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Ojuri, Oluseyi

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**Assessing the Impact of California Senate Bill 743
on Transportation Planning, Traffic Impact Analysis, and Level-of-Service**

THESIS

Submitted in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

in Civil Engineering

By

Oluseyi Ojuri

Thesis Committee:
Professor Michael G. McNally, Chair
Assistant Professor John D. Houston
Professor R. Jayakrishnan

2015

DEDICATION

To my mother; for laying the foundation of my continued triumph.

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ABSTRACT OF THE THESIS

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By

Oluseyi Ojuri

Master of Science in Civil Engineering

University of California, Irvine, 2015

Professor Michael G. McNally, Chair

Since the implementation of CEQA in 1970, traffic impact analyses have been a key component in California's land development. A current paradigm shift towards building and living sustainably has caused policy makers, engineers and planners to reexamine the policies that have been instituted. It has also influenced exploration of solutions that can change future developments. We must first analyze the established system of traffic impact analysis to determine the viability and potential benefits of measuring transportation network efficiency through factors highlighted in Senate Bill (SB) 743. These factors include vehicle miles travelled (VMT), fuel use or automobile trips generated. For the purpose of this paper, the focus will be on the VMT. When VMT analysis is applied on a project level, a list of key questions arise that are related to SB 743's goals of reducing greenhouse gases, increasing multimodal transportation and developing appropriate metrics to conduct transportation analysis. A review of Senate Bill 743 text along with the Governor's Office of Planning and Research report on the Bill paints a picture of what California's future development will look like. Furthermore, an examination of travel trends

and literature about current transportation analysis helps to evaluate the potential success of Senate Bill 743. In summary, Senate Bill 743 symbolizes a huge step towards carbon emission reduction and an excellent opportunity to start a conversation about making land development more sustainable in California. However, the bill leaves out the essential components of existing traffic impact analyses and employs a measure of environmental impact that does not reflect accessibility or multi-modal transportation.

Chapter 1 Introduction

Whenever a new building, neighborhood or city is going to be built, it needs to go through a few key stages of planning in order for the development to be successful. One of the first elements to be considered is transportation. Transportation planners and engineers ask themselves who will be using the development and how they will get there. They use analytical tools, data, and professional judgment to determine the best way for all modes of transportation to access the site. In California, the main tool used to assess the accessibility of a site has been the traffic impact analysis (TIA). TIA uses a “level of service” (LOS) rating system for the roadways surrounding a development. A roadway is considered to have a “good” level of service when automobile delay on that road is low.

The level of service based TIA is very good at ensuring the greatest amount of accessibility for drivers to their desired destinations. It is also a proven method of analysis that is relatively consistent and applicable in a wide variety of transportation situations. Vehicle delay can easily be measured by counting the number of vehicles that pass through an intersection or road segment within a set period of time. Despite all of the advantages of level of service based TIA, the process is limited in its scope because it mainly measures automobile delay. Level of service becomes obsolete in situations where moving the maximum number of vehicles through an intersection is not a priority. Recent changes in California energy policies have caused major shifts in the transportation sector towards greater vehicle efficiency and carbon emissions reductions. Under these policies maintaining vehicle speeds and increasing automobile capacity is no longer the primary concern for new developments.

Since 2000, there have been a number of forward thinking initiatives addressing health issues and climate change. New energy policies include the California Global Warming Solutions Act of 2006, also known as AB 32, which has set a goal for California to reduce its GHG emissions to 1990 levels by 2020 — a reduction of approximately 15 percent below emissions expected under a “business as usual” scenario (Assembly Bill 32 Overview, 2006). In another example, On January 5th of 2015, Governor Jerry Brown announced an ambitious goal of reducing today’s petroleum use in cars and trucks by up to 50 percent by 2050 in order to lower carbon emissions (“California Governor Announces New Goals,” 2015). On the national scale, in 2012 the Obama administration ordered an improvement of the fuel efficiency of cars and light trucks to 35.5 miles per gallon (mpg) by 2016 and 54.5 mpg by model year 2025 (“Obama Administration Finalizes Historic 54.5 MPG,” 2012). In order to achieve these goals, California policy makers have sought ways to reduce carbon fuel-powered automobile use. Senate Bill 743 was introduced as a way to address emissions by reducing the dominance of the automobile in California’s transportation planning and development.

This paper will analyze the degree to which SB 743 addresses the goal of greenhouse gas (GHG) emission reduction in California. It will look at the history of transportation in California as well as recent trends and statistics in order to explore possible changes in today’s transportation planning and the extent to which VMT reduction can play a role.

Chapter 2 Background

Every day transportation planning has a direct impact on the quality of life for all urban residents in California. It influences important factors such as personal and community health, living costs, and how we spend a significant portion of our time. Good transportation planning can determine the overall health of a community by creating an environment that is safe and where people have easy access to each other and local services through multi-modal transportation. Living costs and downtime are also very dependent on available transportation modes and the efficiency of transportation that a commuter chooses to take. Today, many cities look towards roadway expansion and other enhancements that primarily serve automobile drivers when addressing increased traffic demand brought by new development. These transportation strategies can be problematic because they ignore important health, social and economic factors that impact local communities. On a larger scale, recent issues such as climate change and budget deficits can influence the practicality of sprawled land use and automobile-centric transportation systems. If air pollution is to be meaningfully combated, there's a need for a change in the way we design our cities. Because vehicle emissions are a major component of air pollution, the solution begins with our transportation systems.

Although automobile-centric transportation planning has resulted from the desires and needs of California communities, there are many health problems associated with its use. According to NYU sociologist Thomas Laidley, "for every 10 percent increase in sprawl, there is approximately a 5.7 percent increase in per capita carbon emissions [and] a 9.6 percent increase in per capita hazardous pollution" (Laidley, 2015). Pollution from vehicles can trigger respiratory diseases such as asthma that mainly affect children, the elderly and

other vulnerable populations. An array of social justice issues also come into play when multi-modal transportation planning is ignored. Interaction between citizens is reduced when a large portion of time is spent commuting in personal vehicles which can affect community cohesion. The wide roads and highways that support ubiquitous automobile use sometimes separate populations from each other. These divisions can isolate groups who may not have the economic ability to utilize a personal automobile.

The issue of time spent in traffic is not unique to California; however some regions suffer more on average than the rest of the nation. The average travel time for the Orange County and LA areas has remained at approximately 30 minutes for the past five years (Southern California Associated Governments Regional Profiles, 2015; 2000 U.S. Decennial Census & 2010 U.S. Census American Community Survey). The average commute time for all major metro areas in the nation is 26 minutes. Southern California cities have much higher commute time on average when compared to other metro regions. On the local level, the overall demand for alternative modes of transportation in California communities has grown due to factors such as persistent long travel times and high fuel prices. High home prices near urban business center have caused many to people to move to more affordable outlying suburbs, resulting in long commutes for workers and increased traffic. “For every 10 percent increase in sprawl...there is a 4.1 percent decrease in the owner housing affordability index and 2.9 percent reduction in the renter index” (Laidley, 2015). This trend adds to the existing traffic problems. Factors such as high fuel prices have created growing unpredictability of future transportation costs and have influenced political changes in California transportation planning. In addition to addressing the harmful

environmental effects of vehicle emissions, innovative policies can help reflect a new California driving trend which shows a major shift in how people use their automobiles.

