Appendix C

VMT Calculation Worksheet

Measure 1: Install a New Bike Lane

Instructions:

Participants interested in submitting an application for a Credit-Generating item for inclusion in the regional mitigation program must provide all "inputs" on this form. Credit-Generating items must also meet all requirements for inclusion in the program as outlined in the Program Manual, and the user is responsible for verifying that all requirements apply.

Requirements:

☐ Connects to larger existing bikeway network

☐Not currently under construction or funded through other sources[1]

☐Meets one of these facility classifications:

	Facility Class	**Description**	**For WRCOG Calculation Use Only**
☐	Class I	Physically separated from motor vehicle traffic	E
☐	Class II	Striped bicycle lanes that provide exclusive use to bicycles on a roadway	E
☐	Class IV	Protected on street bikeways or cycle tracks	E
☐	Conversion from Class II to IV		E

Inputs:

Input	Units	Description	**For WRCOG Calculation Use Only**
		Brief description of project location and features.	
		Daily vehicle trip count on roadway where bike facility is to be installed	C.1
	Miles	One-way facility length, do NOT include the length of crosswalks	C.1
		Total population of city where bike facility is to be installed	C.1
	Y/N	Is there a university in the area where facility is to be installed AND population is < 250,000	C.2
		Within a ½ mile radius from the proposed facility, how many key destinations are there. Reference figure X Key destinations include banks, post offices, grocery stores, medical centers, pharmacies, office parks, places of	D

		worship, public libraries, schools, universities, colleges, and light rail stations (park &ride) 	
	$	Estimated cost to construct	

Notes

1. Credit-Generating Items that would be classified as off-street paths or trails must submit a form for Measure 1 Install a new bike lane and Measure 2 Provide Pedestrian Network Improvement.
2. Credit-Generating items that are partially funded through other sources must disclose this and provide the source and amount of funding in the brief description of the item on the inputs section of this form.
3. Please provide as much detail as available, if needed or applicable provide attachments that support the inputs on this form such as maps, initial cost estimates, etc.

Install a New Bike Lane

Assumptions:

- 337 annual days of use of new facility
- 2.2 mile of existing regional average one-way bicycle trip length
- 11.7 mile of existing regional average one-way vehicle trip length
- 365 days per year

Table 1 – Growth Factor Adjustment

Facility Class	Description	Growth Factor Adjustment
Class I	Physically separated from motor vehicle traffic	1.54
Class II	Striped bicycle lanes that provide exclusive use to bicycles on a roadway	1.0
Class IV	Protected on street bikeways or cycle tracks	1.54
Conversion from Class II to IV		0.54

Table 2 -Active Transportation Adjustment Factor

ADT	Facility Length	Adjustment Factor
1 – 12,000	<= 1	0.0019
	1.02 to 2	0.0029
	>2	0.0038
12,001 to 24,000	<= 1	0.0014
	1.02 to 2	0.0020
	>2	0.0027
24,001 to 30,000	<= 1	0.0010
	1.02 to 2	0.0014
	>2	0.0019

Table 3 – Adjustment Factor for a University Town with Population <250,000

ADT	Facility Length	Adjustment Factor
1 – 12,000	<= 1	0.0104
	1.02 to 2	0.0155
	>2	0.0207

Source:

1. California Air Resources Board (CARB). 2020. *Quantification methodology for the Strategic Growth council's Affordable Housing and Sustainable Communities Program.* September.
2. Federal Highway Administration (FHWA). 2017. *National household Travel Survey-2017 Table Designer*
3. National Oceanic and Atmospheric Administration (NOAA). 2021. *Global Historical Climatology Network-Daily (GHCN-Daily), Version 3.* 2015-2019 Average of Days Per Year with Precipitation >0.1 inches.

