7 Evaluation

This chapter presents an evaluation of the proposed improvement concept. Using the guidance from the Caltrans Corridor Planning Process Guide (February 2020), including the Smart Mobility Framework, proposed improvement concepts were analyzed to ensure a holistic improvement concept that maximizes future implementation and funding opportunities through competitive grant programs.

Analyses conducted as part of the existing conditions assessment were repeated for the proposed improvement scenario to assess the expected benefits associated with various metrics. Calculated benefits include recommendations proposed by the City's HSIP project in addition to countermeasures recommended by this Plan.

Evaluations included in this chapter include:

- Safety Improvement & Gap Closure
- Improvement in Bicycle Level of Traffic Stress (LTS) & Neighborhood Connectivity
- Intersection Level of Service (LOS)
- Benefit to Disadvantaged Communities
- Community Support
- Benefit-cost of the corridor concept

Safety & Gap Closure Benefits

Safety Benefits

Jurisdictions should take a safe systems approach when implementing infrastructure improvements intended to improve safety on their roadways. A safe systems approach to roadway design focuses on minimizing the risk of fatality or injury for all road users while considering the possibility and likelihood of human error that often cause collisions, examining likely collision types and severity, and emphasizing the importance of considering the safety of vulnerable road users. A component of this approach is anticipating future safety challenges before they occur based on evaluation of recent historical collision data and known safety countermeasures proven to reduce the likelihood of future collisions. This type of forward thinking about improving safety is vital to ensuring jurisdictions have the best chance at proactively managing future crashes.

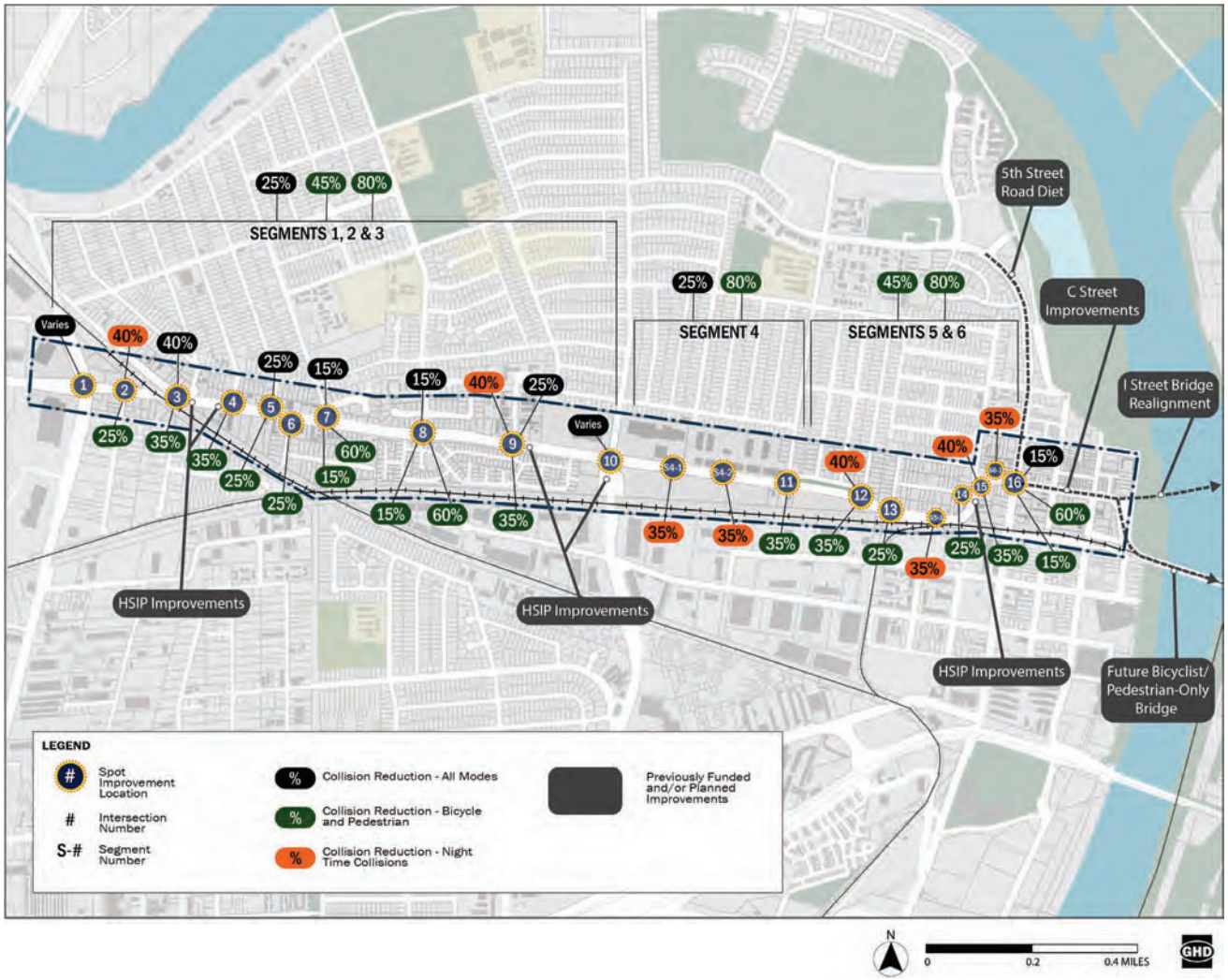
Figure 36 shows the crash reduction factors (CRF) associated with improvements proposed along the corridor, at intersections and along segments. CRFs estimate the potential of a safety improvement to reduce crash rates. CRFs can apply to all crashes, only bicycle and pedestrian crashes, or other specific conditions such as time of day.

Table 11 shows, by intersection and segment location, the safety improvements (or countermeasures) associated with the crash reduction factors shown in Figure 36. Additional detail on how safety improvements were calculated is provided in the Benefit-Cost Analysis section.