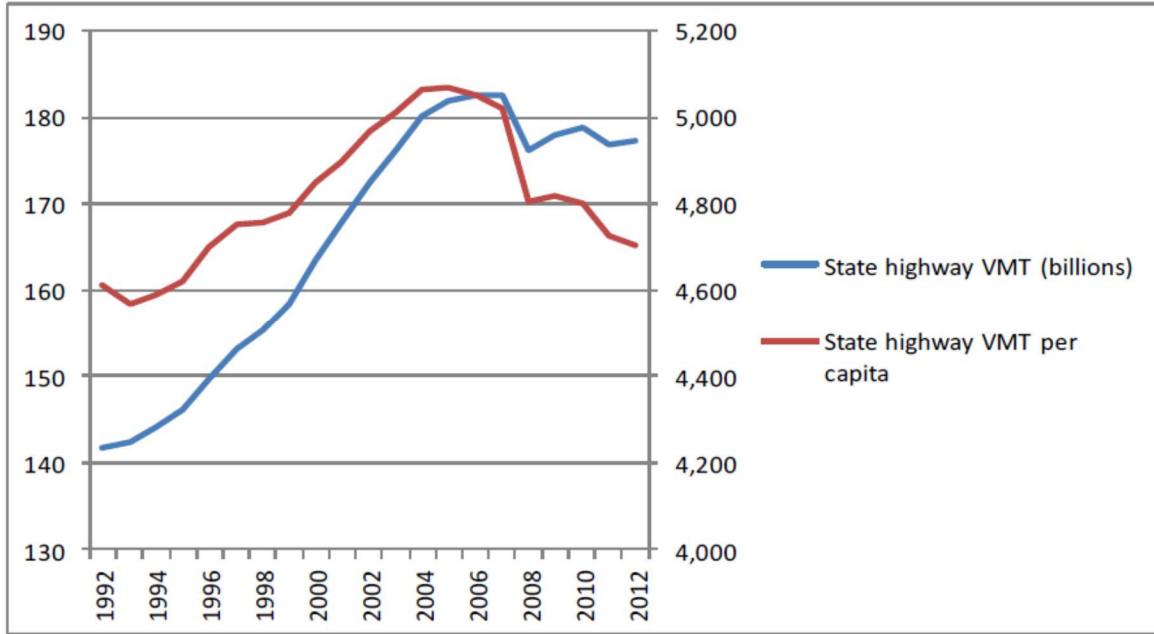


Figure 1. VMT and per Capita VMT of California State Highways, 1992-2012.
Source: Caltrans State Smart Growth Initiative (VMT) and Department of Finance (Population)

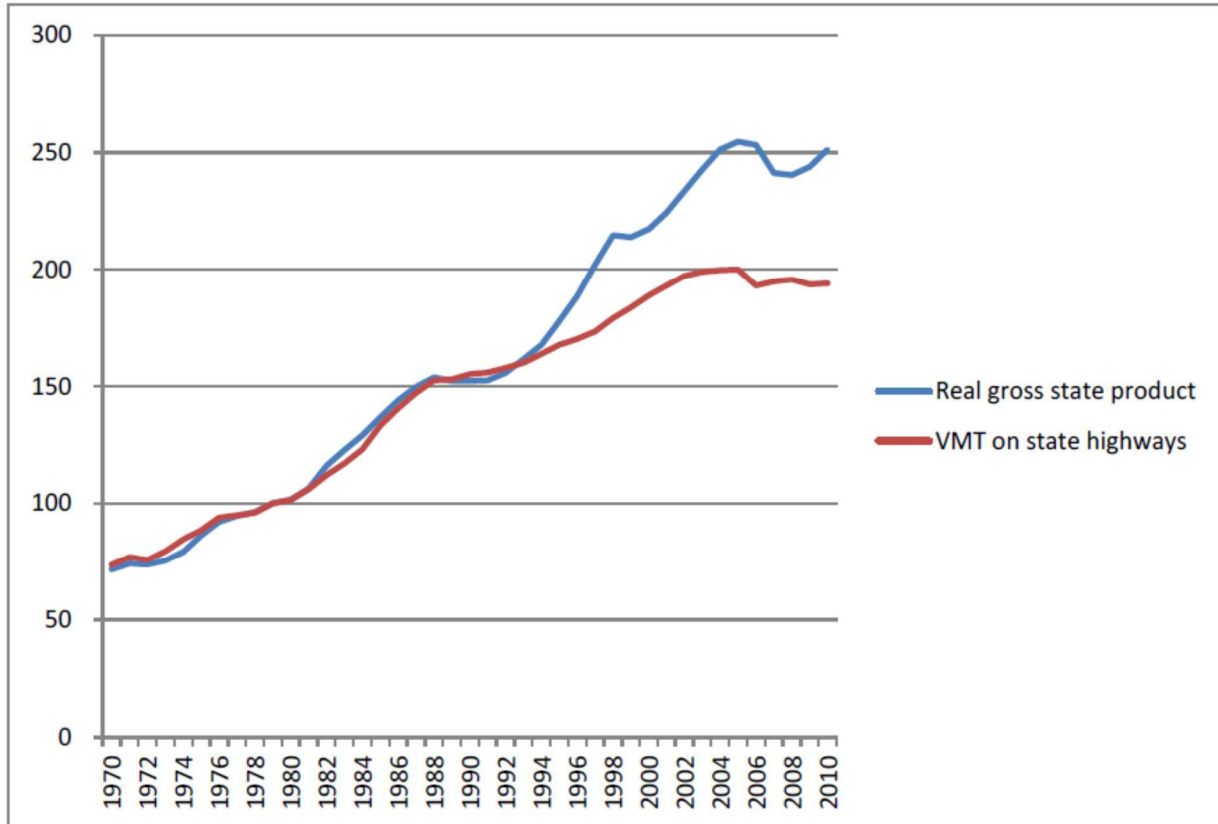


Figure 2. Real (Inflation Adjusted) California Gross State Product (GSP) and VMT on State Highways, 1970-2012. Source: Caltrans State Smart Growth Initiative (VMT) and Department of Finance (Population)

