Draft Vehicle Miles Traveled Analysis

Lacey Ranch Development

Located on the Southeast Corner of Lemoore Avenue and Lacey Boulevard

In the City of Lemoore, California

Prepared for:

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June 28, 2021

Project No. 039-003

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This Draft Vehicle Miles Traveled Analysis has been prepared under the direction of a licensed Traffic Engineer. The licensed Traffic Engineer attests to the technical information contained therein and has judged the qualifications of any technical specialists providing engineering data from which recommendations, conclusions and decisions are based.

Prepared by:

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Project Description

This report describes a Draft Vehicle Miles Traveled (VMT) Analysis prepared by JLB Traffic Engineering, Inc. (JLB) for the Lacey Ranch Development (Project) located on the southeast corner of Lemoore Avenue and Lacey Boulevard in the City of Lemoore. The Project proposes to develop approximately 156-acres with single family residential units, multifamily units and parks. The project description states this development will be limited to a maximum of 825 housing units. Based on information provided to JLB, the Project will go through the preparation of an Environmental Impact Report through the City of Lemoore.

VMT Analysis

Regulatory Setting

Senate Bill (SB) 743 requires that relevant California Environmental Quality Act (CEQA) analysis of transportation impacts be conducted using a metric known as VMT instead of level of service (LOS). VMT measures how much actual auto travel (additional miles driven) a proposed project would create on California roads. If the project adds excessive car travel onto our roads, the project may cause a significant transportation impact.

The State CEQA Guidelines were amended to implement SB 743, by adding Section 15064.3. Among its provisions, Section 15064.3 confirms that, except with respect to transportation projects, a project's effect on automobile delay shall not constitute a significant environmental impact. Therefore, LOS measures of impacts on traffic facilities are no longer a relevant CEQA criteria for transportation impacts.

CEQA Guidelines Section 15064.3(b)(4) states that "[a] lead agency has discretion to choose the most appropriate methodology to evaluate a project's vehicle miles traveled, including whether to express the change in absolute terms, per capita, per household or in any other measure. A lead agency may use models to estimate a project's vehicle miles traveled, and may revise those estimates to reflect professional judgment based on substantial evidence. Any assumptions used to estimate vehicle miles traveled and any revision to model outputs should be documented and explained in the environmental document prepared for the project. The standard of adequacy in Section 15151 shall apply to the analysis described in this section."

As of the creation of this report, neither the City of Lemoore nor Kings CAG have adopted guidelines or thresholds for VMT pursuant to Senate Bill 743. For this reason, this VMT analysis follows the guide of the December 2018 *Technical Advisory on Evaluating Transportation Impacts in CEQA* (TA) published by the Governor's Office of Planning and Research (OPR) and the August 2010 Quantifying *Greenhouse Gas Mitigation Measures* published by the California Air Pollution Control Officers Association (CAPCOA) to analyze the Project's VMT.

The TA contains screening standard and criteria that can be used to screen out qualified development projects that meet the adopted criteria from needing to prepare a detailed VMT Analysis. These criteria may be size, location, proximity to transit or trip making potential. In general development projects that meet one or more of the following criteria can be screened out from a quantitative VMT analysis. In this case, the Project does not meet any of the screening criteria.

For projects that are not screened out, a quantitative analysis of VMT impacts must be prepared and compared against the adopted VMT thresholds of significance. According to the TA, residential developments that generate vehicle travel that is 15 percent or more below the existing residential VMT per capita, measured against the region, are considered to have a less-than-significant transportation impact. The threshold of significance was developed using the County of Kings as the applicable region, and the required reduction of VMT corresponds to Kings County's contribution to the statewide GHG emission reduction target. In order to reach the statewide GHG reduction target of 15%, Kings County must reduce its GHG emissions by 15%. The method of reducing GHG by 15% is to reduce VMT by 15% as well.

Baseline VMT

VMT is simply the product of a number of trips and those trips' lengths. The first step in a VMT analysis is to establish the baseline average VMT, which requires the definition of a region. The established region for the project is Kings County, which is modeled by the Kings County Association of Governments (KCAG). The Project's trip generation, number of residential units, and square footages of non-residential uses were provided to KCAG in order to conduct a Project-specific VMT analysis using the KCAG model for specific Project components. Based on KCAG VMT results, Project components containing residential land uses are projected to yield an average VMT per capita of 9.29 which exceeds the City's VMT threshold for residential uses of 8.16 VMT per capita. As a result, it is recommended that the Project implement VMT mitigation measures for the residential component to reduce VMT per Capita. Appendix A presents the Project VMT outputs from the KCAG model.

VMT Mitigation Measures

The VMT mitigation measures that were considered feasible for this Project include the following: increasing destination accessibility, locate project near bike path/bike lane, improve design of development, provide pedestrian network improvements, provide traffic calming measures, incorporate bike lane street design (on-site), provide bike parking with multi-unit residential projects and dedicate land for bike trails. Worth noting that VMT mitigation measures such as utilize neighborhood electric vehicles (NEVs), provide electric vehicle parking and expanding transit network, to name a few, were not accounted for in the VMT analysis for the proposed Project. For example, the Project will be fitted with bus bays, but due to the improbability that a transit route gets added or expanded, the VMT reduction from this mitigation were not included in the calculations to present a conservative analysis of the Project's VMT. Also, providing NEVs to residents will not effectively reduce VMT per capita unless the Project connects to a greater NEV network that provides NEV access to a variety of land uses. It is estimated that given the design elements associated with the Project and the surrounding multi-modal network, the Project will benefit from reductions in VMT as a result of other measures. Since these measures are not implemented without justification, only the measures presented within this report were considered for this analysis as part of the VMT mitigation measures. The VMT mitigation measures and reduction rates were determined based on the following:

