3539	1583		3514	1583		1695			1799	
Flt Permitted	0.95	1.00	1.00		0.83	1.00		0.94			0.83	
Satd. Flow (perm)	1770	3539	1583		2925	1583		1606			1528	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	15	548	92	52	316	21	24	35	93	22	27	6
RTOR Reduction (vph)	0	0	33	0	0	13	0	74	0	0	5	0
Lane Group Flow (vph)	15	548	59	0	368	8	0	78	0	0	50	0
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4	8		8	2			6		
Actuated Green, G (s)	1.0	21.5	21.5		15.1	15.1		8.1			8.1	
Effective Green, g (s)	1.0	21.5	21.5		15.1	15.1		8.1			8.1	
Actuated g/C Ratio	0.03	0.54	0.54		0.38	0.38		0.20			0.20	
Clearance Time (s)	5.4	5.4	5.4		5.4	5.4		4.7			4.7	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)	44	1916	857		1112	602		327			311	
v/s Ratio Prot	0.01	c0.15										
v/s Ratio Perm			0.04		0.13	0.01		c0.05			0.03	
v/c Ratio	0.34	0.29	0.07		0.33	0.01		0.24			0.16	
Uniform Delay, d1	19.0	4.9	4.3		8.7	7.7		13.2			13.0	
Progression Factor	1.00	1.00	1.00		1.00	1.00		1.00			1.00	
Incremental Delay, d2	4.6	0.1	0.0		0.2	0.0		0.4			0.2	
Delay (s)	23.6	5.0	4.4		8.9	7.7		13.6			13.2	
Level of Service	C	A	A		A	A		B			B	
Approach Delay (s)		5.4			8.8			13.6			13.2	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	7.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	39.7	Sum of lost time (s)	15.5
Intersection Capacity Utilization	46.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	526	88	50	303	20	23	34	89	21	26	6
Future Volume (vph)	14	526	88	50	303	20	23	34	89	21	26	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4		5.4	5.4		4.7			4.7	
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00		1.00			1.00	
Frt	1.00	1.00	0.85		1.00	0.85		0.92			0.99	
Flt Protected	0.95	1.00	1.00		0.99	1.00		0.99			0.98	
Satd. Flow (prot)	1770	3539	1583		3514	1583		1695			1799	
Flt Permitted	0.95	1.00	1.00		0.82	1.00		0.95			0.85	
Satd. Flow (perm)	1770	3539	1583		2912	1583		1621			1565	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	15	548	92	52	316	21	24	35	93	22	27	6
RTOR Reduction (vph)	0	0	46	0	0	14	0	45	0	0	4	0
Lane Group Flow (vph)	15	548	46	0	368	7	0	107	0	0	51	0
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4	8		8	2			6		
Actuated Green, G (s)	0.9	21.1	21.1		14.8	14.8		10.7			10.7	
Effective Green, g (s)	0.9	21.1	21.1		14.8	14.8		10.7			10.7	
Actuated g/C Ratio	0.02	0.50	0.50		0.35	0.35		0.26			0.26	
Clearance Time (s)	5.4	5.4	5.4		5.4	5.4		4.7			4.7	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)	38	1782	797		1028	559		413			399	
v/s Ratio Prot	0.01	c0.15										
v/s Ratio Perm			0.03		0.13	0.00		c0.07			0.03	
v/c Ratio	0.39	0.31	0.06		0.36	0.01		0.26			0.13	
Uniform Delay, d1	20.2	6.1	5.3		10.0	8.8		12.4			12.0	
Progression Factor	1.00	1.00	1.00		1.00	1.00		1.00			1.00	
Incremental Delay, d2	6.6	0.1	0.0		0.2	0.0		0.3			0.1	
Delay (s)	26.9	6.2	5.3		10.2	8.8		12.8			12.2	
Level of Service	C	A	A		B	A		B			B	
Approach Delay (s)		6.6			10.2			12.8			12.2	
Approach LOS		A			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	8.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	41.9	Sum of lost time (s)	20.5
Intersection Capacity Utilization	46.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	8	346	15	69	550	37	25	42	63	57	58	36
Future Volume (vph)	8	346	15	69	550	37	25	42	63	57	58	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4		4.0	5.4			4.7			4.7	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frt	1.00	0.99		1.00	0.99			0.93			0.97	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.98	
Satd. Flow (prot)	1770	3517		1770	3505			1724			1769	
Flt Permitted	0.95	1.00		0.50	1.00			0.93			0.87	
Satd. Flow (perm)	1770	3517		925	3505			1614			1562	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	8	360	16	72	573	39	26	44	66	59	60	38
RTOR Reduction (vph)	0	4	0	0	5	0	0	48	0	0	16	0
Lane Group Flow (vph)	8	372	0	72	607	0	0	88	0	0	141	0
Turn Type	Prot	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases				8			2			6		
Actuated Green, G (s)	0.9	18.6		23.3	19.8			8.6			8.6	
Effective Green, g (s)	0.9	18.6		23.3	19.8			8.6			8.6	
Actuated g/C Ratio	0.02	0.42		0.52	0.44			0.19			0.19	
Clearance Time (s)	5.4	5.4		4.0	5.4			4.7			4.7	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	35	1460		547	1549			309			299	
v/s Ratio Prot	0.00	0.11		c0.01	c0.17							
v/s Ratio Perm				0.06				0.05			c0.09	
v/c Ratio	0.23	0.26		0.13	0.39			0.29			0.47	
Uniform Delay, d1	21.6	8.6		5.4	8.4			15.5			16.1	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	3.3	0.1		0.1	0.2			0.5			1.2	
Delay (s)	24.9	8.7		5.5	8.6			16.0			17.3	
Level of Service	C	A		A	A			B			B	
Approach Delay (s)		9.0			8.3			16.0			17.3	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	10.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	44.8	Sum of lost time (s)	15.5
Intersection Capacity Utilization	48.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	8	346	15	69	550	37	25	42	63	57	58	36
Future Volume (vph)	8	346	15	69	550	37	25	42	63	57	58	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4		4.0	5.4			4.7			4.7	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frt	1.00	0.99		1.00	0.99			0.93			0.97	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.98	
Satd. Flow (prot)	1770	3517		1770	3505			1724			1769	
Flt Permitted	0.95	1.00		0.49	1.00			0.92			0.84	
Satd. Flow (perm)	1770	3517		916	3505			1603			1506	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	8	360	16	72	573	39	26	44	66	59	60	38
RTOR Reduction (vph)	0	2	0	0	3	0	0	22	0	0	7	0
Lane Group Flow (vph)	8	374	0	72	609	0	0	114	0	0	150	0
Turn Type	Prot	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases				8			2			6		
Actuated Green, G (s)	0.9	16.0		20.7	17.2			11.9			11.9	
Effective Green, g (s)	0.9	16.0		20.7	17.2			11.9			11.9	
Actuated g/C Ratio	0.02	0.35		0.45	0.38			0.26			0.26	
Clearance Time (s)	5.4	5.4		4.0	5.4			4.7			4.7	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	35	1236		482	1324			419			393	
v/s Ratio Prot	0.00	0.11		c0.01	c0.17							
v/s Ratio Perm				0.06				0.07			c0.10	
v/c Ratio	0.23	0.30		0.15	0.46			0.27			0.38	
Uniform Delay, d1	22.0	10.7		7.1	10.7			13.4			13.8	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	3.3	0.1		0.1	0.3			0.4			0.6	
Delay (s)	25.3	10.8		7.2	10.9			13.7			14.4	
Level of Service	C	B		A	B			B			B	
Approach Delay (s)		11.1			10.5			13.7			14.4	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	11.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	45.5	Sum of lost time (s)	20.5
Intersection Capacity Utilization	48.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	493	18	7	405	67	9	24	14	123	38	36
Future Volume (vph)	10	493	18	7	405	67	9	24	14	123	38	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4		4.0	5.4			4.7			4.7	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frt	1.00	0.99		1.00	0.98			0.96			0.98	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.97	
Satd. Flow (prot)	1770	3520		1770	3464			1770			1762	
Flt Permitted	0.95	1.00		0.45	1.00			0.93			0.78	
Satd. Flow (perm)	1770	3520		845	3464			1667			1420	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	10	514	19	7	422	70	9	25	15	128	40	38
RTOR Reduction (vph)	0	3	0	0	15	0	0	11	0	0	11	0
Lane Group Flow (vph)	10	530	0	7	477	0	0	38	0	0	195	0
Turn Type	Prot	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases				8			2			6		
Actuated Green, G (s)	0.9	15.9		15.2	14.4			12.1			12.1	
Effective Green, g (s)	0.9	15.9		15.2	14.4			12.1			12.1	
Actuated g/C Ratio	0.02	0.37		0.35	0.34			0.28			0.28	
Clearance Time (s)	5.4	5.4		4.0	5.4			4.7			4.7	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	37	1304		316	1162			470			400	
v/s Ratio Prot	c0.01	c0.15		0.00	0.14							
v/s Ratio Perm				0.01				0.02			c0.14	
v/c Ratio	0.27	0.41		0.02	0.41			0.08			0.49	
Uniform Delay, d1	20.7	10.0		9.0	11.0			11.3			12.8	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	3.9	0.2		0.0	0.2			0.1			0.9	
Delay (s)	24.6	10.2		9.0	11.2			11.4			13.7	
Level of Service	C	B		A	B			B			B	
Approach Delay (s)		10.5			11.2			11.4			13.7	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	11.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	42.9	Sum of lost time (s)	15.5
Intersection Capacity Utilization	40.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	493	18	7	405	67	9	24	14	123	38	36
Future Volume (vph)	10	493	18	7	405	67	9	24	14	123	38	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4		4.0	5.4			4.7			4.7	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frt	1.00	0.99		1.00	0.98			0.96			0.98	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.97	
Satd. Flow (prot)	1770	3520		1770	3464			1770			1762	
Flt Permitted	0.95	1.00		0.45	1.00			0.94			0.78	
Satd. Flow (perm)	1770	3520		845	3464			1673			1420	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	10	514	19	7	422	70	9	25	15	128	40	38
RTOR Reduction (vph)	0	1	0	0	8	0	0	10	0	0	6	0
Lane Group Flow (vph)	10	532	0	7	484	0	0	39	0	0	200	0
Turn Type	Prot	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases				8			2			6		
Actuated Green, G (s)	0.8	16.0		14.8	14.3			13.3			13.3	
Effective Green, g (s)	0.8	16.0		14.8	14.3			13.3			13.3	
Actuated g/C Ratio	0.02	0.36		0.34	0.33			0.30			0.30	
Clearance Time (s)	5.4	5.4		4.0	5.4			4.7			4.7	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	32	1282		295	1128			506			430	
v/s Ratio Prot	c0.01	c0.15		0.00	0.14							
v/s Ratio Perm				0.01				0.02			c0.14	
v/c Ratio	0.31	0.41		0.02	0.43			0.08			0.47	
Uniform Delay, d1	21.3	10.4		9.7	11.6			10.9			12.4	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	5.5	0.2		0.0	0.3			0.1			0.8	
Delay (s)	26.8	10.7		9.7	11.9			11.0			13.2	
Level of Service	C	B		A	B			B			B	
Approach Delay (s)		11.0			11.8			11.0			13.2	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	11.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	43.9	Sum of lost time (s)	20.5
Intersection Capacity Utilization	40.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations								↑			↑	
Traffic Volume (vph)	0	0	0	0	0	0	0	574	0	0	696	0
Future Volume (vph)	0	0	0	0	0	0	0	574	0	0	696	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)								4.0			4.0	
Lane Util. Factor								1.00			1.00	
Frt								1.00			1.00	
Flt Protected								1.00			1.00	
Satd. Flow (prot)								1863			1863	
Flt Permitted								1.00			1.00	
Satd. Flow (perm)								1863			1863	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	0	0	0	624	0	0	757	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	0	0	0	624	0	0	757	0
Turn Type								NA			NA	
Protected Phases								2			6	
Permitted Phases												
Actuated Green, G (s)								41.0			41.0	
Effective Green, g (s)								41.0			41.0	
Actuated g/C Ratio								0.46			0.46	
Clearance Time (s)								4.0			4.0	
Lane Grp Cap (vph)								848			848	
v/s Ratio Prot								0.33			c0.41	
v/s Ratio Perm												
v/c Ratio								0.74			0.89	
Uniform Delay, d1								20.1			22.5	
Progression Factor								1.00			1.00	
Incremental Delay, d2								5.6			13.7	
Delay (s)								25.7			36.2	
Level of Service								C			D	
Approach Delay (s)		0.0			0.0			25.7			36.2	
Approach LOS		A			A			C			D	

Intersection Summary			
HCM 2000 Control Delay	31.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	40.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations								↑			↑	
Traffic Volume (vph)	0	0	0	0	0	0	0	487	0	0	556	0
Future Volume (vph)	0	0	0	0	0	0	0	487	0	0	556	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)								4.0			4.0	
Lane Util. Factor								1.00			1.00	
Frt								1.00			1.00	
Flt Protected								1.00			1.00	
Satd. Flow (prot)								1863			1863	
Flt Permitted								1.00			1.00	
Satd. Flow (perm)								1863			1863	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	0	0	0	529	0	0	604	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	0	0	0	529	0	0	604	0
Turn Type								NA			NA	
Protected Phases								2			6	
Permitted Phases												
Actuated Green, G (s)								41.0			41.0	
Effective Green, g (s)								41.0			41.0	
Actuated g/C Ratio								0.46			0.46	
Clearance Time (s)								4.0			4.0	
Lane Grp Cap (vph)								848			848	
v/s Ratio Prot								0.28			c0.32	
v/s Ratio Perm												
v/c Ratio								0.62			0.71	
Uniform Delay, d1								18.6			19.7	
Progression Factor								1.00			1.00	
Incremental Delay, d2								3.4			5.1	
Delay (s)								22.1			24.8	
Level of Service								C			C	
Approach Delay (s)		0.0			0.0			22.1			24.8	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	23.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	32.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	36	184	37	33	173	14	32	162	31	23	182	27
Future Volume (vph)	36	184	37	33	173	14	32	162	31	23	182	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4		5.4	5.4		4.0	4.7		4.0	4.7	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.99		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1816		1770	1841		1770	1818		1770	1827	
Flt Permitted	0.64	1.00		0.61	1.00		0.62	1.00		0.63	1.00	
Satd. Flow (perm)	1183	1816		1145	1841		1158	1818		1177	1827	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	38	192	39	34	180	15	33	169	32	24	190	28
RTOR Reduction (vph)	0	8	0	0	3	0	0	10	0	0	8	0
Lane Group Flow (vph)	38	223	0	34	192	0	33	191	0	24	210	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	12.8	12.8		12.8	12.8		9.2	8.4		9.2	8.4	
Effective Green, g (s)	12.8	12.8		12.8	12.8		9.2	8.4		9.2	8.4	
Actuated g/C Ratio	0.35	0.35		0.35	0.35		0.25	0.23		0.25	0.23	
Clearance Time (s)	5.4	5.4		5.4	5.4		4.0	4.7		4.0	4.7	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	419	643		405	652		308	423		313	425	
v/s Ratio Prot		c0.12			0.10		c0.00	0.11		0.00	c0.12	
v/s Ratio Perm	0.03			0.03			0.02			0.02		
v/c Ratio	0.09	0.35		0.08	0.29		0.11	0.45		0.08	0.49	
Uniform Delay, d1	7.8	8.6		7.7	8.4		10.2	11.9		10.2	12.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.3		0.1	0.3		0.2	0.8		0.1	0.9	
Delay (s)	7.9	8.9		7.8	8.6		10.4	12.6		10.3	12.9	
Level of Service	A	A		A	A		B	B		B	B	
Approach Delay (s)		8.8			8.5			12.3			12.7	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	36.1	Sum of lost time (s)	14.1
Intersection Capacity Utilization	51.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	36	184	37	33	173	14	32	162	31	23	182	27
Future Volume (vph)	36	184	37	33	173	14	32	162	31	23	182	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4		5.4	5.4		4.0	4.7		4.0	4.7	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.99		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1816		1770	1841		1770	1818		1770	1827	
Flt Permitted	0.64	1.00		0.61	1.00		0.57	1.00		0.63	1.00	
Satd. Flow (perm)	1183	1816		1145	1841		1057	1818		1177	1827	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	38	192	39	34	180	15	33	169	32	24	190	28
RTOR Reduction (vph)	0	7	0	0	3	0	0	7	0	0	5	0
Lane Group Flow (vph)	38	224	0	34	192	0	33	194	0	24	213	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	12.0	12.0		12.0	12.0		15.8	13.7		13.4	12.5	
Effective Green, g (s)	12.0	12.0		12.0	12.0		15.8	13.7		13.4	12.5	
Actuated g/C Ratio	0.29	0.29		0.29	0.29		0.39	0.34		0.33	0.31	
Clearance Time (s)	5.4	5.4		5.4	5.4		4.0	4.7		4.0	4.7	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	348	535		337	542		447	611		400	561	
v/s Ratio Prot		c0.12			0.10		c0.00	0.11		0.00	c0.12	
v/s Ratio Perm	0.03			0.03			0.02			0.02		
v/c Ratio	0.11	0.42		0.10	0.35		0.07	0.32		0.06	0.38	
Uniform Delay, d1	10.5	11.5		10.4	11.3		7.8	10.0		9.3	11.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.5		0.1	0.4		0.1	0.3		0.1	0.4	
Delay (s)	10.6	12.1		10.6	11.7		7.9	10.3		9.3	11.5	
Level of Service	B	B		B	B		A	B		A	B	
Approach Delay (s)		11.9			11.5			10.0			11.3	
Approach LOS		B			B			A			B	