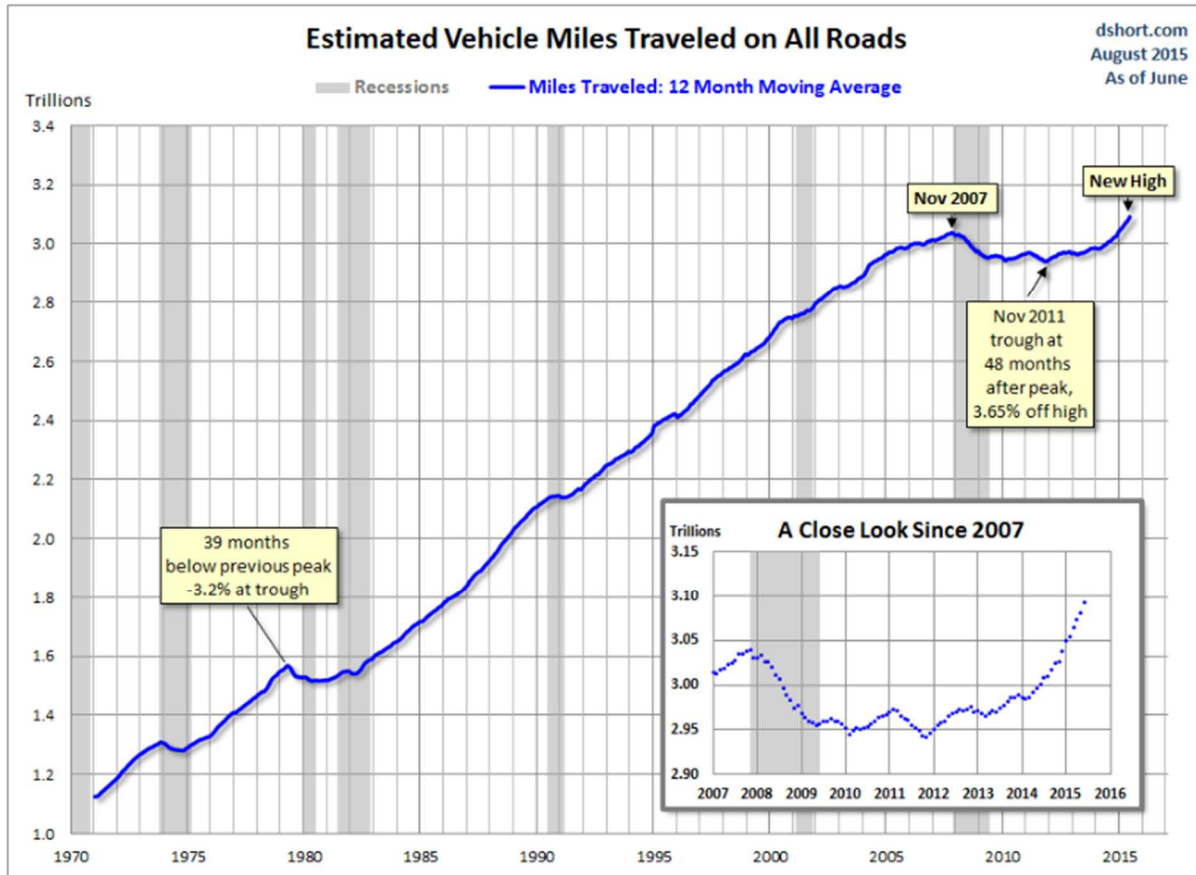


Figure 3. National VMT Trend. Source: McNally, 2015

The inflexion point in 2007 represents the start of a depressed economy and high fuel prices. However, studies conducted by CALTRANS show that VMT trends more closely represent a movement of Californians driving less and taking shorter trips. This trend is further supported by figure 2 showing that real gross state product has greatly outpaced VMT on state highways.

The history of transportation analysis in California has shown a focus on the mobility of people through vehicular modes of transport such as the personal automobile. Until recently, new projects being developed were historically seen as needing to be serviced by the construction of additional roadways in order to ensure the mobility of

drivers to their destinations. California's Department of Transportation (CALTRANS) played a large role in the expansion of the state's roadway system but has since changed from an agency that was tasked with the building out of California's highway systems to an organization that deals with maintenance. Initially, low transportation costs, lack of congestion and new freeways meant that most growing communities built large new roads to serve outlying residential or commercial developments.

California's history with the automobile and pollution problems makes changing the way we develop and plan our cities even more vital. According to the California Air Resources Board, today, "Californians drive approximately 332 billion vehicle miles each year. That driving accounts for 36 percent of all greenhouse gases in the state" (First Update to the Climate Change Scoping Plan, 2014). In addition to high vehicle emission numbers, our existing expansive roadway networks are in a state of disrepair. There is an environmental incentive to reduce the amount of greenhouse gases being released into the air; however there is also an equally important economic growth factor that must be addressed. Under the current local roadway development model, most improvements are funded by new developments. Once these improvements or road additions are made, neither state, local, or federal agencies are able to fully fund operations and maintenance (California Statewide Local Streets and Roads Needs Assessment, 2013). More sustainable and healthy mode choices such as walking, using public transit and biking have only seen sparse investments. In fact, projects designed to improve conditions for pedestrians, bicyclist and transit have been discouraged because of their assumed negative impacts on congestion. CEQA traffic impact studies have only looked at the change in traffic flow, causing most projects to include the construction of larger roads to maintain traffic speeds.

This has put a large financial burden on developers and taxpayers that must pay to maintain roadway additions. In summary, California's transportation policies have caused the state to build roads that it cannot afford to maintain. The recent economic downturn has caused a loss of tax revenues and government cutbacks. Most jurisdictions have reduced investments in capital projects and delayed infrastructure maintenance. Postponing rehabilitation projects is not a sound long term solution because if left to go into disrepair, agencies would have to spend up to ten times more to fix deteriorating roads than if they were well maintained. Many cities continue to build new roads for each new project without seeking alternative transportation improvements, a common policy that continues to exacerbate emission and multi-modal accessibility problems.

2.1 Planning Paradigms

Evaluating the potential success of Senate Bill 743 requires understanding the current paradigm surrounding transportation planning. Senate bill 743 identifies VMT as a possible alternative to LOS when conducting TIA's. The key difference in the two approaches is how a transportation system's performance is measured. This has a significant impact on transportation planning because they determine how efficiency or significant impact is calculated. In a TIA new traffic characteristics caused by a development determines the likelihood of certain negative environmental outcome to occur. Which characteristics a planner chooses to measure or statistical test apply when analyzing data can greatly influence a study's outcome. "Often, there is no single method or unit that conveys all the information needed for evaluation... different measurement units represent different perspectives and assumptions" (Litman, 2011). A planner needs to

consider several different statistics or input factors when evaluating how a transportation study fits into an existing urban context. It is important that decision-makers understand the “different perspectives and assumptions implicit in the measurement units they use.” There are two main categories of measurements used for evaluation. The first types of measurements are traffic based and have been the most widely used for conducting traffic impact analyses (Measuring What Matters: Access to Destinations, 2010). Traffic based measurements include level of service, traffic speed and vehicle trips. Under the current paradigm of transportation planning, the definition of traffic is limited to the flow of automobiles on a roadway network and “travel” is defined as vehicle trips. This perspective creates a system where motorists and their passengers are the primary users of roads. Non-motorist and those who do not own an automobile are considered very small minority groups that do not have a significant impact on transportation or traffic. This perspective of transportation planning also tends to categorize alternatives such as transit and cycling as recreational or optional activities, modes of transportation that are not viable for people to use every day.

The second types of measurement used for TIA’s are distance or fuel based. VMT is a good example of alternate method of assessing travel and is sometimes used to calculate energy consumption. VMT traffic analysis comprises of three overarching elements. First is the frequency of long distance travel in relation to the existence dense land uses where accessibility is high and congestion is low. In order to reduce VMT, there is a need for greater access to amenities in local communities. This means the integration of land-use and transportation planning for new development and creation of additional access for existing areas. The second element is the presence of modal choices for commuters.

Different modes of travel are assessed for their contribution to overall VMT differently. Using VMT as a measure for roadway performance means that developments occurring in urban areas with multiple modes of transportation will have less VMT impact than fringe developments where vehicles are the only realistic mode of transport. Instead of the expansion of vehicle lanes to incorporate added traffic volume for new developments, investment in alternative transportation methods will be favored. For VMT analysis roadway improvement projects such as the addition of designated bus lanes, crosswalks, pedestrian pathways/bridges, and bike lanes could help mitigate an increase in traffic flow.

Transportation in combination with land-use planning involves the expansion of primary roads, rail and metro networks, to allow for growth within cities in a sustainable manner, while delivering adequate land for residential, commercial, recreational and government uses. It also ensures a high standard of living and healthy social infrastructure. Today's planning systems emerged as a response to many of the problems facing American cities at the turn of the 20th century: inner city slums, inadequate infrastructure, poor sanitation, and pollution. The challenges we face today are different, but a similar rethinking of how we organize our cities will be needed to make the goals of SB 743 a reality. It will require stakeholders such as citizens, developers and politicians to embrace new types of developments such as mixed land use and transportation planning tools that fit the changing transportation landscape in California. Planners must work directly with landowners and developers to see how transportation assessment and mitigation can take place for new developments. The goal is for integration of new land into the existing urban fabric in way that reduces greenhouse gas emissions, increases mobility and community connectivity and is economically sustainable.