- Land-Use/Location (Maximum Reduction: 5.00%)
  - LUT-4: Increase Destination Accessibility
    - This measure is appropriate for residential, office, retail, mixed-use and industrial projects in urban or suburban context.
    - It is recommended that the Project implement bicycle facilities within and adjacent to the Project site. Within the Project it is recommended that Class I Bikeways get added along the south side of Street 'S' between Lemoore Avenue and the eastern boundary of the Project and along Street 'G' between Street 'S' and Street 'P'. Also, within the Project it is recommended that Class II Bikeways get added along Street 'S' between Lemoore Avenue and the eastern boundary of the Project and along Mary Drive between Street 'I' and Lacey Boulevard. Adjacent to the Project it is recommended that Class II Bikeways be added along its frontages to Lemoore Avenue between Lacey Boulevard and Glendale Avenue and along Lacey Boulevard between Lemoore Avenue the eastern boundary of the Project.
    - The effectiveness of this measure will depend largely on the Project location and increasing potential for pedestrians to walk and bike to central locations (CAPCOA 2010).
    - VMT Mitigation Method: VMT Reduction (%) = (12 - 8)/12 * 0.2 = 6.67% (CAPCOA 2010)
      - VMT Reduction (%) = Center Distance * B (not to exceed 30%), where
        - Center Distance = (12 - Distance to downtown/job center for Project) / 12
        - B = Elasticity of VMT with respect to distance to downtown or major job center [use 0.2]
  - LUT-8: Locate project near bike path/bike lane
    - This measure is appropriate for residential, office, retail, mixed-use and industrial projects in urban or suburban contexts.
    - It is recommended that the Project implement bicycle facilities within and adjacent to the Project site. Within the Project it is recommended that Class I Bikeways get added along the south side of Street 'S' between Lemoore Avenue and the eastern boundary of the Project and along Street 'G' between Street 'S' and Street 'P'. Also, within the Project it is recommended that Class II Bikeways get added along Street 'S' between Lemoore Avenue and the eastern boundary of the Project and along Mary Drive between Street 'I' and Lacey Boulevard. Adjacent to the Project it is recommended that Class II Bikeways be added along its frontages to Lemoore Avenue between Lacey Boulevard and Glendale Avenue and along Lacey Boulevard between Lemoore Avenue the eastern boundary of the Project.
    - The effectiveness of this measure will depend largely on its implementation as a stand-alone strategy or in combination with multiple design elements that increase opportunities for multi-modal travel (CAPCOA 2010).

- LUT-9: Improve Design of Development
  - This measure is appropriate for residential, office, retail, mixed-use and industrial projects in urban or suburban context.
  - The effectiveness of this measure will depend largely on its implementation as a stand-alone strategy or in combination with multiple design elements that increase opportunities for multi-modal travel (CAPCOA 2010).
  - VMT Mitigation Measure: VMT Reduction (%) = ((58-36)/36) * 0.12 = 7.33% (CAPCOA 2010)
    - VMT Reduction (%) = (Intersection per square mile of project - Typical intersection per square mile) / Typical intersection per square mile (not to exceed 500%), where
      - Intersection per square mile of project = 14 intersections / 0.24 square miles = 58.33
      - Typical intersection per square mile = 36

- Neighborhood/Site Design (Max. Reduction: 5.00%)
  - SDT-1: Provide Pedestrian Network Improvements
    - This measure is appropriate for residential, office, retail, mixed-use and industrial projects in urban, suburban and rural context.
    - It is recommended that the Project implement bicycle facilities within and adjacent to the Project site. Within the Project it is recommended that Class I Bikeways get added along the south side of Street 'S' between Lemoore Avenue and the eastern boundary of the Project and along Street 'G' between Street 'S' and Street 'P'. Also, within the Project it is recommended that Class II Bikeways get added along Street 'S' between Lemoore Avenue and the eastern boundary of the Project and along Mary Drive between Street 'I' and Lacey Boulevard. Adjacent to the Project it is recommended that Class II Bikeways be added along its frontages to Lemoore Avenue between Lacey Boulevard and Glendale Avenue and along Lacey Boulevard between Lemoore Avenue the eastern boundary of the Project.
    - The effectiveness of this measure requires providing a pedestrian access network that internally links all uses and connects to all existing or planned external streets and pedestrian facilities contiguous with the Project site (CAPCOA 2010).
  - SDT-2: Provide Traffic Calming Measures
    - This measure is appropriate for residential, office, retail, mixed-use and industrial projects in urban, suburban and rural context.
    - The effectiveness of this measure requires roadways be designed to reduce motor vehicle speeds and encourage pedestrian and bicycle trips with calming features such as marked crosswalks, curb extensions, raised crosswalks, raised intersections, median islands, tight-corner radii, roundabouts or mini-circles, on-street parking, planter strips with trees, chicanes/chokers and others (CAPCOA 2010).
      - Percentage of intersections with improvement: 25%
      - Percentage of streets with improvements: 100%
    - The Project will incorporate intersection traffic calming features such as mini-circles at the intersections of Beverly Drive and Street 'S', Street 'G' and Street 'S', Street 'L' and Street 'S', Street 'C' and Street 'I', Street 'D' and Street 'I', Mary Drive and Street 'I' and Street 'A' and Street 'F'.

  - The Project will incorporate street traffic calming features including on street parking throughout the Project excluding Street 'S' between Lemoore Avenue and the eastern boundary of the Project as well as Mary Drive between Lacey Boulevard and Street 'J', median islands on Street 'S' between Lemoore Avenue and the Street 'D' and on Mary Drive between Lacey Boulevard and Street 'I', and planter strips with street trees throughout the Project.
- SDT-5: Incorporate Bike Lane Street Design (on-site)
  - This measure is appropriate for residential, office, retail, mixed-use and industrial projects in urban or suburban context.
  - It is recommended that the Project implement of bicycle facilities within and adjacent to the Project site. Within the Project it is recommended that Class I Bikeways get added along the south side of Street 'S' between Lemoore Avenue and the eastern boundary of the Project and along Street 'G' between Street 'S' and Street 'P'. Also, within the Project it is recommended that Class II Bikeways get added along Street 'S' between Lemoore Avenue and the eastern boundary of the Project and along Mary Drive between Street 'I' and Lacey Boulevard. Adjacent to the Project it is recommended that Class II Bikeways be added along its frontages to Lemoore Avenue between Lacey Boulevard and Glendale Avenue and along Lacey Boulevard between Lemoore Avenue the eastern boundary of the Project.
  - The effectiveness of this measure will depend largely on its implementation as a stand-alone strategy or in combination with multiple design elements to strengthen street network characteristics and enhance multi-modal environments (CAPCOA 2010).
- SDT-7: Provide Bike Parking with Multi-Unit Residential Projects
  - This measure is appropriate for residential projects in urban, suburban or rural context.
  - The effectiveness of this measure will depend largely on its implementation as a stand-alone strategy or in combination with multiple design elements to strengthen street network characteristics and enhance multi-modal environments (CAPCOA 2010).
  - It is recommended that the Project implement a minimum of 14 bike parking spaces within the multi-family residential component.
- SDT-9: Dedicate Land for Bike Trails
  - This measure is appropriate for large residential, office, retail, mixed-use and industrial projects in urban, suburban or rural context.
  - The effectiveness of this measure will depend largely on its implementation as a stand-alone strategy or in combination with multiple design elements to strengthen street network characteristics and enhance multi-modal environments (CAPCOA 2010).
  - It is recommended that Class I Bikeways get added along the south side of Street 'S' between Lemoore Avenue and the eastern boundary of the Project and along Street 'G' between Street 'S' and Street 'P'.