12,001 to 24,000	<= 1	0.0073
	1.02 to 2	0.0109
	>2	0.0145
24,001 to 30,000	<= 1	0.0052
	1.02 to 2	0.0078
	>2	0.0104

Table 4

Number of Key Destinations	**Credit within ½ mile of Facility**
0 - 2	0.0000
3	0.0005
4 - 6	0.0010
>=7	0.0015

Percent of Plan/Community VMT

This input should be calculated using the methodology below

$$\frac{\text{Daily vehicle trip count on roadway where bike facility is to be installed} \times \text{One-way facility length}}{\text{Boundary VMT from the most recent version of RIVCOM for the appropriate jurisdictional boundary (i.e. if the bike lane will be installed in City X, the boundary VMT for City X should be extracted from RIVCOM)}}$$

Source:

1. California Air Resources Board (CARB). 2020. *Quantification methodology for the Strategic Growth council's Affordable Housing and Sustainable Communities Program.* September.
2. Federal Highway Administration (FHWA). 2017. *National household Travel Survey-2017 Table Designer*
3. National Oceanic and Atmospheric Administration (NOAA). 2021. *Global Historical Climatology Network-Daily (GHCN-Daily), Version 3.* 2015-2019 Average of Days Per Year with Precipitation >0.1 inches.

CALCULATION

Input B:

____% Percent of Plan/Community VMT (a negative %, refer to calculation

Input C:

____ Active Transportation Adjustment Factor (refer to table 2 or table 3)

Input D:

____ Credits for key destinations near project (refer to table 4)

Input E:

____ Growth Adjustment Factor (refer to table 1)

1)

$$\frac{\text{337 annual days of use of new facility}}{\text{365 days per year}} \times (\text{Input C} + \text{Input D}) \times \text{Input E} \times \text{2.2 miles per trip of existing regional average one-way bike} = \text{Output A}$$

2) Output A / 11.7 miles per trip of existing average one-way vehicle trip = Output B

3) Output B X Input E = **% Reduction**

Source:

1. California Air Resources Board (CARB). 2020. *Quantification methodology for the Strategic Growth council's Affordable Housing and Sustainable Communities Program.* September.
2. Federal Highway Administration (FHWA). 2017. *National household Travel Survey-2017 Table Designer*
3. National Oceanic and Atmospheric Administration (NOAA). 2021. *Global Historical Climatology Network-Daily (GHCN-Daily), Version 3.* 2015-2019 Average of Days Per Year with Precipitation >0.1 inches.

Measure 2: Provide Pedestrian Network Improvement

Instructions:

Participants interested in submitting an application for a Credit-Generating item for inclusion in the regional mitigation program must provide all "inputs" on this form. Credit-Generating items must also meet all requirements for inclusion in the program as outlined in the Program Manual, and the user is responsible for verifying that all requirements apply.

Requirements:

☐ Sidewalk coverage expansion, including building new sidewalks or improving degraded or substandard sidewalk[1]

☐Not currently under construction or funded through other sources[2]

Inputs

Input	Units	Description	For WRCOG Calculation Use Only
	N/A	Brief description of project location and features. Example: Installing new sidewalk on both sides of Example Road between Sample Ave and Template St with new crosswalks and curb ramps at both intersections.	
	Miles	Total length (miles) of sidewalks already built within the project site area. Length is measured on both sides of the street.	B
	Miles	Proposed sidewalk length (miles) in project site area. Length is measured on both sides of the street	C
	$	Estimated cost to construct improvements	

Notes

1. Credit-Generating Items that would be classified as off-street paths or trails must submit a form for Measure 1 Install a new bike lane and Measure 2 Provide Pedestrian Network Improvement.
2. Credit-Generating items that are partially funded through other sources must disclose this and provide the source and amount of funding in the brief description of the item on the inputs section of this form.
3. Please provide as much detail as available, if needed or applicable provide attachments that support the inputs on this form such as maps, initial cost estimates, etc.

Provide Pedestrian Network Improvement

Assumptions:

- -0.05 elasticity of VMT with respect to the ratio of sidewalks-to-streets (source: Frank et al. 2011, Handy et al. 2014)

CALCULATION

Input B:

____Miles of existing sidewalk length in study area. Study area a

Input C:

____ Miles of sidewalk length in study area with measure

$$\left(\frac{\text{Input C}}{\text{Input B}} - 1\right) \times \text{-0.05 Elasticity of VMT with respect to the ratio of sidewalks-to-streets} = \textbf{\% Reduction}$$

Source:

1. Frank, L. M. Greenwald, S. Kavage, and A. Devlin. 2011. *An Assessment of Urban Form and Pedestrian and Transit Improvements as an Integrated GHG Reduction Strategy.* WSDOT Research Report WA-RD 765.1, Washington State Department of Transportation. April.