Intersection Summary			
HCM 2000 Control Delay	11.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	40.7	Sum of lost time (s)	14.1
Intersection Capacity Utilization	51.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	21	160	32	46	146	20	56	137	33	19	125	18
Future Volume (vph)	21	160	32	46	146	20	56	137	33	19	125	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4		5.4	5.4		4.0	4.7		4.0	4.7	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.97		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1817		1770	1829		1770	1809		1770	1827	
Flt Permitted	0.65	1.00		0.63	1.00		0.57	1.00		0.65	1.00	
Satd. Flow (perm)	1207	1817		1178	1829		1061	1809		1203	1827	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	22	167	33	48	152	21	58	143	34	20	130	19
RTOR Reduction (vph)	0	8	0	0	5	0	0	13	0	0	8	0
Lane Group Flow (vph)	22	192	0	48	168	0	58	164	0	20	141	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	13.7	13.7		13.7	13.7		12.3	10.0		9.5	8.6	
Effective Green, g (s)	13.7	13.7		13.7	13.7		12.3	10.0		9.5	8.6	
Actuated g/C Ratio	0.35	0.35		0.35	0.35		0.32	0.26		0.25	0.22	
Clearance Time (s)	5.4	5.4		5.4	5.4		4.0	4.7		4.0	4.7	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	427	643		417	647		379	467		308	406	
v/s Ratio Prot		c0.11			0.09		c0.01	c0.09		0.00	0.08	
v/s Ratio Perm	0.02			0.04			0.04			0.01		
v/c Ratio	0.05	0.30		0.12	0.26		0.15	0.35		0.06	0.35	
Uniform Delay, d1	8.2	9.0		8.4	8.9		9.3	11.7		11.1	12.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.3		0.1	0.2		0.2	0.5		0.1	0.5	
Delay (s)	8.3	9.3		8.5	9.1		9.5	12.2		11.2	13.2	
Level of Service	A	A		A	A		A	B		B	B	
Approach Delay (s)		9.2			9.0			11.5			13.0	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.32		
Actuated Cycle Length (s)	38.7	Sum of lost time (s)	14.1
Intersection Capacity Utilization	47.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	21	160	32	46	146	20	56	137	33	19	125	18
Future Volume (vph)	21	160	32	46	146	20	56	137	33	19	125	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4		5.4	5.4		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.97		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1817		1770	1829		1770	1809		1770	1827	
Flt Permitted	0.65	1.00		0.63	1.00		0.57	1.00		0.65	1.00	
Satd. Flow (perm)	1207	1817		1178	1829		1057	1809		1203	1827	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	22	167	33	48	152	21	58	143	34	20	130	19
RTOR Reduction (vph)	0	7	0	0	5	0	0	9	0	0	5	0
Lane Group Flow (vph)	22	193	0	48	168	0	58	168	0	20	144	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	13.1	13.1		13.1	13.1		12.1	9.8		9.3	8.4	
Effective Green, g (s)	13.1	13.1		13.1	13.1		12.1	9.8		9.3	8.4	
Actuated g/C Ratio	0.34	0.34		0.34	0.34		0.32	0.26		0.24	0.22	
Clearance Time (s)	5.4	5.4		5.4	5.4		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	413	623		403	627		377	464		306	401	
v/s Ratio Prot		c0.11			0.09		c0.01	c0.09		0.00	0.08	
v/s Ratio Perm	0.02			0.04			0.04			0.01		
v/c Ratio	0.05	0.31		0.12	0.27		0.15	0.36		0.07	0.36	
Uniform Delay, d1	8.4	9.2		8.6	9.1		9.2	11.6		11.1	12.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.3		0.1	0.2		0.2	0.5		0.1	0.5	
Delay (s)	8.5	9.5		8.7	9.3		9.4	12.1		11.1	13.2	
Level of Service	A	A		A	A		A	B		B	B	
Approach Delay (s)		9.4			9.2			11.5			12.9	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	10.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	38.2	Sum of lost time (s)	14.4
Intersection Capacity Utilization	47.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	609	58	17	733	21	0	115	23	0	226	76
Future Volume (vph)	32	609	58	17	733	21	0	115	23	0	226	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.4	5.4	4.0	5.4			4.7			4.7	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00			1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.98			0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3524			1821			1799	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			1.00			1.00	
Satd. Flow (perm)	1770	3539	1583	1770	3524			1821			1799	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	33	634	60	18	764	22	0	120	24	0	235	79
RTOR Reduction (vph)	0	0	35	0	2	0	0	8	0	0	15	0
Lane Group Flow (vph)	33	634	25	18	784	0	0	136	0	0	299	0
Turn Type	Prot	NA	Perm	Prot	NA			NA			NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4									
Actuated Green, G (s)	2.2	21.2	21.2	1.0	20.0			15.6			15.6	
Effective Green, g (s)	2.2	21.2	21.2	1.0	20.0			15.6			15.6	
Actuated g/C Ratio	0.04	0.41	0.41	0.02	0.39			0.30			0.30	
Clearance Time (s)	4.0	5.4	5.4	4.0	5.4			4.7			4.7	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	75	1445	646	34	1357			547			540	
v/s Ratio Prot	c0.02	0.18		0.01	c0.22			0.07			c0.17	
v/s Ratio Perm			0.02									
v/c Ratio	0.44	0.44	0.04	0.53	0.58			0.25			0.55	
Uniform Delay, d1	24.2	11.1	9.2	25.2	12.6			13.7			15.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2	4.1	0.2	0.0	14.1	0.6			0.2			1.2	
Delay (s)	28.3	11.3	9.2	39.3	13.2			14.0			16.5	
Level of Service	C	B	A	D	B			B			B	
Approach Delay (s)		11.9			13.8			14.0			16.5	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	13.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	51.9	Sum of lost time (s)	14.1
Intersection Capacity Utilization	51.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	609	58	17	733	21	0	115	23	0	226	76
Future Volume (vph)	32	609	58	17	733	21	0	115	23	0	226	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.4	5.4	4.0	5.4			5.0			5.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00			1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.98			0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3524			1821			1799	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			1.00			1.00	
Satd. Flow (perm)	1770	3539	1583	1770	3524			1821			1799	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	33	634	60	18	764	22	0	120	24	0	235	79
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	33	634	60	18	786	0	0	144	0	0	314	0
Turn Type	Prot	NA	Perm	Prot	NA			NA			NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4									
Actuated Green, G (s)	2.4	23.0	23.0	1.0	21.6			17.0			17.0	
Effective Green, g (s)	2.4	23.0	23.0	1.0	21.6			17.0			17.0	
Actuated g/C Ratio	0.04	0.42	0.42	0.02	0.39			0.31			0.31	
Clearance Time (s)	4.0	5.4	5.4	4.0	5.4			5.0			5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	76	1469	657	31	1373			558			552	
v/s Ratio Prot	c0.02	0.18		0.01	c0.22			0.08			c0.17	
v/s Ratio Perm			0.04									
v/c Ratio	0.43	0.43	0.09	0.58	0.57			0.26			0.57	
Uniform Delay, d1	25.8	11.5	9.8	27.0	13.3			14.5			16.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2	3.9	0.2	0.1	24.7	0.6			0.2			1.4	
Delay (s)	29.8	11.7	9.9	51.7	13.9			14.7			17.5	
Level of Service	C	B	A	D	B			B			B	
Approach Delay (s)		12.4			14.7			14.7			17.5	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	14.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	55.4	Sum of lost time (s)	14.4
Intersection Capacity Utilization	51.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	28	1067	49	11	696	67	0	126	49	0	129	95
Future Volume (vph)	28	1067	49	11	696	67	0	126	49	0	129	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.4	5.4	4.0	5.4			4.7			4.7	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00			1.00	
Frt	1.00	1.00	0.85	1.00	0.99			0.96			0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3492			1792			1756	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			1.00			1.00	
Satd. Flow (perm)	1770	3539	1583	1770	3492			1792			1756	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	29	1111	51	11	725	70	0	131	51	0	134	99
RTOR Reduction (vph)	0	0	27	0	8	0	0	17	0	0	33	0
Lane Group Flow (vph)	29	1111	24	11	787	0	0	165	0	0	200	0
Turn Type	Prot	NA	Perm	Prot	NA			NA			NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4									
Actuated Green, G (s)	1.6	24.9	24.9	0.5	23.8			13.0			13.0	
Effective Green, g (s)	1.6	24.9	24.9	0.5	23.8			13.0			13.0	
Actuated g/C Ratio	0.03	0.47	0.47	0.01	0.45			0.25			0.25	
Clearance Time (s)	4.0	5.4	5.4	4.0	5.4			4.7			4.7	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	53	1678	750	16	1583			443			434	
v/s Ratio Prot	c0.02	c0.31		0.01	0.23			0.09			c0.11	
v/s Ratio Perm			0.02									
v/c Ratio	0.55	0.66	0.03	0.69	0.50			0.37			0.46	
Uniform Delay, d1	25.1	10.6	7.4	25.9	10.1			16.4			16.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2	11.1	1.0	0.0	80.1	0.2			0.5			0.8	
Delay (s)	36.1	11.6	7.4	106.0	10.4			16.9			17.5	
Level of Service	D	B	A	F	B			B			B	
Approach Delay (s)		12.0			11.7			16.9			17.5	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	12.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	52.5	Sum of lost time (s)	14.1
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	28	1067	49	11	696	67	0	126	49	0	129	95
Future Volume (vph)	28	1067	49	11	696	67	0	126	49	0	129	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.4	5.4	4.0	5.4			5.0			5.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00			1.00	
Frt	1.00	1.00	0.85	1.00	0.99			0.96			0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3492			1792			1756	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			1.00			1.00	
Satd. Flow (perm)	1770	3539	1583	1770	3492			1792			1756	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	29	1111	51	11	725	70	0	131	51	0	134	99
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	29	1111	51	11	795	0	0	182	0	0	233	0
Turn Type	Prot	NA	Perm	Prot	NA			NA			NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4									
Actuated Green, G (s)	2.3	28.1	28.1	0.9	26.7			15.2			15.2	
Effective Green, g (s)	2.3	28.1	28.1	0.9	26.7			15.2			15.2	
Actuated g/C Ratio	0.04	0.48	0.48	0.02	0.46			0.26			0.26	
Clearance Time (s)	4.0	5.4	5.4	4.0	5.4			5.0			5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	69	1697	759	27	1591			464			455	
v/s Ratio Prot	c0.02	c0.31		0.01	0.23			0.10			c0.13	
v/s Ratio Perm			0.03									
v/c Ratio	0.42	0.65	0.07	0.41	0.50			0.39			0.51	
Uniform Delay, d1	27.5	11.6	8.2	28.6	11.2			17.9			18.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2	4.1	0.9	0.0	9.7	0.2			0.5			1.0	
Delay (s)	31.6	12.5	8.2	38.3	11.5			18.4			19.5	
Level of Service	C	B	A	D	B			B			B	
Approach Delay (s)		12.8			11.9			18.4			19.5	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	13.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	58.6	Sum of lost time (s)	14.4
Intersection Capacity Utilization	50.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	61	668	80	88	662	195	153	375	246	88	181	47
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	1.00		0.96	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	64	696	83	92	690	203	159	391	256	92	189	49
Adj No. of Lanes	1	2	1	1	2	1	1	2	1	2	2	1
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	82	1393	620	116	1501	662	193	913	392	178	751	326
Arrive On Green	0.05	0.39	0.39	0.07	0.42	0.42	0.11	0.26	0.26	0.05	0.21	0.21
Sat Flow, veh/h	1774	3539	1575	1774	3539	1561	1774	3539	1519	3442	3539	1536
Grp Volume(v), veh/h	64	696	83	92	690	203	159	391	256	92	189	49
Grp Sat Flow(s),veh/h/ln	1774	1770	1575	1774	1770	1561	1774	1770	1519	1721	1770	1536
Q Serve(g_s), s	3.1	12.8	1.9	4.4	12.0	5.3	7.6	8.0	13.0	2.3	3.8	2.2
Cycle Q Clear(g_c), s	3.1	12.8	1.9	4.4	12.0	5.3	7.6	8.0	13.0	2.3	3.8	2.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	82	1393	620	116	1501	662	193	913	392	178	751	326
V/C Ratio(X)	0.78	0.50	0.13	0.79	0.46	0.31	0.82	0.43	0.65	0.52	0.25	0.15
Avail Cap(c_a), veh/h	267	1393	620	267	1501	662	246	1311	563	518	1352	587
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	40.7	19.8	7.1	39.8	17.8	8.3	37.7	26.7	28.6	39.9	28.3	27.7
Incr Delay (d2), s/veh	5.8	1.3	0.4	4.5	1.0	1.2	12.9	0.2	1.4	0.9	0.1	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	6.4	1.3	2.3	6.1	2.9	4.4	3.9	5.6	1.1	1.9	1.0
LnGrp Delay(d),s/veh	46.5	21.1	7.5	44.3	18.8	9.5	50.6	27.0	30.0	40.8	28.5	27.9
LnGrp LOS	D	C	A	D	B	A	D	C	C	D	C	C
Approach Vol, veh/h		843			985			806			330	
Approach Delay, s/veh		21.7			19.3			32.6			31.8	
Approach LOS		C			B			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.6	39.0	13.4	23.3	8.0	41.6	9.5	27.3
Change Period (Y+Rc), s	5.0	* 5	4.0	5.0	4.0	5.0	5.0	* 5
Max Green Setting (Gmax), s	13.0	* 34	12.0	33.0	13.0	34.0	13.0	* 32
Max Q Clear Time (g_c+I1), s	6.4	14.8	9.6	5.8	5.1	14.0	4.3	15.0
Green Ext Time (p_c), s	0.3	5.5	0.0	1.1	0.0	6.1	0.8	2.4

Intersection Summary	
HCM 2010 Ctrl Delay	25.0
HCM 2010 LOS	C

Notes

* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑↑			↑			↑	
Volume (veh/h)	0	1002	0	0	945	0	0	10	0	0	10	0
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1863	0	0	1863	0	0	950	0	0	950	0
Adj Flow Rate, veh/h	0	1044	0	0	984	0	0	10	0	0	10	0
Adj No. of Lanes	0	2	0	0	2	0	0	1	0	0	1	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	0	2	0	0	2	0	0	100	0	0	100	0
Cap, veh/h	0	2712	0	0	2712	0	0	74	0	0	74	0
Arrive On Green	0.00	0.77	0.00	0.00	0.77	0.00	0.00	0.08	0.00	0.00	0.08	0.00
Sat Flow, veh/h	0	3725	0	0	3725	0	0	950	0	0	950	0
Grp Volume(v), veh/h	0	1044	0	0	984	0	0	10	0	0	10	0
Grp Sat Flow(s),veh/h/ln	0	1770	0	0	1770	0	0	950	0	0	950	0
Q Serve(g_s), s	0.0	5.0	0.0	0.0	4.6	0.0	0.0	0.5	0.0	0.0	0.5	0.0
Cycle Q Clear(g_c), s	0.0	5.0	0.0	0.0	4.6	0.0	0.0	0.5	0.0	0.0	0.5	0.0
Prop In Lane	0.00		0.00	0.00		0.00	0.00		0.00	0.00		0.00
Lane Grp Cap(c), veh/h	0	2712	0	0	2712	0	0	74	0	0	74	0
V/C Ratio(X)	0.00	0.38	0.00	0.00	0.36	0.00	0.00	0.14	0.00	0.00	0.14	0.00
Avail Cap(c_a), veh/h	0	8686	0	0	8686	0	0	851	0	0	851	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh	0.0	2.0	0.0	0.0	1.9	0.0	0.0	22.1	0.0	0.0	22.1	0.0
Incr Delay (d2), s/veh	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.8	0.0	0.0	0.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	2.4	0.0	0.0	2.2	0.0	0.0	0.1	0.0	0.0	0.1	0.0
LnGrp Delay(d),s/veh	0.0	2.1	0.0	0.0	2.0	0.0	0.0	22.9	0.0	0.0	22.9	0.0
LnGrp LOS		A			A			C			C	
Approach Vol, veh/h		1044			984			10			10	
Approach Delay, s/veh		2.1			2.0			22.9			22.9	
Approach LOS		A			A			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		8.0		43.3		8.0		43.3
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		46.0		126.0		46.0		126.0
Max Q Clear Time (g_c+I1), s		2.5		7.0		2.5		6.6
Green Ext Time (p_c), s		0.1		32.3		0.1		32.3

Intersection Summary	
HCM 2010 Ctrl Delay	2.3
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	33	1105	113	107	592	87	119	275	239	216	232	45
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	1.00		0.97	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	34	1128	115	109	604	89	121	281	244	220	237	46
Adj No. of Lanes	1	2	1	1	2	1	1	2	1	2	2	1
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	42	1428	636	139	1658	732	150	774	335	300	821	358
Arrive On Green	0.02	0.40	0.40	0.08	0.47	0.47	0.08	0.22	0.22	0.09	0.23	0.23
Sat Flow, veh/h	1774	3539	1575	1774	3539	1563	1774	3539	1532	3442	3539	1543
Grp Volume(v), veh/h	34	1128	115	109	604	89	121	281	244	220	237	46
Grp Sat Flow(s),veh/h/ln	1774	1770	1575	1774	1770	1563	1774	1770	1532	1721	1770	1543
Q Serve(g_s), s	1.8	26.3	3.1	5.7	10.3	1.9	6.3	6.3	13.9	5.9	5.2	2.2
Cycle Q Clear(g_c), s	1.8	26.3	3.1	5.7	10.3	1.9	6.3	6.3	13.9	5.9	5.2	2.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	42	1428	636	139	1658	732	150	774	335	300	821	358
V/C Ratio(X)	0.81	0.79	0.18	0.79	0.36	0.12	0.81	0.36	0.73	0.73	0.29	0.13
Avail Cap(c_a), veh/h	226	1428	636	226	1658	732	188	1203	521	365	1203	524
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	45.8	24.6	8.8	42.6	16.0	5.7	42.3	31.2	34.2	41.9	29.8	28.6
Incr Delay (d2), s/veh	12.4	4.5	0.6	3.7	0.6	0.3	14.5	0.1	1.1	4.3	0.1	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.0	13.7	1.9	2.9	5.2	1.3	3.7	3.1	6.0	3.0	2.5	1.0
LnGrp Delay(d),s/veh	58.1	29.1	9.4	46.3	16.7	6.1	56.9	31.3	35.3	46.2	29.9	28.7
LnGrp LOS	E	C	A	D	B	A	E	C	D	D	C	C
Approach Vol, veh/h		1277			802			646			503	
Approach Delay, s/veh		28.1			19.5			37.6			36.9	
Approach LOS		C			B			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.4	43.0	12.0	26.8	6.2	49.1	13.2	25.6
Change Period (Y+Rc), s	5.0	* 5	4.0	5.0	4.0	5.0	5.0	* 5
Max Green Setting (Gmax), s	12.0	* 38	10.0	32.0	12.0	38.0	10.0	* 32
Max Q Clear Time (g_c+I1), s	7.7	28.3	8.3	7.2	3.8	12.3	7.9	15.9
Green Ext Time (p_c), s	0.2	6.5	0.0	1.3	0.0	4.2	0.4	1.4

Intersection Summary	
HCM 2010 Ctrl Delay	29.2
HCM 2010 LOS	C

Notes

* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑↑			↑			↑	
Volume (veh/h)	0	1560	0	0	786	0	0	10	0	0	10	0
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1863	0	0	1863	0	0	950	0	0	950	0
Adj Flow Rate, veh/h	0	1592	0	0	802	0	0	10	0	0	10	0
Adj No. of Lanes	0	2	0	0	2	0	0	1	0	0	1	0
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	0	2	0	0	2	0	0	100	0	0	100	0
Cap, veh/h	0	2958	0	0	2958	0	0	52	0	0	52	0
Arrive On Green	0.00	0.84	0.00	0.00	0.84	0.00	0.00	0.05	0.00	0.00	0.05	0.00
Sat Flow, veh/h	0	3725	0	0	3725	0	0	950	0	0	950	0
Grp Volume(v), veh/h	0	1592	0	0	802	0	0	10	0	0	10	0
Grp Sat Flow(s),veh/h/ln	0	1770	0	0	1770	0	0	950	0	0	950	0
Q Serve(g_s), s	0.0	9.8	0.0	0.0	3.5	0.0	0.0	0.7	0.0	0.0	0.7	0.0
Cycle Q Clear(g_c), s	0.0	9.8	0.0	0.0	3.5	0.0	0.0	0.7	0.0	0.0	0.7	0.0
Prop In Lane	0.00		0.00	0.00		0.00	0.00		0.00	0.00		0.00
Lane Grp Cap(c), veh/h	0	2958	0	0	2958	0	0	52	0	0	52	0
V/C Ratio(X)	0.00	0.54	0.00	0.00	0.27	0.00	0.00	0.19	0.00	0.00	0.19	0.00
Avail Cap(c_a), veh/h	0	6107	0	0	6107	0	0	598	0	0	598	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh	0.0	1.8	0.0	0.0	1.3	0.0	0.0	33.0	0.0	0.0	33.0	0.0
Incr Delay (d2), s/veh	0.0	0.2	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	1.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	4.5	0.0	0.0	1.7	0.0	0.0	0.2	0.0	0.0	0.2	0.0
LnGrp Delay(d),s/veh	0.0	1.9	0.0	0.0	1.3	0.0	0.0	34.7	0.0	0.0	34.7	0.0
LnGrp LOS		A			A			C			C	
Approach Vol, veh/h		1592			802			10			10	
Approach Delay, s/veh		1.9			1.3			34.7			34.7	
Approach LOS		A			A			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		8.0		65.0		8.0		65.0
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		46.0		126.0		46.0		126.0
Max Q Clear Time (g_c+I1), s		2.7		11.8		2.7		5.5
Green Ext Time (p_c), s		0.1		49.2		0.1		50.1

Intersection Summary	
HCM 2010 Ctrl Delay	2.0
HCM 2010 LOS	A

Appendix D – Evaluation of Road-over-Rail Alternative.