Table I identifies the Recommended VMT mitigation measures appropriate for residential land uses, the recommended VMT reduction rates per the *Quantifying Greenhouse Gas Mitigation Measures* published by CAPCOA. Appendix A presents a summary of the VMT reduction associated with each mitigation measure identified in Table I.

Table I: Recommended VMT Mitigation Measures

VMT Category	***Transportation Categories***							
VMT Sub-Categories	**Land-Use/Location**			**Neighborhood / Site Enhancement**				
VMT Measures	LUT-4: Increase Destination Accessibility	LUT-8: Locate Project near Bike Path/Bike Lane	LUT-9: Improve Design of Development	SDT-1: Provide Pedestrian Network Improvements	SDT-2: Provide Traffic Calming Measures	SDT-5: Incorporate Bike Lane Street Design (on-site)	SDT-7: Provide Bike Parking with Multi-Unit Residential Projects	SDT-9: Dedicate Land for Bike Trails
VMT Measure Reduction Rate[1] (%)	6.67	N/A	7.33	2.00	0.5	N/A	N/A	N/A
Max. VMT Measure Reduction Rate[2] (%)	20.00	N/A	21.30	2.00	1.00	N/A	N/A	N/A
Category VMT Reduction Rate (%)	13.51			2.49				
Max. Category VMT Reduction Rate[2] (%)	5.00			5.00				
Transportation VMT Reduction Rate (%)	7.37[3]							
Max. Transportation VMT Reduction Rate[2] (%)	10.00							

Note: 1 = VMT Reduction Rate based on engineering judgement, data provided by the developer and CAPCOA *Quantifying Greenhouse Gas Mitigation Measures*
2 = Maximum Reduction Rates are derived from CAPCOA Quantifying Greenhouse Gas Mitigation Measures
3 = Calculated using the Max. Category VMT Reduction Rate if the Category VMT Reduction Rate is greater than the Max. Category Reduction Rate

VMT Results and Conclusion

As can be seen in Table II below, VMT mitigation measures and Internal Capture are projected to reduce the residential VMT per capita from 9.29 to 8.61. This reduced residential VMT is short of meeting the City's Threshold of 8.16 VMT per capita. In conclusion, the Project with mitigations would result in significant but unavoidable VMT impacts by the residential components pursuant to the *Quantifying Greenhouse Gas Mitigation Measures* published by CAPCOA.

Table II: Residential VMT Results

Project Components	***Kings CAG plus Project VMT Results[1]***	***Reduction in VMT from Mitigation[2]***	***VMT (With Mitigations)***	***City of Lemoore VMT Threshold***	***Significant VMT Impact?***
Residential	9.29 / capita	-0.68 / capita	8.61 / capita	8.16 / capita	Yes

Note: 1 = VMT Results per Kings CAG model
2 = VMT Mitigation Measures from CAPCOA *Quantifying Greenhouse Gas Mitigation Measures*

- Per the Kings CAG model, the Project's VMT for the residential component was output to be 9.29 VMT per capita which exceeds the City of Lemoore threshold of 8.16 VMT per capita.
- The reduction of VMT per capita from recommended mitigations is 0.68 and reduces the residential VMT per Capita to 8.61.
- As a result, the residential components after applying reductions from mitigations are projected to result in a significant but unavoidable VMT impact.

Study Participants

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Appendix A: VMT Output and Mitigation Measures

TAZ	CITY	Population	Employment	Home Based Production VMT	Home Based Work Attraction VMT	VMT per Capita	VMT per Employment
949	0	477	0	3521.30	0.00	7.38	0.00
950	0	740	0	7141.56	0.00	9.65	0.00
951	0	1128	0	11113.85	0.00	9.85	0.00

Lacey Ranch VMT Analysis

		TAZ:	**Average**
		Land Use:	Residential
		Kings CAG Total Project VMT Output:	21776.71
		Project Total Population (based on Kings CAG Data):	2345.00
		Kings CAG Project Select Zone VMT per Capita Output:	9.29
		County of Kings Average VMT per Capita (Based on Kings CAG Model):	*9.60*
		City of Lemoore VMT Threshold (15% reduction to the County of Kings Average VMT per Capita):	*8.16*
		Target VMT Satisfied?	FALSE
		% deviation from target threshold:	12.16%
Measure #	*VMT Mitigation*	*Grouped with*	*VMT Reduction Rate (%)*
	Land Use/Location		
LUT-4	Increase Destination Accessibility	N/A	6.67%
LUT-8	Locate Project near Bike Path/Bike Lane	LUT-4	N/A
LUT-9	Improve Design of Development	N/A	7.33%
		Land Use/Location Category VMT Reduction (%)	**13.51%**
		Max. Land Use/Location Category VMT Reduction (%)	**5.00%**
	Neighborhood/Site Enhancements		
SDT-1	Provide Pedestrian Network Improvements	N/A	2.00%
SDT-2	Provide Traffic Calming Measures	N/A	0.50%
SDT-5	Incorporate Bike Lane Street Design (on-site)	LUT-9	N/A
SDT-7	Provide Bike Parking with Multi-Unit Residential Projects	LUT-9	N/A
SDT-9	Dedicate Land for Bike Trails	LUT-9	N/A
		Neighborhood/Site Enhancements Category VMT Reduction (%)	**2.49%**
		Max. Neighborhood/Site Enhancements Category VMT Reduction (%)	**5.00%**
		Transportation Cross-Category VMT Reduction (%)	**7.37%**
		Max. Transportation Cross-Category VMT Reduction (%)	**10.00%**
		Project VMT with Mitigation:	8.61
		VMT Reduction from Mitigations:	0.68
		City of Lemoore VMT Threshold:	*8.16*
		Target VMT Satisfied?	FALSE

