MONTEBELLO BOULEVARD
GRADE SEPARATION PROJECT

INFRA Grant Benefit-Cost Analysis

I. INTRODUCTION

A Benefit-Cost Analysis (BCA) was conducted for the Montebello Boulevard Grade Separation Project (the Project). The Project is located on Montebello Boulevard in the City of Montebello, California and is one of many Union Pacific Railroad (UPRR) crossings in Los Angeles County on the Alameda Corridor-East (ACE) Trade Corridor serving the Ports of Los Angeles and Long Beach. According to the Federal Railroad Administration Web Accident Prediction System, the current Montebello at-grade crossing has the highest crash probability in Los Angeles County on UPRR[1]. Grade separating the crossing is a regional priority, as demonstrated by strong community support in the City of Montebello and by the robust commitment of Los Angeles County sales tax measure funds to the Project. In addition, the current Montebello at-grade crossing causes significant traffic delays that ripple through the local traffic network, primarily during peak morning and afternoon periods.

The BCA provides a monetization and discounting of Project costs over a 20-year horizon, in a common unit of measurement in present day dollars. This BCA attempts to be comprehensive and objective in identifying and quantifying project benefits and costs, and complying with the guidelines for the BCA as outlined in the INFRA Grant Notice of Funding Availability. The benefits that have been estimated for the Project have been categorized by four long-term outcomes of Economic Vitality, Mobility, Safety and Community/Environment. A conservative approach has been taken in all cases where judgment was used in estimating the extent of benefits. In addition, an effort has been made to present the BCA estimation in as transparent a fashion as possible. The Project has been determined to have a **Benefit-Cost Ratio of 1.1** at a 7% discount rate**.**

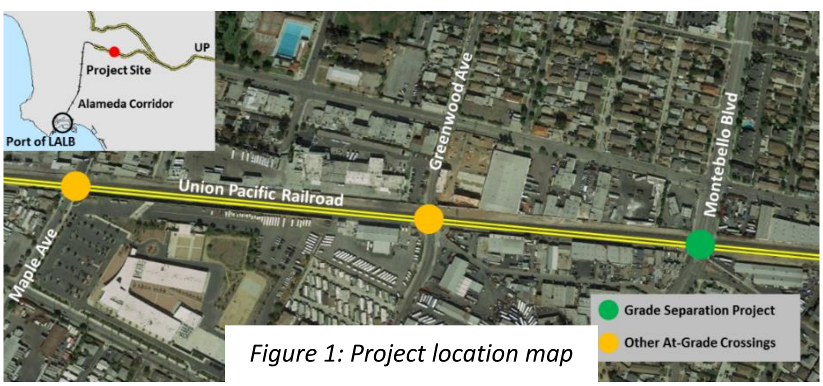

Figure 1: Project location map

[1] See Federal Railroad Administration Web Accident Prediction System Report posted to http://www.theaceproject.org/infra . The highest ranked crossing, at Fairway Drive in the City of Industry, is closed to traffic for construction of a grade separation project by the San Gabriel Valley Council of Governments. Hence, Montebello Boulevard advances as the most hazardous crossing of the UPRR in Los Angeles County.

II. SUMMARY OF BENEFITS QUANTIFIED

The primary benefits that were quantified to determine the Benefit-Cost Ratio are as follows:

1. The Project's elimination of the at-grade crossing at Montebello Boulevard will lead to a reduction in the total time that vehicles and trucks spend waiting for passing trains. A traffic network analysis reveals that these improvements will lead to further travel time improvements throughout the highly congested local roadway network.
2. The Project's grade separation, and at-grade safety improvements at two adjacent crossings to the west, will allow for the authorization by the Federal Railroad Administration of a Quiet Zone, reducing the negative impacts of train horn noise to nearby households. The value of train horn noise reduction is estimated based households' willingness to pay, consistent with a 2006 Transportation Research Part D study[2] and USDOT guidance offered at a debrief meeting on 9/18/2018.
3. The Project will improve crossing safety by eliminating the possibility of collisions between commuter or freight train and vehicles, pedestrians and bicyclists at Montebello Boulevard. As noted above, this crossing is the most likely on the UPRR in Los Angeles County to experience a collision on an annual basis, according to the FRA Web Accident Prediction System.
4. Constructing a grade separation at Montebello Boulevard's rail crossing will reduce wait times for vehicles, which will lead to a reduction in fuel consumption and toxic emissions caused by idling vehicles.
5. The ACE Trade Corridor provides connectivity between the Ports of Los Angeles and Long Beach and the inland United States. The corridor mainly handles containerized imports and exports, which are generally high-value commodities that are sensitive to delays that could result from at-grade crossing crashes. The Montebello Boulevard Grade Separation Project, as a part of the overall ACE Program, will eliminate the possibility of a vehicular crash at the crossing and improve the reliability of freight movement between the Ports of Los Angeles and Long Beach and the transcontinental rail network, thus reducing the costs associated with freight delays.

Additional project benefits have been quantified and described in the grant narrative, but were not directly monetized for the BCA, including:

1. Improving access for emergency vehicles and other city services between the north and the south side of the city.
2. Short-term project benefits such as construction jobs and spending are excluded from the BCA in accordance with USDOT guidance.

[2] Bellinger, William, (2006). The Economic Valuation of Train Horn Noise: A US Case Study. *Transportation Research Part D: Transport and Environment*, Volume 11, Issue 4, pp 310-314.

Table 1 summarizes the results of the BCA in terms of the results for each of the Long-Term Outcomes, and the following sections of this document describe the methodology and the basis of assumptions, including references to sources used in the development of the BCA.

Table 1: BCA Summary Results (7% discount)

CATEGORY	NET PRESENT VALUE (7% DISCOUNT)
Economic Outcome	$8,852,414
Mobility Outcome	$76,502,200
Safety Outcome	$9,178,984
Community / Environment Outcome	$19,002,220
Total Benefits (a)	$113,535,819
Life Cycle Project Cost (including maintenance) @ 7% (b)	$117,669,955
Residual Value (c)	$13,357,159
Net Present Value (a-b+c)	$9,223,022
Benefit Cost Ratio	**1.1**

III. PROJECT SUMMARY

For the purposes of the quantitative BCA, the continued operation of UPRR freight and Metrolink commuter trains through the City of Montebello without the grade separation project is considered the baseline, or "without-project" condition. The construction of a grade separation is considered the "with-project" condition.

Table 2 provides a project summary matrix as described in the Notice of Funding Availability that identifies the baseline, the changes, the types of impacts, the affected populations, the economic benefit, and a summary of results for each category of benefit. In addition to the descriptions and tables that are included in the following sections, the complete Excel Workbook that incorporates the calculations for the BCA is provided.

Table 2: Benefits Summary

TYPE OF IMPACTS	POPULATION AFFECTED BY IMPACTS	ECONOMIC BENEFIT	SUMMARY OF RESULTS (7% DISCOUNT RATE)
Reduced vehicular wait time behind train gates and reduced peak period travel times throughout the local transportation network	Drivers and passengers of peak period vehicles and trucks going through the Montebello Boulevard crossing and the surrounding local transportation network	• Reduction in fuel consumption • Reduction in vehicle/truck operating costs • Reduction in emissions • Reduction in the peak period wait times of vehicle drivers, truck drivers and passengers at the Montebello Boulevard crossing and throughout the local transportation network	$85.4 million reduction in costs associated with local network delay times
Increase in residential property values due to reduced train horn noise	Homeowners in the proximity of the rail crossing	Increase in the value of residential properties in proximity of the grade crossing	$19.0 million total increase in residential property values
Reduction in the number of Highway-Rail Crashes (including potential commuter rail and pedestrian crashes)	• Montebello residents • Metrolink commuters • Motorist commuters • Broader population and producers who are reliant on goods exported or imported through the Ports of Los Angeles and Long Beach	• Fatalities and injuries avoided • Property damages to vehicles, locomotives and rail infrastructure avoided • Additional costs associated with rerouting of vehicular traffic avoided • Additional costs associated to train delays avoided	$9.2 million reduction in costs associated with crashes