Evaluation of Road-over-Rail Alternative

At the beginning of the development for grade separation concepts at the selected candidate locations, the grade separation formations has been evaluated. Two major categories of the separation formations are defined as: elevation of rail/ roadway, and depression of rail/ roadway. The elevation form is constructing elevated structures, consisted of bridges, viaduct and retained fill, to separate existing at grade crossing by allowing railways or roadways to cross over the other. The depression form is constructing bridges, culverts, and retained channels to separate existing at grade crossing by allowing railways or roadways to pass under the other.

The depression form requires major excavation which is more costly, environmentally impacting and risky with the concerns of variant geotechnical conditions. Also, all the selected at grade crossings for grade separation locate in highly developed urban areas, where intensive underground utilities network is anticipated. The depression form of the grade separation will generate tremendous impacts to the existing underground utilities due to the scale of excavation, and results in prolonged and extensive utilities mitigation tasks which are costly. Furthermore, the hydraulic factor of flash flood specifically in the LA Metropolitan area will require additional cost for pump stations with extra capacities and efficiencies. With all these concerns, depression form is considered only when absolutely necessary, which was not the case in any of the candidate for grade separation. So, for the grade separation concepts developing, only elevation form was applied to all the selected locations.

The elevation formation of the grade separation can be further divided in two alternatives as rail-over-road and road-over-rail.

It was determined that the optimal solution for each of the crossings analyzed was rail-over-road. Major reasons for this determination include:

1. Road-over-rail alternative may carry bigger footprint with more local impacts

2. While both elevated roadway and elevated trackway would adopt a maximum grade of 5%, the road-over-rail alternative's elevated structures over the LRT and UP tracks, which requires 23.5' vertical clearance over UPRR's top of rails (comparing to only 16' over roads for rail-over-road alternative), would require longer approach ramps (more than 500 feet long plus vertical curves) and wider width (40 to 50 feet wide, depending on the lane numbers). Such structures would not only be very costly but also, in most of the cases, non-viable solution as these would highly impact adjacent intersections, streets and/or driveways.

   Figure 1, a sketched footprint of 103rd Street road-over-rail grade separation, demonstrates the extent of elevated roadway structure's footprint and its potential impacts to the surrounding.

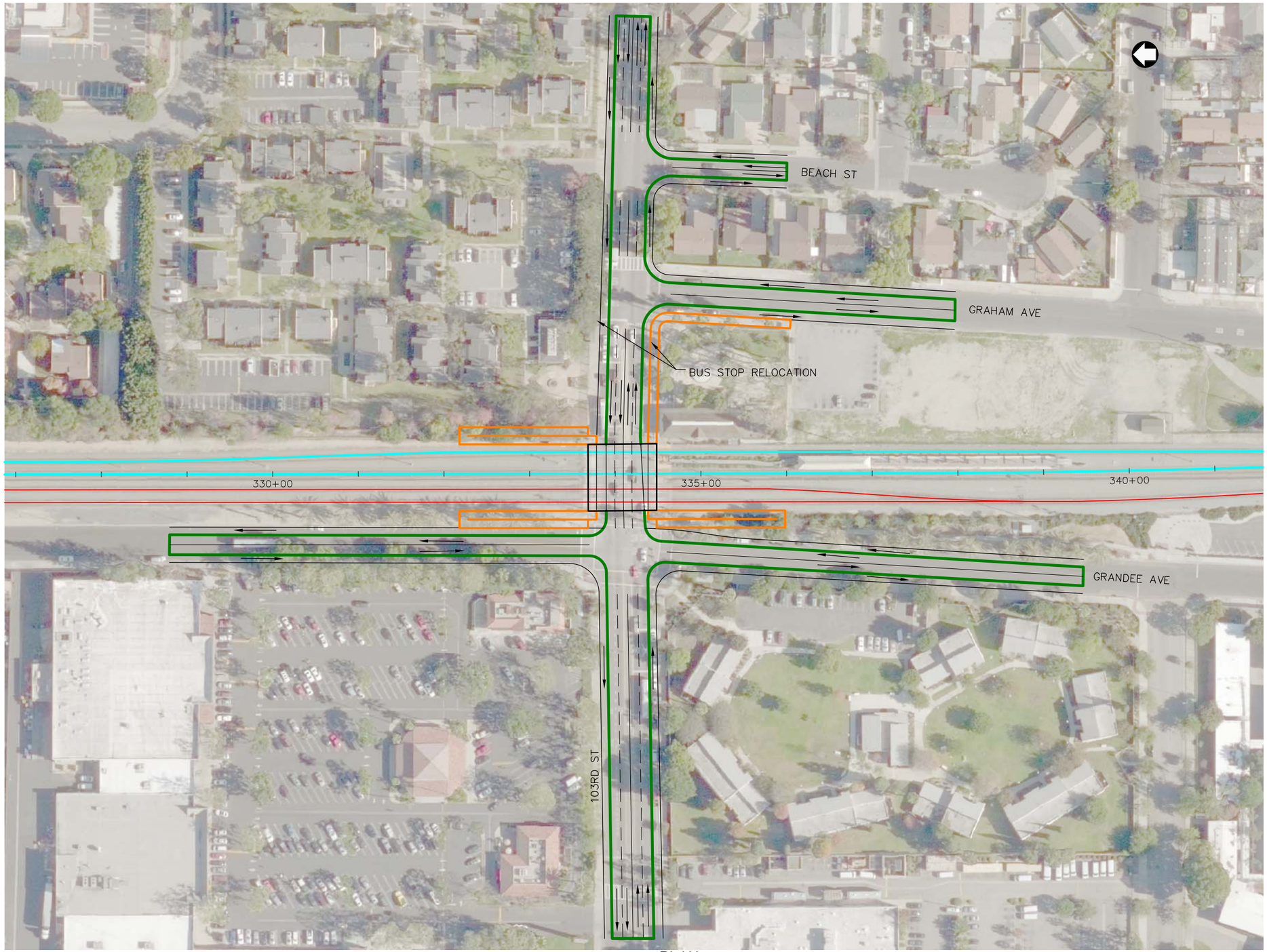
   The aerial photo in **Figure 2**, shows a similar road-over-rail structure for visualization the extent and impacts of such grade separation.

3. Road-over-rail alternative may require more R-O-W acquisition and additional viaducts for frontage roads

   When the proposed road-over-rail structures block the existing accesses of adjacent properties along the roads to be elevated, frontage roads would be needed to mitigate such access impacts. These frontage roads shall have sufficient widths not only for the access to the properties but also the passage of emergency vehicles, see **Figure 3**. Unfortunately, the existing roadways to be elevated generally do not have the provision of additional right-of-way to accommodate sufficiently wide frontage roads. So, to meet this frontage road width needs, the projects would either acquire additional right-of-way from the adjacent properties, and/ or construct viaduct instead retained fill to provide additional with beneath the viaduct overhang. However, this extended viaduct could be aesthetic impact and invite public opposition, see **Figure 4**.

4. The road-over-rail alternative would produce a longer and less ADA friendly climbing sidewalks than rail-over-road alterative which leave the pedestrian paths at grade. See **Figure 5**.

5. Road-over-rail alternative would have more negative impacts to the local vehicle traffic during construction and would force to shut down the crossing. Such road closure requires a temporary grade crossing close to the existing one or implement a traffic detour towards the adjacent grade crossing.



PLAN

NOTES:

- RAMPS 5% MAX
- 23.5' VERTICAL CLEARANCE OVER TOR

LEGEND:

- BLUE LINE TRACKS
- UP TRACKS
- BLUE LINE SHOOFLY
- LIMIT OF APPROACH RAMPS
- PEDESTRIAN ADA RAMPS
- STRUCTURE OVER LRT AND UP

60' 0 60' 120'

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY JC
DRAWN BY CC
CHECKED BY JC
IN CHARGE
DATE 06-22-18

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

RSE, INC.
1075 Old County Road
Belmont, CA 94002
www.rserail.com

METRO BLUE LINE

103RD ST/CENTURY BLVD
GRADE SEPARATION
ROAD-OVER-RAIL

CONTRACT NO
DRAWING NO Figure 1 REV
SCALE 1"=60'
SHEET NO D-3

J:\Project\14AEC180888\04-CAD\Sheets\103rd St Ramp.dwg
Friday, June 22, 2018 5:20:28 PM

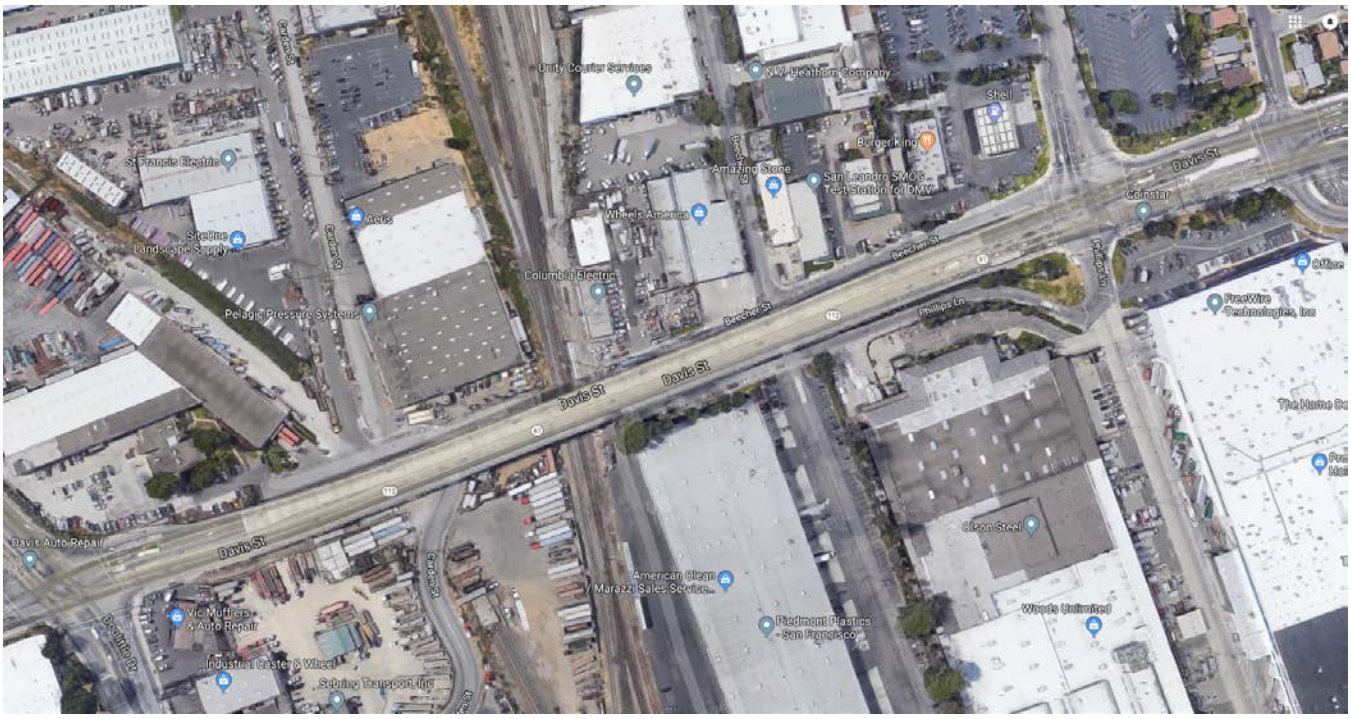


Figure 2. - Aerial Photo of the Roadway Overhead Structure over UPRR

Davis Street Overhead, San Leandro, CA

Figure 3. - Frontage Roads on the sides of overhead structure require sufficient widths for emergency vehicle access.

Figure 4. - Extensive viaduct structure will provide additional widths for the frontage roads but also introduce “eye sores” to neighborhood.

Figure 5. - The long climbing sidewalk along Lawrence Expwy Overhead Structure

City of San Jose, CA

TASK 6 - Final Report

Metro Blue Line Grade Crossing Safety Policy Analysis Step 1 and Analysis Step 2

Los Angeles County Metropolitan Transit Authority

July 24, 2018

Quality Information

Prepared by	Checked by	Approved by
Tiffany Huang	Brent Ogden	Marlen Alfonso

Revision History

Revision	Revision date	Details	Authorized	Name	Position
Draft Report	April 13, 2018	Partial Draft (M1)	NA	NA	NA
Revised Draft Report	April 30, 2018	Internal Version (Incorporates Metro Comments)	NA	NA	NA
Updated Draft Report	June 15, 2018	Updated to include M2 Results	NA	NA	NA
Draft Final Report	June 29, 2018	Incorporates Metro comments	NA	NA	NA
Final Report	July 18, 2018	Incorporates Metro comments	NA	NA	NA
Revised Final Report	July 24, 2018	Incorporates Metro comment	NA	NA	NA

Distribution List

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Table of Contents

Figures

Tables

1. Introduction

This Technical Memorandum transmits the results of the Analysis Step 1 (Initial Screening) and Analysis Step 2 (Detailed Analysis) evaluation of all grade crossings along the Metro Blue Line (MBL) alignment in accordance with the Los Angeles Metro Grade Crossing Safety Policy, hereafter referred to as the Policy.

1.1 Background

MBL is a 22-mile light rail line running between Los Angeles and Long Beach. Opened in 1990, it is the oldest light rail line within the Metro Rail network. As more rail lines opened in Los Angeles County, Metro has updated its safety standards, continually making further improvements and advancing safety for the public. This project is a component of that ongoing effort and responds to a February 2017 Board Committee's motion to study additional grade separations along the Blue Line alignment that would improve safety and operations in terms of service reliability and schedule adherence.

There are 78 vehicle/pedestrian at-grade crossings along MBL alignment. Since MBL's construction, Metro had adopted the Metro Grade Crossing Safety Policy for Light Rail Transit in 2003, which was then revised in 2010. The Policy was developed to determine which crossings need to be grade separated when a new light rail line or a new extension to a light rail line is being considered. The Policy was not intended to prioritize grade crossings for separation on an existing operating line such as the MBL, and there are no universally accepted industry guidelines for doing so, therefore a new method for prioritization had to be devised.

The new method chosen was based upon a formula used by the California Public Utilities Commission for prioritizing state investments in the "Section 190" (Grade Separation) funds for mainline heavy rail crossings, considering MBL-specific collision data, operational data characterizing vehicular and pedestrian activity levels, and other safety-related factors specific to LRT operations. This approach is consistent with an earlier study also conducted in response to a previous Board motion to evaluate the rank of a grade separation of the W Wardlow Road crossing in relation to other gated crossings on the MBL.

1.2 Grade Crossing Evaluation Overview

This document takes this process described above one step further – even though the Policy does not strictly apply to the MBL, which is an existing line, it was nevertheless applied, assuming the MBL were a new line proposed for construction.

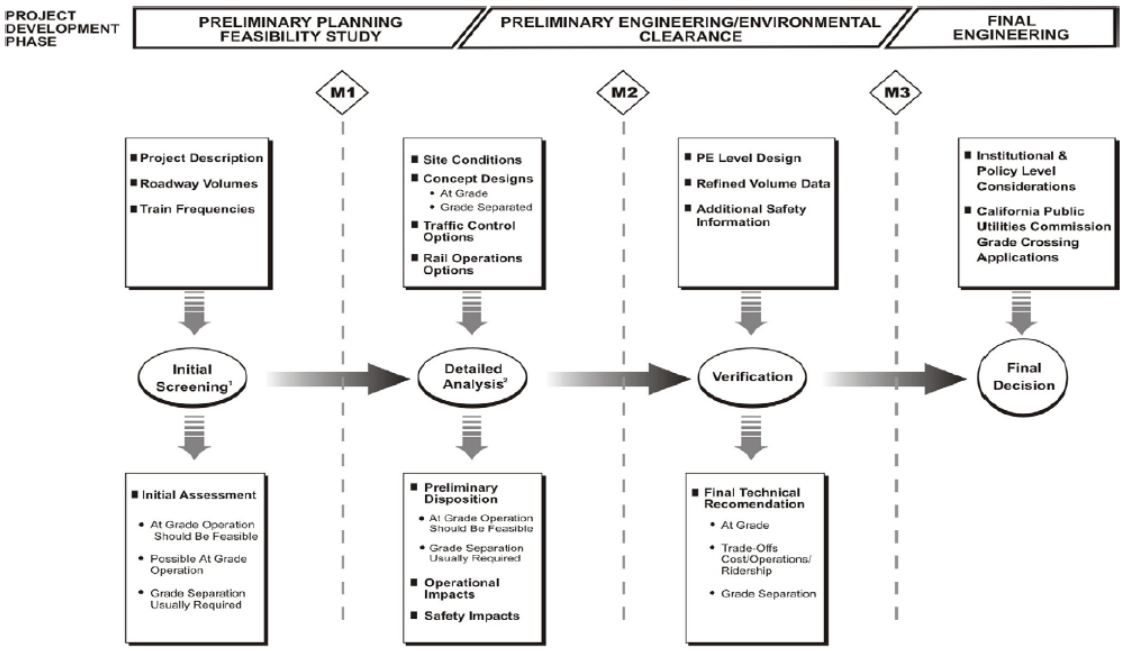
Figure 1 shows the 3-step safety review process of the Policy which includes:

- Analysis Step 1 – Initial Screening,
- Analysis Step 2 – Detailed Analysis, and
- Analysis Step 3 – Verification.

Between the initial publication of the Policy in December 2003 and the Revised Policy in October 2010, the analytical protocols have been renamed from Milestones to Analysis Steps, but these terms are essentially interchangeable.

Note, for this report, the steps will hereafter be referred to as Analysis Steps as congruent to the latest revised Policy.

Figure 1. – Light Rail Grade Crossing Review Process



Source: LA Metro Grade Crossing Safety Policy for Light Rail Transit, 2010.

2. Analysis Methodology

To complete the analyses outlined in the Policy, data was collected to inform the inputs for both Analysis Steps 1 and 2.

2.1 Alignment Description

For the purposes of this analysis, the existing grade crossings are divided into three sections, the Los Angeles Street Running segment, the “Mid Corridor” segment extending from Los Angeles through Vernon to Long Beach which is located within the former Pacific Electric railroad right-of-way generally paralleled by the Union Pacific San Pedro Subdivision, and the Long Beach Street Running segment.

The Los Angeles Street Running segment includes a “side running” alignment along the east side of South Flower Street as well as a “median running” alignment along Washington Boulevard – all grade crossings are controlled by traffic signals, except at the Flower/I-10 on-ramp intersection where a left turn gate pilot project is underway.

The Mid Corridor section passes through the City of Los Angeles, unincorporated Los Angeles County, City of Compton, and the City of Long Beach. The northernmost crossing in the Mid Corridor section is located at E. 20th Street in Los Angeles and the southernmost crossing is at Spring Street in Long Beach – all crossings are controlled with crossing gates and some crossings have adjacent traffic signals at the frontage roads.