Table 11 Safety Improvements

Improvement Type	Location #
Convert Signalized Intersection to Roundabout	1, 10
Install High Visibility Crosswalk and Cross-Bike Markings	2, 5, 6, 13, 14
Install High Visibility Crosswalk Markings, Median Refuge Island and RRFBs	3, 4, 9, 11, 12, 15, S4-1, S4-2
Improve Retroreflective Back Plates on Signal Hardware, Implement Leading Pedestrian Interval & Upgrade Crossings	7, 8, 16
Install Class IV Separated Bikeways	S1, S2, S3, S4, S5
Install Sidewalk	S1, S2, S3, S4, S5
Install Class I Shared-Use Path	S5
Install Buffered Bike Lanes	S5
Install Segment Lighting	S5

Figure 36 Safety Countermeasure Reduction Factors



Gap and Barrier Closure Benefits

From top to bottom, the figures to the right show sidewalk gap closures, as well as crossing improvements and recommended bicycle facilities, which will close gaps and address high stress barriers to connectivity.

Sidewalks are recommended throughout the corridor where gaps in the sidewalk network currently exist. Six-foot sidewalks are recommended west of Kegle Drive and East of 8th Street. Eight-foot sidewalks are proposed between Kegle Drive and 8th Street, in addition to a recommended 14-foot Class I facility through Elkhorn Plaza to provide a parklike feel for which the community voiced support.

Pedestrian crossing improvements are recommended along most Sacramento Avenue crossings, which will result in LTS 1 crossing opportunities. Crossing improvements include one-through four-way high visibility crossings, pedestrian refuge islands, and RRFBs. The proposed recommendations shorten crossing distance, increase pedestrian visibility, and make walking and bicycling along and across Sacramento Avenue safer and more comfortable.

Protected bicycle facilities are prioritized throughout the corridor. Eight-foot Class IV bikeways with an 8-foot landscape buffer are proposed between Harbor Boulevard and Kegle Drive. Six-foot elevated Class IV bikeways with a buffer between the sidewalk are proposed between Kegle Drive and 6th Street. The bicycle facility is effectively a Class I facility shared with pedestrians, but the delineated bicycle markings, as well as the separation between pedestrian and bicycle traffic, reduces conflict between people walking and bicycling. The Class I shared use path proposed along Elkhorn Plaza is open for bicycle travel, but an on-street, 6-foot buffered Class II is also recommended along this segment for commuters.

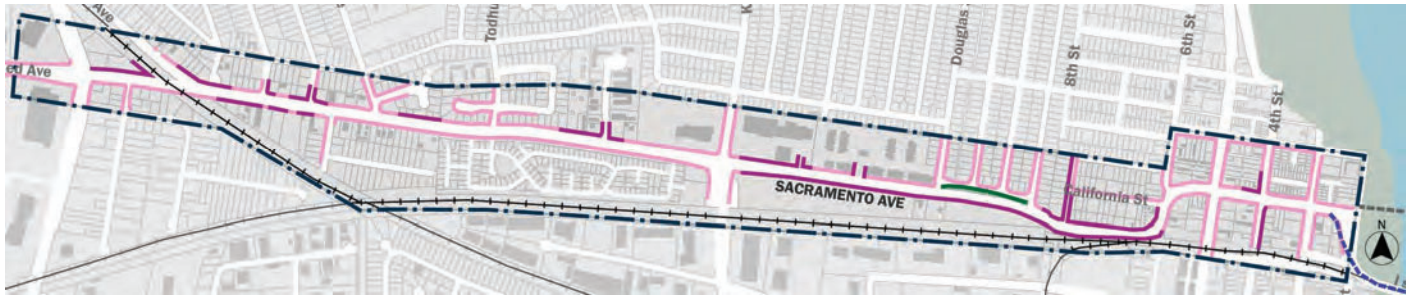


Figure 37 Sidewalk Gap Closure

Figure 38 Intersection Crossing Improvements

Figure 39 Bicycle Improvements

Level of Traffic Stress & Connectivity Benefit

The figures to the right show the bicycle level of traffic stress (LTS) expected following implementation of the proposed improvement concept presented in Chapter 3 of the Draft Plan. For more information on the LTS methodology, see Chapter 3 of the Draft Plan.

As shown, the improved condition provides low-stress connectivity throughout the corridor where high stress segments, approaches and crossings created barriers to connectivity in the existing condition.

LTS on corridor segments improves to LTS 1 following implementation of Class IV separated bikeways, or cycle tracks along the entirety of the corridor and a Class I shared-use path through Elkhorn Plaza. The cycle tracks are separated from vehicular traffic with a combination of landscaped and stamped concrete treatments. Additionally, the cycle tracks are a raised concept, placing bicyclists at sidewalk-level.

Left-turn lane approaches that were previously LTS 3 or 4 are addressed by installing new two-stage turn maneuvers at multiple intersections, where bicyclists are directed to cross at enhanced crossing locations instead of at left-turn pocket locations. Right-turn pockets at Harbor Blvd, and Jefferson Boulevard / Kegle Drive are addressed by the separated bicycle and pedestrian ramps proposed as part of the roundabout concepts at the two locations. A protected intersection concept at 5th and C Street improves LTS of both left- and right-turn approaches and the intersection crossing.

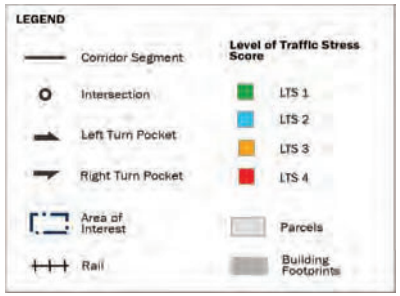


Figure 40 Improved Segment LTS

Figure 41 Improved Approach LTS

Figure 42 Improved Crossing LTS

Vehicular Benefit

Figure 43 shows the expected intersection Level of Service (LOS) (based on vehicular delay) in the future condition without the improvements proposed in the Plan, while Figure 44 shows the expected LOS in the future condition following the implementation of the proposed improvements presented in Chapter 6. For more information on LOS thresholds, see Chapter 3. Future traffic conditions were estimated by using an average growth factor for the corridor derived in coordination with the City to be consistent with anticipated General Plan buildout and regional growth.

As shown in Figure 43, the vehicular LOS in the future condition will be degraded in the PM peak hour at the intersections of Sacramento Avenue with Solano Street and Jefferson Boulevard / Kegle Drive, at LOS F and LOS E, respectively. It should be noted that the City's General Plan sets a threshold for acceptable vehicular operations at LOS E. However, the intersection of Jefferson Boulevard / Kegle Drive will also experience queue spillbacks that contribute to poor air quality and driveway blockages.