IV. ASSUMPTIONS

A. Project Cost

The Benefit to Cost Ratio of the grade separation project at Montebello Boulevard is calculated using project costs spanning from 2017 to 2023, as shown in Table 3. **In total, the Montebello Boulevard Grade Separation Project has a year of expenditure capital cost of $133.3 million.**

Table 3: Project Cost Projection

YEAR	PROJECT COST
Prior Expenditure	$14,100,000
2019	$23,100,000
2020	$26,400,000
2021	$23,200,000
2022	$23,200,000
2023	$23,200,000
Total	**$133,300,000**

Project costs are broken down by construction costs as well as right-of-way acquisition costs, design costs, and management costs. Further breakdown of costs associated with the Montebello Boulevard Grade Separation Project can be found in the accompanying model ("Cost Estimates" Sheet).

B. Mobility

MOBILITY
✓ **15.0 million hours of reduced auto and truck travel time**
✓ **$76.5 million saved in congestion costs and delayed cargo movement**

The grade separation project will improve traffic flows in the area around the Montebello crossing. Under the "without project" scenario, the local traffic network is highly congested in 2024 with AM peak period travel speeds estimated at 8.7 mph and with crossing gates down an estimated 8 minutes per peak hour. As has been demonstrated in other highly urbanized areas, a single rail grade separation can have significant travel benefits throughout the local network[3]. The current traffic network surrounding Montebello Boulevard is burdened by more than 18,000 vehicles during both the AM and PM peak periods (system boundaries are shown in Appendix A). Given these volumes, even modest improvements in travel speeds in the local network will yield significant public benefits.

To measure the extent of these improvements, LIN Consulting, Inc., was commissioned to perform an independent network-level traffic analysis for the 30-minute driving radius area from

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[3] http://www.seattle.gov/transportation/docs/lander/SLanderStreetGradeSeparationRailroadSafetyProject_Final.pdf

the Montebello crossing. The analysis was performed for AM and PM peak hours only. Even when limited to only AM and PM peak hours, the "with project" scenario showed significant travel time savings throughout the local Montebello network (Table 6 and Table 7 in Appendix A). Table 4 summarizes findings from the network-level traffic analysis.

Table 4: AM and PM Peak Hour Traffic Summary – 2024 vs 2045

	2024 Without Project	2024 With Project	2045 Without Project	2045 With Project
Total Distance (miles) - AM	20,934	23,524	18,536	24,209
Total travel time (hr) – AM	2,400	1,807	5,033	1,964
Total delay (hr) – AM	1,704	1,022	4,423	1,155
Total Distance (miles) - PM	23,109	23,381	18,631	23,563
Total travel time (hr) – PM	3,540	2,503	7,486	2,590
Total delay (hr) – PM	2,779	1,725	6,879	1,806

Value of time savings of the traffic network are estimated by comparing the number of traffic network users in the no-build and build scenarios. In doing so, to remain conservative, benefits realized by new entrants into the traffic network because of its improved efficiency and reduced traffic are not quantified. Table 5 summarizes these findings.

Table 5: Adjusted Traffic Time Savings - 2024 vs 2045

Year	2024	2045
Travel Time Savings (hr)	1,319	8,976
Delay Time (hr)	1,328	8,998

The Project's elimination of the Montebello Boulevard at-grade crossing will lead to two types of reductions in time of vehicles within the network-level study area. First, vehicles and trucks will save time spent waiting for passing trains. Second, travel time savings will result from the increased efficiency of the network and reduced total vehicle hours travelled. During the peak hour, crossing gates are down an average of 8 minutes per hour. Eliminating "surges" in peak hour vehicle traffic held back by frequent and long passing freight trains will reduce congestion and queuing impacts on intersections within a 30-minute drive of the crossing. Average vehicle occupancy of 1.39 and truck occupancy of 1.00 persons was assumed for estimating these benefits.

In total, the Project will result in $76.0 million in total benefits associated with travel time savings. In the accompanying model, Sheet "valueOfTime" contains calculations for quantifying the costs associated with everyday travel time and delayed cargo movement savings because of the Project.