Chart 6-2: Transportation Strategies Organization

Transportation Measures (Five Subcategories) Global Maximum Reduction (all VMT): urban = 75%; compact infill = 40%; suburban center or suburban with NEV = 20%; suburban = 15%

Global Cap for Road Pricing needs further study

Transportation Measures (Four Categories) Cross-Category Max Reduction (all VMT): urban = 70%; compact infill = 35%; suburban center or suburban with NEV = 15%; suburban = 10%

Land Use / Location	Neighborhood / Site Enhancement	Parking Policy / Pricing	Transit System Improvements	Commute Trip Reduction	Road Pricing Management	Vehicles
				Max Reduction = 15% overall; work VMT = 25%; school VMT = 65%;	Max Reduction = 25% (all VMT)	
Max Reduction: urban = 65%; compact infill = 30%; suburban center = 10%; suburban = 5%	Max Reduction: without NEV = 5%; with NEV = 15%	Max Reduction = 20%	Max Reduction = 10%	(assumes mixed use) Max Reduction = 25% (work VMT)	Max Reduction = 25%	
Density (30%)	Pedestrian Network (2%) 2.00%	Parking Supply Limits (12.5%)	Network Expansion (8.2%)	CTR Program Required = 21% work VMT Voluntary = 6.2% work VMT	Cordon Pricing (22%)	Electrify Loading Docks
Design (21.3%) 7.33%	Traffic Calming (1%) 0.5%	Unbundled Parking Costs (13%)	Service Frequency / Speed (2.5%)	Transit Fare Subsidy (20% work VMT)	Traffic Flow Improvements (45% CO2)	Utilize Alternative Fueled Vehicles
Location Efficiency (65%)	NEV Network (14.4) <NEV Parking>	On-Street Market Pricing (5.5%)	Bus Rapid Transit (3.2%)	Employee Parking Cash-out (7.7% work VMT)	Required Contributions by Project	Utilize Electric or Hybrid Vehicles
Diversity (30%)	Car Share Program (0.7%)	Residential Area Parking Permits	Access Improvements	Workplace Parking Pricing (19.7% work VMT)		
Destination Accessibility (20%) 6.67%	Bicycle Network <Lanes> <Parking> <Land Dedication for Trails> N/A		Station Bike Parking	Alternative Work Schedules & Telecommute (5.5% work VMT)		
Transit Accessibility (25%)	Urban Non-Motorized Zones		Local Shuttles	CTR Marketing (5.5% work VMT)		
BMR Housing (1.2%)			Park & Ride Lots*	Employer-Sponsored Vanpool/Shuttle (13.4% work VMT)		
Orientation Toward Non-Auto Corridor				Ride Share Program (15% work VMT)		
Proximity to Bike Path N/A				Bike Share Program		
				End of Trip Facilities		
				Preferential Parking Permit		
				School Pool (15.8% school VMT)		
				School Bus (6.3% school VMT)		

Note: Strategies in bold text are primary strategies with reported VMT reductions; non-bolded strategies are support or grouped strategies.

3.1.4 Increase Destination Accessibility

Range of Effectiveness: 6.7 – 20% vehicle miles traveled (VMT) reduction and therefore 6.7-20% reduction in GHG emissions.

Measure Description:

The project will be located in an area with high accessibility to destinations. Destination accessibility is measured in terms of the number of jobs or other attractions reachable within a given travel time, which tends to be highest at central locations and lowest at peripheral ones. The location of the project also increases the potential for pedestrians to walk and bike to these destinations and therefore reduces the VMT.

Measure Applicability:

- Urban and suburban context
- Negligible impact in a rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Distance to downtown or major job center

Mitigation Method:

% VMT Reduction = Center Distance * B [not to exceed 30%]

Where

Center Distance = Percentage decrease in distance to downtown or major job center versus typical ITE suburban development = (distance to downtown/job center for typical ITE development – distance to downtown/job center for project) / (distance to downtown/job center for typical ITE development)

Center Distance = 12 - Distance to downtown/job center for project) / 12
See Appendix C for detail

B = Elasticity of VMT with respect to distance to downtown or major job center (0.20 from [1])

Assumptions:

Data based upon the following references:

[1] Ewing, R., and Cervero, R., "Travel and the Built Environment - A Meta-Analysis." Journal of the American Planning Association, <to be published> (2010). Table 4.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[38]
CO_2e	6.7 – 20% of running
PM	6.7 – 20% of running
CO	6.7 – 20% of running
NOx	6.7 – 20% of running
SO_2	6.7 – 20% of running
ROG	4 – 12% of total

Discussion:

The VMT reductions for this strategy are based on changes in distance to key destinations versus the standard suburban distance in North America. This distance is used as a baseline to mirror the distance to destinations reflected in the land uses for the ITE Trip Generation Manual, which is the baseline method for determining VMT.