As shown in Figure 44, following implementation of corridor improvements, LOS during both peak hours is anticipated to improve with implementation of the proposed roundabout intersections. The roundabouts proposed at the Harbor Boulevard and Jefferson Boulevard intersections will decrease vehicular delays, reducing corridor travel times and reducing emissions from traffic congestion and queues. The vehicular delays seen in the future condition without the proposed roundabout at the Jefferson Boulevard intersection would otherwise require intersection widening to accommodate future traffic at a similar level of performance for all users. Intersection widening along the corridor would conflict with the competing goals of this plan, which include reducing barriers to multimodal connectivity.

No improvements are recommended to address the LOS F condition during the PM peak hour at the Solano Street intersection. While this intersection could be signalized to address the anticipated LOS deficiency, this side-stop-controlled intersection is not expected to meet peak hour signal warrants for signalization. A receiving outbound two-stage left turn lane would also help address operations but would conflict with the proposed installation of a mid-block crossing and RRFB through the HSIP funded project at this location. This intersection should be monitored as area traffic redistributes following implementation of the proposed HSIP-funded turn channelization and restrictions at Sunset Avenue. As conditions warrant, the City may consider options to address operational concerns through signalization, left turn access control, or other turn restrictions. Alternatively, the City may choose to seek City Council approval for an LOS threshold exemption at this location to accommodate the complete street improvements.

The intersection of Sacramento Avenue and 5th Street is anticipated to degrade from an LOS C to an LOS D condition during the PM peak hour with the implementation of the proposed protected intersection, which removes turn channelization on some movements in exchange for reduced crossing distances and reduced levels of traffic stress for pedestrians and cyclists. LOS D conditions are considered acceptable per City standards during peak hours.

Figure 43 Future Intersection LOS without Project Improvements

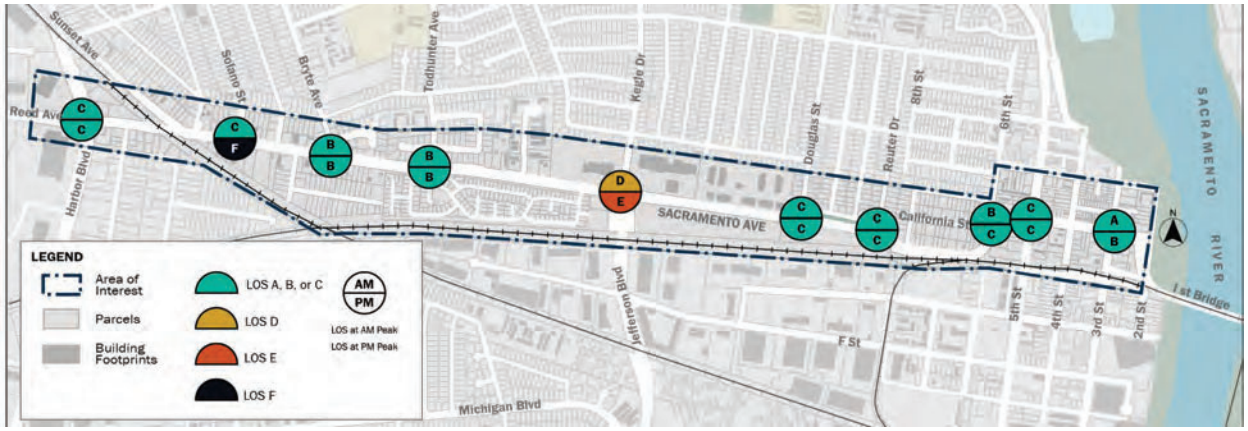
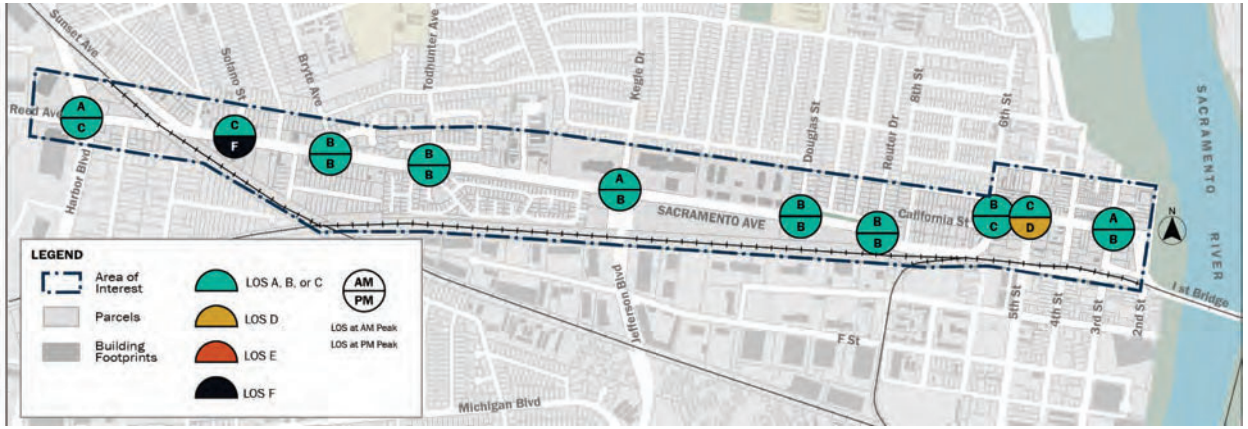


Figure 44 Future Intersection LOS with Project Improvements



Disadvantaged Community Benefit

Disadvantaged community (DAC) status can be measured based on a variety of criteria at the U.S. Census Tract level. The DAC status criteria examined in this Plan are consistent with the California Transportation Commission (CTC) 2023 Active Transportation Program Guidelines (Cycle 6) for identifying disadvantaged community status. While not an exhaustive list, the DAC criteria analyzed in this Plan include the following

- Median Household Income (MHI)
- CalEnviroScreen 4.0
- SACOG Environmental Justice Areas (Regional Definition)

The DAC analysis included in the Plan was completed prior to the official release of the 2025 Active Transportation Program (Cycle 7). Thus, Cycle 6 criteria were used. As the City seeks grant application funding to implement the improvements proposed in the Plan, the DAC analysis should be updated to reflect the most current program criteria, as appropriate.