The Long Beach Street Running segment includes a “median running” alignment along Long Beach Boulevard as well as a single track, “one-way loop” median alignment along Long Beach Boulevard, W. 1st Street, Pacific Avenue and W. 8th Street – all crossings are controlled with traffic signals. **Figure 2** provides an overview of the MBL crossings and stations.

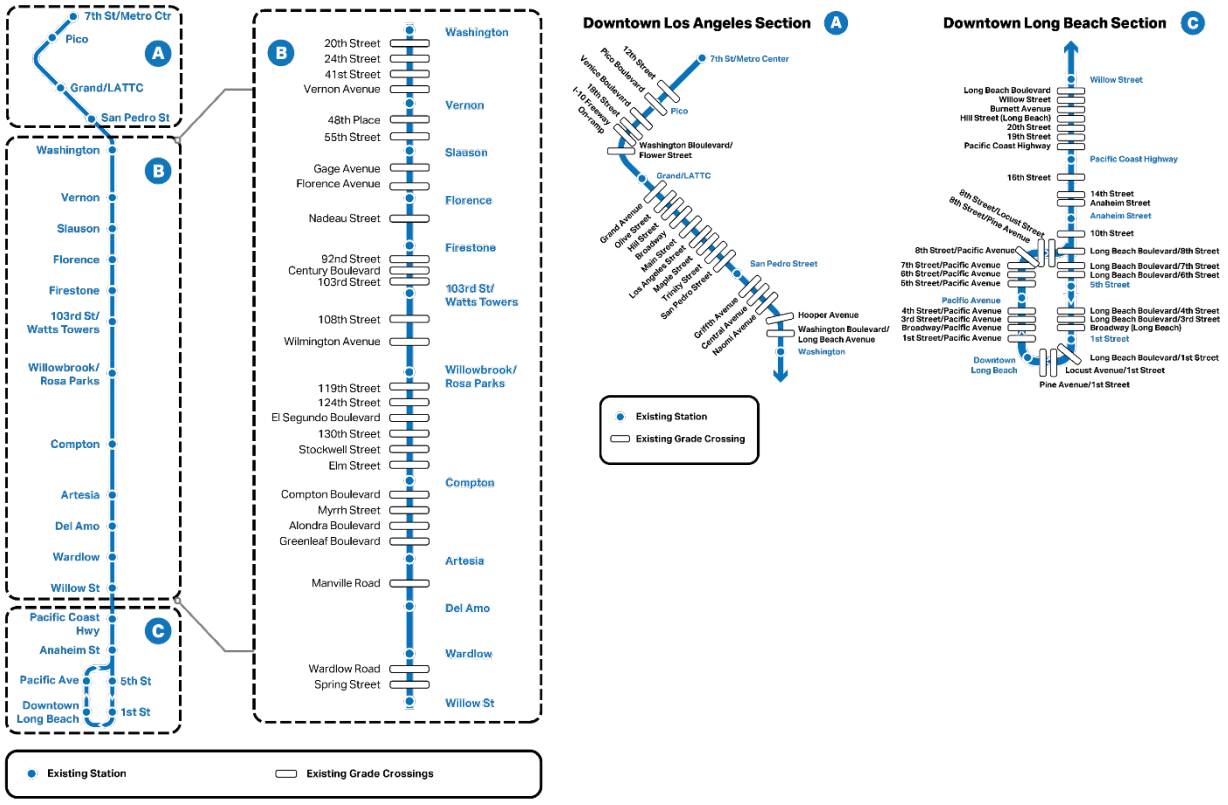


Figure 2. – MBL Overview and Mid-corridor, Downtown and Long Beach Sections crossings Maps.

The configuration of the alignments, traffic control at each grade crossing, and light rail maximum speeds are shown, per segment, in **Table 1**. The maximum speeds depend upon distance from stations, horizontal curvature, and vertical profile.

Table 1. – Alignment Configuration, Traffic Control and Maximum Speed

Segment	Alignment Configuration	Traffic Control	Light Rail Maximum Speed
Los Angeles Street Running	Side Running and Median Running LRT	Traffic Signals & Transit Priority	35 mph
Mid Corridor	Shared Railroad Corridor and off-street LRT Rail Corridor	Railroad Devices* with some adjacent traffic signals	55 mph
Long Beach Street Running	Median Running LRT One-Way Median Loop LRT	Traffic Signals & Transit Priority	35 mph

* *Railroad devices include flashing lights, gates, and audible devices.*

2.2 Roadway Volumes

Roadway volumes were collected from intersection traffic counts at intersections adjacent to at-grade crossings. Data collection for the Mid Corridor was completed for the previous study in 2017. Data collection for the Los Angeles Street Running and Long Beach Street Running Segments was conducted in January and February of 2018.

AM and PM turning movement counts in 15-minute increments were collected during the peak hour periods of 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM. Counts included traffic, pedestrian, and bicycle volumes.

The overall peak hour was determined from these periods and used for calculation of conflict volume, defined as peak hour volume per lane, which represents the horizontal axis in the initial screening nomograph (as shown in **Figure 4** through **Figure 6**).

The conflict volume was determined by evaluating the highest peak hour conflicting movement flow rate (by direction) and dividing that by the number of lanes for that movement. The calculations for these conflict volumes vary by the type of grade crossing configuration. Evaluated configurations were categorized as mid-block, median, side running, or at-grade turn grade crossings.

The calculation methodologies for conflict volumes for each configuration are provided in **Appendix A**.

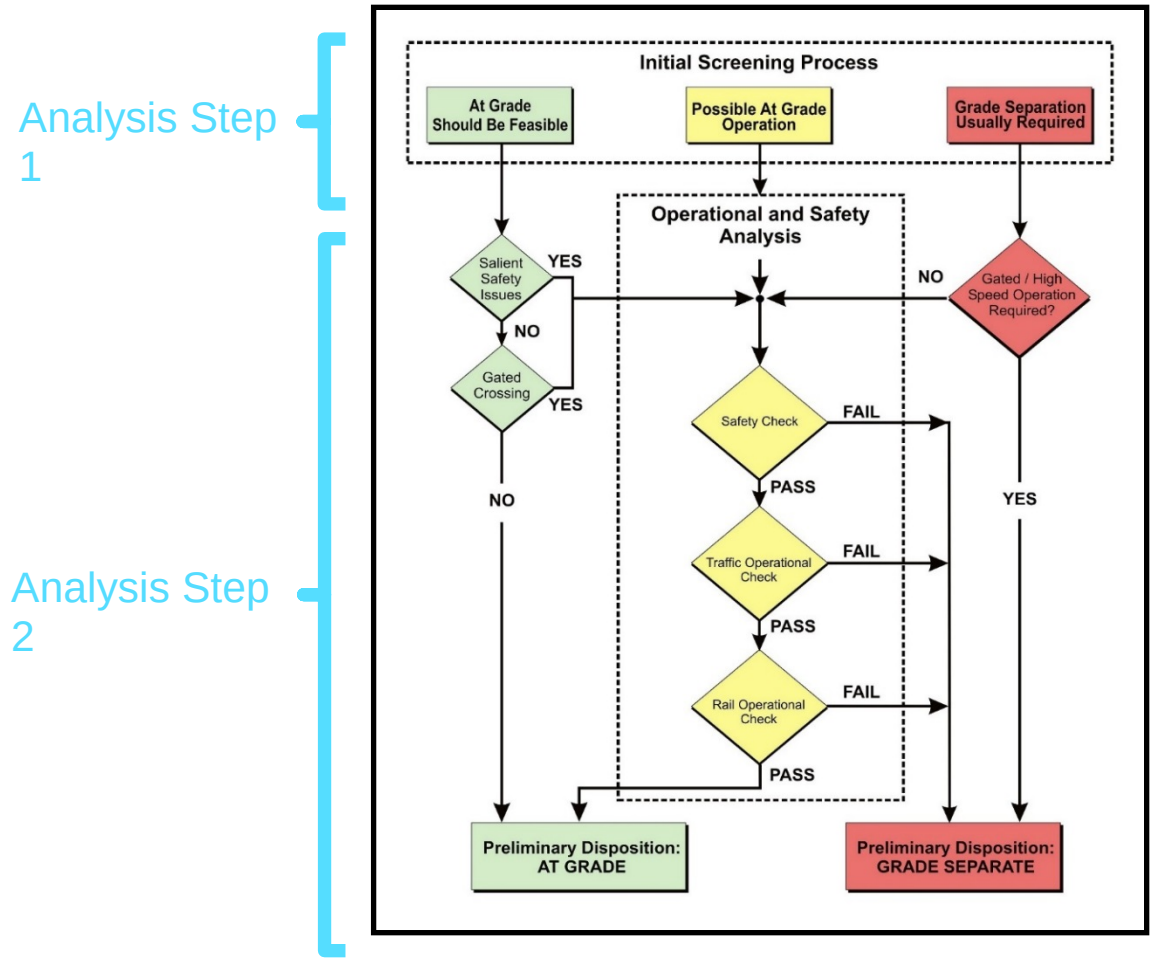
2.3 Train Frequencies

The maximum peak time headway is 6 minutes, or 10 trains per hour in each direction. This represents the vertical axis in the initial screening nomograph.

2.4 Evaluation Methodology

This section summarizes the methodology used in evaluating grade crossings, as specified in the Policy. **Figure 2** below shows graphically the flowchart process for evaluating each grade crossing.

Figure 3. – LA Metro Grade Crossing Safety Policy Analysis Flowchart



Source: Metro Grade Crossing Safety Policy for Light Rail Transit (2011)

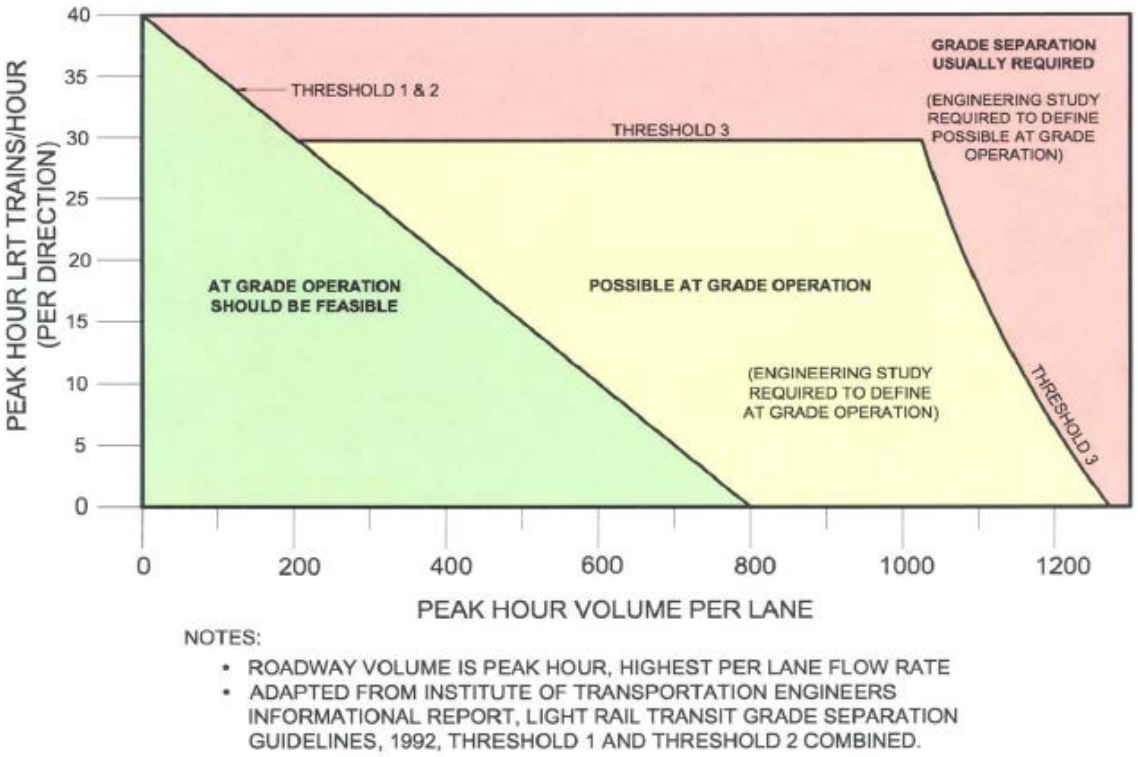
2.4.1 Analysis Step 1

Analysis Step 1 developed the preliminary assessments of each grade crossing, categorizing each in the following groups:

- At-grade operation should be feasible (“Green Zone”);
- Possible At-grade operation (“Yellow Zone”); and
- Grade separation usually required (“Red Zone”).

To make these assessments, the project team graphed each grade crossing’s peak hour conflict volume per lane against the peak hour trains per hour per direction on the *Nomograph for Initial Screening* provided in the Policy, shown in **Figure 3**.

Figure 4. – Nomograph for Initial Screening



Source: Metro Grade Crossing Safety Policy for Light Rail Transit (2011).

2.4.2 Analysis Step 2

Analysis Step 2 carries the grade crossing assessment further. Crossings screened in the Green Zone in Analysis Step 1 are further evaluated to determine whether there are salient safety issues which need to be evaluated as part of the Safety Check, or, if the crossing is proposed to be gated before a preliminary disposition of “At Grade” can be confirmed. All Yellow Zone crossings require evaluation of the Safety Check plus the Rail and Traffic Operational Checks, and can be recommended for “At Grade” operation if treatments can be provided for all issues which are identified. Red Zone crossings are ordinarily considered to be “Grade Separated” unless modifications to Traffic and Rail Operations can be identified along with treatments for any Safety Check findings. For example, adding roadway capacity to lower the conflict volume or operating the LRT under lower priority may allow a Red Zone crossing to be proposed for At Grade operation.

At each grade crossing, the goal is to consider crossing safety, the rail operation, and cross traffic operation such that all safety concerns are addressed and an acceptable balance between rail and traffic operation is achieved. Design options that may enhance any of the three parameters may impact one or both of the other parameters. Thus, the approach in considering recommendations at each grade crossing is to strike a balance between each of the three interconnected concerns.

3. Analysis Step 1 Findings

3.1.1 Los Angeles Street Running Segment

The Los Angeles Street Running segment transitions from below grade operation to at-grade operation beginning at the 12th Street crossing. This alignment lies in the city of Los Angeles, side-running along the east side of Flower Street, turning eastbound at Washington Boulevard, and median-running along Washington Boulevard. The crossings along this trackway are controlled by traffic signals and the maximum speed on this segment is 35 mph.

The nomograph shows only two dots in the yellow zone, because the conflict volumes at Central and Griffith Avenues are essentially the same. Therefore, **Table 2** lists three crossings on the yellow zone.

Figure 4 and **Table 2** summarize the results of Analysis Step 1 for the Los Angeles Street Running segment.

Figure 4. – Nomograph for Initial Screening for Los Angeles Street Running Segment

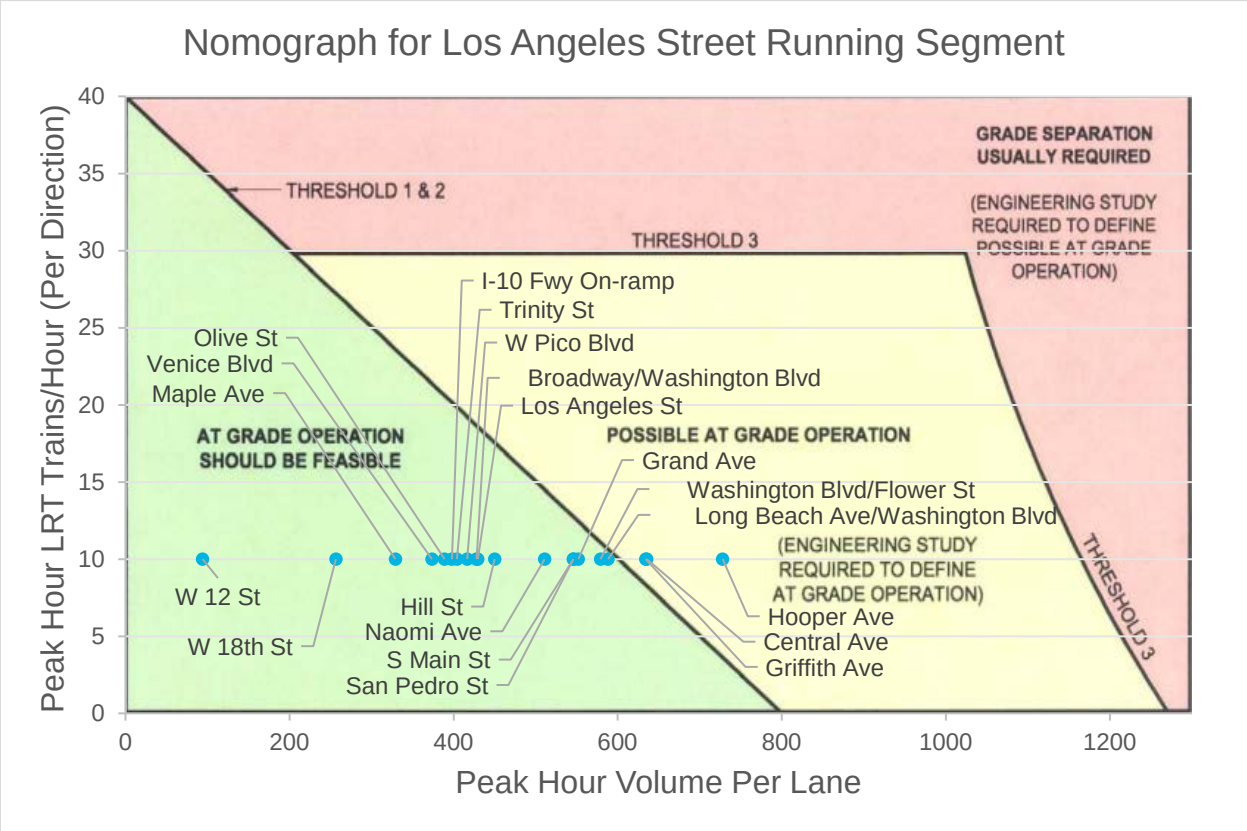


Table 2. – Los Angeles Street Running Segment Initial Screening Results

Grade Crossing	Alignment Configuration	Initial Screening Results	Notes and Next Steps
W 12 St.	Side-running	At-grade operation should be feasible	
W Pico Blvd.	Side-running	At-grade operation should be feasible	
Venice Blvd.	Side-running	At-grade operation should be feasible	
I-10 Fwy. On-ramp	Side-running	At-grade operation should be feasible	
W 18th St.	Side-running	At-grade operation should be feasible	
Washington Blvd./Flower St.	At-grade Turn	At-grade operation should be feasible	
Grand Ave.	Median	At-grade operation should be feasible	

Grade Crossing	Alignment Configuration	Initial Screening Results	Notes and Next Steps
Olive St.	Median	At-grade operation should be feasible	
Hill St.	Median	At-grade operation should be feasible	
Broadway	Median	At-grade operation should be feasible	
S Main St.	Median	At-grade operation should be feasible	
Los Angeles St.	Median	At-grade operation should be feasible	
Maple Ave.	Median	At-grade operation should be feasible	
Trinity St.	Median	At-grade operation should be feasible	
San Pedro St.	Median	At-grade operation should be feasible	
Griffith Ave.	Median	Possible at-grade operation	Analysis Step 2
Central Ave.	Median	Possible at-grade operation	Analysis Step 2
Naomi Ave.	Median	At-grade operation should be feasible	
Hooper Ave.	Median	Possible at-grade operation	Analysis Step 2
Long Beach Ave./Washington Blvd.	At-grade Turn	At-grade operation should be feasible	

3.1.2 Mid Corridor Segment

The Mid Corridor segment of the MBL consists of the 27 gated crossings that includes 20th Street crossing in the north through the Spring Street crossing in the south. The Mid Corridor segment runs through various cities in Los Angeles County.