Highway-rail crashes can also lead to vehicle delay time. Additionally, when a train is traveling eastward, a crash at Montebello Boulevard has historically caused closures at three nearby at-grade crossings within 4,500 ft. of Montebello Boulevard (Vail Avenue, Maple Avenue, and Greenwood Avenue). Therefore, congestion and delayed cargo movement costs at these crossings resulting from a crash at Montebello Boulevard are included. In the accompanying model, Sheet "CrashCostsAtCrossings" contains calculations for quantifying the time cost saving associated with highway-rail crashes at Montebello Boulevard. The potential costs are broken down by delay and diversion time of vehicles and delayed highway and rail cargo at Montebello Boulevard and potentially Greenwood Avenue, Maple Avenue and Vail Avenue for both fatal and non-fatal crashes. Rail operator time costs are also included in this section. These congestions costs and delayed cargo movements from avoided highway-rail crashes result in $494,158 in total savings with the Project.

Over the BCA horizon, the total net present value (NPV) of these avoided delays was determined to be $76.5 million.

C. Economic Vitality Outcome

OPERATING COSTS
✓ **$8.9 million saved in auto, bus and truck operating costs**
✓ **15.0 million total hours of wait time for autos, buses and trucks saved**

The Project will save a total of 15.0 million hours of wait time for autos and trucks over a 20-year period following completion. A summation of total vehicle hours saved with the grade separation project can be found in Sheet "operatingCost" within the attached model.

The savings in auto and truck miles will lead to reduced vehicle operating costs. Reductions in operating costs were estimated based on USDOT's Benefit-Cost Analysis Guidance for INFRA Applications[4] recommended monetized values of $0.39 and $0.90 for operating costs per mile for cars and trucks, respectively. **Over the BCA horizon, the total NPV of these savings was determined to be $8.9 million.**

Operating cost saving calculations can be found in the accompanying model ("operatingCost"), broken down into sections by mode.

D. Safety

The Montebello Boulevard crossing is in an area with multiple land uses, including residential, school, commercial and industrial land uses. Such conditions and proximity to an active railroad corridor will result in safety issues, as evidenced by accidents within the UPRR corridor. Today,

[4] https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/14091/benefit-cost-analysis-guidance-2018.pdf

the Montebello Boulevard crossing has the highest crash probability rating along the UPRR in Los Angeles County.

The Project improves the safety of the crossing by eliminating the possibility of train vs. vehicle and pedestrian crashes at Montebello Boulevard. Without the Project, the annual crash costs are expected to be about $1.3 million through the analysis period.[5]

The study assumes that eliminating the possibility of a train-pedestrian crash has an annual benefit of $960,000. This value is solely based on historical incidences. In the past 30-years, the at-grade crossing at Montebello Blvd has experienced three fatal train-pedestrian crashes, or one every 10 years.

The Project Area serves cross-town vehicular traffic in addition to trucks accessing industrial companies near the tracks. **The Project's grade separation at Montebello Boulevard will create $9.2 million in total NPV safety benefits.** Crash cost savings calculations are spread throughout three Sheets ("crashCostsAtCrossings", "crashProbabilities", and "corridorSafetyCosts") within the attached model. Final calculations are found in "corridorSafetyCosts", Lines 113-129.