As shown in Chapter 4: Existing Conditions, the entirety of the corridor area of interest is identified as a disadvantaged community based on one or more of the criteria listed above. The proposed corridor improvements would serve these disadvantaged populations by providing vital connectivity between existing and future local destinations to the north, south and along the corridor.

Grant funding applications for the Active Transportation Program assess DAC status based on project location and severity of the disadvantage. Project location assesses whether the project is located partially or fully within a DAC, while severity assesses the level of disadvantage per the criteria established by CTC Cycle 6 guidelines. As described in the Cycle 6 guidelines, a one through four points scale is ascribed based on the severity of the DAC.

This criterion for determining DAC severity is described in further detail below for each of the measures of DAC included in the Plan. The DAC severity criteria for the Census Tracts along the corridor are also described by segment below.

Severity Criteria

Median Household Income

Communities located within Census Tracts with a MHI of less than 80 percent of the statewide median, or less than $60,188.00 is considered disadvantaged.[12] The number of points awarded for each level of severity is described below.

- 0 points: greater than 80 percent of the MHI, or greater than $60,188.00
- 1 point: between 75 percent and less than 80 percent of MHI, or between $56,426.25 and $60,188.00
- 2 points: between 70 percent and less than 75 percent of MHI, or between $52,664.50 through $56,426.24
- 3 points: between 65 percent and less than 70 percent of MHI, or between $48,902.75 through $52,664.49
- 4 points: less than 65 percent of MHI, or less than $48,902.75

CalEnviroScreen 4.0

CalEnviroScreen (CES) 4.0 results are reported on a scale of 0 to 100, with 90th percentile being the most disadvantaged and the 10th percentile being the least disadvantaged. In order to be considered disadvantaged based on CalEnviroScreen results under the Active Transportation Program Cycle 6 guidelines, a Census tract must be within the top 25 percent disadvantaged. The number of points awarded for each level of severity is described below.

12 Based on data U.S. Census Data Table B19013, 2015-2019 American Community Survey (ACS) 5-Year estimates. Statewide median income for this vintage is $75,235.

- 0 points: above 25 percent most disadvantaged, or a CES score percentile of less than 75.
- 1 point: between 20 percent and 25 percent most disadvantaged, or a CES score percentile of between 75 and 80.
- 2 points: between 15 percent through less than 20 percent disadvantaged, or a CES score percentile of between 80 and 85.
- 3 points: between 10 percent and less than 15 percent most disadvantaged, or a CES score percentile of between 85 and 90.
- 4 points: less than 10 percent most disadvantaged, or a CES score percentile of between 90 and 100.

Regional Definition

If there is a regionally-adopted DAC definition, this can be used to assess DAC status. SACOG has a regional definition called Environmental Justice Areas, which considers a variety of factors such as: income status, minority status, DAC status identified by CES 3.0, as well as other vulnerabilities. A regional definition is ascribed zero or one points based on whether or not the community qualifies under that definition or not.

Table 12 DAC Severity by Segment

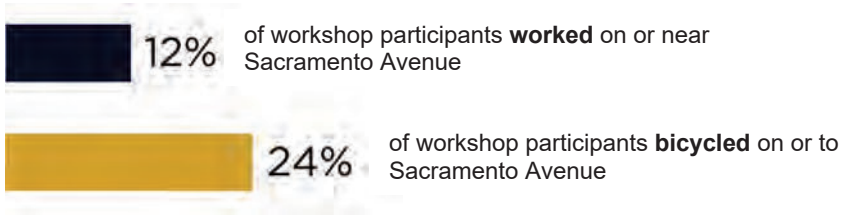
Segment Location	DAC Category		
	MHI	CES 4.0	Regional Definition
Segment 1	1 Point	4 Points	1 point
Segment 2	1 Point	4 Points	1 point
Segment 3	1 Point	4 Points	1 point
Segment 4	4 Points	3 points	1 point
Segment 5	4 Points	3 points	1 point
Segment 6	4 Points	3 points	1 point

DAC Severity by Segment

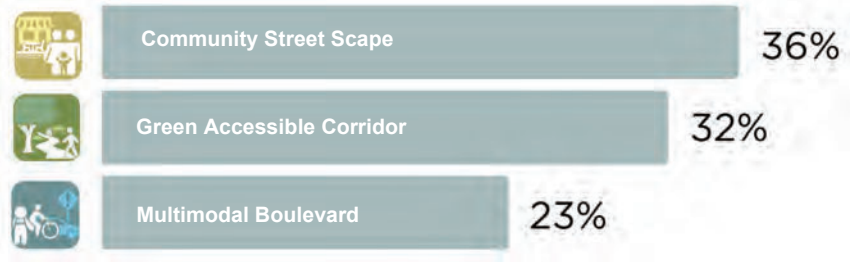
Table 12 shows the number of points a project in each segment would receive based on severity using the DAC criteria included in the Plan, per the 2023 Active Transportation Program Guidelines. As shown, assessing DAC severity based on MHI alone shows Segments four, five and six as the highest severity of disadvantage along the corridor, while segments one, two and three are somewhat disadvantaged based on income alone. When assessing DAC severity based on CES 4.0 results, segments one, two and three show the highest severity of disadvantage, followed by segments four, five and six, which are slightly less disadvantaged based on the CES results. The regional definition shows all six segments as disadvantaged, but the number of points received using this definition is lower.

Community Support

At Workshop 1, a significant portion of participants indicated that they worked on Sacramento Avenue or used the Corridor to get to work (12 percent). A fourth of participants indicated that bicycling was their primary mode of transportation along or to and from the corridor.