2.2 Case Studies

There are a few case studies of cities that have embraced infill development and experienced greater accessibility for its residents. A good illustration is the city of Denver, which saw a large flux of infill projects between 1982 and 2007. When looking at the effects of denser developments on local transportation, it was found that even though there was more delay (2.5-3 times more) due to the increased traffic, there was more access to key destinations, therefore shortening trips and reducing overall travel time. Because more essential destinations were created in close proximity to each other and to residents, travelers were able to spend less time on the road. If California seeks to increase infill developments in order to decrease emissions and increase multimodal accessibility, smart growth projects that can help achieve this goal cannot be analyzed under the current system of delay metrics. If we are to accomplish a more efficient transportation system, a new method of assessing how we travel must be adopted.

Long range studies from over 40 U.S and European regions found that significant reductions in VMT, emissions and fuel use were possible when using specific transportation policies in combination with multimodal investment projects. The results found that overall, 10 to 20 percent reductions in VMT compared to future trend scenarios were achievable. This is while supporting the same level of job and housing growth. Number for emissions and fuel use showed similar reduction figures as VMT. In most cases, the highway LOS was the same or better than the future trend scenario despite the limitation of roadway expansion. The most successful scenarios had policies that integrated smart growth and compact land-use strategies, ample transit services, and did not expand

highway systems. Auto pricing policies such as fuel taxes, work trip parking charges, or all-day tolls increased the effectiveness of the policies (Johnston, 2008).

Five U.S. study scenarios that utilized land-use, transit and other policies to reduce vehicle travel resulted in 10% or more reductions in VMT. The scenario regions belonged to the National Association of Regional Councils. The study areas did not employ the pricing of fuel or roadways. The land use policies typically utilized density increases or TODs. SCAG was one of the regions that experienced a significant decline in VMT, with a 10 percent reduction in 25 years. Their primary land-use strategy was the housing and jobs focus around existing centers and transit corridors. Contra Costa was another California region that experienced a significant decline in VMT numbers. The region's scenario saw a 17.3 percent reduction in VMT over 20 years by placing growth in existing urbanized areas and along rail transit routes. For both cases travel models and GIS evaluation tools were used to calculate VMT (Bartholomew, 2005).

Chapter 3 Agencies, Jurisdictions and Government Requirements

Currently, traffic impact analyses conducted for new developments are performed at one of two levels. Smaller projects, such as the construction of a two-story office building in an existing urban area, only require a local traffic impact analysis to be conducted. This can be performed by the city where the development is being constructed. In some cases a traffic analysis may also need to be approved by the county if the project is larger or is located near a major arterial. For cities, the main concern has been maintaining a good level of service for existing intersections surrounding the development. Additional traffic during peak hours is often a concern of local residents. In cases where LOS is determined to be poor, transportation planning measures are taken to maintain traffic flow and speed while minimizing delay. Mitigation measures may include traffic signal timing enhancements, roadway additions or traffic flow reconfiguration.

The second level at which a TIA is conducted is through the county or regional transportation agency. Usually these projects are large enough to warrant a CEQA analysis. A TIA done through CEQA is primarily concerned with a project's environmental impact and often requires the outlining of mitigation measures to help reduce pollutants and carbon emissions. In practice, TIA's at the regional level also utilize LOS to determine traffic volume and flow that is then extrapolated to predict emissions. The methodology of TIA's correlates a low LOS grade with stationary or delay vehicles that tend to release more carbon emissions than free flowing vehicles.

A reworking of California's state transportation agency has created a new transportation development system in which more projects are funded and controlled at the local level. Local municipalities now have more power to implement their own

transportation plans, allowing for projects that better suit the needs and makeup of their specific regions. State and national departments such as Caltrans have been slow to adapt to the changing transportation structure and have often been a barrier to smart growth initiatives in California. The passage of state planning goals in AB 857 (2002), transportation greenhouse gas reduction strategies SB 375 (2008), and SB 743 today have sought to fill in the gaps for state agencies and move California towards a more sustainable transportation system (State Smart Growth Initiative, 2014).

3.1 Senate Bill 743

Senate Bill 743 was introduced by Governor Brown in September of 2013 to address today's issues that were seen as being ignored by our current transportation impact analysis methods. Its authors sought to impact how we live and work, with the goal of protecting natural resources and enhancing the quality of life for California residents. In theory, this would be accomplished by encouraging more infill developments, which directs growth into existing cities and suburbs. According to SB 743, this goal has been impeded by a number of factors including the use of LOS in transportation analysis. The elimination of LOS for traffic impact analyses related to CEQA is the first step outlined by the bill. Historically we have grown cities out rather than up because of the mitigation measures associated LOS. A possible solution highlighted in SB 743 is the measurement and reduction of VMT to help reduce the negative effects of development and personal automobiles on the environment. SB 743 is an extension of SB 375, which originally addressed the transportation planning problems in California cities. SB 375 or the Sustainable Communities and Climate Protection sought to correct to way we conduct land

use planning by utilizing transportation planning as pre-development tool rather than as an after-thought. The 2008 bill supports the State's climate action goals to reduce greenhouse gas (GHG) emissions through coordinated transportation and land use planning with the goal of more sustainable communities (Sustainable Communities, 2015).

The language used in SB 743 states that there is an important link between creating sustainable communities and the enabling of infill development. The definition of “infill” is the development of vacant or underutilized land in areas surrounded by existing development and where traffic already exists. These types of developments are favored under the new SB 743 because it loads little vehicle traffic onto roadway networks during the traffic modeling process. Infill projects produce shorter trips between origins and destinations that are more easily served by transit, bikes and pedestrians. Despite lower vehicle traffic, under the previous California Environmental Quality Act (CEQA) regulations, infill projects triggered environmental impacts because it pushed roadway level of service (LOS) over the threshold of significance (Senate Bill 743 Webinar Presentation, 2014).

SB 743 identifies outlying developments or sprawl as a major cause of unsustainable growth. During TIA modeling process, outlying developments tend to load 3 to 4 times more traffic on a network than infill developments. Despite this, it has a low impact on LOS because outlying projects are usually located in areas with little traffic to begin with. Outlying projects begin the process of filling up traffic to the LOS threshold. They occur in sparsely populated areas, allowing for traffic to be spread over other intersections with few LOS threshold issues. Projects under the current CEQA guidelines tend to promote sprawl because later developments that increase density and accessibility push LOS over the threshold. The result is often infill projects that are not economically viable because of the

incurred costs associated with LOS mitigation. Often times, the required roadway additions are not possible within the limited space of some project sites (*SB 743 Webinar Presentation, 2014*).

Because of the inadequacies and inconsistencies in TIA modeling, there has long been discussion about the effectiveness of CEQA guidelines. Some local governments, transportation agencies and other advocates called for the Governor's Office of Planning and Research (OPR) to modify CEQA's transportation analysis guidelines towards a more multi-modal impact evaluation. SB 743 has mandated OPR to research and examine standards that will achieve three main goals. The first goal is to reach a reduction in greenhouse gases by changing California's transportation and land-use planning structure. The second goal is to develop strategies that will create a more multimodal transportation system. Third is the reexamination of the metrics used to conduct transportation analysis under CEQA. The combination of these objectives will help reduce VMT numbers in California. (*Updating Transportation Impact Analysis in the CEQA Guidelines, 2014*).

