Appendix C: Scenario Modeling Assumptions

San Bernardino County Long Range Multimodal Transportation Plan

July 16, 2024

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1 Scenario Development

To inform the development of the Long-Range Multimodal Transportation Plan (LRMTP), several scenarios have been identified and modeled using the latest version of SBCTA's San Bernardino Transportation Analysis Model, SBTAM+. SBTAM+ is a travel forecasting model based on the regional model developed by the Southern California Association of Governments (SCAG) and allows analysis of future travel patterns with new infrastructure and land use assumptions. Through scenarios with different assumptions regarding the transportation network, travel patterns, or land use, SBCTA can test how investment strategies perform against each other in multiple potential futures. This identifies which strategies and projects "rise to the top" and provide substantive benefits in multiple scenarios and help understand which strategies and projects perform better in particular scenarios, providing SBCTA with roadmaps to follow depending on how future trends play out.

To inform recommendations in the LRMTP, scenarios were developed by varying two dimensions: the transportation network (infrastructure and services) and demand context (where and how much people want to travel). This approach was presented to the Mobility and Community Working Groups, which provided input onto trends and drivers of travel behavior for the demand context scenarios.

1.1 Transportation Networks

Two levels of transportation investment were modeled, providing insight into how additional investment changes performance of the system:

Baseline: The Baseline Scenario includes transportation improvements that can be funded with known funding sources: Measure I, mitigation fees, gas tax funds, tolls, and reasonably expected discretionary grants.

Enhanced (SCAG RTP "Plan" network): This scenario assumes more availability of new funding sources, such as a renewal of Measure I, statewide vehicle mile fees, and significant discretionary grants. This scenario corresponds to the fiscally constrained scenario for the SCAG RTP.

1.2 Demand Context Scenarios

In collaboration with the Mobility and Community Working Groups, the Project team developed three context scenarios to reflect possible ways society could change over the next decade in ways that would impact travel behavior. At the second Mobility and Community Working Group meetings, the Project team led a group discussion on expected societal changes that could impact travel demand and conducted an exercise using Fehr & Peers' TrendLab+ tool to forecast high level estimates of changes to key performance indicators such as vehicle miles traveled (VMT) based on the direction of changes.

The transportation demand context is shaped by external factors that agencies can anticipate but not control, as well as public policy decisions outside the transportation sector. The first two scenarios developed reflect either reversion from of acceleration of post-pandemic trends that are largely outside the control of public agencies. The third scenario represents a change in land use policy to support more sustainable development that is coordinated with transportation investments. While these policies are not directly controlled by SBCTA, its municipal partners can influence development through their land use authority.

The three demand context scenarios include:

Return to Normal: This scenario represents the baseline in SBTAM+, which is calibrated to 2019 travel patterns and does not assume on-going impact from pandemic. However, the scenario does include planned projects in future year transportation network and future growth in employment and population. In other words, this scenario represents a future where projects are built and the county grows, but travel behavior reverts to pre-pandemic conditions.

Virtual Future: In contrast to the Return to Normal, this scenario represents magnification of the changes in travel pattens after the pandemic, with telecommuting continuing to surge, thus changing the number and types of trips workers make.

Smart Growth: This scenario represents a change in land use away from dispersed, low-density suburban and exurban development to an approach focused on compact communities oriented around transit corridors to support higher transit use and shorten trips by homes, employment, services, and other destinations in closer proximity.

1.3 Sensitivity Tests

To understand the potential impacts of transportation system or policy changes, two additional scenarios were developed as sensitivity tests:

Transit Expansion: This scenario tests the possible effects of substantially expanding transit service in the region. It assumes doubling of frequency on all bus routes as well as planned passenger rail improvements consistent with Metrolink's existing capital program.

Pricing: Road pricing has emerged as potential strategy both to reduce congestion and VMT and as a potential replacement for gas tax funding as vehicles become increasingly electrified. Caltrans is currently conducting a road user charge pilot. This scenario assumes that a pricing scheme is implemented at the state or SCAG region level.

The scenarios and sensitivity tests referenced above do not represent recommendations and are intended to test what types of interventions result in significant changes in transportation system performance. These scenarios were constructed so as to hypothetically test the degree to which key performance indicators might change in response to a transportation or land use strategy without limiting the strategy to what might be legislatively, politically, or financially feasible or by any negative economic consequences that might occur. Therefore, it should not be assumed that these scenarios are possible to implement but may provide guidance regarding general policy directions that could or should be explored further over the long term.