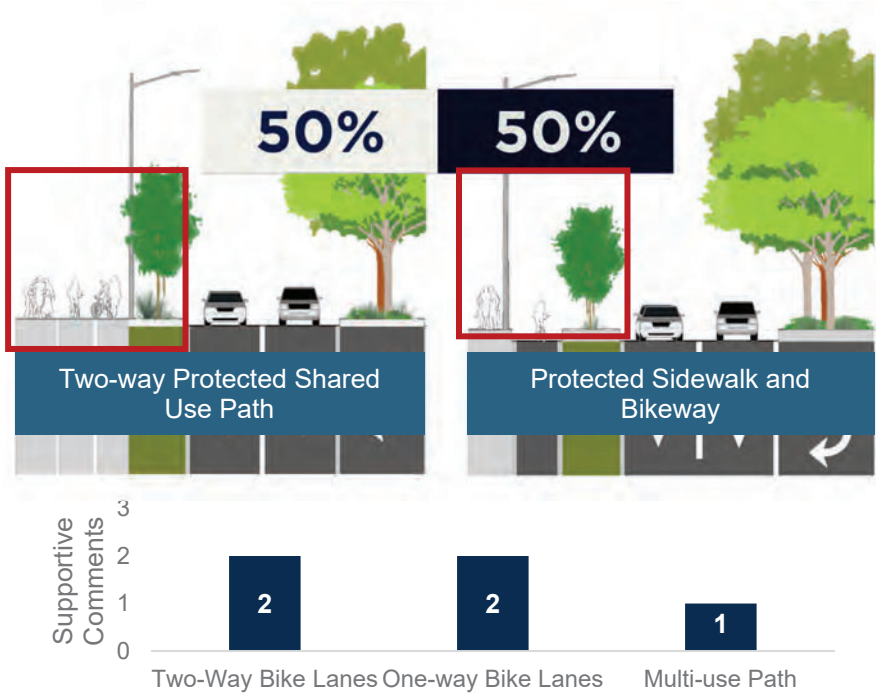


Attendees of the workshop were also asked what vision they wanted to prioritize for the corridor, with participants showing interest in a community streetscape (pedestrian amenities, greenspace, wayfinding) a green accessible corridor (green infrastructure, multi-use paths, access to recreation), and a multimodal boulevard (micro-mobility, electric vehicle charging, multi-use facilities).



At the second Workshop 2, attendees were presented with a variety of pedestrian and bicycle design options along the corridor. Between Harbor Boulevard and Jefferson Boulevard/Kegle Drive, participants indicated equal interest both a shared use path where bicyclists and pedestrians would share the space, and a protected sidewalk and bikeway where the pedestrian and bicycle paths were distinguished from one another.

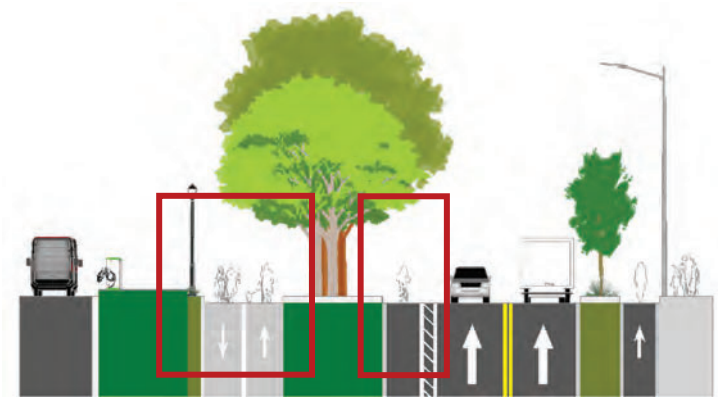
Attendees were asked what additional facilities should be included in the Plan, and respondents favored two-way and one-way bicycle lanes. Participants also indicated an interest in an accessible green corridor that prioritizes tree coverage and green infrastructure, off street paths, and connections to riverfront trails.



With a strong interest in an improved pedestrian experience as well as an emphasis on bicycling and commuting, it was important to prioritize a network that addresses the needs of different road users. A separated, elevated cycle track with improved landscaping allows for commuters, families, and recreators to all enjoy Sacramento Avenue at their own pace, reduce conflict between road users and provide a park-like feel the community has prioritized throughout the engagement process. To address access to recreational facilities, a two-way,

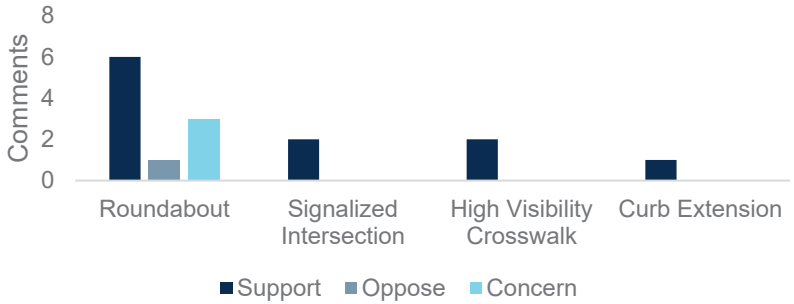
elevated cycle track is recommended between Solano Street and Bryte Street to connect users to a future recreational trail.

To further prioritize community interest in a green corridor, the Plan proposes to elevate the existing green space at Elkhorn Plaza by recommending a bidirectional shared-use path, on-street buffered bicycle facilities, electric vehicle charging and improved crossings. Eight attendees indicated support for the design concept for Elkhorn Plaza design. The concept continues to create space for commuters through the buffered Class II bicycle pathway while adding a shared-use path the community voiced support for.

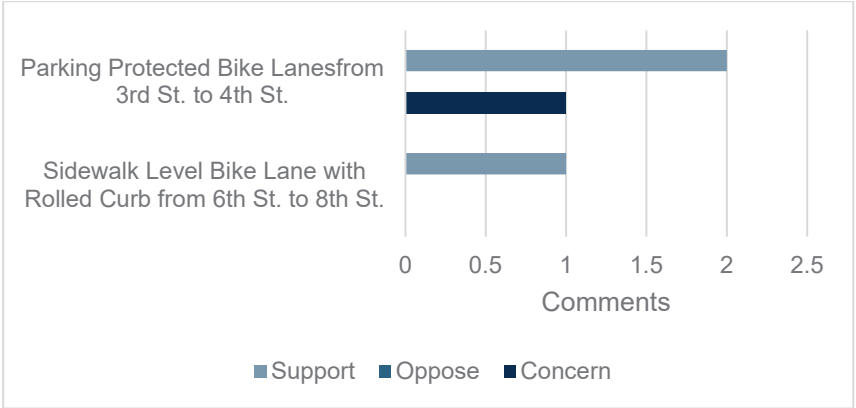


At Jefferson Boulevard/Kegle Drive, attendees voiced support for a roundabout, although they had concerns about emergency vehicle access, proper signage, and future increases in traffic volume. The roundabouts proposed will be mountable for emergency vehicles and large trucks. Signage directing all road users how to navigate the roundabout is recommended as well. Roundabouts are designed to mitigate queuing at intersections; as traffic volumes increase, the roundabout will relieve wait times and keep traffic flowing, while also prioritizing bicycle and pedestrian safety.