OPR released its preliminary draft of SB 743 Guidelines on August 6, 2014. It will go through numerous public revisions based on public input. Once completed, the draft will be submitted to the natural resources agency, to go through a formal rule making process. This process also includes further public review that may entail multiple revisions. The completed package is then sent to the office of administrative law, where it will officially go into effect after it is accepted by the department. The current extent of enforcement for alternative methods of measuring transportation impacts only includes developments that are proximal to transit areas. Successive drafts may expand this mandate to include statewide application. Once SB 743 is finalized, OPR will add a new section 15064.3 to the

CEQA guideline which outlines the new measurements for transportation impacts (Updating Transportation impact Analysis in the CEQA Guidelines, 2014; California Legislature: Senate Bill 743, 2013). The bill recommends a number of criteria alternatives to level of service. This includes vehicle miles traveled, vehicle miles traveled per capita, automobile trip generation rates, or automobile trips generated. It also establishes criteria for the models used in order to maintain accuracy, reliability and consistency. Although the LOS and traffic congestion will no longer be considered an impact on the environment under CEQA, public agencies will still be required to analyze significant transportation impacts related to air quality, noise, and safety. These other impacts can still be measured using LOS.

If VMT is ultimately chosen as the standard metric by which traffic is analyzed, the main purpose of conducting a transportation analysis under CEQA will be to determine the distance that a project may cause travelers to drive. Senate Bill 743 summarizes the parameters that lead agencies will be expected to use when calculating VMT. It states that “an evaluation of the environmental effects of a proposed project need not be exhaustive, but the sufficiency of an EIR is to be reviewed in the light of what is reasonably feasible” (Updating Transportation impact Analysis in the CEQA Guidelines, 2014). A lead agency would not be expected to include every last mile, however the scope of travel should include demand outside of agency district boundaries. This element of SB 743 is important because the new CEQA guidelines seek to be more comprehensive in capturing and recognizing the connection between local and non-local transportation networks and their effect on each other. Today, some lead agencies do not take travel demand from adjacent jurisdictions into consideration, making the results of transportation analyses

unrepresentative or inaccurate. This fact has been a complaint of many transportation professionals and has largely been seen as a flaw in some types of LOS analysis.

In addition to the emphasis on representative models, SB 743 clarifies that there is also a need for professional judgment in estimating vehicles miles travelled. The models used to calculate VMT are only tools to help facilitate the protection of the environment and promotion of multi-modal transit. The professional discretion of transportation planners and engineers will play a big part in determining the application of data results for different urban landscapes. As with the current LOS analysis, all results must be explained and justified, independent of whether mitigation measures are needed.

As with the rethinking of delay as an environmental impact, SB 743 calls for a reevaluation of possible mitigation measures when a significant impact is found. Although a list of possible mitigation measures are provided in the document, OPR states that the lead agency for the project holds full discretion regarding which mitigation should be applied. It is expected that as VMT analysis becomes included in agencies' transportation analysis and is better understood, more innovations for mitigation measures will come from local sources. For the project by project application of SB 743, it is important to understand that CEQA, "does not limit any public agency's ability to condition a project pursuant to other laws" (Updating Transportation impact Analysis in the CEQA Guidelines, 2014). This means that although delay is no longer considered an impact under CEQA, public agencies that have existing laws requiring minimum levels of service in their municipal code or general plans are not required to change those conditions. This same principle applies to mitigation measures previously adopted by cities, counties and regional agencies or future regulations that agencies wish to impose. In practice, the regulations of SB 743 are meant to be

adaptable in congruence with political, environmental and cultural changes. If an agency wishes to change its codes, the removal of rules solely meant to address automobile delay will not be required to go through environmental review.

The application of SB 743 will be gradual due to the understanding that VMT analysis is new to most public agencies. The changes in CEQA review process will happen in a number of stages. The first stage includes new environmental review procedures for projects located within one-half mile of major transit stops and high quality corridors. These areas were partially chosen first because of their focus under SB 375 and the general familiarity of local agencies with VMT estimation tools. In addition, effective January 2014, some infill projects will no longer be required to analyze impacts related to parking. The second stage of the new CEQA guidelines addresses that they will only apply to new projects and not those that are already under environmental review. Thirdly, the bill application states that agencies outside the limits of transit areas are still able to amend their CEQA guidelines to include the new procedures. The final part of the SB 743 roll-out will have all rules apply statewide.

Chapter 4 Analysis

4.1 Scope

The scope of LOS and VMT analysis vary substantially due to the fact that LOS measures traffic demand at a specific intersection while VMT estimates the total distance that a driver travels in order to complete a trip. There are a few key components of LOS analysis that adds to its simplicity but also limits its scope. LOS is conducted on an individual intersection-by-intersection basis, mainly focusing on nearby intersections close to the subject project site. This allows for traffic data such as vehicle counts to be easily collected, analyzed and compared to other intersections. Despite this, the methodology is flawed because it does not consider the impact of surrounding developments or intersections outside the boundary of analysis. VMT analysis offers an alternate measure for determining a project's environmental impacts and transportation efficiency. There are a number of benefits with using VMT including modeling on a larger scale, which is already used to calculate greenhouse gas emission and energy use in CEQA. Overall, it has much better accuracy in determining emissions and is able to capture the full extent of regional vehicle travel rather than single intersection analysis. A major drawback of VMT analysis is the lack of readily available data used to calculate the metric. VMT analysis is also less focused than LOS and may not provide information that is relevant to a specific area.

4.2 Criteria

There are a number of criteria by which a project can be evaluated to warrant a TIA under CEQA. The methodology behind setting up criteria for analysis is to determine factors that will most likely cause significant impacts on the environment. There are many

circumstances in which a project will have a less than significant impact on its surrounding and will not warrant a TIA. Under the new regulations of SB 743 generally, projects that are located within one-mile of either an existing major transit stop or a stop along an existing high quality transit corridor will not be considered to have a significant impact on the environment. This is also the case for projects that see a net decrease in the vehicle miles travelled. Projects with land use plans that follow a sustainable community strategy or have a reduction in VMT equal or less than an existing sustainable community strategy will have a less than significant impact.

There are three major criteria measures by which a TIA may be warranted. The first measure by which a project is gauged is its potential to cause induced travel. Project may induce additional vehicle traffic due to factors such as roadway expansions, lane number increases and new activities occurring at the site. In this case a TIA must be conducted to compare before and after travel conditions. The addition of arterial highway lanes is a type of element that may cause significant impact on vehicle use and pollution. An exception to this trend are rural areas where the primary purpose of adding lanes is to improve safety and vehicle speeds are not significantly changed. Other exceptions for roadway additions include improvements that do not solely serve to increase vehicle flow but instead provide better safety or operations. Examples of improvements include rail grade separations, transit facilities and lanes, or rehabilitation and maintenance. Calculating induced travel is important in transportation planning because studies show that adding new lanes in areas that are already congested tend to lead to more people driving further distances, therefore increasing VMT. By adding new lanes and increasing speeds, people who would not have otherwise made a long trip and are now able to access distant locations in a shorter time.

New capacity makes driving a more attractive method of travel. On the other hand, increases in roadway capacity can also remove barriers to growth in undeveloped areas. It is important to carefully measure the effect of additional roadway capacity based on the existing urban conditions and goals of the local community. Transportation projects that lead to net decrease in VMT travelled generally have a less than significant impact on the environment.