Measure 3: Increase Transit Service Frequency

Instructions:

Participants interested in submitting an application for a Credit-Generating item for inclusion in the regional mitigation program must provide all "inputs" on this form. Credit-Generating items must also meet all requirements for inclusion in the program as outlined in the Program Manual, and the user is responsible for verifying that all requirements apply.

Requirements:

☐ Proposed plan will increase transit frequency on one or more transit lines

☐ Not currently under construction or funded through other sources[1]

Inputs

Input	Units	Description	For WRCOG Calculation Use Only
	N/A	Brief description of project location and features. Example: Increase example transit service frequency on Route XX from 60 minute headways to 45 minute headways.	
	%	Change in transit frequency. Frequency is measured as the number of arrivals over a given time (e.g., buses per hour). Frequency is the inverse of transit headway, defined as the time between transit vehicle arrivals on a given route. This can be calculated as transit frequency with measure minus existing transit frequency divided by existing transit frequency.	B
	%	Number of transit routes receiving the frequency improvement as a fraction of the total transit routes in the plan/community	C
	$	Estimated annual cost to implement	

Notes

1. Credit-Generating items that are partially funded through other sources must disclose this and provide the source and amount of funding in the brief description of the item on the inputs section of this form.
2. Please provide as much detail as available, if needed or applicable provide attachments that support the inputs on this form such as maps, initial cost estimates, etc.

Increase Transit Service Frequency

Assumptions:

- 0.5 Elasticity of transit ridership with respect to frequency of service
- 1.37% average transit mode share of all trips in Riverside-San Bernardino-Ontario area
- 96.88% average transit mode share of all trips in Riverside-San Bernardino-Ontario area
- 57.8 statewide mode shift factor adjustment to reflect the reduction in vehicle trips associated with a reduction in person trips

CALCULATION

Input B:

____% Percent of increase in transit frequency

Input C:

____ % Level of implementation

1) Input B X 1.37% average transit mode share for Riverside-San Bernardino-Ontario area X 0.5 elasticity of transit ridership with respect to frequency of service X 96.88% vehicle mode share in plan/ Community = Output A

2) $\frac{\text{Output A}}{\text{96.88\% vehicle mode share in plan/community}}$ = Output B

3) (-) Input C X Output B = **% Reduction**

Source:

1. Federal highway Administration (FHWA). 2017a. *National household Travel Survey-2017 Table Designer*. Travel Day PMT by TRPTRANS by HH_CBSA.
2. Federal highway Administration (FHWA). 2017b. *National Household Travel Survey-2017 Table Designer.* Average Vehicle occupancy by HHSTFIPS.
3. Handy, S. K. Lovejoy, M. Boarnet, S. Spears. 2013. *Impacts of Transit service Strategies on Passenger Vehicle use and Greenhouse gas Emissions.* October.

Measure 4: Extend Transit Network Coverage or Hours

Instructions:

Participants interested in submitting an application for a Credit-Generating item for inclusion in the regional mitigation program must provide all "inputs" on this form. Credit-Generating items must also meet all requirements for inclusion in the program as outlined in the Program Manual, and the user is responsible for verifying that all requirements apply.

Requirements:

☐ Frequency of existing bus line increases OR extending existing bus line to cover new areas and times.

☐Not currently under construction or funded through other sources[1]

Inputs

Input	Units	Description	For WRCOG Calculation Use Only
	N/A	Brief description of project location and features. Example: Expand example local transit network by adding existing transit services near example project site to better serve example community.	
	Miles or Hours	Miles or service hours present in the community without the expansion of service	B
	Miles or Hours	Miles or service hours present in the community with the expansion of service	C
	$	Estimated annual cost to implement	

Notes

1. Credit-Generating items that are partially funded through other sources must disclose this and provide the source and amount of funding in the brief description of the item on the inputs section of this form.
2. Please provide as much detail as available, if needed or applicable provide attachments that support the inputs on this form such as maps, initial cost estimates, etc.