At C Street and 5th Street, one participant commented that pedestrian and bicycle traffic should be protected at the intersection. Attendees also showed support for high visibility crosswalks and curb extensions throughout the corridor.



The community has indicated support for protected bicycle facilities throughout the community engagement process. In some segments of Sacramento Avenue, the roadway is narrower and requires alternatives to the landscaped buffers recommend throughout the rest of the corridor. Sidewalk level bike lanes with rolled curbs received support from the community, shown below, as well as parking protected bicycle lanes.



Benefit-Cost Analysis

In addition to the benefits discussed in previous sections, benefits that could be translated to a monetized value were also analyzed to complete a benefit-cost assessment. Many grant funding programs either require a benefit-cost assessment, or the grant application is seen as more competitive when a return on investment can be shown vis-à-vis a benefit-cost analysis.

The benefits expected to result from the recommended improvement concept are estimated based on various methodologies described in additional detail in this section. Benefits described here were monetized based on the societal cost information presented in the Caltrans 2020 Economic Parameters.

All project benefits are reported in annualized and projected 20-Year life cycle costs. To identify a benefit-cost ratio, the monetized benefits are divided by planning-level costs, reported in 2023 dollars. The benefit-cost ratio reflects a return-on-investment (ROI), which is important to consider when assessing project selection in competitive grant funding programs.

Improvement Costs

The cost estimates for the proposed corridor improvements are shown below by segment and the corridor as a whole. As shown in Table 13, the entire corridor is estimated to have a total cost of almost $57 million.

There are several projects along the Sacramento Avenue corridor that are already planned and programmed for funding by the City of West Sacramento. These projects include HSIP improvements at several intersections along the corridor, and the 5th Street Road Diet & C Street Improvements. HSIP projects are planned at the intersections of Sacramento Avenue with Sunset Avenue, Solano Street, and Simon Terrace, as well as C Street / 6th Street. The 5th Street Road Diet project extends north from C Street / 5th Street to Lighthouse Dr, while the C Street Improvements include recommendations east of C Street / 6th Street to the eastern end of the corridor study area. Costs associated with improvements recommended above may overlap with the costs associated with this Plan. Additional information on the overlap between previously planned projects and the improvement concepts recommended in this Plan can be found in Chapter 6: Improvement Concepts.

Detailed cost estimates are provided in the Appendix.

Table 13 Improvement Costs

Corridor Location	Cost Estimate
Segment 1	$14,438,000
Segment 2	$9,231,000
Segment 3	$18,960,000
Segment 4	$4,735,000
Segment 5	$4,770,000
Segment 6	$4,772,000
Entire Corridor	$56,906,000

Estimated Bicycle Benefits

Based on research cited in the National Cooperative Highway Research Program (NCHRP) Report 552, *Guidelines for Analysis of Investment in Bicycle Facilities,* bicycle facilities proposed in the Plan may result in induced bicycling demand for new facilities among both existing and new bicyclists. The NCHRP 552 methodology describes an approach for estimating the induced demand associated with a given bicycle facility and translates the demand to the monetized benefit categories described below.

- **Mobility Benefits** represent the time cost associated with a shift to a new bicycle facility based on the time bicycle commuters are willing to spend to access an improved facility.
- **Health Benefits** represent the annual per-capita health cost savings from physical activity benefits associated with a new bicycle facility.
- **Recreation Benefits** represent the time cost that new bicyclists induced by a new bicycle facility are willing to spend on a typical recreation day.
- **Decreased Auto Use Benefits** represent the user cost savings associated with reduced congestion and air pollution.

This analysis quantifies the induced bicycling demand expected to be associated with the proposed improvements and monetizes the annualized mobility, health, recreation and decreased auto use benefits provided by the projected induced bicycling demand at high, moderate, and low estimates based on Census population and commuter pattern data and average bicycling trip length estimates from 2021 Replica data. The methodology is based on several assumptions:

- Existing bicyclists near a new facility will shift from the existing nearby facility to the new facility.
- The new facility will result in an induced number of bicyclists as a function of the number of existing bicyclists, relative to the attractiveness of the proposed facility (i.e., Class I shared-use path vs. Class II bicycle lanes).
- People are more likely to ride a bicycle if they live within 1.5 miles of a facility than if they live outside that distance.

The NCHRP 552 methodology suggests that existing bicycle commute mode share can be utilized to estimate the number of existing and future bicycle ridership based on low, moderate, and high likelihood multipliers and the population within 1.5-mile, 1-mile, and 0.5-mile buffers that surround a given bicycle facility. According to the NCHRP 522 research, the total rate of adult bicycling ranges from a low estimate, based on the Census bicycling commute mode share, to a high estimate, based on 0.6 percent plus three times the Census commute share.[13]

Moreover, the highest likelihood of a member of the population using the facility exists if they live within a 0.5-mile buffer around the facility. Thus, demand is calculated at low, medium, and high estimates for the populations at each buffer distance. Each buffer area—at 0.5-, 1- and 1.5-mile distances from a proposed bicycle improvement is created using a network-based analysis in a GIS environment.

Based on the high-estimate likelihood multiplier, it is estimated that new bicycling trips induced by the improvements along Sacramento Avenue could include roughly 35,000 commute trips, almost 220,000 adult non-commute trips, and almost 5,000 trips by children annually. The annual monetized benefits, as well as the 20-year life cycle benefits associated with induced bicycling demand is shown in Table 14.

Of the overall corridor bicycle benefits, approximately 20 percent is associated with Segment 3, while the remaining segments account for between 14 to 18 percent of the overall benefits.