The purpose for the 30% cap on % VMT reduction is to limit the influence of any single environmental factor (such as destination accessibility). This emphasizes that community designs that implement multiple land use strategies (such as density,

[38] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

design, diversity, destination, etc.) will show more of a reduction than relying on improvements from a single land use factor.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (8 miles to downtown/job center) =
$$\frac{12-8}{12}\times 0.20 = 6.7\%$$
- High Range % VMT Reduction (0.1 miles to downtown/job center) =
$$\frac{12-0.1}{12}\times 0.20 = 20.0\%$$

Preferred Literature:

- -0.20 = elasticity of VMT with respect to job accessibility by auto
- -0.20 = elasticity of VMT with respect to distance to downtown

The Ewing and Cervero report [1] finds that VMT is strongly related to measures of accessibility to destinations. The weighted average elasticity of VMT with respect to job accessibility by auto is -0.20 (looking at five total studies). The weighted average elasticity of VMT with respect to distance to downtown is -0.22 (looking at four total studies, of which one controls for self selection[39]).

Alternative Literature:

- 10-30% reduction in vehicle trips

The VTPI literature [2] suggests a 10-30% reduction in vehicle trips for "smart growth" development practices that result in more compact, accessible, multi-modal communities where travel distances are shorter, people have more travel options, and it is possible to walk and bicycle more.

Alternative Literature References:

[2] Litman, T., 2009. "Win-Win Emission Reduction Strategies." Victoria Transport Policy Institute (VTPI). Website: http://www.vtpi.org/wwclimate.pdf. Accessed March 2010. (p. 7, Table 3)

[39] Self selection occurs when residents or employers that favor travel by non-auto modes choose locations where this type of travel is possible. They are therefore more inclined to take advantage of the available options than a typical resident or employee might otherwise be.

Other Literature Reviewed:

None

Project-Specific VMT Reduction Calculation

% VMT Reduction = ((12-8)/12) * 0.20 = 6.67%

3.1.8 Locate Project near Bike Path/Bike Lane

Range of Effectiveness: Grouped strategy. [See LUT-4]

Measure Description:

A Project that is designed around an existing or planned bicycle facility encourages alternative mode use. The project will be located within 1/2 mile of an existing Class I path or Class II bike lane. The project design should include a comparable network that connects the project uses to the existing offsite facilities.

This measure is most effective when applied in combination of multiple design elements that encourage this use. Refer to Increase Destination Accessibility (LUT-4) strategy. The benefits of Proximity to Bike Path/Bike Lane are small as a standalone strategy. The strategy should be grouped with the Increase Destination Accessibility strategy to increase the opportunities for multi-modal travel.

Measure Applicability:

- Urban or suburban context; may be applicable in a rural master planned community
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Alternative Literature:

Alternate:

- 0.625% reduction in vehicle miles traveled (VMT)

As a rule of thumb, the *Center for Clean Air Policy (CCAP) Guidebook* [1] attributes a 1% to 5% reduction associated with comprehensive bicycle programs. Based on the CCAP guidebook, the TIAX report allots 2.5% reduction for all bicycle-related measures and a 1/4 of that for this measure alone. (This information is based on a TIAX review for SMAQMD).

Alternative Literature References:

[1] Center for Clean Air Policy (CCAP). *Transportation Emission Guidebook*. http://www.ccap.org/safe/guidebook/guide_complete.html; TIAX Results of 2005 Literature Search Conducted by TIAX on behalf of SMAQMD.

Other Literature Reviewed:

None

3.1.9 Improve Design of Development

Range of Effectiveness: 3.0 – 21.3% vehicle miles traveled (VMT) reduction and therefore 3.0-21.3% reduction in GHG emissions.

Measure Description:

The project will include improved design elements to enhance walkability and connectivity. Improved street network characteristics within a neighborhood include street accessibility, usually measured in terms of average block size, proportion of four-way intersections, or number of intersections per square mile. Design is also measured in terms of sidewalk coverage, building setbacks, street widths, pedestrian crossings, presence of street trees, and a host of other physical variables that differentiate pedestrian-oriented environments from auto-oriented environments.

Measure Applicability:

- Urban and suburban context
- Negligible impact in a rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Number of intersections per square mile

Mitigation Method:

$$\% \text{ VMT Reduction} = \text{Intersections} * B$$

Where

Intersections = Percentage increase in intersections versus a typical ITE suburban development

$$= \frac{\text{Intersections per square mile of project} - \text{Intersections per square mile of typical ITE suburban development}}{\text{Intersections per square mile of typical ITE suburban development}}$$

$$= \frac{\text{Intersections per square mile of project} - 36}{36}$$

See Appendix C for detail [not to exceed 500% increase]

B = Elasticity of VMT with respect to percentage of intersections (0.12 from [1])

Assumptions:

Data based upon the following references:

[1] Ewing, R., and Cervero, R., "Travel and the Built Environment - A Meta-Analysis." *Journal of the American Planning Association*, <to be published> (2010). Table 4.

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[43]
CO_2e	3.0 – 21.3% of running
PM	3.0 – 21.3% of running
CO	3.0 – 21.3% of running
NOx	3.0 – 21.3% of running
SO_2	3.0 – 21.3% of running
ROG	1.8 – 12.8% of total

Discussion:

The VMT reductions for this strategy are based on changes in intersection density versus the standard suburban intersection density in North America. This standard density is used as a baseline to mirror the density reflected in the *ITE Trip Generation Manual*, which is the baseline method for determining VMT.

The calculations in the Example section look at a low and high range of intersection densities. The low range is simply a slightly higher density than the typical ITE

[43] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

development. The high range uses an average intersection density of mixed use/transit-oriented development sites (TOD Site surveys in the Bay Area for *Candlestick-Hunters Point Phase II TIA,* Fehr & Peers, 2009).

There are two separate maxima noted in the fact sheet: a cap of 500% on the allowable percentage increase of intersections per square mile (variable A) and a cap of 30% on % VMT reduction. The rationale for the 500% cap is that there are diminishing returns to any change in environment. For example, it is reasonably doubtful that increasing intersection density by a factor of six instead of five would produce any additional change in travel behavior. The purpose for the 30% cap is to limit the influence of any single environmental factor (such as design). This emphasizes that community designs that implement multiple land use strategies (such as density, design, diversity, etc.) will show more of a reduction than relying on improvements from a single land use factor.