The crossings in this segment are gated, allowing the trains to operate at a maximum speed of 55 mph. Per the Policy, gated segments in the "Green Zone" on the nomograph require further assessment to evaluate safety impacts. Therefore, even those gated crossings in the Green Zone will need a queue check to verify whether traffic signal preemption or anti-queuing measures will need to be considered. **Figure 5** and **Table 3** summarize the results of Analysis Step 1 for the Mid Corridor segment.

Figure 5. – Nomograph for Initial Screening for Mid Corridor Segment

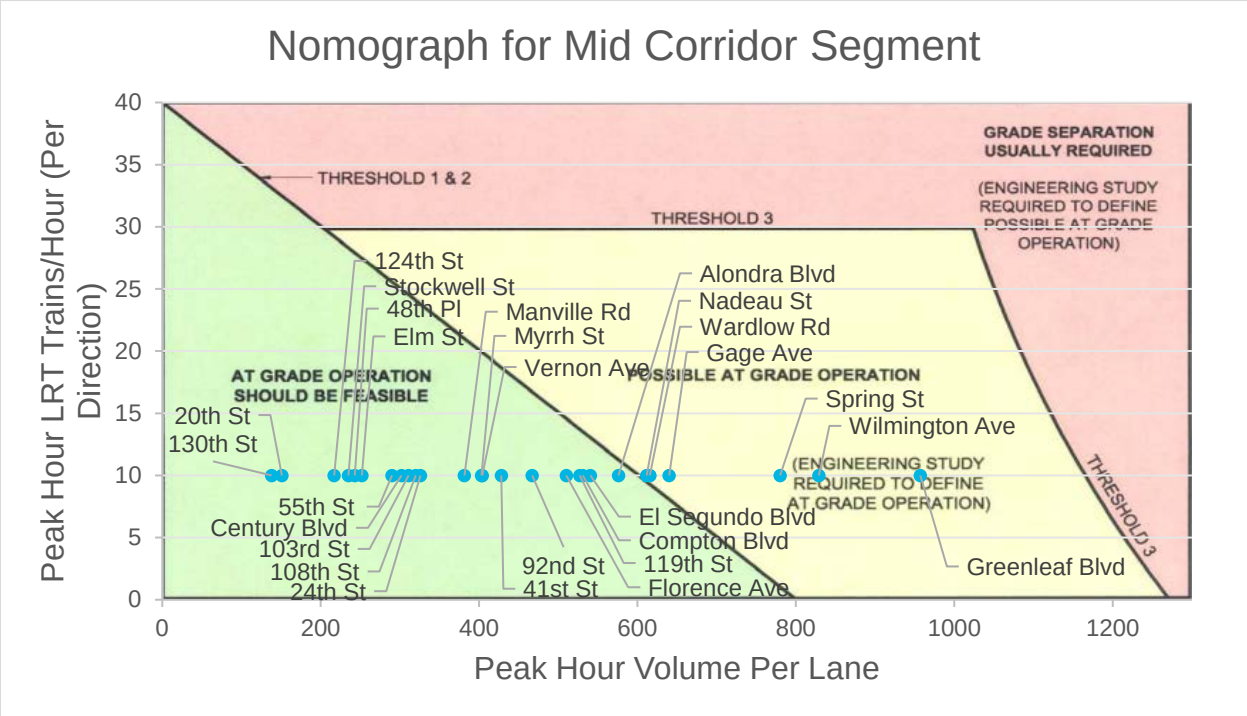


Table 3. – Mid Corridor Segment Initial Screening Results

Grade Crossing	Alignment Configuration	Initial Screening Results	Notes and Next Steps
20th St.	Median	At-grade operation should be feasible	Analysis Step 2*
24th St.	Median	At-grade operation should be feasible	Analysis Step 2*
41st St.	Median	At-grade operation should be feasible	Analysis Step 2*
Vernon Ave.	Median	At-grade operation should be feasible	Analysis Step 2*
48th Pl.	Median	At-grade operation should be feasible	Analysis Step 2*
55th St.	Median	At-grade operation should be feasible	Analysis Step 2*
Gage Ave.	Mid-block	Possible at-grade operation	Analysis Step 2
Florence Ave.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
Nadeau St.	Mid-block	Possible at-grade operation	Analysis Step 2
92nd St.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
Century Blvd.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
103rd St.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
108th St.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
Wilmington Ave.	Mid-block	Possible at-grade operation	Analysis Step 2
119th St.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
124th St.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
El Segundo Blvd.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
130th St.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
Stockwell St.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
Elm St.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
Compton Blvd.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
Myrrh St.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
Alondra Blvd.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
Greenleaf Blvd.	Mid-block	Possible at-grade operation	Analysis Step 2
Manville Rd.	Mid-block	At-grade operation should be feasible	Analysis Step 2*
Wardlow Rd.	Mid-block	Possible at-grade operation	Analysis Step 2
Spring St.	Mid-block	Possible at-grade operation	Analysis Step 2

3.1.3 Long Beach Street Running Segment

The Long Beach Street Running segment runs from the Long Beach Boulevard crossing in the north and around the loop south of 8th Street/Long Beach Blvd. This segment runs along the median of Long Beach Boulevard, and converts to a one-way, single track loop south of 8th Street, along 1st Street, Pacific Avenue, and 8th Avenue until it connects back onto Long Beach Blvd. This segment is controlled by traffic signals and operates at a maximum speed of 35 mph. There are no gates in this segment.

Figure 6 and **Table 4** summarize the results of Analysis Step 1 for the Long Beach Street Running segment. There are two dots clearly within the yellow zone; however, since the conflict volumes computed from the traffic count data at Pacific Coast Highway place the dot very close to the yellow zone, and as traffic volumes are subject to day-to-day fluctuation, this crossing was analyzed further in Analysis Step 2.

* The policy requires that all gated crossings should be advanced for evaluation under Analysis Step 2 to determine whether queueing and other safety-related issues may require mitigation before the feasibility of at-grade operation is confirmed.

Figure 6. – Nomograph for Initial Screening for Long Beach Street Running Segment

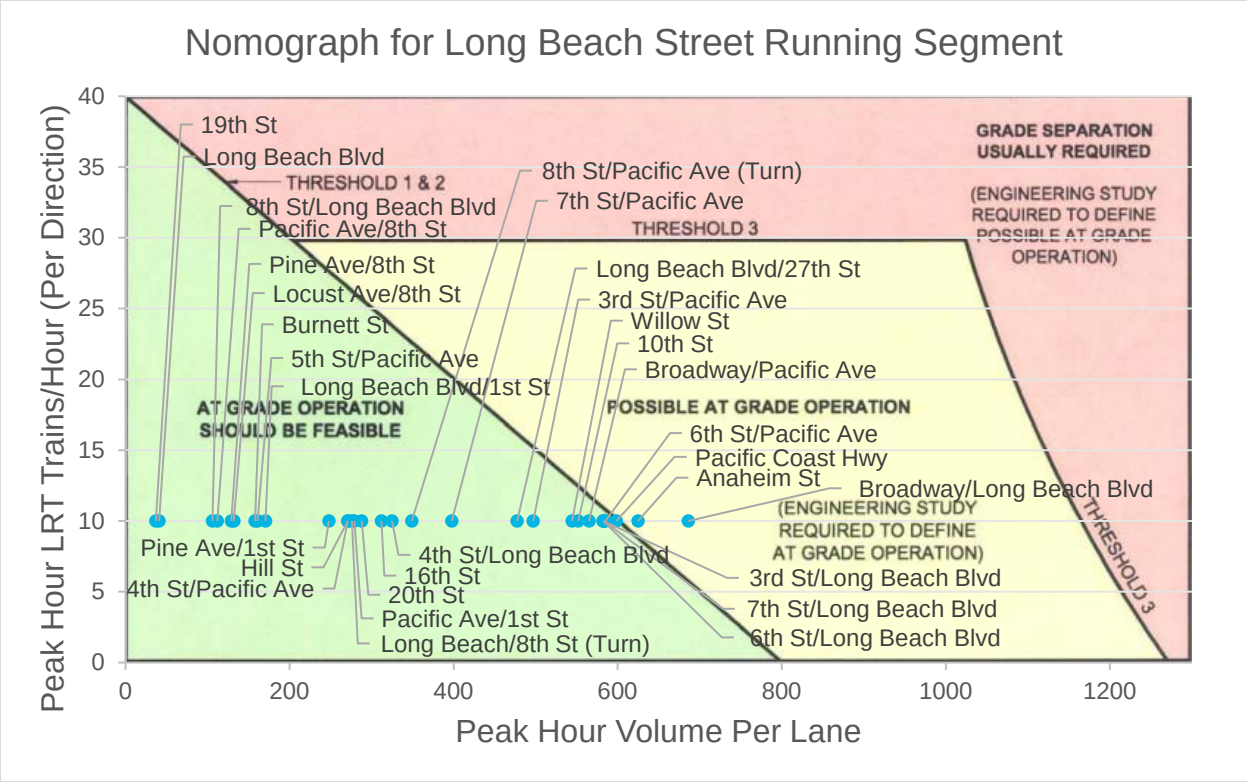


Table 4. – Long Beach Street Running Segment Initial Screening Results

Grade Crossing	Alignment Configuration	Initial Screening Results	Notes and Next Steps
Long Beach Blvd./ 27th St.	Mid-block	At-grade operation should be feasible	
Willow St.	Median	At-grade operation should be feasible	
Burnett St.	Median	At-grade operation should be feasible	
Hill St.	Median	At-grade operation should be feasible	
20th St.	Median	At-grade operation should be feasible	
19th St.	Median	At-grade operation should be feasible	
Pacific Coast Hwy.	Median	At-grade operation should be feasible	Analysis Step 2*
16th St.	Median	At-grade operation should be feasible	
Long Beach Blvd.	Median	At-grade operation should be feasible	
Anaheim St.	Median	Possible at-grade operation	Analysis Step 2
10th St.	Median	At-grade operation should be feasible	
8th St./ Long Beach Blvd.	Median	At-grade operation should be feasible	
Long Beach Blvd./ 8th St. (Turn)	At-grade Turn	At-grade operation should be feasible	
7th St./ Long Beach Blvd.	Median	At-grade operation should be feasible	
6th St./ Long Beach Blvd.	Median	At-grade operation should be feasible	

* Although the crossing is plotted in the green zone based upon roadway volume data, Analysis Step 2 was performed because the point very close to the yellow zone, and traffic volumes are subject to variation from day to day.

Grade Crossing	Alignment Configuration	Initial Screening Results	Notes and Next Steps
4th St./ Long Beach Blvd.	Median	At-grade operation should be feasible	
3rd St./ Long Beach Blvd.	Median	At-grade operation should be feasible	
Broadway/ Long Beach Blvd.	Median	Possible at-grade operation	Analysis Step 2
Long Beach Blvd./ 1st St.	At-grade Turn	At-grade operation should be feasible	
Locust Ave./1st St.	Median	At-grade operation should be feasible	
Pine Ave./1st St.	Median	At-grade operation should be feasible	
Pacific Ave./1st St.	At-grade Turn	At-grade operation should be feasible	
Broadway/Pacific Ave.	Median	At-grade operation should be feasible	
3rd St./Pacific Ave.	Median	At-grade operation should be feasible	
4th St./Pacific Ave.	Median	At-grade operation should be feasible	
5th St./Pacific Ave.	Median	At-grade operation should be feasible	
6th St./Pacific Ave.	Median	At-grade operation should be feasible	
7th St./Pacific Ave.	Median	At-grade operation should be feasible	
8th St./ Pacific Ave. (Turn)	At-grade Turn	At-grade operation should be feasible	
Pacific Ave./8th St.	Median	At-grade operation should be feasible	
Pine Ave./8th St.	Median	At-grade operation should be feasible	
Locust Ave./8th St.	Median	At-grade operation should be feasible	

4. Analysis Step 2 Findings

Crossings that advance to Analysis Step 2 include all Yellow Zone crossings. Green Zone crossings that were evaluated to have salient safety issues or have gated crossing operations also advance to Analysis Step 2.

Thus, in addition to three crossings in the Los Angeles Street Running segment and three crossings in the Long Beach Street Running segment that fall within or near the boundary of the Yellow Zone, all crossings in the Mid Corridor segment were further analyzed in Analysis Step 2. All crossings analyzed in Analysis Step 2 are listed below:

Washington Boulevard Segment:

- Griffith Street
- Central Avenue
- Hooper Street

Mid Corridor Segment:

- 20th Street
- 24th Street
- 41st Avenue
- Vernon Avenue
- 48th Place
- 55th Street
- Gage Avenue
- Florence Avenue
- Nadeau Street
- 92nd Street
- Century Boulevard
- 103rd Street
- 108th Street
- Wilmington Avenue
- 119th Street
- 124th Street
- El Segundo Boulevard
- 130th Street
- Stockwell Street
- Elm Street
- Compton Boulevard
- Myrrh Street
- Alondra Boulevard
- Greenleaf Boulevard
- Manville Road
- Wardlow Road
- Spring Street

Long Beach Boulevard Segment:

- Pacific Coast Highway (SR-1)
- Anaheim Street
- Broadway

4.1 Rail Operational Check

This provision of the Policy is primarily intended to accommodate consideration of treatments along street-running sections operating under traffic signal control where trains may be given lower priority to improve traffic operations.

Train speeds are affected by the presence of grade crossings, stations, and preemption/priority control at the grade crossings, and it may be necessary to balance the priority given to trains with service to conflicting roadway traffic. The threshold for acceptable rail operations is dependent upon Metro's goals in its rail operating plan: A passing grade in the rail operations check is achieved if rail operations through the grade crossing will not significantly degrade Metro's overall travel time requirements for the corridor.

Train speeds allowed by CPUC under the provisions of *General Order 143-B* limit the maximum authorized speed though street-running crossings to 35 mph and to 55 mph through gated crossings.

Metro Blue Line operates a peak period of 10 train crossings per hour per direction, equaling to 20 train crossings total per hour. The traffic effects of LRT operations through the at-grade crossings will depend upon the operation of traffic signals, if present, and crossing gates, if provided.

Train movements along street running sections such as the Los Angeles Street Running and Long Beach Street Running segments are controlled by the intersection traffic signals; transit priority may be provided to expedite LRT movement or trains may advance operating within a "slot" provided by the background signal cycle, or a combination of both. The signal system must terminate conflicting movements prior to train arrival, and LRT right-of-way needs to be cleared prior to train arrival. The LRT operator must be given a clear "Stop" or "Go" signal indication sufficiently in advance of the arrival at the crossing so the train can either proceed through the crossing or be brought to a stop (under "service braking") in the event the LRT green cannot be provided. Thus, the LRT phase must be activated 20 – 30 seconds in advance of train arrival, depending upon the speed of the train, and the LRT phase needs to continue until the LRT has "checked out" of the crossing after clearing the roadway. Therefore, the total LRT phase may last about 40 seconds or longer. However, "compatible" traffic movements (such as parallel through movements) can overlap with the LRT service to maximize the utilization of the available intersection capacity.

Along the gated Mid Corridor segment, trains operate at the maximum authorized speed under the control of the LRT signaling system – as trains approach the crossings, where the LRT generally has right-of-way, warning devices are activated and nearby traffic signals are "preempted" to assure there are no vehicles stranded on the tracks. "Advance preemption" can be provided to manage the termination of conflicting traffic movements and clearance of the crossing in advance of train arrival.

The duration for each train to clear an intersection is based on the timing recommendations shown in the Policy, as shown below:

- 20 - 23 seconds warning time (minimum 20 seconds required by CPUC); the crossing gates will lower during this interval
- 7 seconds passage time (3 car train, 35 mph)
- 3 seconds clearance time (100-foot roadway right-of-way)
- 2 seconds checkout time (allowance for lag in "checkout")
- 5 seconds gate up/car start-up time
- 5 seconds random arrival delay

Total effective gate blockage time: 42-45 seconds, so the analysis considered 45 seconds to be conservative. (This is slightly longer than the duration of the LRT phase at a typical on-street section where traffic signals are providing control.)

Continuous "fine tuning" of the traffic and train control systems may occur during the lifecycle of the LRT line operations. Specific recommendations of traffic and train control systems are included in **Section 5** of this report.

Under current operations, trains are operated through the grade crossings in conformance with the CPUC maximum allowable speeds, full preemption is provided at all the gated mid-corridor crossings, and LRT trains operate along the on-street sections without any extraordinary restrictions to accommodate street traffic. Therefore, with regards to the outcome of the rail operational check as it relates to this assessment of the MBL crossings, all crossings have "passed" the rail operational check.

4.2 Traffic Operational Check

A traffic operations check was performed to check traffic queuing safety at gated crossings. Grade crossings located adjacent or near to signalized intersections were evaluated using a combination of field review (to observe current conditions and qualitative factors) as well as the traffic volumes used for Analysis Step 1. The results of this analysis were used to develop recommended treatments for locations where queuing across the tracks was observed or is projected to occur.

4.2.1 Operational Volumes

Consistent with the provisions of the Metro Policy, the volumes used in this analysis are the same conflicting movement traffic volumes used in Analysis Step 1 to determine conflict volumes. These operational volumes were

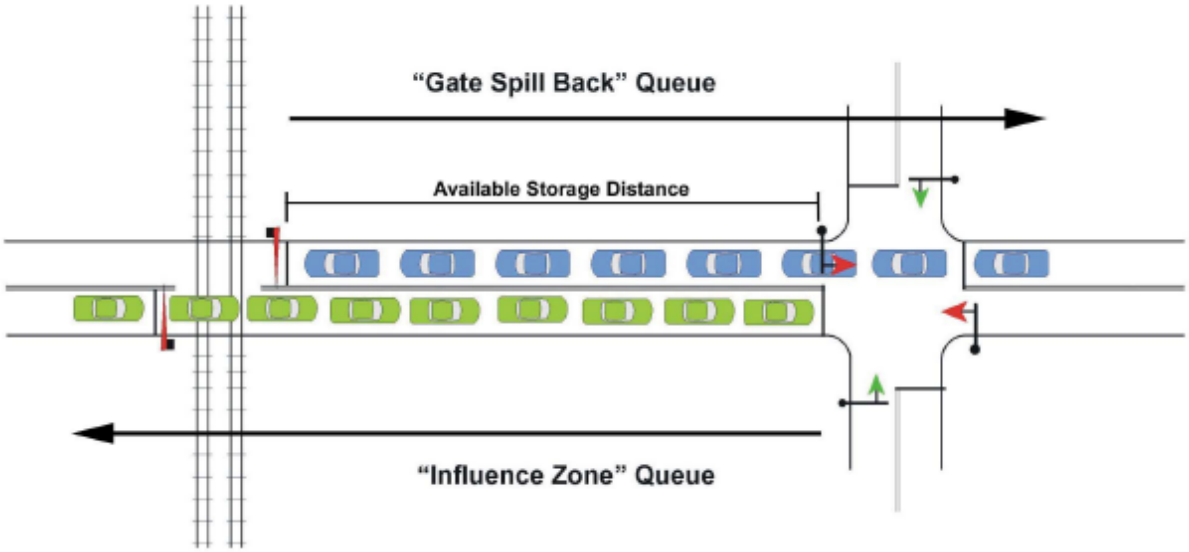
used to verify the Gate Spillback and Influence Zone Queues. Queues were determined by identifying the peak volume per lane of traffic for each approach.