E. Community/Environmental Outcomes

i. Noise Pollution Reduction Benefits

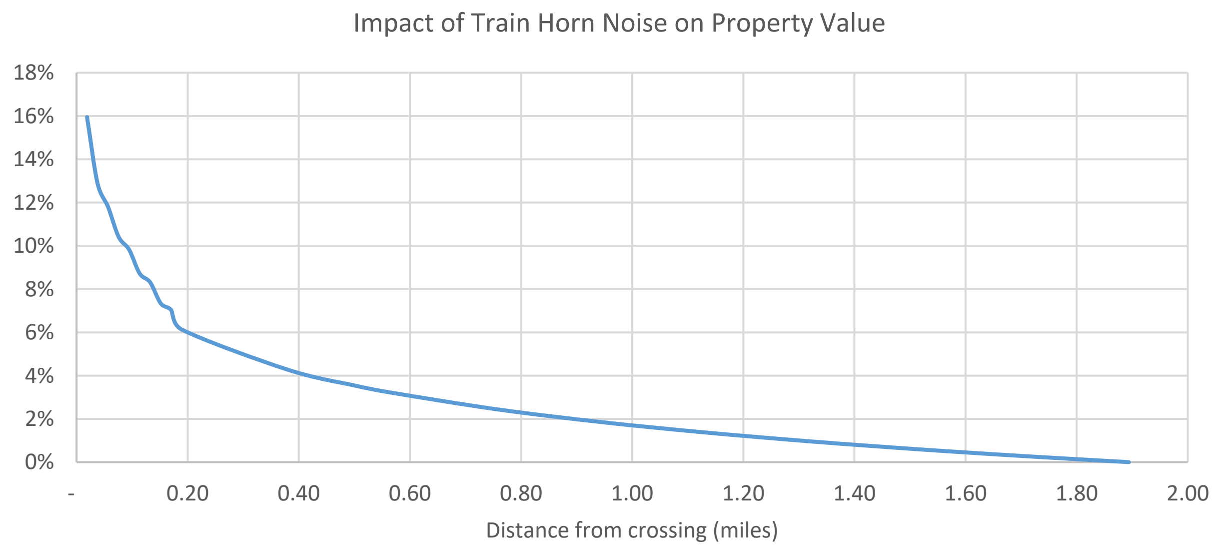
PROPERTY VALUE
✓ **Willingness to pay of $6,109 per 10 db of noise reduction**
✓ **$18.7 million total NPV in property values**

Conversion of the Montebello at-grade crossing to a grade separated crossing would eliminate the noise pollution caused by train horns at the crossing and help enable the establishment of a Quiet Zone. (Grade separated crossings do not require train horns, crossing gates, speed restrictions or other safety measures.) In his 2006 paper titled, The Economic Valuation of Train Horn Noise: A US Case Study[6], Bellinger demonstrated the relationship between train horn noise levels and households' willingness to pay to eliminate the noise. In his research, he found households are willing to pay $4,800 for every 10 db of noise exposure above the background noise level in 2004 dollars ($6,109 inflation adjusted). This approach was mutually agreed upon with USDOT through a debriefing call and email follow-ups. The meeting was held on 9/18/2018 and was attended by Darren Timothy and Paul Baumer from USDOT.

[5] Crash probabilities were calculated based on the guidelines in the Federal Railroad Administration (FRA)'s *Railroad-Highway Grade Crossing Handbook* and *Highway-Rail Crossing Inventory Data*. Safety costs were calculated based on the guidelines in NCHRP-755, with primary and secondary affect costs customized to properly reflect the crash costs at the Project location.

[6] Bellinger, William, (2006). The Economic Valuation of Train Horn Noise: A US Case Study. *Transportation Research Part D: Transport and Environment*, Volume 11, Issue 4, pp 310-314.

Figure 2: Impact of Train Horn Noise on Property Values



This estimate, combined with FRA's guideline of noise decay function calculations for train horns[7] was used to estimate households' willingness to pay to eliminate the train horn noise, shown in Figure 2. In sum, grade separation noise levels are substantially and quantifiably lower than at-grade crossing noise levels, and this lower level of community impacts translates directly to property values.

The willingness to pay for households living in **0.0 – 0.5, 0.5 – 1.0, 1.0 – 1.5 and 1.5 – 2.0 miles from the crossing is $6,824, $3,275, $1,427 and $217 per household**, respectively leading to a total of $30.3 million. For this benefit to be realized, upgrading existing safety gates to four-quadrant or "quad" gates will be undertaken by the applicant at two other at-grade-crossings located immediately to the east of Montebello Boulevard, at Greenwood and Maple avenues. Those projects have an estimated cost of $0.5 million each. Assuming noise reduction benefits are allocated to individual project proportional to their respective costs, share of Montebello from total benefits will be equal to $30.1 million. Based on this adjustment **the total noise reduction benefit of the project is equal to $18.7 million at 7% discount rate.** These calculations can be found in the accompanying model ("noiseReduction"), broken down into sections by distance from the Project Area.