Local safety is the second major criterion for determining a project's impact. Localized effects of projects can include the increased exposure of pedestrians and bicyclists to vehicles. Safety risks are especially magnified in roadway conflict areas such as intersections and driveways. Example projects that would reduce the safety for these travelers would be developments that involve the removal of pedestrian crosswalks, bicycle lanes or increase roadway crossing times and distances. Another safety factor that must be controlled for is speed differentials of adjacent travel lanes that are greater than 15 miles per hour. Higher vehicle speeds resulting from a project can endanger people using other modes of transport in addition to increasing the likelihood for more frequent and severe accidents. Local safety is also an element that is outlined in SB 743 in addition to VMT reduction. The balance between convenience to drivers and roadway layout that promotes multimodal transportation is an issue that must be addressed in every project. A project must clarify whether it can cause significant unsafe conditions for travelers of all modes. The safety of all transportation users are considered, analyzed and addressed on the local level.

The third criterion used to decide whether a TIA is warranted is a project projected energy use. One of the main goals of EIR's is to promote the wise and efficient use of

energy. In addition to generating air pollution, vehicle travel can consume substantial amounts of energy. Over 40 percent of California's energy consumption occurs in the transportation sector and passenger vehicles account for 74 percent of emissions from the transportation sector (Energy Aware Planning Guide, 2011). Energy conservation can be achieved by reaching three goals outlined by the amendments to appendix F in senate bill 743. The first is decreasing the overall per capita energy consumption. The second is decreasing the reliance on fossil fuels, such as: coal, natural gas, and oil. The third is increasing the reliance on renewable energy sources. In order to make sure that the new SB 743 has the desired impact on California cities, the document mandates that EIRs include an energy consumption analysis for all projects. CEQA already requires EIRs to include discussions about harmful emissions and wasteful energy use. In addition, lead agencies may include other environmental impact possibilities and potential conservation measures. Four different factors can be used to quantify a project's overall energy impact. The first is identifying energy consuming equipment and processes in operation during a project. The second involves the type of materials and design features for a project can be analyzed and changed after identifying which is the most energy intensive. The energy efficiency of a project can also be calculated by each mode's additional trips and the VMT caused by its completion. The third energy factor is the total energy requirements of the project by fuel type and end use. This section can potentially summarize the energy consumption inputs and outputs from equipment, workers, and facilities. These will be compared to the project's energy use upon completion. The end energy consumption calculated can also be compared to that of similar projects in the region. The identification of energy supply is a fourth factor that will incentivize the use of renewable energy for powering projects. It

takes into account the use of coal power plants and their negative effect on the environment while simultaneously creating a system that makes investment in renewable energy more economical. Theoretically, a project that sources its energy from renewable power will have an advantage over projects powered by dirty energy. Existing energy supplies and energy use patterns in the region will also be taken into consideration. For example, the effects of the project on peak and based periods demand for electricity will be calculated. In addition projects that utilized efficient modes of transportation during and post construction will factored into the reduction of energy use.

After all of the criteria used to define a projects impact is analyzed it must then be examined for the methodology behind the results. For example, a lead agency must ensure that a TIA is not limiting the scope of its analysis to its own political boundaries. Doing so could produce results that are not valid under the definition provided in SB 743. The calculation of VMT should be conducted and reviewed using professional judgment in order to reach a reasonable conclusion. The models used for analysis should be documented and justified in addition to any revisions to its outputs.

4.3 Trip Generation

In order to properly analyze how urban planners formulate strategies for development, it is important to identify how people travel and how it can change based on individual needs. These travel behaviors are used to calculate trip rates that can be used to model in TIA's. The different types of trips in urban areas are influenced by two general factors: the population that needs to be served, and how far a person has to travel. Short trips can be made efficiently through modes such as walking or biking, but only if the

destinations are in a compact area. Trips that are longer but along a major corridor are best served by public transit. Trips that are further away from major urban corridors can be made more efficiently using automobiles or taxis. Non-automobile transport should accommodate 20-40% of the population unable to drive due to factors such as age, disability and economic barriers. A well-rounded transportation system with many options to complete trips has many benefits including parking infrastructure savings, fuel savings, affordability, increased safety, and decreased pollution emissions (Litman, 2014). SB 743 states that infill developments promote efficient urban land-use and balanced transportation options. Under this assumption, the benefits of supporting infill development in California include: providing housing opportunities closer to jobs, encouraging community revitalization, reducing suburban sprawl, making better use of existing infrastructure, encouraging walking and the use of transit and reducing the need for automobile ownership. (Trip-Generation Rates for Urban Infill Land Uses in California, 2009).

Today's transportation planning is based on a transportation analysis system that is fundamentally biased towards the automobile. LOS and the travel time index (TTI) are limited in their scope because they only measure automobile congestion intensity which is the reduction in roadway traffic speeds during peak hours of the day. It does not take congestion exposure into consideration. This means that the distance that drivers travel during peak hours, as well as other travel options, is not accounted for. This fact is relevant because denser urban developments may have higher levels of congestion but also have relatively lower transportation costs and shorter travel distances for trips. The presence of alternate modes of transportation for travelers combined with greater accessibility to

services and destinations within a proximate location, allow for these benefits. In comparison, sprawled urban developments in many California cities usually have less congestion but very high per capita congestion costs. The costs of owning an automobile combined with longer traveling distances causes overall transportation costs to be higher than in compact urban developments (Cortright, 2010 & Litman, 2014).

The limited scope of parameters that have established current trip generation rates also makes calculating VMT accurately a difficult proposition. Fuel consumption and VMT are currently used to model transport, energy and emissions for varying projects. Both factors are calculated to determine how a project can be manipulated to impose the least amount of environmental costs. They are generally calculated by using the number of vehicle trips associated with the type of land use multiplied by the average commute distance for an area. The problem with these types of models is the lack planning experience and data for accurately measuring the effects of land-use and travel behavior on the figures (Access to Destinations, 2010). New smart growth transportation planning and analysis models have utilized elasticities to predict VMT. These elasticities are sensitive to a number of key factors that promote smart development; they include density, diversity, design and destinations. This tool is powerful because it can be used to measure changes in driving habits based on changes in one of the four factors (Assessment of Local Models and Tools for Analyzing Smart-Growth Strategies, 2007).

Professional transportation planners and engineers have historically used trip generation rates determined by the Institute of Transportation Engineers to complete traffic impact analyses. The biggest flaw with using trip generation rates to predict or measure travel is that existing data primarily reflects suburban developments. There has

been little data collected in dense urban areas that are proximate to transit areas. This means that results from traffic impact analyses in infill areas are not always representative or applicable to the project site location. In the cases where ITE trips are used to predict travel behavior for infill sites, automobile demand is the primary measure taken into consideration and it is often over estimated. The way travel demand is currently measured for development projects discourages the creation of infill projects. There are numerous costly mitigation measures associated with increased automobile traffic for a potential project site. The first step is for trip generation models to include the use of alternate modes of transportation such as walking, biking and transit. More research needs to be conducted in this field before it can be accurately used to plan and promote smart growth developments in California. (Trip-Generation Rates for Urban Infill Land Uses in California, 2009).

In OPR's draft of SB 743 guidelines, there is a provision of some direction of how to calculate VMT. Under SB 743, lead agencies will be responsible for calculating VMT associated with their respective projects and documenting their method of analysis. The simplest way to calculate VMT is to estimate it from trips generated or attracted by a project. The sources of these trips include populations such as visitors, residents, employees, students, and other travelers. Demographics and economic statistics categorized by each zone or type of land-use can be used to estimate vehicle trips per household area. This type of VMT analysis is called trip-based VMT. An agency can look at the expected travel behavior that will occur due a project's construction as well as its effect on other trip segments. To accurately determine whether a project will create shorter trips, a large study area must be used for the process. The standard four-step travel demand

model can be used to measure trip-based VMT as well as three other VMT calculation methods defined by OPR (Local Models and Tools for Assessing Smart Growth, 2007).