2 Scenario Assumptions

2.1 Return to Normal

This scenario represents the baseline in SBTAM+, which is calibrated to 2019 travel patterns and does not assume on-going impacts from the pandemic. This scenario includes default assumptions for demographics and land use consistent with the SCAG Regional Transportation Plan (RTP) (household and job growth forecasts by TAZ). These show significant growth overall in county, with some reductions in specific TAZs, particularly for individual employment sectors.

2.2 Virtual Future

In contrast to the Return to Normal scenario, this scenario represents a continuation of the post-pandemic rise in telecommuting, but even going beyond what exists today. To reflect the largest possible impact of remote work, this scenario assumes that all workers who can work from home do so. No changes to transportation network or demographic/land use forecasts from the baseline were made.

The share of jobs that can be done from home was determined by employment sector to apply trip reductions to TAZs by their level of employment in each sector. A University of Chicago study estimated the proportion of jobs that could be done remotely by North American Industry Classification System (NAICS) category, ranging from 4 percent in accommodation and food service to 83 percent in education (Dingel & Neiman 2020). Each NAICS category was mapped to an employment sector in SBTAM+. For sectors corresponding to multiple NAICS industries, a weighted average telecommuting percentage was calculated based on the existing employment in the county for that industry derived from the Census Bureau's Longitudinal Employer-Household Dynamics Origin-Destination Employment Statistics, as shown in Table 2-1 below (US Census Bureau 2023). Trip generation in SBTAM+ was modified to reduce home-based work trips for each sector by the respective work from home rate.

Table 1. Estimated Telecommute Share by Sector

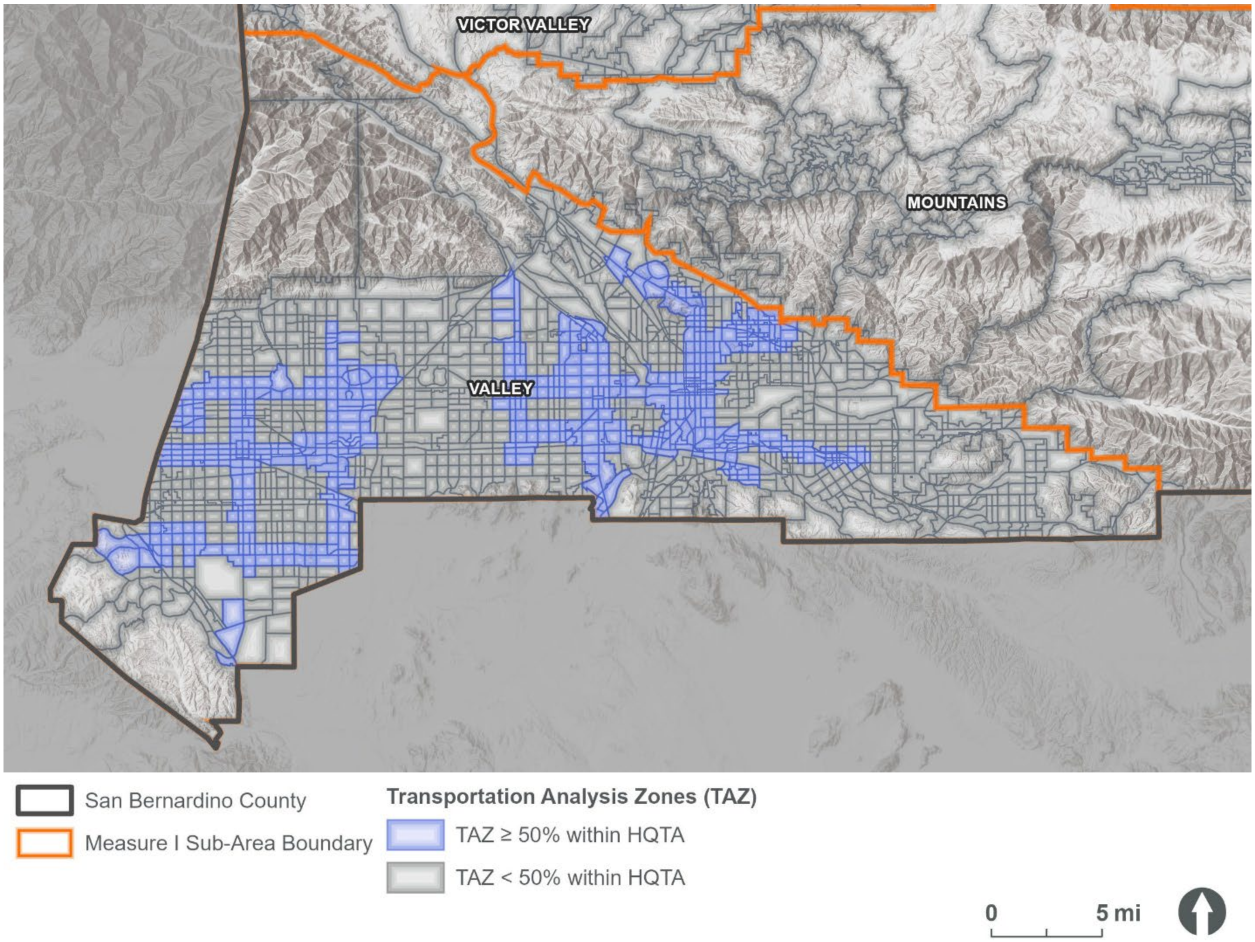
NAICS			SBTAM+	
Industry	**Estimated share that can WFH**	**Existing Employment**	**Employment Sector**	**Estimated WFH Share**
Agriculture, Forestry, Fishing and Hunting	8%	2,064	Agriculture and mining	28%
Mining, Quarrying, and Oil and Gas Extraction	25%	1,034		
Utilities	37%	4,816		
Construction	19%	42,731	Construction	19%
Manufacturing	22%	51,089	Manufacturing	22%
Wholesale Trade	52%	42,297	Wholesale trade	52%
Retail Trade	14%	83,605	Retail trade	14%
Transportation and Warehousing	19%	120,003	Transportation and warehousing	19%
Information	72%	4,132	Information	72%
Finance and Insurance	76%	16,474	Finance, insurance, and real estate	63%
Real Estate and Rental and Leasing	42%	9,776		
Professional, Scientific, and Technical Services	80%	24,540	Professional and business service	80%
Management of Companies and Enterprises	79%	5,967		
Educational Services	83%	59,982	Education and health service	44%
Health Care and Social Assistance	25%	128,035		
Arts, Entertainment, and Recreation	30%	9,066	Leisure and hospitality service	7%