[7] https://www.fra.dot.gov/Page/P0599

ii. Air Pollution

Constructing a grade separation at the rail crossing will reduce wait times for vehicles, which will lead to a reduction in fuel consumption and toxic emissions caused by idling vehicles. Based on Caltrans Guidelines, over the BCA horizon, the **Project will create environmental savings of $286,081.** Environmental cost saving calculations can be found in Sheet "emissions" within the attached model.

	Passenger ($)	Truck ($)	Total Value ($)
Carbon	$43,109	$33	$43,075
NOx	$76,204	$7,639	$68,565
PM10	$111,037	$251	$110,786
SOx	$21,160	$6,937	$14,223
VOC	$16,572	$427	$16,145
Total	**$268,081**	**$15,288**	**$252,794**

F. Residual Value

Residual Value
✓ **$3.0 Million in Right of Way value (NPV)**
✓ **$10.4 Million in construction value (NPV)**

The Benefit to Cost Ratio (BCR) of the Project is calculated with a discount rate of 7% and capital expenditures occurring between 2017 and 2023. Its design life exceeds 20 years beyond the BCA horizon, with its construction elements lasting 75 years or more and the Right-of-Way not depreciating.

At the end of the BCA horizon, the Project is expected to retain 100% of ROW value ($17.0 Million) and 73% of its non-ROW value ($85.3 Million). At 2043, the present value of the future maintenance costs, assuming remaining life of 55 years, annual maintenance costs equal to about 2.2% of construction cost and discount rate of 7% is $24.4 million. The present value of ROW is equal to $3.0 million and the present value of the remainder of the project (87.3 – 24.4) is equal to $10.4 million. Based on these assumptions, by the end of 2043, the Project is determined to have a **residual value of $13.4 million** at a 7% discount rate. Project residual value calculations can be found in Sheet ("BenefitCostSummary"), lines 7 to 43 within the attached model.

G. Operations and Maintenance Costs

In addition to capital costs associated with the Project, the BCR includes annual operations and maintenance costs once the project is completed. Based on a share of the total Project cost, operation and maintenance activities are assumed to have annual cost of $1.75 million (about 2.2% of construction costs) over the 20-year project horizon.

V. APPENDIX

A. Travel Time Reduction

Vehicular delay and travel time savings are estimated using the Synchro model. The Synchro model inputs assume an increase in demand that is independent of the capability of the network to handle the traffic (also known as capacity). This regional growth is calculated using growth factors calculated from the regional gravity model (SCAG 2008). It is common for saturated networks such as Montebello to receive traffic from outside the project area that is normally metered. The model attempts to compensate for this by metering traffic at the outer fringes. This results in “denied entry” once the ability of the model to absorb traffic is at capacity. The proposed project provides the model with a higher throughput capacity, which in turn means that the model network can absorb more traffic. The introduction of a grade separation, especially where average gate blockage times add up to roughly 8 minutes per peak hour, as shown in Figure 3, results in a significant increase in throughput capacity of the modeled roadway network, Figure 4. While the Synchro program is designed to be a mesoscopic traffic analysis model by intersection, the accompanying Simtraffic software attempts to apply these mesoscopic variables using microsimulation-style vehicle behavior models and parameters (e.g., car-following behavior, lane-changing decision distances) to produce simulated performance. While not truly a microsimulation, Simtraffic can produce various Measures of Effectiveness (MOEs) that are valid for use in cost-benefit decision making.

Figure 3: Traffic Distribution – Northbound (NB) vs. Southbound (SB)