Extend Transit network Coverage or Hours

Assumptions:

- 0.7 Elasticity of transit demand with respect to service miles or service hours
- 57.8% statewide mode shift factor adjustment to reflect the reduction in vehicle trips associated with a reduction in persons trips, since some vehicles carry more than one person
- 1.37% average transit mode share of all trips by California, Riverside-San Bernardino-Ontario area (source: San Diego Association of Governments (SANDAG), 2019, mobility management VMT reduction calculator tool)

CALCULATION

Input B:

____Miles of total transit service or service hours in plan/community **before**

Input C:

____Miles of total transit service or service hours in plan/community **after**

1) $\frac{\text{Input C} - \text{Input B}}{\text{Input B}} =$ Output A

2) 1.37% average transit mode share for Riverside-San Bernardino-Ontario area X 0.7 elasticity of transit demand with respect to service miles/hours X 57.8% statewide mode shift factor X 1 ratio of vehicle trip reduction to VMT = Output B

3) -1 X Output A X Output B = **% Reduction**

Source:

1. Handy, S., K. Lovejoy, M. Boarnet, and S. Spears. 2013. *Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions.* October.
2. Federal Highway Administration (FHWA). 2017. *National household Travel Survey-2017 Table Designer.* Average Vehicle Occupancy by HHSTFIPS.

Measure 5: Provide Subsidized Vanpool

Instructions:

Participants interested in submitting an application for a Credit-Generating item for inclusion in the regional mitigation program must provide all "inputs" on this form. Credit-Generating items must also meet all requirements for inclusion in the program as outlined in the Program Manual, and the user is responsible for verifying that all requirements apply.

Requirements:

☐Not currently under construction or funded through other sources[1]

Inputs

Input	Units	Description	For WRCOG Calculation Use Only
	N/A	Brief description of program location and features. Provide any details that are available on the anticipated users of the vanpool	
	#	Number of vanpools to be funded	
	$	Estimated Annual cost to implement	

Notes

1. Credit-Generating items that are partially funded through other sources must disclose this and provide the source and amount of funding in the brief description of the item on the inputs section of this form.
2. Please provide as much detail as available, if needed or applicable provide attachments that support the inputs on this form such as maps, initial cost estimates, etc.

Implement Subsidized or Discounted Transit Program

Assumptions:

- Average length of a one-way vehicle commute trip in the region is 18.62
- Average emission factor of average employee vehicle is 307.5 g CO2e per mile
- Average vanpool occupancy (including driver) is 6.25 occupants
- Average length of one-way vanpool commute trip is 42.0 miles per trip
- Vanpool emission factor is 763.4 g CO2e per mile

CALCULATION

Input B:

____% of employees participate in vanpool

1) (1 – Input B) X 18.62 average miles per trip of a one-way vehicle commute trip in the region X 307.5 gCO2e per mile average emission factor of average employee vehicle = Output A

2) Input B X (42.0 miles per trip average length of one-way vanpool commute trip / 6.25 average vanpool occupants) X 763.4 gCO2e per mile van pool emission factor = Output B

3) Input B X 42.0 miles per trip average length of one-way vanpool commute trip X 307.5 gCO2e per mile average emission factor of average employee vehicle = Output C

4) (Output A + Output B) / (Output A + Output C) X -1 = **% Reduction**

Sources:

1. San Diego Association of Governments (SANDAG). 2019. *Mobility management VMT Reduction Calculator Tool-Design Document*. June.
2. Federal Highway Administration (FHWA). 2017. *National Household Travel Survey-2017 Table Designer.*
3. California Air Resources Board (CARB). 2020. *EMFAC2017 v1.0.3.* August.

Measure 6: Installing New Bus Shelters

Instructions:

Participants interested in submitting an application for a Credit-Generating item for inclusion in the regional mitigation program must provide all "inputs" on this form. Credit-Generating items must also meet all requirements for inclusion in the program as outlined in the Program Manual, and the user is responsible for verifying that all requirements apply.