Accommodation and Food Services	4%	59,420		
Other Services (excluding Public Administration)	31%	19,126	Other service	31%
Administration & Support, Waste Management and Remediation	31%	62,808		
Public Administration	41%	35,450	Public administration	41%

2.3 Smart Growth

This scenario represents a change in land use away from dispersed, low-density suburban and exurban development to an approach focused on compact communities oriented around transit corridors. No changes in the transportation network or total growth in households and employment are assumed compared to the baseline scenario. As shown in Figure 1, TAZs within the Valley subarea with more half of their area in a High-Quality Transit Area (HQTA), defined based on the 2020 SCAG RTP, were identified was “Transit TAZs” (SCAG 2021). HQTAs are areas within one half-mile of a well-serviced transit stop or a transit corridor with 15-minute or less service frequency during peak commute hours in the 2045 planned transportation network within the adopted 2020 RTP. Growth in employment and population was reallocated from non-Transit TAZs to Transit TAZs. Growth was only reallocated within the Valley, as it is the only subregion with HQTAs. Employment growth in the Valley was reallocated by sector individually.

Figure 1. Transit TAZs



Growth in each demographic and land use variable (households or employment by sector) between 2019 and the baseline 2050 forecast was calculated for each TAZ. For TAZs with negative forecasted growth for a demographic variable, the original forecast was maintained for that variable. For TAZs with positive growth that are not in an HQTA, growth was changed to zero, so the 2019 level was maintained. For TAZs with positive growth that are in an HQTA, growth was inflated proportionally such that the total growth across the Valley subarea remained as originally forecasted. No decreases in any variables were made relative to 2019 beyond those already included in the baseline forecast. In other words, existing land uses are not assumed to be displaced at a large scale; only new growth was reallocated to the Transit TAZs.

3 Sensitivity Tests

3.1 Transit Expansion

The Transit Expansion sensitivity test carried forward the reallocated growth assumptions developed for the Smart Growth scenario. For all bus routes in the SCAG region, service frequency is doubled relative to what is included in the Baseline transportation network. No other changes were made to the Baseline network. For Omnitrans alone, the operating costs for Fiscal Year 2023-2024 are estimated at $100 million. Doubling the frequency would likely be less than an additional $100 million, but there is no state, federal, or local source of funding that could fill a gap of that magnitude. The Baseline network includes rail frequency improvements enabled by Metrolink's capital program, and no additional improvements are assumed.