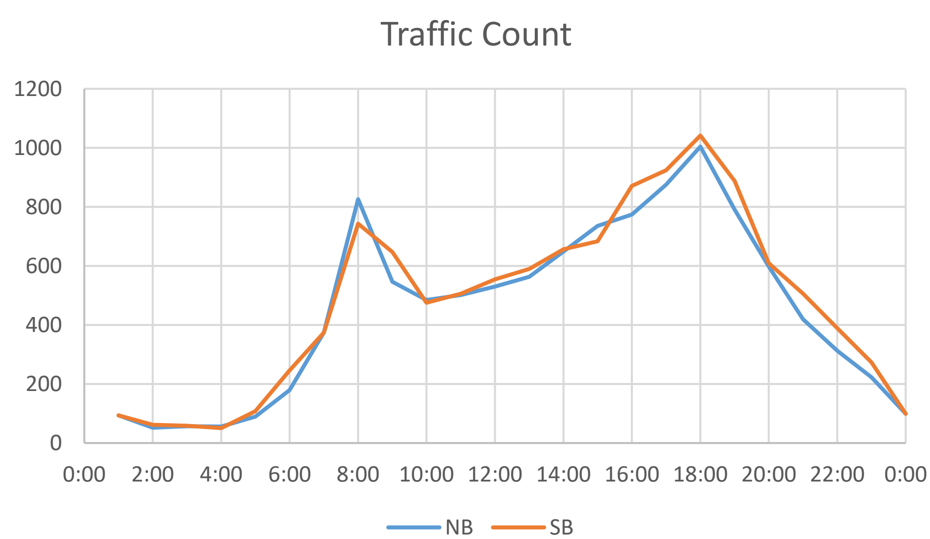
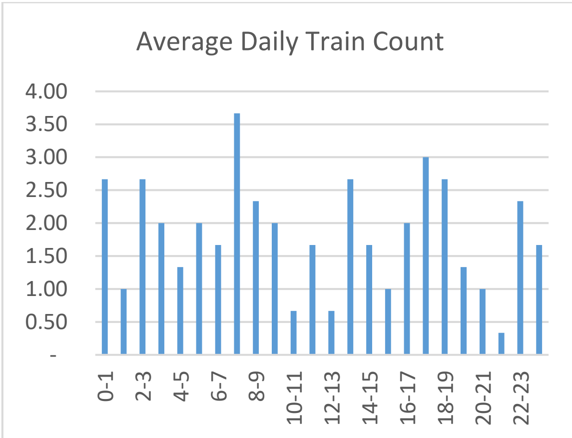
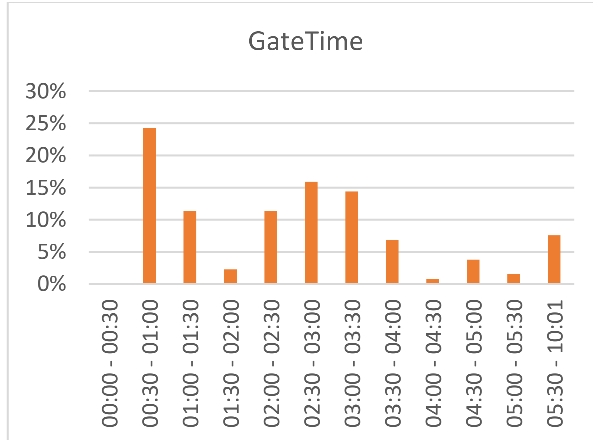


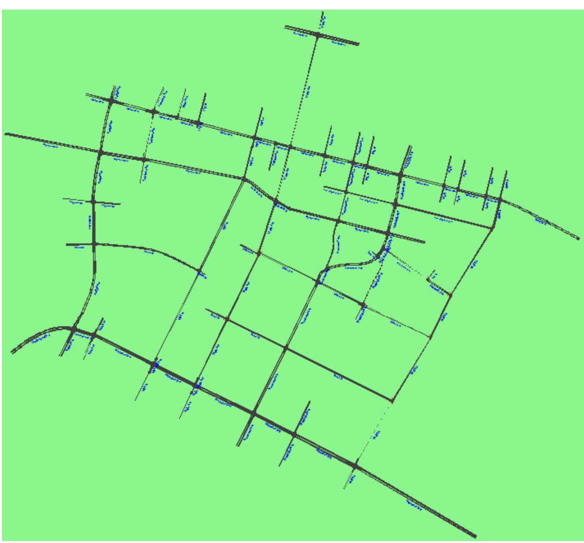
Figure 4: Average train count by hour of the day (left), Gate Down-Up Time Distribution (Right)