Requirements:

☐Not currently under construction or funded through other source[1]

Inputs

Input	Units	Description	For WRCOG Calculation Use Only
	N/A	Brief description of project location and features. Example: Installing new sidewalk on both sides of Example Road between Sample Ave and Template St with new crosswalks and curb ramps at both intersections.	
	#	Number of stops with new shelters	
	Boardings/day	Average number of boardings per day at each stop with new shelters	
	Boardings/day	Average number of boardings per day across the transit agency	
	$	Estimated cost to construct	

Notes

1. Credit-Generating items that are partially funded through other sources must disclose this and provide the source and amount of funding in the brief description of the item on the inputs section of this form.
2. Please provide as much detail as available, if needed or applicable provide attachments that support the inputs on this form such as maps, initial cost estimates, etc.

Installing New Bus Shelters

Assumptions:

- Transit mode share in the Riverside-San Bernardino-Ontario core-based statistical area is 1.37%
- The percentage of transit users who would otherwise drive is 83.3%
- Average auto occupancy is 1.45 riders per vehicle
- The percentage of total travel time spent waiting for transit trips is 24.9%
- The percentage of perceived total travel time spent waiting (transit trips with shelters) is 20.3%
- The percentage of total travel time spent waiting (transit trips with shelters and real-time arrival information [RTI]) is 15.8
- Wait time elasticity is -0.54

CALCULATION

Input B: Number of bus stops with new bus shelters

Input C: Average number of boardings per day at each transit station with new shelters

Input D: Average number of boardings per day across the transit agency

1) Input B X (Input C / Input D) X 1.37 % Transit Mode Share X (Percent who would otherwise drive/Average auto occupancy) X (Percent of total time waiting – Percent of perceived total time waiting with shelters) X (Wait time elasticity)

= **% Reduction (for bus shelters**

2) Input B X (Input C / Input D) X 1.37 % Transit Mode Share X (Percent who would otherwise drive/Average auto occupancy) X (Percent of total time waiting – Percent of perceived total time waiting with shelters with RTI) X (Wait time elasticity)

= **% Reduction (for bus shelters with RTI only)**

Sources:

1. Fan, Y., A. Guthrie, and D. Levinson. 2016. Waiting time perceptions at transit stops and stations: Effects of basic amenities, gender, and security. Transportation Research Part A: Policy & Practice 88:251–264. Available: https://doi.org/10.1016/j.tra.2016.04.012. Accessed: December 2023.
2. Federal Highway Administration (FHWA). 2017. 2017 National Household Travel Survey. Available: https://nhts.ornl.gov/. Accessed: December 2023.
3. Federal Highway Administration (FHWA). 2023. 2022 National Household Travel Survey. Available: https://nhts.ornl.gov/. Accessed: January 2024.
4. Taylor, B. D., H. Iseki, M. Smart, and M. A. Miller. 2009. The Effects of Out-of-Vehicle Time on Travel Behavior: Implications for Transit Transfers. California PATH Program. Available: https://trid.trb.org/view/886713. Accessed: December 2023.
5. Watkins, K., B. Ferris, A. Borning, G. Scott Rutherford, and D. Layton. 2011. Where Is My Bus? Impact of mobile real-time information on the perceived and actual wait time of transit riders. Transportation Research Part A: Policy & Practice 45:839–848. Accessed: December 2023.

Measure 7: Implement Subsidized or Discounted Transit Program

Instructions:

Participants interested in submitting an application for a Credit-Generating item for inclusion in the regional mitigation program must provide all "inputs" on this form. Credit-Generating items must also meet all requirements for inclusion in the program as outlined in the Program Manual, and the user is responsible for verifying that all requirements apply.