3.2 Road Pricing

The Pricing sensitivity test uses the default demographic and land use forecasts from SBTAM+ and assumes the Enhanced transportation network. Consistent with the SCAG regional model, SBTAM+ uses a baseline auto operating cost of 26.78 cents per mile in 2011 dollars, which includes fuel costs and other costs such as tires, repair, insurance, and other maintenance activities. To test the effect of a potential road pricing scheme and establish a relationship between price changes and changes in other variables, auto operating costs were doubled in the model. This extreme increase is not a proposed strategy, but a data point used to extrapolate an elasticity of demand (the degree to which variables such as VMT decrease as operating costs increase). The cost increase would apply to all vehicle trips across the SCAG region, including both passenger vehicles and trucks.

4 Modeling Results

Modeling results for each context scenario, the Enhanced Network scenario, and the Transit Expansion sensitivity test are shown in Table 2. The impact of road pricing on VMT is described below, but it is excluded from the results table because the test was conducted to estimate an elasticity for VMT, not specific forecasts for each performance measure. Relative to a return to pre-pandemic conditions, both the Virtual Future and Smart Growth scenarios result in modest reductions in VMT. The Virtual Future sees substantial decline in overall travel time, delay, and transit ridership as a result of removing commute trips that are especially likely to occur at congested times of day. The Smart Growth scenario results in a significant percentage increase in transit ridership within San Bernardino, but because baseline ridership is low, the impact on vehicle travel is muted.

The Enhanced transportation network achieves travel time savings and an increase in transit ridership relative to the Baseline network with return to normal conditions. However, VMT increases slightly as drivers are willing to take longer trips on less congested roads. The Transit Expansion sensitivity test increased transit ridership to the greatest degree and also showed large decreases in total travel time and VMT.

The road pricing sensitivity test showed an elasticity of -0.17, meaning that each 10 percent increase in operating costs would be expected to reduce VMT by 1.7 percent. In 2024 dollar terms, an increase equivalent to one dollar per gallon of gasoline would be expected to reduce VMT by 1.9 percent, assuming average fuel economy of 25 miles per gallon (Bureau of Labor Statistics 2024). Imposing such a cost increase would represent more than doubling the current state and federal gas taxes.

Table 2. Modeling Results by Scenario (2050 – please note important caveats on this anslysis in Sections 2 and 3)

All Performance Measures	2050 Baseline	Virtual Future		Smart Growth		Enhanced Network		Smart Growth + Transit Expansion	
	Value	Value	%Δ*	Value	%Δ*	Value	%Δ*	Value	%Δ*
Total VMT	90,759,248	87,251,407	-4%	89,096,205	-2%	91,172,483	0%	81,520,239	-10%
Truck VMT	12,805,961	12,759,831	0%	12,742,465	0%	12,914,432	1%	12,589,982	-2%
Total VHT	2,130,922	1,992,203	-7%	2,089,892	-2%	2,008,779	-6%	1,826,424	-14%
Truck VHT	242,181	234,534	-3%	239,982	-1%	232,517	-4%	229,884	-5%
Passenger VMT per Capita	29.8	28.5	-4%	29.4	-1%	29.9	0%	26.5	-11%
PHT, work trips	888,256	621,599	-30%	867,617	-2%	842,286	-5%	784,639	-12%
PHT, non-work trips	1,511,292	1,626,937	8%	1,470,405	-3%	1,424,281	-6%	1,343,048	-11%
Total delay	244,074	174,774	-28%	240,029	-2%	133,520	-45%	154,634	-37%
Delay per capita (minutes)	5.6	4.0	-28%	5.5	-1%	3.1	-45%	3.6	-36%
Drive alone mode share, work trips	80.2%	80.3%	0%	79.1%	-1%	79.2%	-1%	69.5%	-11%
Drive alone mode share, non-work trips	39.6%	39.9%	0%	39.4%	0%	39.0%	-1%	35.9%	-4%
Transit ridership	137,385	93,625	-32%	166,003	21%	195,955	43%	499,977	264%
Truck delay	22,831	16,177	-29%	21,948	-4%	12,160	-47%	15,056	-34%
Share of population within half mile of transit stop	71.4%	71.4%	0%	73.5%	2%	72.7%	1%	73.5%	2%
Share of population in disadvantaged communities within half mile of transit stop	88.1%	88.1%	0%	89.0%	1%	88.9%	1%	89.0%	1%
Share of employment within half mile of transit stop	74.5%	74.5%	0%	79.8%	5%	76.2%	2%	79.8%	5%
Share of population within HQTAs	30.3%	30.3%	0%	37.6%	7%	30.3%	0%	37.6%	7%
Share of population in disadvantaged communities within HQTAs	48.0%	48.0%	0%	55.6%	8%	48.0%	0%	55.6%	8%
Share of employment within HQTAs	42.5%	42.5%	0%	56.9%	14%	42.5%	0%	56.9%	14%
GHG emissions	35,482	34,111	-4%	34,832	-2%	35,644	0%	31,870	-10%