The second method of calculating VMT is by using a tour that is defined as a series of trips beginning and ending at a residence. This means that the total VMT calculated includes all the VMT from trips to and from a household, in addition to the stop at the project that was made by the traveler. The goal of calculating VMT this way is to represent the effect the project has on travel choices. For example, “A project, which is accessible by automobile, can influence a traveler to choose travel by vehicle for their days’ needs, and this choice necessitates automobile use along the rest of their tour, which can, in turn, influence destination choices” (Updating Transportation impact Analysis in the CEQA Guidelines, 2014). This model is activity-based and collective rather than factoring in individual trips. The model is sensitive to a number of characteristics that can influence the destinations a person wants to go. It then creates a ‘tour’ for the commuter that includes all of their desired destinations before returning home. Under the activity-based model, VMT is defined and calculated using individual households. Regional municipalities such as the San Francisco County Transportation Authority (SFCTA) have developed working activity-based models for VMT (Local Models and Tools for Assessing Smart Growth, 2007).

Another method for calculating VMT is through the utilization of existing calculations from the development already on the subject site. Trip and tour-based models can be used to map travel-demand behavior for the existing area, which can then be extrapolated to determine VMT for the new project. This is possible because the travel behavior for a new project tends to resemble travel patterns that exist pre-construction. The final method is area-wide VMT analysis, which calculates the total VMT for an area

before and after a project is completed. It is a holistic calculation of VMT numbers rather than a per-capita calculation of VMT changes for a development site. It can be used to create a big picture of the travel behavior within a region.

4.4 Level of Significance

The first sentence in the SB 743 subdivision (b)(1) containing guidelines for VMT and land use projects, states “vehicle miles traveled is generally the most appropriate measure of transportation impacts.” When considering the application of SB743, it is important to keep in mind that CEQA guidelines are intended for large array of agencies and projects, making VMT analysis only appropriate in certain situations. When appropriate, alternate measures can be used for environmental analysis. SB 743 did not specifically clarify thresholds of significance when measuring VMT. A lead agency may have to determine what significance level is appropriate based on the type and location of the project in relation to rural, urban, transit-oriented or suburban developments. Some potential options for determining significant impacts have been outlined by the bill but OPR is yet to set specific standards.

One example for determining the standard for measuring a level of significant impact is to compare the VMT for a project against the regional average. A VMT number greater than the regional average, would be considered significant. The average could be calculated as a unit of per capita or per employee, representing the overall efficiency of the transportation network surrounding the project. Data for regional averages can be sourced from existing travel demand models. A regional area can be defined as a metropolitan organization’s limits or a transportation plan area within which a project is located. In the

case where a local community wants to enforce a stricter threshold, significant impact is not limited to being greater than the regional average.

Using regional average for VMT is a good metric to compare against to determine significant impact because it “generally represents the area within which most people travel for their daily needs” (Updating Transportation impact Analysis in the CEQA Guidelines, 2014). It also allows for a dynamic representation of the broad array of transportation and land-use structures in California. The traffic demand models and data that currently exist are regionally based, making regional averages the practical, efficient and economic choice for analysis. Subdivision (b)(1) of SB 743 also gives examples of project types that would have less than significant impact on the environment. This includes projects located in areas adequately served by transit. If VMT in these areas are generally considered to be low because of high transit use by travelers, transportation improvements may not be needed. Projects that have a less than significant impact on the environment include developments that decrease overall VMT such as “the addition of a grocery store to an existing neighborhood that enables existing residents to drive shorter distances (Updating Transportation impact Analysis in the CEQA Guidelines, 2014).” Some exceptions to these types of developments include a health center that may allow local residents to have a medical location that is accessible by walking but still attracts significant vehicle traffic from neighboring cities. Another example is “a project located near transit but that also includes a significant amount of parking [which] might indicate that the project may still generate significant vehicle travel” (Updating Transportation Impact Analysis in the CEQA Guidelines, 2014).

4.5 Mitigation

SB 743 calls for the complete elimination of vehicle delay as an environmental impact and therefore the mitigation measure associated within. There are a number of consequences related to the removal of delay calculation that will have long-term ramifications for development in California. The first consequence of SB 743 is that new methods for addressing VMT mitigation are now on the table. All of these measures have the potential of addressing important environmental and social issues connected to transportation. On the other hand, the absence of LOS analysis may have unintended effects that the measure was meant to prevent. The advantages of VMT analysis must be carefully considered and evaluated for effectiveness when applied in the field. The suggested mitigation measures outlined by OPR are based on the California Air Pollution Control Officers Association's guide on Quantifying Greenhouse Gas Mitigation Measures. The referenced guide is "peer-reviewed research on the effects of various mitigation measures, and provides substantial evidence that the identified measures are likely to lead to quantifiable reductions in vehicle miles traveled" (Updating Transportation Impact Analysis in the CEQA Guidelines, 2014). The fifteen measures that are meant to address a wide array for health, social and environmental issues include the following:

A. Improving or increasing access to transit.

A project that has been deemed to have a significant impact on the surrounding environment can take a number of steps to increase the accessibility of transit for locals and commuters. A transportation planner can look at an existing transportation corridor to see if additional facilities such as bus stops, would improve and promote transit use. The goal of this measure is to increase the number of overall transit routes and pathways that

allow for making transit an easy and viable alternative to automobile use. In areas such as the suburbs, it can result in the expansion of transit routes to regions that would not otherwise be served. Because public transit is the only affordable/viable option of transportation for a significant portion of the population, transit expansion also addresses social equality issues. These issues result from the development of automobile-dependent communities.

Transit oriented development (TOD) as specified in SB 743 refers to residential and commercial areas designed to maximize transit access. Elements such as proximity to transit stops, intersection density and land use mix increases transit use (Ewing & Cervero, 2010). For example, Lund, Cervero and Willson (2004) found that California residents near transit stations are about five times more likely to commute by transit as the average worker located in the same city. In regions such as the Greater Los Angeles area, where the transportation system is already saturated with numerous congested highways, factors such as Braess' paradox can sometimes cause for LOS mitigation measures to do more harm than good. In transportation engineering, the paradox reveals that in some cases, widening a roadway or the addition of pathways for traffic can cause congestion to worsen.

B. Increasing access to common goods and services, such as groceries, schools, daycares, and medical facilities.

The application of this mitigation measure can lead to the construction of more mixed use, compact developments that allow for quick access to essential neighborhood services without the over-reliance on automobiles for transportation. Denser residential and commercial developments would have less of an impact on VMT. In urban areas, it would lead to more infill projects, which can resolve issues of accessibility. In suburban

areas, it may mean the trend towards vertical growth rather than urban sprawl, which often separates different populations and uses. Important community destinations, such as grocery stores, schools, retail stores, medical facilities and libraries would become linked to where residents actually live. There are a number of benefits from improved proximity of community destinations. This includes enhanced health from increased ability to walk and bike, social equity by allowing all economic populations to have affordable access to transportation and nearby destinations for those who cannot drive.