Requirements:

☐Transit passes are made available to a portion of the population of Western Riverside County that do not currently have access or will lose access to discounted or free transit fare[1]

☐Not currently under construction or funded through other sources[2]

Inputs

Input	Units	Description	For WRCOG Calculation Use Only
	N/A	Brief description of program location and features. Example: Installing new sidewalk on both sides of Example Road between Sample Ave and Template St with new crosswalks and curb ramps at both intersections.	
	$	Fare per ride or the cost of a monthly pass for typical transit service.	B
	$	Proposed difference between full fare price and discounted or subsidized fare	C
		Population eligible for subsidized fare (i.e. all veterans in Western Riverside County) and estimated number of people this population represents (i.e. 6,000 residents)	D
	$	Annual cost to implement	

Notes

1. Please provide details as to the population(s) that will gain access to discounted or free transit passes. If populations lose access to free or discounted passes at a certain time unless additional funding is identified, please provide details on this. Please note, to be eligible as CEQA mitigation and be part of the regional mitigation program, transit passes must be provided for individuals that don't currently have a pass, or would provide additional discount/subsidy to an individual who has a pass. More details on eligibility are listed below. Please provide as much information as possible to ensure that the credit-generating item's eligibility can be confirmed.
    a. Eligible

i. Providing discounted or free passes to a group that does not currently have access to discounted or free passes
ii. Extending an existing program that is not fully funded for the foreseeable future
iii. Providing passes to a group which already has access but they are providing additional passes
iv. Increasing the subsidy level for an existing group (discounted goes to free)

b. Not eligible
i. Providing passes to members of a group who are currently included in a program, such as university students traveling to school who have passes funded by their university.
ii. Providing free or discounted passes to any person who already has a free rides (disabled persons, etc)

2. Credit-Generating items that are partially funded through other sources must disclose this and provide the source and amount of funding in the brief description of the item on the inputs section of this form.
3. Please provide as much detail as available, if needed or applicable provide attachments that support the inputs on this form such as maps, initial cost estimates, etc.

Implement Subsidized or Discounted Transit Program

Assumptions:

- Transit mode share of all trips or work trips
    - If blank, fill with the appropriate constant assumptions provided by the Federal highway Administration, 2017, National Household Travel Survey

      Table 1 – Average Mode Share of All Trips by CA Core-Based Statistical Area

Transit mode share	1.37%
Vehicle mode share	96.88%
Transit mode share of work trips	1.12%

- -0.43 elasticity of transit boardings with respect to transit fare price
- 50% of transit trips that would otherwise be made in a vehicle
- 1.0 conversion factor of vehicle trips to VMT

CALCULATION

Input B:

____$ Average transit fare without subsidy

Input C:

____ $ Subsidy Amount

Input D:

____ % of employees/residents eligible for subsidy

Input E:

____ % of project generated VMT from employees/residents

Input F:

____ % Transit mode share of all trips or work trips

Sources:

1. Federal highway Administration (FHWA). 2017. *National Household Travel Survey -2017 Table Designer*. Travel Day PMT by TRPTRANS by HH_CBSA, Workers by WRKTRANS by HH_CBSA.
2. Handy, L. and S. Boarnet. 2013. *Impacts of Transit Service Strategies on Passenger vehicle use and Greenhouse Gas Emissions*.
3. Taylor, B., D. miller, H. Iseki, and C. Fink. 2008. *Nature and/or Nuture? Analyzing the Determinants of Transit Ridership Across US Urbanized Areas*. Transportation Research Part A: Policy and pRactice, 43 (1), 60-77.

Calculation Sheet

$$\frac{\text{Input C}}{\text{Input B}} \times \text{-0.43 elasticity of transit boarding with respect to transit fare} \times \text{Input D} \times \text{Input E} \times \text{Input F Or Table 1} \times$$

$$\text{50\% of transit trips that would otherwise be made in a vehicle} \times \text{1.0 conversion factor of vehicle trips to VMT} = \textbf{\% Reduction}$$

Sources:

1. Federal highway Administration (FHWA). 2017. *National Household Travel Survey -2017 Table Designer*. Travel Day PMT by TRPTRANS by HH_CBSA, Workers by WRKTRANS by HH_CBSA.
2. Handy, L. and S. Boarnet. 2013. *Impacts of Transit Service Strategies on Passenger vehicle use and Greenhouse Gas Emissions*.
3. Taylor, B., D. miller, H. Iseki, and C. Fink. 2008. *Nature and/or Nuture? Analyzing the Determinants of Transit Ridership Across US Urbanized Areas*. Transportation Research Part A: Policy and pRactice, 43 (1), 60-77.