Notes:

VMT = vehicle miles traveled, VHT = vehicle hours traveled, PHT = person hours traveled, HQTA = high quality transit area, GHG = greenhouse gas

* Compared with 2050 Baseline

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5 Key Findings

The modeling results provide insight into how changes in the transportation network or background demand conditions impact system performance (vehicle miles, vehicle hours, delay, transit ridership, etc.) under a range of hypothetical scenarios. Key findings include:

- While changes in demand contexts (virtual future, smart growth) can affect certain measures, overall impacts on vehicle travel are minimal. Even if all employees that could telecommute did telecommute, the reduction in VMT is only 4%. This is largely because commute trips comprise only about 20 percent of all trips, which might represent only about 25% of the auto-related VMT. Smart growth had a surprisingly limited impact on VMT, even though 100 percent of the new growth (from 2019 to 2050) was placed into High Quality Transit Areas. Part of the reason for this is that the growth represents a relatively small proportion of all development (existing and future), and only a small portion of those new trips will take transit. It demonstrates how difficult it is to “move the VMT needle” regionally with growth redistribution strategies. This is not to say that transit-oriented development shouldn’t be encouraged. But even with major initiatives on TOD, the regional impact will be limited.
- The additional projects in the Enhanced Network provide benefits in reducing delay and increasing transit ridership but fail to reduce VMT.
- With the Baseline Network, congestion hotspots exist in all background contexts along SR-210 in the West Valley and in the vicinity of Rancho Cucamonga and Ontario International Airport.
- Sensitivity testing shows that substantial changes in transportation costs (via pricing) or the transportation network (doubling bus frequency) have commensurate impacts on travel behavior and effect meaningful change on key indicators. However, these scenarios were intended as hypothetical tests of sensitivity to better understand what would need to occur for significant changes in travel behavior to be realized and would generally be deemed as not feasible or fundable at this time. It should be noted that the Transit Expansion scenario, when bundled with the Enhanced Network and Smart Growth did have an estimated 10 percent reduction in VMT but represents assumptions that are unlikely to be realized in the real world. Similarly, increasing the cost of driving can be expected to reduce VMT, but large changes in VMT would require burdensome increases in costs to the traveling public.
- One of the significant observations from this analysis is how challenging it is to reduce VMT. For example, the historic drop in light-duty vehicle travel caused by the COVID-19 pandemic and nationwide lockdowns during the spring and summer of 2020 represented a VMT reduction of just over 12% nationally, which is four times greater than the previous largest drop in VMT experienced during the Great Recession of 2008 (FHWA 2023).
- Numerous prior national and statewide studies have indicated the potential role pricing could play in reducing auto trips and travel. But to significantly move the needle, the increases in costs by auto would likely need to be higher than the traveling public is able or willing to endure. All of the strategies tested in the modeling scenarios have some degree of merit. Telecommuting will play its role, as will smart growth, transit service improvements, and pricing. But the expectations of change in travel behavior need to be realistic if we are to shape

a transportation and emissions reduction strategy that maintains mobility while reducing the impacts that transportation can have on communities and climate change.

- Achieving the benefits of any of the scenarios tested requires action by numerous agencies and private actors responsible for different elements of each scenario. Table 3 below summarizes the parties responsible for each major component of each modeling scenario. While SBCTA plays a role in planning, funding, and in some cases implementing projects, it does not control all investment and ultimately cannot fully control behavior of traveling public.

Table 3. Parties Responsible for Components of Each Scenario

Scenario Component	Responsible Entity(s)	Modeling Scenario					
		2050 Baseline	Virtual Future	Smart Growth	Enhanced Baseline	Transit Expansion	Road Pricing
Implementation of baseline projects	Various (SBCTA, cities, transit agencies, Caltrans, etc.)	✓	✓	✓	✓	✓	✓
Implementation of enhanced network projects	Various (SBCTA, cities, transit agencies, Caltrans, etc.)				✓		✓
Increase telework	Employers and employees, primarily of private businesses		✓				
Concentrate future growth along transit corridors	Local jurisdictions and real estate developers			✓		✓	
Implement road user charge	Caltrans or SCAG						✓
Double bus frequency	Transit agencies (Omnitrans, VVTA, Basin Transit, Mountain Transit, Needles Area Transit)					✓	

6 References

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