4.2.2 Influence Zone and Gate Spillback Queues

The traffic operations check at gated crossings included evaluation of the Gate Spillback Queue and Influence Zone Queue to determine whether there is sufficient storage for queues caused by adjacent traffic signals and by crossing gates. This illustrates the difference between each type of queue and what overflow, or insufficiency, looks like at a typical grade crossing.

As shown in the diagram, the Influence Zone queue originates at a signalized intersection. Vehicles waiting at the red signal will queue in the available storage, and queues that extend to the grade crossing are determined to be overflow and require treatment. The Gate Spillback queue originates at the gates of the grade crossing, and overflow queuing extends into the nearby signalized intersection. If queuing problems are identified, treatments such as pre-signals, queue cutters, or other forms of queue management should be considered.

Figure 7. – Grade Crossing Queues Illustrating Queue Overflow Beyond Capacity



Source: Metro Grade Crossing Safety Policy for Light Rail Transit (2011)

For each potential grade crossing, Gate Spillback queues and Influence Zone queues were analyzed for adjacent signalized intersections within 1,000 feet of the crossing, at gated crossings, or within 600 feet along street running sections operating under traffic signal control.[1]

Computation methodology of average Influence Zone and Gate Spillback queues from the Policy is based on the Webster's equation. A peaking factor of 1.5 or 2.0 was applied to the average queues to identify the maximum design queue that could occur during the peak period due to variations in arrival rate. This results in a 95th percentile queue, with the queue length computed using an assumption of a vehicle length of 25 feet. In other Metro light rail projects including the Exposition Line and the Foothill Extension for Metro Gold Line, a peaking factor of 1.5 was used. In this study, at locations with low volumes (and thus high potential variability in arrival rate), a peaking factor of 2.0 was used. For high volume crossings where variability is low, the peaking factor of 1.5 was used.

Tables 5 and 6 indicate the results of the Influence Zone and Gate Spillback queuing evaluations, respectively. Queuing analysis was completed for each intersection in the Mid corridor gated segment. Those grade crossings that did not have a signalized intersection within 1,000 feet of the crossing were omitted from the analysis. It should be

[1] The typical minimum spacing of signalized intersections is 600 feet or more and it is unlikely that a queue of stopped vehicles would extend through and block a signalized intersection.

noted that the analysis omits locations where there are signalized frontage road intersections immediately adjacent to the rail corridor, because these locations are already interconnected and have pre-emption protocols.

Table 5. – Influence Zone Queue Table

Grade Crossing	Adjacent Cross Street	Movement Direction	Storage Distance (ft.)	AM Peak Hour		PM Peak Hour	
				95th Percentile Queue (ft.)	Adequate Storage	95th Percentile Queue (ft.)	Adequate Storage
Gage Ave.	Miramonte Blvd.	WB	515	265	Yes	160	Yes
	Holmes Ave.	EB	550	243	Yes	254	Yes
Florence Ave.	Miramonte Blvd.	WB	500	532	No	326	Yes
	Graham Ave.	EB	565	144	Yes	131	Yes
Nadeau St.	Maie St.	WB	290	277	Yes	120	Yes
	Beach St.	EB	290	143	Yes	120	Yes
Wilmington Ave.	Imperial Hwy.	SB	410	263	Yes	393	Yes*
Greenleaf Blvd.	Tamarind Ave.	EB	600	120	Yes	405	Yes
Pacific Ave.	Spring St.	WB	450	316	Yes	327	Yes
	Wardlow Rd.	EB	460	231	Yes	383	Yes

** Field observation indicated a queuing problem at peak hour.*

The Influence Zone queuing quantitative analysis results, shown in **Table 5**, indicates the storage at Florence Avenue is inadequate and that the storage at Wilmington Avenue is marginal in relation to predicted maximum potential queues. However, Metro operations does not have a record of recurrent queueing at Florence Avenue, so treatments are not recommended now. Conversely, field observation identified queuing across the crossing at Wilmington Avenue, so treatments are recommended. (Refer to **Section 5**, which provides crossing-by-crossing recommendations.)

The crossing gate spillback queues for locations where there are signalized intersections beyond the rail corridor and frontage roads are shown in **Table 6**. As indicated in the table, there is adequate storage space so that queue spillback into upstream intersections is not predicted and therefore no treatments have been recommended.

Table 6. – Spillback queue analysis

Grade Crossing Location	Direction	Available Storage (ft)	Vehicle Storage Length (ft)	
			AM Peak Hour	PM Peak Hour
Gage Avenue	EB	515	150	150
	WB	550	150	150
Florence Avenue	EB	500	113	113
	WB	565	113	150
Nadeau Street	EB	290	113	150
	WB	290	150	113
Wilmington Avenue	NB	410	150	150
Greenleaf Boulevard	WB	600	150	150
Spring Street	EB	450	188	263
	WB	700	188	188

4.3 Safety Check

Per the Policy, twelve safety issues should be checked at each grade crossing to determine whether the site conditions at the crossing location are suitable for safe at-grade operation. The safety check was performed using readily available data, field observations, and correspondence with Metro's staff.

The 12 safety issues identified in the Policy that were evaluated in this study are as follows:

- **Queue length**: If queues from adjacent signals is likely to back up into the grade crossing, potentially leaving vehicles stuck on the tracks.
- **Sight distance**: If vehicles approaching the crossing can see an approaching train in the event of gate failure at a sufficient distance to safely stop.
- **Visual clutter**: The presence of distracting signage, advertisements, or attention drawing features that compete with train signals.
- **Traffic speed**: If traffic speed relative to roadway configuration allow sufficient stopping distance for vehicles when train gates are lowered.
- **Heavy trucks**: The volume of heavy freight vehicles that have longer starting and stopping times.
- **Pedestrian volumes**: The typical number of pedestrians crossing the tracks.
- **School route**: The likelihood of school children using the crossing due to school proximity or designated school zone.
- **Emergency vehicle route**: The likelihood of emergency vehicles being delayed by gate down events due to proximity of a fire hall, emergency medical facility, or police depot.
- **Accident history**: Number of injury, fatal, pedestrian involved, bicycle involved, or train involved crashes over the last ten years.
- **Gate drive around**: If crossing gates sufficiently block available crossing routes, including opposing lanes.
- **Signing and striping**: If roadway markings are well maintained and provide clear direction for traffic to use the crossing safely.
- **Traffic control**: Verification that the existing traffic control measures are appropriate for the volume of traffic and that control devices provide consistent and clear direction for safe and efficient traffic flow.

Each characteristic for each crossing was evaluated and the results are shown in Green, in the event there were no significant findings or comments; in Yellow, for instances in which comments were noted but for which treatment would not be required; or in Red, where treatments or follow-on actions have been recommended.

The results are shown in **Table 7**; the numbers correspond to specific comments which are elaborated in Section 5 which provides crossing-by-crossing recommendations.

Table 7. – Metro Blue Line Grade Crossing Analysis Results of M2 Analysis

Crossing	Segment	(1) Queue Checks	(2) Sight Distance	(3) Visual Clutter	(4) Traffic Speed	(5) Heavy Trucks	(6) Pedestrian Volumes	(7) School Route	(8) Emergency Vehicle Rte.	(9) Accident History	(10) Gate Drive Around	(11) Signing & Striping	(12) Traffic Control
Griffith	Los Angeles Street Running	n.a.	n.a.	1	0	1	1	0	0	0	n.a.	0	1
Central		n.a.	n.a.	1	0	1	1	0	0	1	n.a.	0	1
Hooper		n.a.	n.a.	1	0	2	1	0	0	1	n.a.	0	1
20th St.	Mid Corridor	1	0	0	0	3	1	0	0	0	0	1	2
24th St.		1	0	0	0	3	1	0	0	0	0	1	2
41st Ave.		1	0	0	0	1	1	0	0	4	4	1	2
Vernon Ave.		1	0	1	0	0	4	0	0	0	3	0	2
48th Pl.		1	0	0	0	0	1	0	0	0	4	0	2
55th St.		n.a.	0	0	0	0	1	1	0	0	4	0	3
Gage Ave.		0	1	1	0	0	1	0	0	0	3	0	0
Florence Ave.		2	1	1	0	0	6	1	0	0	3	0	0
Nadeau St.		2	0	0	0	0	1	1	1	0	2	0	0
92nd St.		n.a.	0	0	0	0	2	1	0	0	4	0	4
Century Blvd.		1	1	0	1	0	2	1	0	0	2	0	2
103rd St.		1	1	0	0	0	1	1	0	0	4	0	2
108th St.		n.a.	0	0	0	0	1	1	0	0	4	2	5
Wilmington Ave.		2	1	1	0	0	2	1	0	0	2	0	6
119th St.		1	0	0	0	0	1	0	2	0	2	0	2 7 8
124th St.		1	0	0	0	0	1	0	0	0	1	0	2 7 8
El Segundo Blvd.		1	0	1	1	0	1	0	0	6	2	0	2 7 8
130th St.		1	0	0	0	0	4	0	0	0	2	0	2 7 8
Stockwell St.		1	0	0	0	0	1	1	0	0	2	0	2 7 8
Elm St.		n.a.	0	0	0	0	2	0	0	0	1	0	9
Compton Blvd.		1	0	1	0	0	3	0	1 3	5	1	0	2 7 8
Myrrh St.		1	0	0	0	0	1	1	1 3	0	1	0	2
Alondra Blvd.		1	0	1	1	0	1	1	0	3	1	0	2 8
Greenleaf Blvd.		0	0	0	0	0	1	0	0	0	3	0	0
Manville Rd.		n.a.	0	0	0	2	1	0	0	0	4	2	0
W. Wardlow Rd.		1	0	0	1	0	1	1	0	0	2	3	10
Spring St.		0	0	0	0	0	1	1	2	0	2	1	0
Pacific Coast Hwy.	Long Beach Street Running	n.a.	n.a.	0	0	0	1	0	0	2	n.a.	0	1 11
E. Anaheim St.		n.a.	n.a.	0	0	0	2	0	2	1	n.a.	0	1
E. Broadway		n.a.	n.a.	0	0	0	2	0	1 3	0	n.a.	0	1

5. Findings and Recommendations

5.1 Findings

The safety concerns identified in the Policy, and potential treatments are as follows.

5.1.1 Traffic Queuing (1)

The primary concern is queuing from a nearby traffic signal which could cause traffic to back up across the tracks ("Influence Zone") and the secondary concern is traffic backing up into an adjacent intersection due to queuing spilling back from the crossing gates ("Gate Spillback"). This measure is not applicable on street running segments where the grade crossing is in the middle of an already signalized intersection or where there are no traffic signals near the crossing.

MUTCD requires consideration of interconnection of signals within 200 feet.

More recent guidance (NCUTCD, ITE) recommends consideration of interconnection of signals at significantly longer distances based upon traffic projections and/or field observations.

This assessment also includes other sources of queuing such as traffic conflict points downstream from the crossing, adjacent railroad crossing, etc. that were determined through field observations.

The Milestone 2 assessment found that all but one of the grade crossings are either far enough from adjacent signals to avoid queuing conflicts, or are equipped with interconnection and are pre-empted to clear the tracks when a train approaches. Crossings indicated with ⓪ do not have queues likely to back up into the crossing or adjacent intersections. Crossings indicated with ① could potentially have queues of sufficient length to back up into the grade crossing or adjacent intersections, but are interconnected and have recommended pre-emption protocols.

Florence Avenue, marked with ②, has potential for WB through traffic to back up into the crossing from the Florence / Miramonte intersection. However, with the current operations, no reports of queues are being reported by train operators. If problems are observed in the future, consider installation of queue detection loops in the WB lanes downstream from the crossing and use the existing interconnected signal at Florence / Graham as a "queue cutter" signal.

Nadeau Street, marked with ②, has potential for WB through traffic to back up into the crossing from the Nadeau / Maie intersection. Like Florence Avenue, with the current operations, no reports of queues are being reported by train operators. If problems are observed in the future, consider installation of interconnection with "advance pre-emption" (required due to the long clear storage zone) to preclude queuing on crossing.

The Wilmington Avenue crossing shown with ② has the potential for SB through traffic to back up into the crossing from the Wilmington / Imperial ramps intersection. As the length of the clear storage zone is large, pre-emption is impractical. Consider installation of a new traffic signal at Wilmington / E. 114th with interconnection to the Wilmington / Imperial signal and provide coordinated operation with "green extensions" at the downstream signals to preclude queuing on the tracks. Alternatively, elimination of the NB left turn into E. 115th and reconfiguration of the southbound roadway would provide 2 full lanes of storage departing the crossing.

5.1.2 Sight Distance (2)

The focus of this assessment was to determine if approaching vehicles can see an approaching train before entering the grade crossing area. This measure is not applicable for street running segments of the rail as they are controlled by a typical traffic signal and sight distance is not a factor.

All grade crossings either have unobstructed sight distance as shown with ⓪ or have partial sight obstruction, but are equipped with necessary warning devices to alert traffic of oncoming trains and shown with ①.

5.1.3 Visual Clutter (3)

Field observations were conducted to identify visual clutter that would increase the mental workload of drivers sufficiently to distract them from train signals or keep clear markings in the track area. Grade crossings marked with ⓪ were identified with no visual clutter concerns and crossings marked with ① had moderate visual clutter associated with a typical urban roadway within a commercial district. No mitigation is recommended.

5.1.4 Traffic Speed (4)

Speed limits near the grade crossings are appropriate for roadway geometry and traffic conditions. At most grade crossings, prevailing traffic speeds are nominal for the functional classification of the roadway and were marked with ⓪. Some vehicles have been observed exceeding the speed limit at four of the crossings. However, the active devices at the crossings will warn roadway users of approaching LRT trains and there is adequate sight distance for drivers to see these devices at the observed traffic approach speeds. Therefore, no additional treatments are recommended for these locations which were marked with ①.

5.1.5 Heavy Trucks (5)

Heavy trucks take longer to stop and to start moving. They also need more space when stopped between intersections and rail tracks.

Crossings with high truck volumes will likely need additional green time on signals to adequately clear the intersection and grade crossings areas. ⓪ indicates a low percentage of heavy trucks. ① indicates a moderate percentage of heavy trucks consistent with the adjoining land uses noted. ② or ③ indicates a high percentage of heavy trucks consistent with the adjoining land uses noted, at locations flagged with ③ follow up is recommended.

No treatment is recommended at Hooper Street (②), because any truck which enters the intersection would clear during the “yellow” or “red” signal phases. However, at 20th Street, and 24th Streets (③), where traffic signals are present both upstream as well as downstream from the track area, consider verifying the signal timing to assure clearance of the track area is provided for all vehicles.

5.1.6 Pedestrian Volumes (6)

Pedestrian volume counts have been collected to characterize pedestrian activity into 6 levels:

Table 8. – Pedestrian Volumes Ranking and Key

Rank	Description
①	Very low pedestrian volume (<100 peak hour)
②	Low pedestrian volume (100 – 200 peak hour)
③	Low to Moderate pedestrian volume (201 – 400 peak hour)
④	Moderate pedestrian volume (401 – 800 peak hour)
⑤	Moderate to High pedestrian volume (801 – 1,000 peak hour)
⑥	High pedestrian volume (>1,000 peak hour)

All crossings include pedestrian treatments consisting of signalized crosswalks at street-running sections and pedestrian automatic gates at mid-corridor “railroad” type crossings. No further mitigation is recommended.

5.1.7 School Route (7)

Unattended children using grade crossings are more likely to disregard signs and engage in higher risk behaviors. The presence of marked school crosswalks would indicate greater likelihood that children would need to use the crossing. None of the grade crossings have a marked school crosswalk. There are several crossings however that are less than 0.25 miles from a school. Those crossings are marked with ①, while crossings with no nearby school

are marked with ⓪. None of the crossings have any appreciable volume of school children using the crossings to warrant further treatment.

5.1.8 Emergency Vehicle Route (8)

Emergency vehicles are the highest priority traffic and should not be impeded by lengthy gate down intervals or congestion caused by train operations.

Crossings were reviewed for proximity to emergency facilities, typical length of gate down intervals, and availability of alternate routes. Crossings with no nearby emergency facilities were marked with ⓪. Crossings with a Fire Station within 0.25 miles were marked with ①. Crossings with an Emergency Room within 0.25 miles were marked with ②. Crossings with a Police Station within 0.25 miles were marked with ③.

The analysis concluded that there are alternate routes and usual “gate down” time of less than one minute which do not require treatment.

5.1.9 Accident History (9)

10 years of data was collected from UC Berkeley’s Traffic Injury Mapping System (TIMS) spanning 2008 through 2017. Data from 2015 through 2017 is still considered preliminary, so may not be complete at the time of this study. Over this period, the database includes 571 crashes involving injury or death at or near the grade crossings. 74 of those crashes involved pedestrians, 62 involved bicycles, and six resulted in a fatality.

Crash activity at grade crossings in the street running segments, which correlates to higher traffic volumes along the arterial corridors and cross streets. Crashes were reviewed for patterns that might be mitigated through adjustments to grade crossing operations or geometry.

Table 9. – Accident History Ranking and Key

Rank	Description
⓪	Lower crash activity, no mitigation recommended
①	Street running segment: Non-LRV collision history indicates potential high accident location; no specific recommendations for roadway modifications identified.
②	Pacific Coast Highway: Non-LRV collision history indicates potential high accident location; refer to Column (12) – Traffic Control for recommendations.
③	Alondra Boulevard: Non-LRV collision history indicates potential high accident location; refer to Column (12) – Traffic Control for recommendations.
④	41st Street: Non-LRV collision history indicates potential high accident location; no specific recommendations for roadway modifications identified.
⑤	Compton Boulevard: Non-LRV collision history indicates potential high accident location; refer to Column (12) – Traffic Control for recommendations.
⑥	El Segundo Boulevard: Non-LRV collision history indicates potential high accident location; refer to Column (12) – Traffic Control for recommendations.

5.1.10 Gate Drive Around Potential (10)

Drivers typically respect train gates when they know that delays will be short. In areas with slow moving or very long freight trains, drivers are more likely to attempt to beat the train by driving around lowered gates when they cannot see the train. Several factors influence the potential for gate drive around including roadway width, traffic speed, and excessive gate down times.

Since there are no gates on the street running segments these crossings have been marked as not applicable. LRT crossings with no included freight track result in low potential for crossing gate drive around due to usual “gate down” time of less than one minute; no mitigation recommended and they have been marked with ⓪. Crossings equipped with four-quadrant gates mitigates potential for crossing gate drive-arounds and are marked with ①. Crossings of roadways equipped with medians are marked with ②. Presence of freight track with longer gate-down times for occasional freight trains increases potential for gate drive-arounds, however, four-lane roadway with moderate to high traffic levels reduces likelihood. No mitigation recommended and these crossings are marked with ③. Presence of a freight track with longer gate-down times for occasional freight trains increases potential for gate drive-arounds; lower traffic volumes may increase likelihood for gate drive-arounds. Mitigation such as four-quadrant gates could be considered if frequent gate drive-around incidents are recorded. These locations are marked with ④.