[13] U.S. Census Bicycle Commute Mode Share Estimates, American Community Survey (ACS) 2021 5-Year Estimates, Table S0801 Commuting Characteristics By Sex

Table 14 Induced Bicycling Demand Benefits

Annual Bicycle Facility Benefits	Annualized Monetized Benefits	20 -Year Benefits
Mobility Benefits		
Separated Bikeway	$560,457	$8,338,181
On-Street Bike Lane	$124,289	$1,849,112
Health Benefits		
High Estimate	$77,581	$1,154,210
Moderate Estimate	$40,406	$601,144
Low Estimate	$39,299	$584,664
Recreation Benefits		
High Estimate	$1,944,826	$28,934,101
Moderate Estimate	$884,765	$13,163,072
Low Estimate	$853,178	$12,693,130
Decreased Auto Use Benefit	$12,802	$190,465
Total Annual Benefits		
High Estimate	*$2,719,955*	*$40,466,069*
Moderate Estimate	*$1,622,720*	*$24,141,974*
Low Estimate	*$1,590,025*	*$23,655,552*

Estimated Safety Benefits

Safety benefits associated with the improvements proposed by the Plan were estimated by calculating the expected reduction in collisions associated with improvements proposed along the corridor at locations with a history of collisions, using the methodology described in the Highway Safety Manual, 1st Edition (AASHTO 2010). Crash modification factors (CMFs) from the California Local Roadway Safety Manual (LRSM) (version 1.6, April 2022) were utilized to estimate reduction in collisions. Because the LRSM states the CMF associated with converting an intersection to a roundabout varies, the Highway Safety Improvement Program (HSIP) Analyzer published by Caltrans was used to estimate benefits for the two proposed roundabout locations. The following countermeasures from the LRSM were applied along the corridor:

Non-Signalized Intersections

- NS01: Add intersection lighting
- NS13: Install splitter-islands on the minor road approaches
- NS14: Install raised median on approaches
- NS20PB: Install pedestrian crossing at uncontrolled locations (signs and markings only)
- NS21PB: Install/upgrade pedestrian crossing at uncontrolled locations (with enhanced safety features)

Signalized Intersections

- S02: Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number
- S16: Convert intersection to roundabout (from signal)
- S20PB: Install advance stop bar before crosswalk (Bicycle Box)
- S21PB: Modify signal phasing to implement a Leading Pedestrian Interval (LPI)

Roadway Segments

- R01: Add Segment Lighting
- R08: Install raised median
- R33PB: Install Separated Bike Lanes
- R34PB: Install sidewalk/pathway (to avoid walking along roadway)

Because collision reduction and safety benefits can be calculated only where there is a history of collisions, some corridor locations did not result in a safety benefit and are not included here. Table 15 summarizes the applied countermeasures by corridor location that resulted in a monetized safety benefit at intersections and along segments, respectively. The total crashes, per location, and resulting monetized safety benefit are presented in Table 16 and for intersections and roadway segments. The safety benefit is presented in 20-year life-cycle benefit amounts.

Table 15 Safety Countermeasures Resulting in Benefit

Corridor Location	Countermeasure 1	2	3
Intersections			
Harbor Blvd/Reed Ave	S16	-	-
Oak St	NS01	NS20PB	-
Sunset Ave	NS13	-	-
Solano Street	NS14	-	-
Yolo St (North Leg)	NS20PB	-	-
Bryte Ave	S02	S20PB	S21PB
Todhunter Ave	S02	S20PB	S21PB
Simon Terrace	NS01	NS14	NS21PB
Jefferson Blvd / Kegle Dr	S16	-	-
Douglas St	NS21PB	-	-
Rueter Dr	NS01	-	-
6th St / C St	NS01	NS21PB	-
5th St / C St	S02	S20PB	S21PB
Segments			
Harbor Blvd to Solano St	R08	-	-
Solano St to Todhunter Ave	R08	-	-
Todhunter Ave to Jefferson Blvd /Kegle Dr	R08	R33PB	R34PB
Jefferson/Kegle Dr to Douglas St	R08	R33PB	R34PB
Douglas St to California St	R01	-	-
California St to 5th St & C St	R01	-	-

Table 16 Crash History & Safety Benefits

Corridor Location	Crashes (2017-21) All	P & B	Safety Benefit
Intersections			
Harbor Blvd/Reed Ave	32	-	$15,503,847
Oak St	3	1	$103,790
Sunset Ave	5	-	$472,800
Solano Street	8	-	$325,300
Yolo St (North Leg)	4	1	$5,588
Bryte Ave	10	2	$254,608
Todhunter Ave	11	3	$5,270,048
Simon Terrace	5	2	$594,600
Jefferson Blvd / Kegle Dr	39	2	$18,925,920
Douglas St	9	2	$447,720
Rueter Dr	7	-	$47,680
6th St / C St	8	1	$465,820
5th St / C St	15	2	$352,276
Total Safety Benefit			**$ 42,769,996**
Segments			
Harbor Blvd/Reed Ave	2	-	$29,800
Oak St	3	-	$120,700
Sunset Ave	6	2	$1,454,266
Solano Street	5	2	$1,496,178
Yolo St (North Leg)	2	-	$223,860
Bryte Ave	10	-	$41,720
Total Safety Benefit			**$ 3,324,804**

Estimated Operational Benefits

Vehicular operations benefits associated with the proposed plan were based on AM and PM peak hour delay at study intersections. The savings between the No Build (future conditions without project) and Build conditions (future conditions with project) were used to estimate benefits. The cost per person hour of delay was based on the following societal cost parameters in which the 2020 Caltrans Economic Parameters were used as a base and then grown by one percent per year to 2023:

- Automobile: $18.33 per hour per person
- Truck: $32.96 per hour per person
- A weighed average rate was calculated using the corridor's average two percent truck percentage:
- Blended: $18.08 per hour per person
- Benefits were calculated by converting average intersection delay per vehicle into hours of delay per person, assuming a vehicle occupancy rate of 1.15. Annualization was based on 260 working days. Benefits are summarized in Table 17 below.

Table 17 Operational Benefits

Scenario	Person Hours of Delay		
	No Build	Build	Savings
AM Peak	54	38	16
PM Peak	78	60	18
Combined Peak Hours	132	98	34
Annualized	34,275	25,430	8,845
Annual Benefit			**$159,961**
20-Year Benefit			**$2,379,813**

Estimated Air Quality / Emissions Benefits

Air quality and emissions benefits were calculated for the two proposed roundabouts and the proposed bicycle facilities separately. Emissions reduction benefits associated with the proposed roundabouts were calculated using outputs from Sidra traffic modelling software. The SB-1 Emissions Calculator, a component of the Cal-B/C Suite developed by Caltrans' Transportation Economic Branch, was used to calculate the benefits associated with the proposed bicycle facilities.