Example:

Sample calculations are provided below:

- Low Range % VMT Reduction (45 intersections per square mile) = (45 – 36) / 36 * 0.12 = 3.0%
- High Range % VMT Reduction (100 intersections per square mile) = (100 – 36) / 36 * 0.12 = 21.3%

Preferred Literature:

- -0.12 = elasticity of VMT with respect to design (intersection/street density)
- -0.12 = elasticity of VMT with respect to design (% of 4-way intersections)

Ewing and Cervero's [1] synthesis showed a strong relationship of VMT to design elements, second only to destination accessibility. The weighted average elasticity of VMT to intersection/street density was -0.12 (looking at six studies). The weighted average elasticity of VMT to percentage of 4-way intersections was -0.12 (looking at four studies, of which one controlled for self-selection[44]).

Alternative Literature:

Alternate:

- 2-19% reduction in VMT

[44] Self selection occurs when residents or employers that favor travel by non-auto modes choose locations where this type of travel is possible. They are therefore more inclined to take advantage of the available options than a typical resident or employee might otherwise be.

Growing Cooler [2] looked at various reports which studied the effect of site design on VMT, showing a range of 2-19% reduction in VMT. In each case, alternative development plans for the same site were compared to a baseline or trend plan. Results suggest that VMT and CO_2 per capita decline as site density increases as well as the mix of jobs, housing, and retail uses become more balanced. *Growing Cooler* notes that the limited number of studies, differences in assumptions and methodologies, and variability of results make it difficult to generalize.

Alternate:

- 3 – 17% shift in mode share from auto to non-auto

The Marshall and Garrick paper [3] analyzes the differences in mode shares for grid and non-grid ("tree") neighborhoods. For a city with a tributary tree street network, a neighborhood with a tree network had auto mode share of 92% while a neighborhood with a grid network had auto mode share of 89% (3% difference). For a city with a tributary radial street network, a tree neighborhood had auto mode share of 97% while a grid neighborhood had auto mode share of 84% (13% difference). For a city with a grid network, a tree neighborhood had auto mode share of 95% while a grid neighborhood had auto mode share of 78% (17% difference). The research is based on 24 California cities with populations between 30,000 and 100,000.

Alternative Literature References:

[2] Ewing, et al, 2008. Growing Cooler – The Evidence on Urban Development and Climate Change. Urban Land Institute.

[3] Marshall and Garrick, 2009. "The Effect of Street Network Design on Walking and Biking." Submitted to the 89th Annual Meeting of Transportation Research Board, January 2010. (Table 3)

Other Literature Reviewed:

None

Project-Specific VMT Reduction Calculation

% VMT Reduction = (((14/0.24)-36)/36) * 0.12 = 7.33%

3.2 Neighborhood/Site Enhancements

3.2.1 Provide Pedestrian Network Improvements

Range of Effectiveness: 0 - 2% vehicle miles traveled (VMT) reduction and therefore 0 - 2% reduction in GHG emissions.

Measure Description:

Providing a pedestrian access network to link areas of the Project site encourages people to walk instead of drive. This mode shift results in people driving less and thus a reduction in VMT. The project will provide a pedestrian access network that internally links all uses and connects to all existing or planned external streets and pedestrian facilities contiguous with the project site. The project will minimize barriers to pedestrian access and interconnectivity. Physical barriers such as walls, landscaping, and slopes that impede pedestrian circulation will be eliminated.

Measure Applicability:

- Urban, suburban, and rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects
- Reduction benefit only occurs if the project has both pedestrian network improvements on site and connections to the larger off-site network.

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The project applicant must provide information regarding pedestrian access and connectivity within the project and to/from off-site destinations.

Mitigation Method: **Project-Specific VMT Reduction Calculation**

Estimated VMT Reduction	Extent of Pedestrian Accommodations	Context
2%	Within Project Site and Connecting Off-Site	Urban/Suburban
1%	Within Project Site	Urban/Suburban
< 1%	Within Project Site and Connecting Off-Site	Rural

Assumptions:

Data based upon the following references:

- Center for Clean Air Policy (CCAP) Transportation Emission Guidebook. http://www.ccap.org/safe/guidebook/guide_complete.html (accessed March 2010)
- 1000 Friends of Oregon (1997) "Making the Connections: A Summary of the LUTRAQ Project" (p. 16): http://www.onethousandfriendsoforegon.org/resources/lut_vol7.html

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[45]
CO_2e	0 - 2% of running
PM	0 - 2% of running
CO	0 - 2% of running
NOx	0 - 2% of running
SO_2	0 - 2% of running
ROG	0 – 1.2% of total

Discussion:

As detailed in the preferred literature section below, the lower range of 1 – 2% VMT reduction was pulled from the literature to provide a conservative estimate of reduction potential. The literature does not speak directly to a rural context, but an assumption was made that the benefits will likely be lower than a suburban/urban context.

Example:

N/A – calculations are not needed.

Preferred Literature:

[45] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

- 1 - 2% reduction in VMT

The Center for Clean Air Policy (CCAP) attributes a 1% reduction in VMT from pedestrian-oriented design assuming this creates a 5% decrease in automobile mode share (e.g. auto split shifts from 95% to 90%). This mode split is based on the Portland Regional Land Use Transportation and Air Quality (LUTRAQ) project. The LUTRAQ analysis also provides the high end of 10% reduction in VMT. This 10% assumes the following features:

– Compact, mixed-use communities
– Interconnected street network
– Narrower roadways and shorter block lengths
– Sidewalks
– Accessibility to transit and transit shelters
– Traffic calming measures and street trees
– Parks and public spaces

Other strategies (development density, diversity, design, transit accessibility, traffic calming) are intended to account for the effects of many of the measures in the above list. Therefore, the assumed effectiveness of the Pedestrian Network measure should utilize the lower end of the 1 - 10% reduction range. If the pedestrian improvements are being combined with a significant number of the companion strategies, trip reductions for those strategies should be applied as well, based on the values given specifically for those strategies in other sections of this report. Based upon these findings, and drawing upon recommendations presented in the alternate literature below, the recommended VMT reduction attributable to pedestrian network improvements, above and beyond the benefits of other measures in the above bullet list, should be 1% for comprehensive pedestrian accommodations within the development plan or project itself, or 2% for comprehensive internal accommodations and external accommodations connecting to off-site destinations.