5.1.11 Signing and Striping (11)

Worn pavement markings and striping can cause driver uncertainty and allow for conflicts between vehicle movements that slow traffic and increase the potential for crashes. ⓪ indicates no signing and striping concerns have been identified at this location. ① indicates that striping shows signs of wear from truck traffic; consider updating pavement markings. ② indicates that striping shows extreme signs of wear; recommend updating pavement markings. ③ indicates that recommendations from the prior study are not yet implemented and are still appropriate.

5.1.12 Traffic Control (12)

This assessment reviewed traffic control at and near grade crossings for appropriateness, efficiency, and safety.

The field review took note of signal operations, visibility, and coordination; stop sign right-of-way and labeling; signage condition, visibility, and effectiveness; and available vehicle storage at signals to avoid vehicles being stopped on tracks.

Several of the study grade crossings have complicated characteristics including adjacent frontage roads, skews, and adjacent freight service that all have their own traffic control needs. Several observations and recommendations are included in this section for consideration.

Table 10. – Traffic Control Ranking and Key

Rank	Description
⓪	Indicates no traffic control concerns have been identified at this location.
①	Indicates traffic control provided by traffic signal which controls both LRT as well as vehicular movements at the crossing. No recommended changes.
②	Indicates presence of adjacent preempted traffic signal in “shared corridor” crossing with conventional freight line. Metro crossing gate equipment includes “event recorders” which is recommended by the Federal Railroad Administration for all crossings which are interconnected with nearby traffic signals.
③	Remove “ALL WAY” (R1-3P) plaque from stop signs on frontage road and replace with “TRAFFIC FROM LEFT/RIGHT DOES NOT STOP” (W4-4Ap) plaque; remove “ALL WAY” (R1-3P) plaque from stop signs on 55th Street and replace with “ONCOMING TRAFFIC DOES NOT STOP” (W4-4bP) plaque. Also install “ONE WAY” arrows at frontage road approaches visible to approaching cross street traffic.
④	Consider installation of “CROSS TRAFFIC DOES NOT STOP” (W4-4P) plaque at frontage road stop signs at 92nd Street.
⑤	Remove STOP SIGN from eastbound 108th approaching the grade crossing; Remove “ALL WAY” (R1-3P) plaques from STOP SIGNS at frontage road; install “TRAFFIC FROM LEFT/RIGHT DOES NOT STOP” (W4-4Ap) plaques at frontage road STOP SIGNS; install

Rank	Description
	“ONCOMING TRAFFIC DOES NOT STOP” (W4-4bP) plaque at STOP SIGN on westbound approach to frontage road intersection.
⑥	Grade crossing at Wilmington Avenue is at extreme skew angle; this is a potential source of confusion for roadway users, but the recently installed pedestrian gates and swing gates channelizes users to appropriate crossing points.
⑦	Cross street phasing plan does not provide track clearance when crossing is not preempted.
⑧	Frontage road phasing plan does not provide track clearance when crossing is not preempted.
⑨	Install “TRAFFIC FROM LEFT/RIGHT DOES NOT STOP” (W4-4Ap) plaques at frontage road STOP SIGNS; install “ONCOMING TRAFFIC DOES NOT STOP” (W4-4bP) plaque at STOP SIGNS on Elm Street.
⑩	Refer to prior study for recommendations.
⑪	Plaque on “No Pedestrians” sign at platform emergency exit should be revised to indicate that the station access crosswalk is located at Pacific Coast Highway (not either direction); also consider placing additional “No Pedestrians” sign(s) with advisory plaque directing patrons to Pacific Coast Highway entrance proximate to end of channelized exit pathway.

Crossings marked ⑦ and/or ⑧ have adjacent or nearby intersections that currently do not operate to safety standards. The suggested traffic signal phasing plan is included in **Appendix B**.

5.2 Recommendations

This section summarizes recommendations noted above by grade crossing.

5.2.1 Griffith Street

No recommendations.

5.2.2 Central Avenue

No recommendations.

5.2.3 Hooper Street

No recommendations.

5.2.4 20th Street

Due to the high volume of heavy vehicles, consider verifying the signal timing to assure clearance of the track area is provided for all vehicles.

5.2.5 24th Street

Due to the high volume of heavy vehicles, consider verifying the signal timing to assure clearance of the track area is provided for all vehicles.

5.2.6 41st Avenue

No recommendations.

5.2.7 Vernon Avenue

No recommendations.

5.2.8 48th Place

No recommendations

5.2.9 55th Street

Remove “ALL WAY” (R1-3P) plaque from stop signs on frontage road and replace with “TRAFFIC FROM LEFT/RIGHT DOES NOT STOP” (W4-4Ap) plaque; remove “ALL WAY” (R1-3P) plaque from stop signs on 55th Street and replace with “ONCOMING TRAFFIC DOES NOT STOP” (W4-4bP) plaque.

Also install “ONE WAY” arrows at frontage road approaches visible to approaching cross street traffic.

5.2.10 Gage Avenue

No recommendations.

5.2.11 Florence Avenue

No recommendations.

5.2.12 Nadeau Street

No recommendations.

5.2.13 92nd Street

No recommendations.

5.2.14 Century Boulevard

No recommendations.

5.2.15 103rd Street

No recommendations.

5.2.16 108th Street

Striping shows extreme signs of wear; recommend updating pavement markings.

Remove STOP SIGN from eastbound 108th approaching the grade crossing; Remove “ALL WAY” (R1-3P) plaques from STOP SIGNS at frontage road; install “TRAFFIC FROM LEFT/RIGHT DOES NOT STOP” (W4-4Ap) plaques at frontage road STOP SIGNS; install “ONCOMING TRAFFIC DOES NOT STOP” (W4-4bP) plaque at STOP SIGN on westbound approach to frontage road intersection.

5.2.17 Wilmington Avenue

Analysis supplemented with field review indicates that there is a potential for SB through traffic to back up into the crossing from the Wilmington / Imperial ramps intersection. As the length of the clear storage zone is large, pre-emption is impractical.

Consider installation of a new traffic signal at Wilmington / E. 114th with interconnection to the Wilmington / Imperial signal and provide coordinated operation with “green extensions” at the downstream signals to preclude queuing on

the tracks. Alternatively, elimination of the NB left turn into E. 115th and reconfiguration of the southbound roadway would provide 2 full lanes of storage departing the crossing.

5.2.18 119th Street

Cross street phasing plan does not provide track clearance when crossing is not preempted. Frontage road phasing plan does not provide track clearance when crossing is not preempted.

5.2.19 124th Street

Cross street phasing plan does not provide track clearance when crossing is not preempted. Frontage road phasing plan does not provide track clearance when crossing is not preempted.

5.2.20 El Segundo Boulevard

Cross Street phasing plan does not provide track clearance when crossing is not preempted. Frontage road phasing plan does not provide track clearance when crossing is not preempted.

5.2.21 130th Street

Cross street phasing plan does not provide track clearance when crossing is not preempted. Frontage road phasing plan does not provide track clearance when crossing is not preempted.

5.2.22 Stockwell Street

Cross street phasing plan does not provide track clearance when crossing is not preempted. Frontage road phasing plan does not provide track clearance when crossing is not preempted.

5.2.23 Elm Street

Install “TRAFFIC FROM LEFT/RIGHT DOES NOT STOP” (W4-4Ap) plaques at frontage road STOP SIGNS; install “ONCOMING TRAFFIC DOES NOT STOP” (W4-4bP) plaque at STOP SIGNS on Elm Street.

5.2.24 Compton Boulevard

Cross street phasing plan does not provide track clearance when crossing is not preempted. Frontage road phasing plan does not provide track clearance when crossing is not preempted.

5.2.25 Myrrh Street

No recommendations.

5.2.26 Alondra Boulevard

Frontage road phasing plan does not provide track clearance when crossing is not preempted.

5.2.27 Greenleaf Boulevard

No recommendations

5.2.28 Manville Road

Striping shows extreme signs of wear; recommend updating pavement markings.

5.2.29 Wardlow Road

No recommendations.

5.2.30 Spring Street

No recommendations.

5.2.31 Pacific Coast Highway (SR 1)

Plaque on “No Pedestrians” sign at platform emergency exit should be revised to indicate that the station access crosswalk is located at Pacific Coast Highway (not either direction); also consider placing additional “No Pedestrians” sign(s) with advisory plaque directing patrons to Pacific Coast Highway entrance proximate to end of channelized exit pathway.

5.2.32 Anaheim Street

No recommendations.

5.2.33 Broadway

No recommendations.

6. Conclusion

Retroactively applying Metro's Grade Crossing Safety Policy to the Metro Blue Line crossings has yielded various recommendations for improving operation and safety at these existing crossings. Whereas there are some crossings at high volume roadways that may benefit from grade separation to improve efficiency in rail and traffic operations along with increased convenience to the traveling public, from the perspective of operating safety as determined by the Policy, no grade separations are required.

Appendix A.– Conflict Volume Calculation Methodology

Appendix A – Conflict Volume Calculation Methodology

The Grade Crossing Safety Policy considers the highest peak period one-way cross-street traffic level – “conflict volume” – and the one-way LRT train frequencies which are plotted on the Analysis Step 1 “Milestone 1” nomograph. The conflict volume is determined by evaluating the highest per-lane AM and PM peak hour movement crossing the tracks at each crossing, considering each lane group and direction separately.

Where the grade crossing is at a “mid-block” location, the highest per-lane approach flow (in either direction) should be considered. Where a crossing is immediately adjacent to a frontage road intersection, all departure leg traffic, including left-turns and right-turns towards the crossing, should be considered.

Additional considerations apply where there are “shared lanes” such as a “through-and-right” curb lane: Even though right or left turning traffic in a shared lane may not cross the tracks, vehicles in shared lanes consume roadway capacity therefore reducing the effective capacity of the cross street. For this reason, left- and right-turning traffic in a shared through lane approaching the crossing was generally included in the conflict volume calculation with one exception: Where a shared through-and-right turn lane was wide enough for right-turning vehicles to squeeze by through traffic (a condition referred to as a “shadow” turn lane), then the right-turn volume was not included.

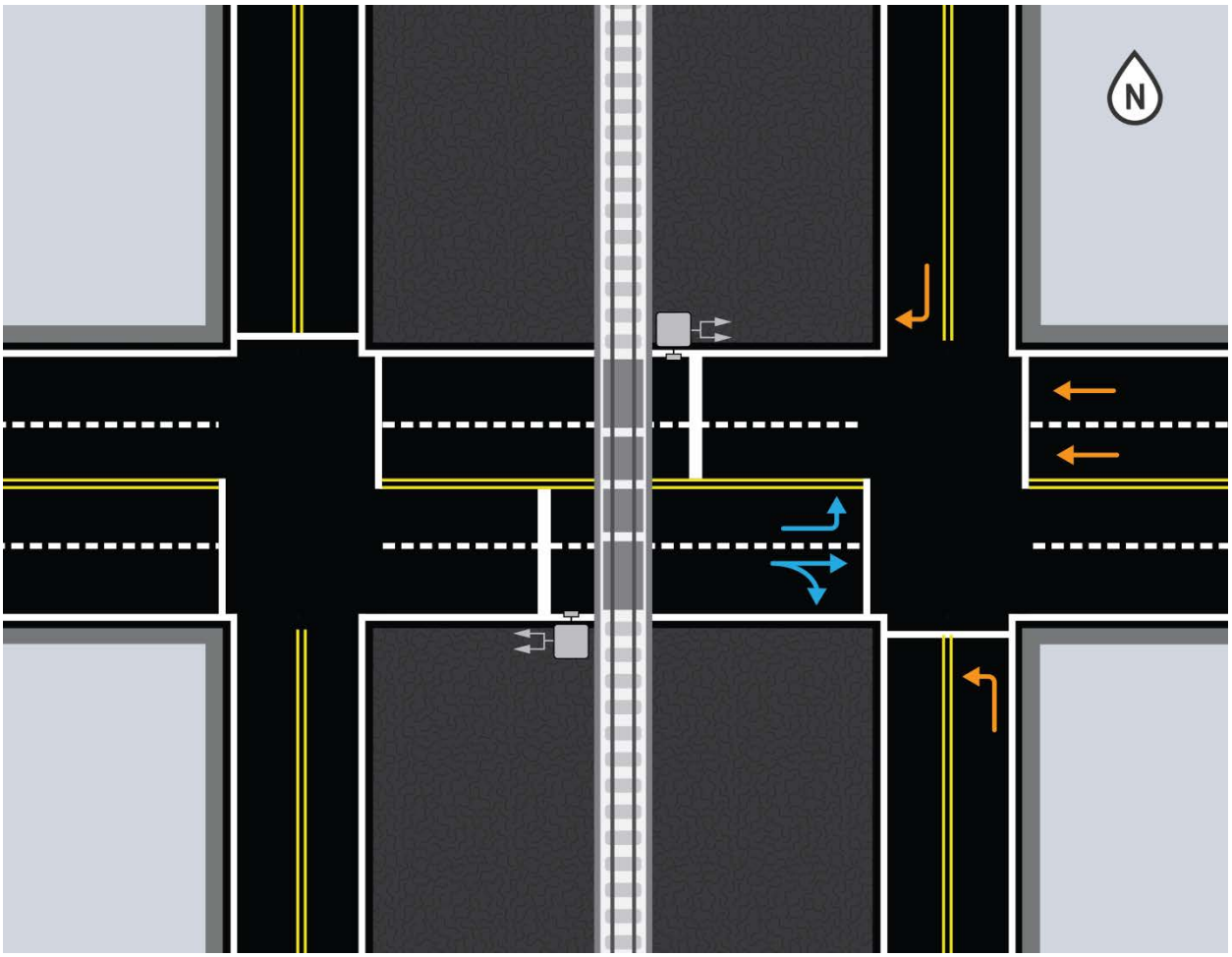
Finally, the conflict volume is based on the highest per-lane volume occurring in any individual “lane group”. For example, if there are left-turn lane(s) extending through the crossing, and if the per-lane volume in the left-turn lane group exceeds the per-lane volume in the through-lane lane group, then the left-turn conflict volume was considered rather than the through lane conflict volume.

Examples of the calculations for various configurations are described below.

A.1 H-Intersection Grade Crossing

For the example, for an “H-intersection” grade crossing as shown in **Figure A-1**, the conflict volume was computed as the greater of the eastbound or westbound per-lane volume, divided by the number of lanes: As shown in the figure, the conflict volume would be the greater of the sum of the westbound through volume plus the southbound right-turn, plus the northbound left-turn divided by two lanes (orange arrows); or of the sum of the eastbound left plus through plus right volume, divided by two lanes.

Figure A-1. – Sample Conflict Volume for an H-Intersection Grade Crossing

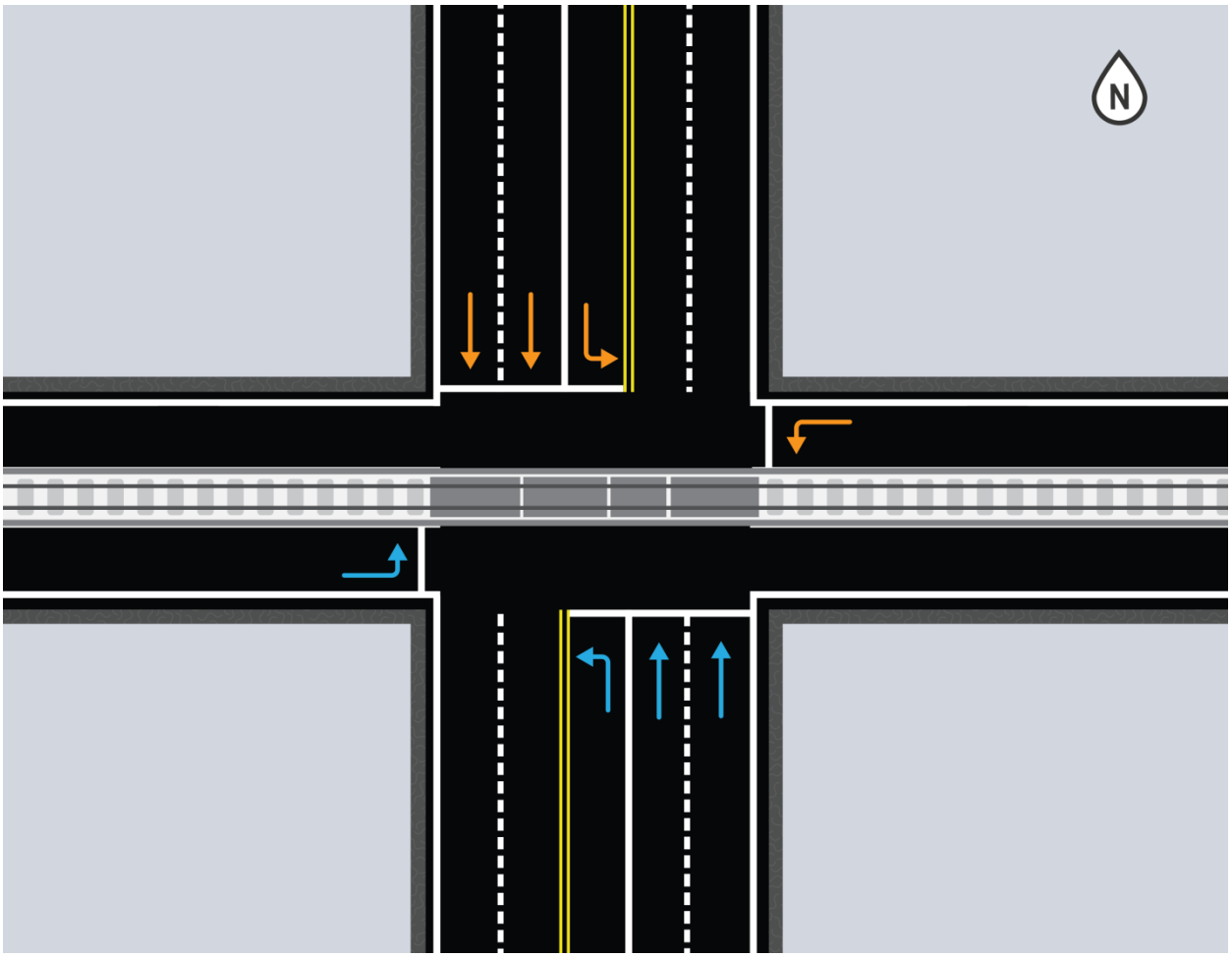


A.2 Median Grade Crossing

In the example, median grade crossing in **Figure A-2**, the at-grade railway is aligned along the median of the east-west street, separating the eastbound and westbound movements. For grade crossings of median-running tracks, the cross-street approach volume plus parallel left-turn volume and the opposing cross-street approach volume plus its parallel left-turn volume are compared, and the greater volume is used.

The diagram shows three northbound approach lanes: one left-turn, and 2 through lanes. The northbound conflict volume would be the greater of either the northbound left-turn volume or the northbound through volume divided by two, plus the eastbound left turn volume (blue arrows). A similar calculation would be made for the southbound and westbound approach volumes, and the resulting conflict volume would be the greater of either the volume indicated by the blue arrows or the volume indicated by the orange arrows. (Other movements have been omitted from the diagram for simplicity.)