Study corridor travel speed inputs were generated from Sidra to inform the emissions calculator. Study corridor VMT was estimated using existing and future ADT by segment, multiplied by segment length. The VMT reductions associated with the proposed bicycle facilities were calculated using NCHRP 552 bicycle mode shift methodology described in the Bicycle Benefits section, which were applied to the "plus project" scenario.

Table 18 presents the reductions in emissions and benefit associated with the proposed plan's effect on VMT and travel delays along the corridor.

Table 18 Air Quality & Emissions Benefits

Emission	Emissions Reductions (in Short Tons)		Emissions Reduction Benefit Value	
	Annual	20-Years	Annual	20-Years
CO (Carbon Monoxide)	0.543	10.861	$35.76	$715.28
CO_2 (Carbon Dioxide)	375.331	7,506.629	$14,343.69	$286,873.77
NO_X (Nitrous Oxides)	0.246	4.919	$3,004.56	$60,091.30
PM_{10} and $PM_{2.5}$ (Particulate Matter)	0.006	0.126	$673.53	$13,470.53
SO_X (Sulfur Oxides)	0.004	0.074	$192.57	$3,851.50
VOC (Volatile Organic Compounds)	0.080	1.597	$73.34	$1,466.87
Total Emissions Benefit			**$18,323**	**$366,469**

Livability Benefits (Non-Monetized)

In addition to the monetized benefits discussed previously, the improvements proposed as part of the Plan offer a variety of livability benefits associated with the implementation of street trees that are not directly monetizable. These are described in the sections below.

Street Trees

While street trees come at a cost with regards to maintenance, the benefits associated with street trees outweigh these costs. Street trees can improve safety, provide green infrastructure, storm mitigation, energy savings and health benefits, as well as provide economic benefits to a given neighborhood or a jurisdiction more broadly.

Research suggests that street trees can improve safety, reducing crashes and injuries on urban roadways. Features such as street trees and urban planters along a roadway have been found to be associated with a reduction in midblock crashes, with the crash reduction decreasing between 5 and 20 percent. "While the cause for these reductions is not clear, the author suggests that the presence of a well-defined roadside edge may be leading drivers to exercise greater caution."[14] Street trees physically separate vehicle and pedestrian spaces more clearly, creating a more defined street edge and assisting drivers in distinguishing the street from bicycling and walking areas. Speed reduction and more context-appropriate urban traffic speeds have been found to be associated with treed streets. Traffic speed reductions of between 5 and 15 mph have been found to be associated with a well-developed tree canopy, contributing to a safer, more walkable, and bikeable environment.

The "urban heat island" effect is known to occur when natural land cover is replaced by concentrations of pavement, building, and other surface types that absorb and retain heat. "This effect increases energy costs, air pollution levels, and heat-related illness and mortality. "[15] Temperature rises of between three and seven degrees, which result in energy cost increases and the presence of ozone and other harmful gases.

Shade provided by street trees reduces energy costs by up to 35 percent. Moreover, California studies have shown that tree shade can extend the life of street surfaces by up to 60 percent, reducing maintenance costs over time. This is due to the reduction in daily temperature fluctuations between heating and cooling pavement and concrete, which cause damaging expansion and contraction of street surfaces.

Street trees can provide health, environmental and stormwater benefits. Trees provide health and environmental benefits by converting the pollutants associated with vehicle exhaust, which contribute to poor air quality, and health and climate impacts, into oxygen. "A single urban street tree converts enough carbon monoxide and carbon dioxide to meet the oxygen needs of two people for a full year."[16] Street trees can reduce stormwater runoff and flooding, and when properly designed, landscaped areas can serve as stormwater management areas, or bioswales.

The presence of street trees can also provide economic development benefits, such as increased property values and retail sales. According to the U.S. Forest Service, "the presence of street trees increases adjacent home values by an average of $13,000," while the National Main Street Center asserts "that a good tree canopy can increase retail sales by 12 cents on the dollar in large cities and 9 cents on the dollar in smaller ones"[17]

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[14] Dumbaugh, Eric (2005) "Safe streets, livable streets." Journal of the American Planning Association, Vol. 71, No. 3, pp 283–300
[15] Environmental Protection Agency (EPA). Green Infrastructure. "Reduce Urban Heat Island Effect,"

[16], [17] AARP Livability Fact Sheets - Street Trees, AARP Livable Communities | Walkable and Livable Communities Institute, 2014.

Benefit-Cost Results

Based on the results of the benefit assessment and the monetization of the benefits, a total corridor benefit for the proposed plan was calculated at more than $90 million. Using the planning-level cost estimates for the proposed improvements, and the total monetized benefits, a benefit/cost ratio of 1.58 was calculated. This demonstrates a positive return on investment for the proposed corridor plan.

The total corridor benefit and benefit-cost ratio is shown in Table 19.

Benefit-Cost by Segment

The benefit-cost by corridor segment is shown in Table 20. The benefit-cost results by segment do not account for air quality or emissions benefits, which are calculated on a corridor basis only.

Table 19 Corridor Benefit-Cost

Benefit Type	Annualized Benefit	20-Year Benefit
Bicycle Mode Shift	$2,719,955	$40,466,069
Operations/Delay	$159,961	$2,379,813
Safety	-	$46,819,320
Air Quality/Emissions	$18,323	$366,469
Total Benefit	**$2,898,240**	**$90,031,671**
Total Cost		**$56,906,000**
Benefit-Cost Ratio		**1.58**

Table 20 Benefit-Cost by Segment

Benefit Type	Segment Location					
	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
Bicycle Mode Shift	$6,722,887	$6,217,455	$7,944,935	$5,563,031	$6,630,836	$7,386,925
Operations / Delay	$1,126,539	$-	$2,190,780	$(441,520)	$-	$(495,986)
Safety	$16,435,537	$5,650,943	$20,974,786	$1,943,898	$271,540	$859,816
Air Quality/Emissions	$61,078	$61,078	$61,078	$61,078	$61,078	$61,078
Total Benefit	**$24,346,041**	**$11,929,476**	**$31,171,580**	**$7,126,487**	**$6,963,454**	**$7,811,834**
Total Cost	**$14,438,000**	**$9,231,000**	**$18,960,000**	**$4,735,000**	**$4,770,000**	**$4,772,000**
Benefit-Cost Ratio	**1.69**	**1.29**	**1.64**	**1.51**	**1.46**	**1.64**