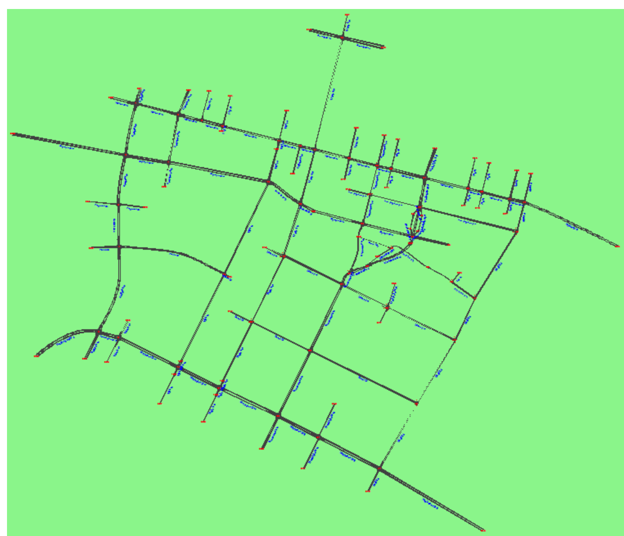




The model is run with seeding of 30 minutes and estimates are generated based on the average of 10 runs. The location of the project, one of the most highly-congested areas in Los Angeles County, makes the 30 minutes seeding time a sensible choice (it takes around 30 minutes to traverse the identified area). Moreover, 30 minutes is also where the model achieved equilibrium (roughly) regarding number of vehicles in the model, Figure 4. The model was run for 60 minute intervals, with 10 runs each. Each model seed number is assigned sequentially, so the randomness factor should be minimized.

Figure 5: No Project Model (left), Plus Project Model (right)





Model outputs for AM and PM peak hours are shown in Tables 7 and 8. The model was initially designed for project start year of 2022. However, since the project start date is postponed, the BCA model uses the interpolation of Table 6 and Table 7 for its input, as shown in "inputPrep" sheet.

Table 6: AM Peak Output

	MOE	Existing	2022 No Project	2022 + Project	2045 No Project	2045 + Project
(a)	Denied entry (#)	55	1,155	280	5,466	469
(b)	Total distance traveled (mi)	23,003	21,162	23,459	18,536	24,209
(c)	Total travel time (hr)	1,355	2,149	1,792	5,033	1,964
(d)	Total delay (hr)	588	1,445	1,009	4,423	1,155
(b) / (c)	Average speed (mph)	17.0	9.9	13.1	3.7	12.3

Table 7: PM Peak output

	MOE	Existing	2022 No Project	2022 + Project	2045 No Project	2045 + Project
(a)	Denied entry (#)	2,181	1,981	1,433	9,382	1,171
(b)	Total distance traveled (mi)	21,012	23,536	23,364	18,631	23,563
(c)	Total travel time (hr)	3,259	3,164	2,495	7,486	2,590
(d)	Total delay (hr)	2,567	2,388	1,717	6,879	1,806
(b) / (c)	Average speed (mph)	6.5	7.4	9.4	2.5	9.1

B. Train and Traffic Volume Increase

Traffic through the corridor may vary based on container traffic at the Ports of Los Angeles and Long Beach. Due to slower markets, major carrier issues, and competition with East Coast ports from the expansion of the Panama Canal, intermodal traffic has grown more slowly than expected, and as a result, the Port of Los Angeles and Long Beach have re-estimated their long-term container forecasts. According to the ports, containerized cargo imports to Los Angeles and Long Beach are expected to grow on average by 4.7 percent per year from 2020 to 2030, down from their previous projection of 6 percent per year. The ports now project reaching 35 million TEUs by 2040. Current rail traffic at the crossing includes 36 UPRR freight trains and 12 Metrolink passenger trains per day[8]. The throughput is expected to grow by 2.7 percent per year capturing some of the containerized traffic growth at Los Angeles and Long Beach[9].

Vehicular traffic is projected based on Los Angeles County 2010 Congestion Management Plan (CMP) at a compound annual growth rate of 0.67%.

[8] KOA Corporation, Final Report Appendix: Alameda Corridor East Phase II Grade Separation Traffic Study and Concept Plans, December 2011, posted to http://www.theaceproject.org/infra

[9] Ibid.