Figure A-2. – Sample Conflict Volume for a Median Grade Crossing

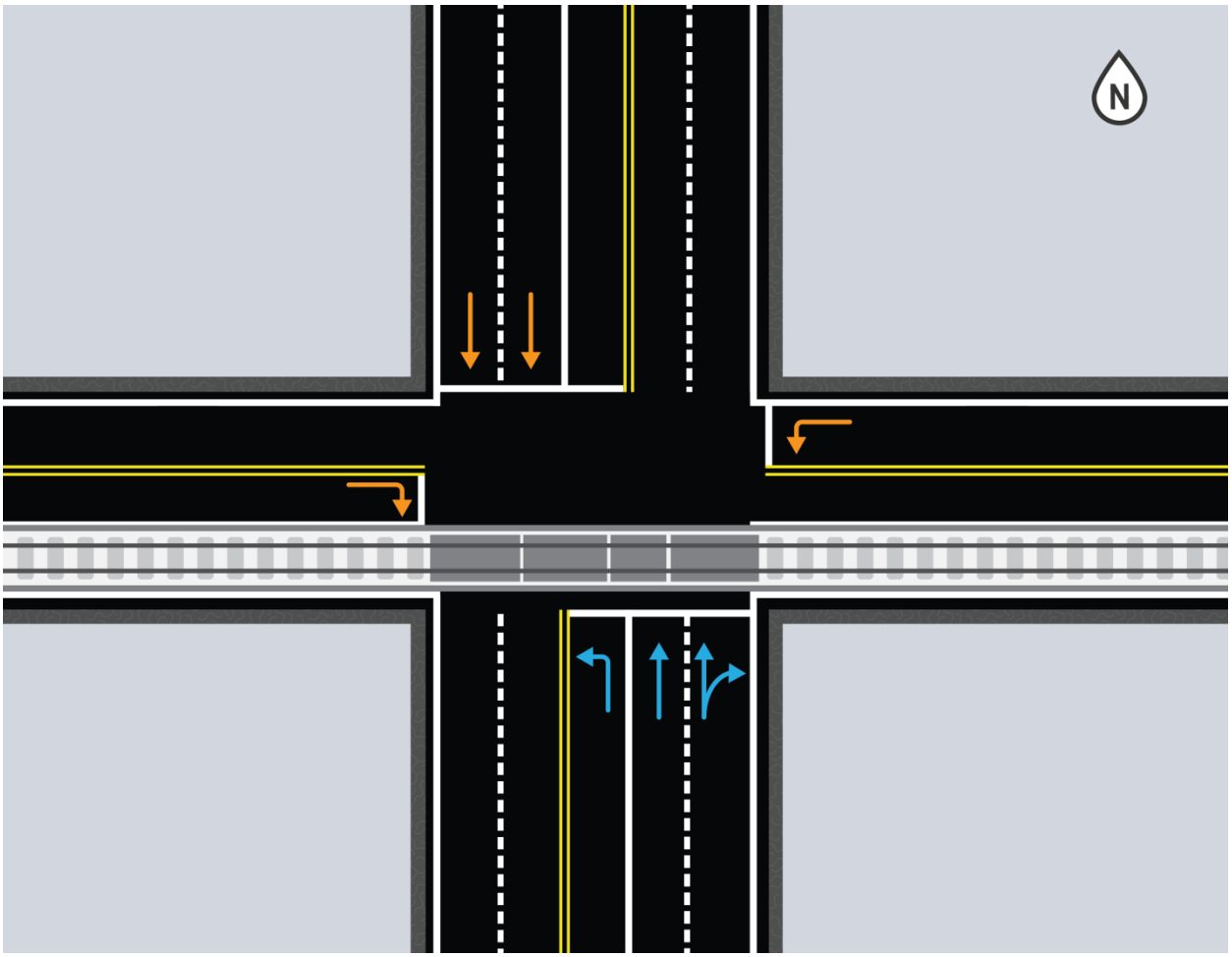


A.3 Side-running Grade Crossing

In the example side-running grade crossing in **Figure A-3**, the at-grade railway is aligned along the south side of the east-west street. For grade crossings of side-running tracks, the near-side cross-street approach volume and the opposing (far side) cross-street approach volume plus its parallel westbound left-turn and eastbound right-turn volume are compared, and the greater volume is used.

The diagram shows three northbound approach lanes: one left-turn lane, one through lane, and one through-right lane. The northbound approach was calculated by comparing the through plus right-turn divided by two lanes, and the northbound left-turn volume divided by one lane. The greater of that comparison resulted in the northbound conflict movement, represented by the blue arrows. The southbound movement, represented by the orange arrows, included the southbound through movements divided by two lanes, added to the westbound left-turn movement and the eastbound right-turn movement. The greater conflict volume of the blue versus orange arrows was used for graphing and analysis.

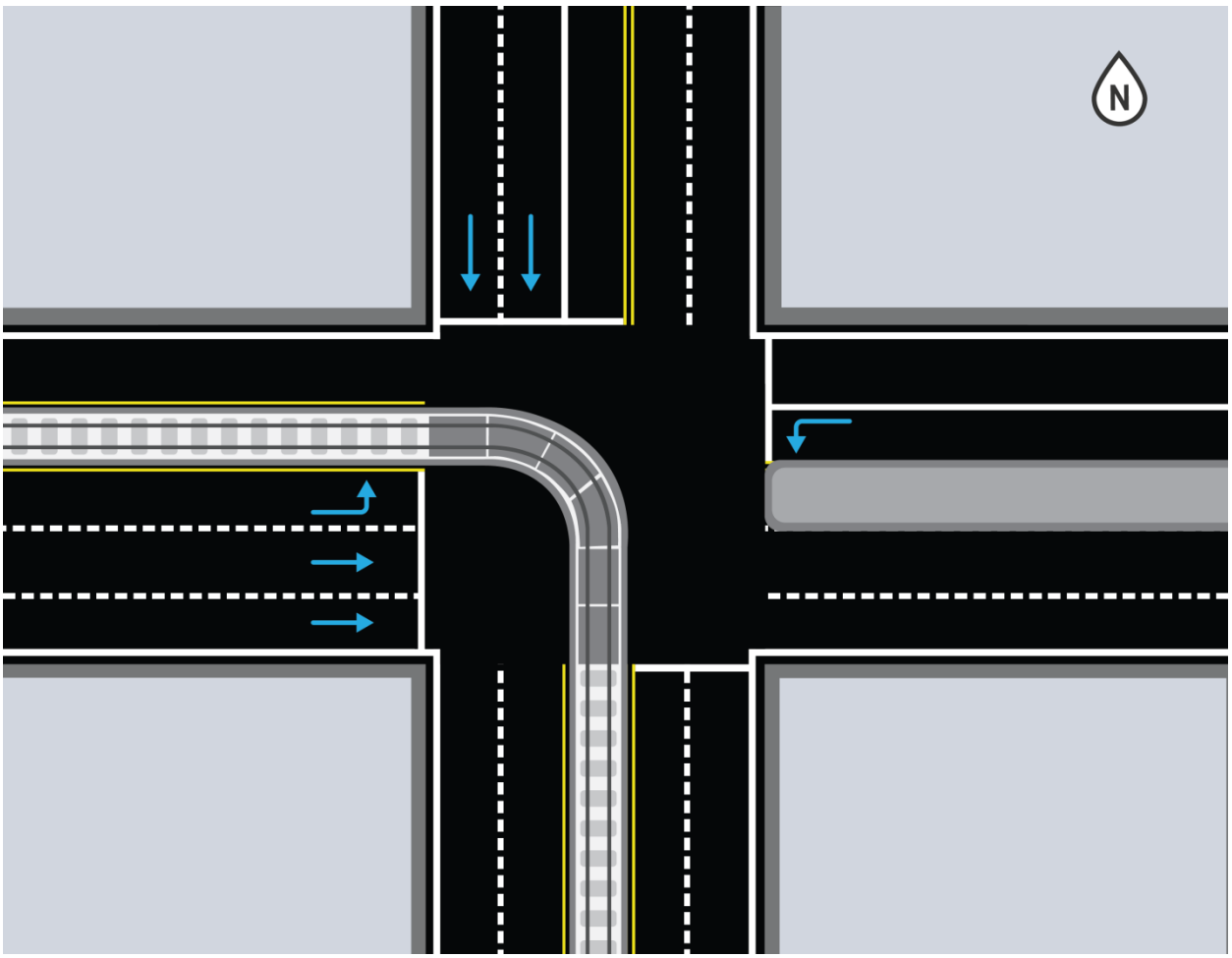
Figure A-3. – Sample Conflict Volume for a Side-running Grade Crossing



A.4 At-Grade Turn Crossing

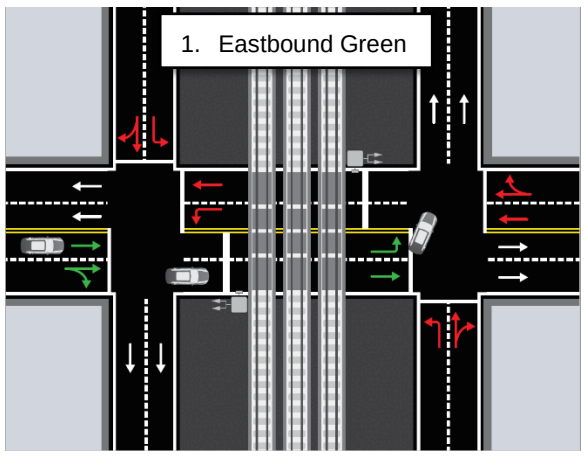
At-Grade turns provide a transition from median running track in one direction to median running track in a perpendicular direction, or from a side-running track to a median running track in a perpendicular direction. For at-grade turns, all movements that cross the track were added for the conflict volume. In the example in **Figure A-4**, the greater of the eastbound through volume divided by two lanes and eastbound left-turn volume divided by one lane (due to dedicated left-turn lane policy described above) was added to the southbound through volume divided by two lanes and the westbound left-turn volume divided by one lane.

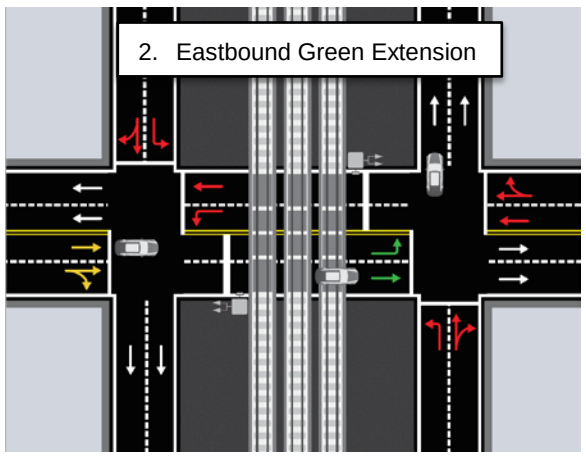
Figure A-4. – Sample Conflict Volume for an At-Grade Turn

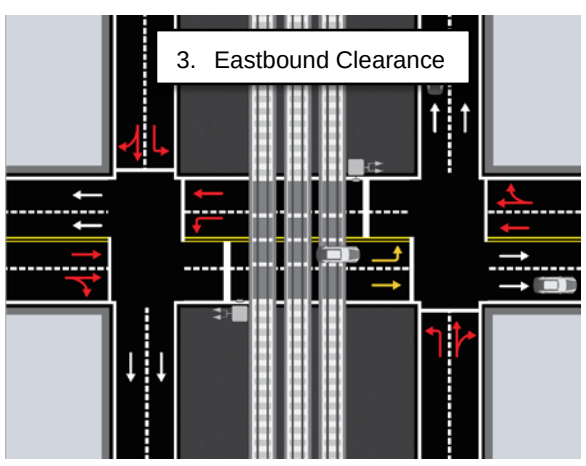


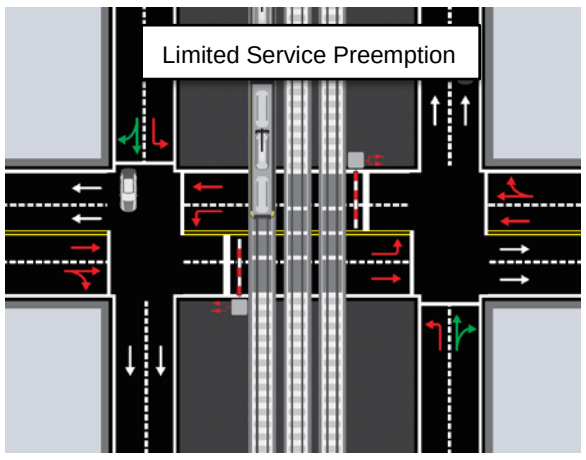
Appendix B. – Grade Crossing Signal Phasing Diagram

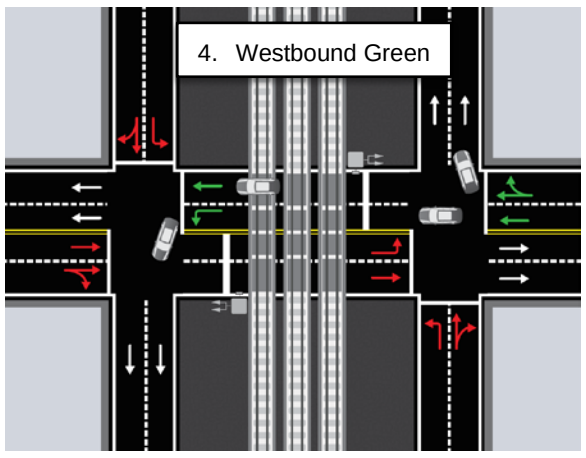
Appendix B – Grade Crossing Signal Phasing Diagram

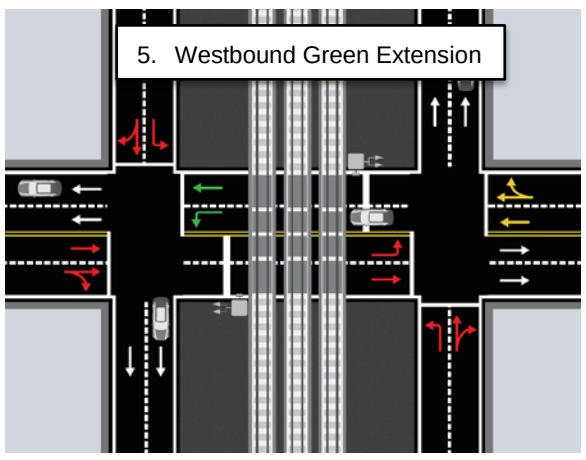


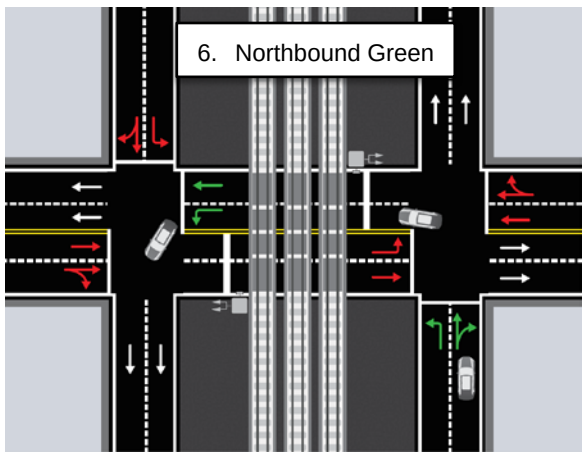


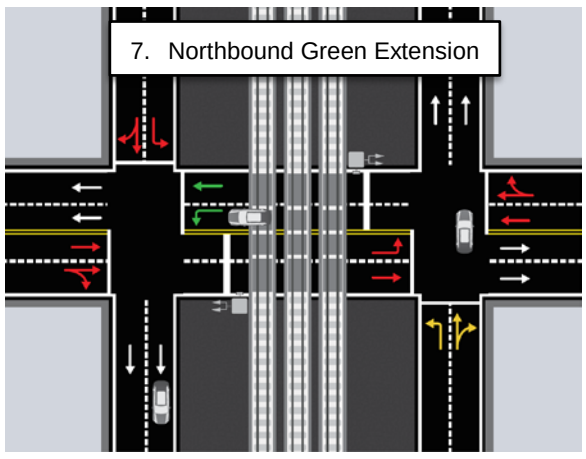


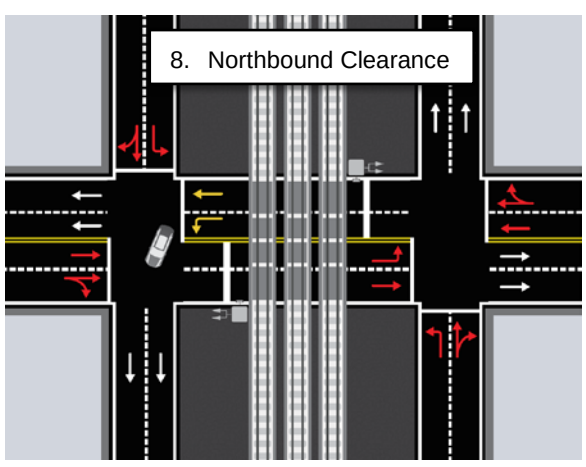


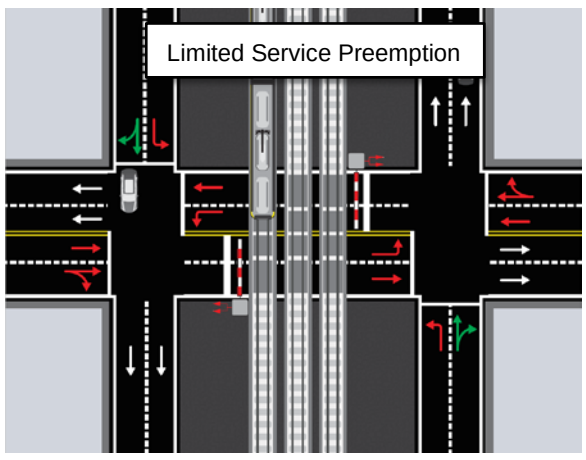


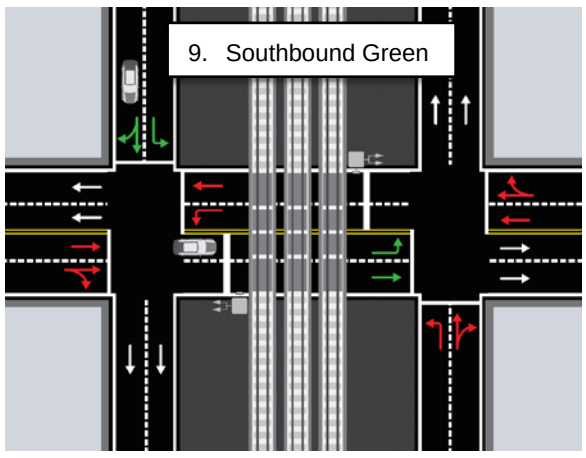


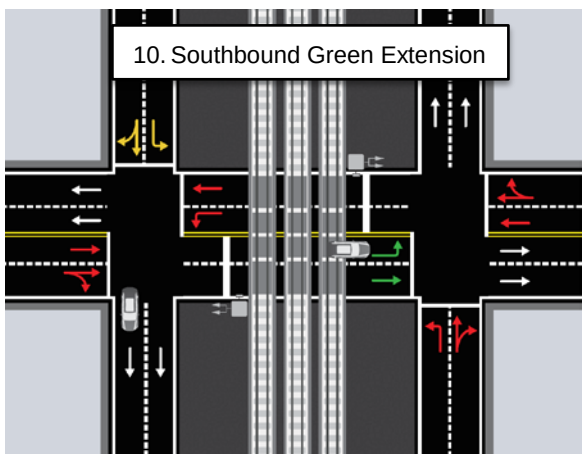












(Back to 1. Eastbound Green)