Alternative Literature:

Alternate:

- Walking is three times more common with enhanced pedestrian infrastructure
- 58% increase in non-auto mode share for work trips

The Nelson\Nygaard [1] report for the City of Santa Monica Land Use and Circulation Element EIR summarized studies looking at pedestrian environments. These studies have found a direct connection between non-auto forms of travel and a high quality pedestrian environment. Walking is three times more common with communities that have pedestrian friendly streets compared to less pedestrian friendly communities. Non-auto mode share for work trips is 49% in a pedestrian friendly community, compared to 31% in an auto-oriented community. Non-auto mode share for non-work trips is 15%, compared to 4% in an auto-oriented community. However, these effects also depend upon other aspects of the pedestrian friendliness being present, which are accounted for separately in this report through land use strategy mitigation measures such as density and urban design.

Alternate:

- 0.5% - 2.0% reduction in VMT

The Sacramento Metropolitan Air Quality Management District (SMAQMD) Recommended Guidance for Land Use Emission Reductions [2] attributes 1% reduction for a project connecting to *existing* external streets and pedestrian facilities. A 0.5% reduction is attributed to connecting to *planned* external streets and pedestrian facilities (which must be included in a pedestrian master plan or equivalent). Minimizing pedestrian barriers attribute an additional 1% reduction in VMT. These recommendations are generally in line with the recommended discounts derived from the preferred literature above.

Preferred and Alternative Literature Notes:

[1] Nelson\Nygaard, 2010. City of Santa Monica Land Use and Circulation Element EIR Report, Appendix – Santa Monica Luce Trip Reduction Impacts Analysis (p.401). http://www.shapethefuture2025.net/

Nelson\Nygaard looked at the following studies: Anne Vernez Moudon, Paul Hess, Mary Catherine Snyder and Kiril Stanilov (2003), Effects of Site Design on Pedestrian Travel in Mixed Use, Medium-Density Environments, http://www.wsdot.wa.gov/research/reports/fullreports/432.1.pdf; Robert Cervero and Carolyn Radisch (1995), Travel Choices in Pedestrian Versus Automobile Oriented Neighborhoods, http://www.uctc.net/papers/281.pdf;

[2] Sacramento Metropolitan Air Quality Management District (SMAQMD) Recommended Guidance for Land Use Emission Reductions. (p. 11) http://www.airquality.org/ceqa/GuidanceLUEmissionReductions.pdf

Other Literature Reviewed:

None

3.2.2 Provide Traffic Calming Measures

Range of Effectiveness: 0.25 – 1.00% vehicle miles traveled (VMT) reduction and therefore 0.25 – 1.00% reduction in GHG emissions.

Measure Description:

Providing traffic calming measures encourages people to walk or bike instead of using a vehicle. This mode shift will result in a decrease in VMT. Project design will include pedestrian/bicycle safety and traffic calming measures in excess of jurisdiction requirements. Roadways will be designed to reduce motor vehicle speeds and encourage pedestrian and bicycle trips with traffic calming features. Traffic calming features may include: marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, roundabouts or mini-circles, on-street parking, planter strips with street trees, chicanes/chokers, and others.

Measure Applicability:

- Urban, suburban, and rural context
- Appropriate for residential, retail, office, industrial and mixed-use projects

Baseline Method:

See introduction to transportation section for a discussion of how to estimate trip rates and VMT. The CO_2 emissions are calculated from VMT as follows:

$$CO_2 = VMT \times EF_{running}$$

Where:

VMT = vehicle miles traveled

$EF_{running}$ = emission factor for running emissions

Inputs:

The following information needs to be provided by the Project Applicant:

- Percentage of streets within project with traffic calming improvements
- Percentage of intersections within project with traffic calming improvements

Mitigation Method: **Project-Specific VMT Reduction Calculation**

		% of streets with improvements			
		25%	*50%*	*75%*	*100%*
		% VMT Reduction			
% of intersections with improvements	*25%*	**0.25%**	**0.25%**	**0.5%**	**0.5%**
	50%	**0.25%**	**0.5%**	**0.5%**	**0.75%**
	75%	**0.5%**	**0.5%**	**0.75%**	**0.75%**
	100%	**0.5%**	**0.75%**	**0.75%**	**1%**

Assumptions:

Data based upon the following references:

[1] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.*(p. B-25) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendices_Complete_102209.pdf

[2] Sacramento Metropolitan Air Quality Management District (SMAQMD) *Recommended Guidance for Land Use Emission Reductions.* (p.13) http://www.airquality.org/ceqa/GuidanceLUEmissionReductions.pdf

Emission Reduction Ranges and Variables:

Pollutant	Category Emissions Reductions[46]
CO_2e	0.25 – 1.00% of running
PM	0.25 – 1.00% of running
CO	0.25 – 1.00% of running
NOx	0.25 – 1.00% of running
SO_2	0.25 – 1.00% of running
ROG	0.15 – 0.6% of total

Discussion:

The table above allows the Project Applicant to choose a range of street and intersection improvements to determine an appropriate VMT reduction estimate. The Applicant will look at the rows on the left and choose the percent of intersections within

[46] The percentage reduction reflects emission reductions from running emissions. The actual value will be less than this when starting and evaporative emissions are factored into the analysis. ROG emissions have been adjusted to reflect a ratio of 40% evaporative and 60% exhaust emissions based on a statewide EMFAC run of all vehicles.

the project which will have traffic calming improvements. Then, the Applicant will look at the columns along the top and choose the percent of streets within the project which will have traffic calming improvements. The intersection cell of the row and column selected in the matrix is the VMT reduction estimate.

Though the literature provides some difference between a suburban and urban context, the difference is small and thus a conservative estimate was used to be applied to all contexts. Rural context is not specifically discussed in the literature but is assumed to have similar impacts.

For a low range, a project is assumed to have 25% of its streets with traffic calming improvements and 25% of its intersections with traffic calming improvements. For a high range, 100% of streets and intersections are assumed to have traffic calming improvements

Example:

N/A - No calculations needed.

Preferred Literature:

- -0.03 = elasticity of VMT with respect to a pedestrian environment factor (PEF)
- 1.5% - 2.0% reduction in suburban VMT
- 0.5% - 0.6% reduction in urban VMT

Moving Cooler [1] looked at Ewing's synthesis elasticity from the Smart Growth INDEX model (-0.03) to estimate VMT reduction for a suburban and urban location. The estimated reduction in VMT came from looking at the difference between the VMT results for Moving Cooler's strategy of pedestrian accessibility only compared to an aggressive strategy of pedestrian accessibility and traffic calming.

The Sacramento Metropolitan Air Quality Management District (SMAQMD) *Recommended Guidance for Land Use Emission Reductions* [2] attributes 0.25 – 1% of VMT reductions to traffic calming measures. The table above illustrates the range of VMT reductions based on the percent of streets and intersections with traffic calming measures implemented. This range of reductions is recommended because it is generally consistent with the effectiveness ranges presented in the other preferred literature for situations in which the effects of traffic calming are distinguished from the other measures often found to co-exist with calming, and because it provides graduated effectiveness estimates depending on the degree to which calming is implemented.

Alternative Literature:

None

Alternative Literature References:

None

Other Literature Reviewed:

None

3.2.5 Incorporate Bike Lane Street Design (on-site)

Range of Effectiveness: Grouped strategy. [See LUT-9]

Measure Description:

The project will incorporate bicycle lanes, routes, and shared-use paths into street systems, new subdivisions, and large developments. These on-street bike accommodations will be created to provide a continuous network of routes, facilitated with markings and signage. These improvements can help reduce peak-hour vehicle trips by making commuting by bike easier and more convenient for more people. In addition, improved bicycle facilities can increase access to and from transit hubs, thereby expanding the "catchment area" of the transit stop or station and increasing ridership. Bicycle access can also reduce parking pressure on heavily-used and/or heavily-subsidized feeder bus lines and auto-oriented park-and-ride facilities.

Refer to Improve Design of Development (LUT-9) strategy for overall effectiveness levels. The benefits of Bike Lane Street Design are small and should be grouped with the Improve Design of Development strategy to strengthen street network characteristics and enhance multi-modal environments.

Measure Applicability:

- Urban and suburban context
- Appropriate for residential, retail, office, industrial, and mixed-use projects

Alternative Literature:

Alternate:

- 1% increase in share of workers commuting by bicycle (for each additional mile of bike lanes per square mile)

Dill and Carr (2003) [1] showed that each additional mile of Type 2 bike lanes per square mile is associated with a 1% increase in the share of workers commuting by bicycle. Note that increasing by 1 mile is significant compared to the current average of 0.34 miles per square mile. Also, an increase in 1% in share of bicycle commuters would double the number of bicycle commuters in many areas with low existing bicycle mode share.

Alternate:

- 0.05 – 0.14% annual greenhouse gas (GHG) reduction
- 258 – 830% increase in bicycle community

Moving Cooler [2], based off of a national baseline, estimates 0.05% annual reduction in GHG emissions and 258% increase in bicycle commuting assuming 2 miles of bicycle lanes per square mile in areas with density > 2,000 persons per square mile. For 4 miles of bicycle lanes, estimates 0.09% GHG reductions and 449% increase in bicycle commuting. For 8 miles of bicycle lanes, estimates 0.14% GHG reductions and 830% increase in bicycle commuting. Companion strategies assumed include bicycle parking at commercial destinations, busses fitted with bicycle carriers, bike accessible rapid transit lines, education, bicycle stations, end-trip facilities, and signage.

Alternate:

- 0.075% increase in bicycle commuting with each mile of bikeway per 100,000 residents

A before-and-after study by Nelson and Allen (1997) [3] of bicycle facility implementation found that each mile of bikeway per 100,000 residents increases bicycle commuting 0.075%, all else being equal.

Alternative Literature References:

[1] Dill, Jennifer and Theresa Carr (2003). "Bicycle Commuting and Facilities in Major U.S. Cities: If You Build Tem, Commuters Will Use Them – Another Look." *TRB 2003 Annual Meeting CD-ROM*.

[2] Cambridge Systematics. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Technical Appendices. Prepared for the Urban Land Institute. http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf

[3] Nelson, Arthur and David Allen (1997). "If You Build Them, Commuters Will Use Them; Cross-Sectional Analysis of Commuters and Bicycle Facilities." *Transportation Research Record 1578.*

Other Literature Reviewed:

None

3.2.7 Provide Bike Parking with Multi-Unit Residential Projects

Range of Effectiveness: Grouped strategy. [See LUT-9]

Measure Description:

Long-term bicycle parking will be provided at apartment complexes or condominiums without garages. Refer to Improve Design of Development (LUT-9) strategy for effectiveness ranges in this category. The benefits of Bike Parking with Multi-Unit Residential Projects have no quantified impacts and should be grouped with the Improve Design of Development strategy to encourage bicycling by providing strengthened street network characteristics and bicycle facilities.

Measure Applicability:

- Urban, suburban, or rural contexts
- Appropriate for residential projects

Alternative Literature:

No literature was identified that specifically looks at the quantitative impact of including bicycle parking at multi-unit residential sites.

Alternative Literature References:

None

Other Literature Reviewed:

None

3.2.9 Dedicate Land for Bike Trails

Range of Effectiveness: Grouped strategy. [See LUT-9]

Measure Description:

Larger projects may be required to provide for, contribute to, or dedicate land for the provision of off-site bicycle trails linking the project to designated bicycle commuting routes in accordance with an adopted citywide or countywide bikeway plan.

Refer to Improve Design of Development (LUT-9**)** strategy for ranges of effectiveness in this category. The benefits of Land Dedication for Bike Trails have not been quantified and should be grouped with the Improve Design of Development strategy to strengthen street network characteristics and improve connectivity to off-site bicycle networks.

Measure Applicability:

- Urban, suburban, or rural contexts
- Appropriate for large residential, retail, office, mixed use, and industrial projects

Alternative Literature:

No literature was identified that specifically looks at the quantitative impact of implementing land dedication for bike trails.

Alternative Literature References:

None

Other Literature Reviewed:

None