The current LOS based traffic impact analysis does not allow for certain types of growth such as infill development. The methodology of determining a roadway's level of service makes all forms of automobile traffic delay undesirable. Most infill developments will show an increase in traffic delay when a TIA is performed. This is a problem because denser developments that may be beneficial and necessary for the community end up being blocked or scaled down. In some areas, Infill developments can result in improvements in the accessibility, connectivity, and efficiency of a community's transportation system. LOS mitigation measures can be problematic in land use development because it often results in the reduction of the size and density of a project that may be needed for the local population. It can have economic implications such as a limiting accessibility and the number of destination within an area. Although the demand for services to a particular area may be reduced to prevent LOS impacts, the demand for the region is still present and will result in development being pushed to less urbanized areas of the city. This also causes traffic to be pushed outside the scope of the project into areas with less efficient transportation. In the subject site, mitigation through widening adjacent roadways worsens livability, increases vehicle travel and reduces the ability to add bike lanes and transit

facilities. On the other hand, bus priority lanes can increase person throughput per lane.

C. Incorporating affordable housing into the project

This mitigation measure also addresses many socio-economic issues that exist in California and are related to its auto dependent urban structure. Although it does not directly contribute to the preservation and protection of the environment, there are benefits that come with the inclusion of affordable housing. The low income or affordable housing population may be more likely to use transit or an alternate means of transport to cars. Historically, auto-dependent suburbs have made it difficult for low-income residents to live in sprawled communities due to the high cost of living associated with the land use design.

D. Improving the job/housing fit of the community

In regions such as the LA area, long commute times and high transportation costs are present because of the separation of job centers and affordable housing. Sprawl is what causes the decentralization of employment centers and the necessity of commuters to use automobiles to reach their destinations. A potential project that is located near a job center can reduce VMT for commuters, make getting to work more affordable and less time consuming. Researchers have created an index that compiles four factors contributing to sprawl: residential density; neighborhood mix of homes, jobs, and services; strength of activity centers and downtowns; and accessibility of the street network (Measuring Sprawl, 2014). Sprawl is also directly connected with increases in greenhouse gas emissions and VMT. SB 743 addresses VMT and pollution through targeted mitigation measures that help improve elements of the four index factors. These policy measures will have the greatest effect of future development in California. Instead of adding additional car lanes and

increasing vehicle speeds, a number of environmentally conscious and beneficial alternatives can be implemented.

An argument that is often made for continuing LOS traffic analysis is that its elimination would result in denser urban development without increased capacity, therefore leading to traffic problems. However, studies have been found that there is no significant effect of density on the amount of delay that commuters experience on a daily basis. Similarly, compact urban development has no effect on average travel time. Research conducted by Ewing found that when analyzing the sprawling index of the largest urban areas in the nation there was no difference in average commute time between the top ten most and least sprawling metros (Ewing, US Di-centennial Census). Suburban areas with relatively little traffic delay tend to have job centers that are dispersed. This trend negates the benefit of decreased traffic and causes commuters to travel further to reach their destinations.

E. Incorporating neighborhood electric vehicle network

This mitigation measure signals the shift away from the use of fossil fuel-dependent vehicles and the expansion of alternate fuel facilities. Facilities that adapt to support electric vehicles will contribute to the reduction of greenhouse gases while encouraging a sustainable alternative to gasoline-powered automobiles. This specific mitigation measure may help add to the proliferation of electric vehicles over the next few decades by making it a convenient transportation option.

F. Orienting the project for transit, bicycle, and pedestrian facilities

This measure will be effective in promoting multi-modal transportation by removing the need for developers to add more car lanes and to increase automobile

accessibility. Over time, the construction of new multi-modal facilities will enhance the connectivity of existing bike, pedestrian, and bus networks. The result will help travelers more easily switch between modes without sacrificing time, accessibility, or safety.

G. Improving pedestrian or bicycle networks, or transit service.

Improving alternate transport networks help make completing trips without a car more practical, safe and timely. Measuring these modes may also be a practical alternative to LOS vehicle delay analysis. Multi-Modal Analysis can take the benefits of LOS analysis while achieving a wider scope of traffic measurement. LOS rating for pedestrian, bicycle and transit will provide a clear assessment of roadways that need to be improved to increase their accessibility.

H. Traffic calming.

Traffic calming involves roadway design that slows or limits traffic speeds. It includes feature such as speed bumps, narrow driving lanes or streets, on-street parking or physical barriers. These roadway modifications make it easier and safer for pedestrians and bicyclists to share the road with vehicles.

I. Providing bicycle parking.

Bicycle parking is essential for increasing active transportation ridership because it increases the convenience of using alternate modes of transportation. A destination with adequate bicycle parking supply provides property safety, comfort and practicality for riders. Lack of bicycle parking can discourage would be riders from taking trips.

J. Limiting parking supply.

Key provisions of SB 743 include reforming parking CEQA analysis for urban infill projects. Parking management in communities allows for local municipalities to ensure the

efficient use of space for land-use conducive to multi-modal transit. It allows for denser development, and more space for additional bike path, walkways and transit stops.

K. Unbundling parking costs.

The unbundling of parking costs means the separation of parking fees from living costs such as rent. For example, instead of paying \$2000 per month for a two bedroom apartment and two parking spaces, a renter would pay \$1,700 and \$150 extra for each parking space that is needed (Weinberger, et al. 2008). Studies have shown that unbundling parking costs can significantly reduce vehicle ownership, therefore cutting vehicle miles travelled for individuals. In fact, it has been found that shifting from conventional parking requirements to cost-recovery parking in urban environments typically reduces automobile commuting 10-30% (Shoup, 2005). Unbundling parking costs allows for drivers to see the real cost of owning a vehicle at a specific location. It creates a financial incentive to use alternate modes of transportation, a perk that was previously non-existent. It also allows for non-vehicle owners to be compensated for being sustainable.

L. Parking or roadway pricing or cash-out programs.

Roadway pricing or cash-out programs typically involve providing commuters the choice between free parking and the cash equivalent for using alternative modes of transportation. The goal of this measure is to encourage the use of multi-modal transportation through financial incentives while reducing vehicle ownership. In practice, a commuter could choose to use the cash on modes of transportation that are more cost efficient and less harmful to the environment.

M. Implementing a commute reduction program.

This mitigation strategy can involve efforts for regional and local municipalities to work with firms and merchants to provide easier modes transportation and strategies to encourage alternative travel mode use.

N. Providing car-sharing, bike sharing, and ride-sharing programs.

Ride sharing, car-sharing and bike sharing programs reduce VMT by eliminating the need for commuters to own or use personal vehicles. Projects that support transportation sharing programs can help expand existing travel networks and destinations, making the system more convenient and feasible. Transportation sharing works best in areas with central districts or employment areas because denser developments have rally points that are more accessible. This mitigation measure has the biggest positive effect on the low-income commuter who may not have the financial means to own a vehicle.

O. Providing transit passes.

Providing transit passes can help reduce VMT by subsidizing the cost of using alternative modes of transportation. For example, a project that involves the construction of an office site can develop a program in which all employees are provided with free transit passes.

Chapter 5 Conclusion

When looking at the influence of automobile use on the goals of SB 743, it is important to not completely write off the use of LOS analysis. The tradeoffs between automobile traffic speed and accessibility factors must be weighed along with other elements highlighted under the bill. Transportation planning and land use planning can be broken down into a number of key factors. These factors affect the overall performance of a transportation network and its ability to fulfill the goals set under SB 743. The First element is the size of roads near urban developments. The historic solution has been to expand roads with the construction of new developments in order to accommodate the additional automobile traffic. The result has been higher traffic speeds and a barrier effect that reduces access for pedestrians and cyclers. In order for people to use transit, there needs to be pathways to and from stops. Large roads disrupt these pedestrian pathways and make stops difficult to access. The second element of transportation planning is determining the allocation of road space to different modes of transit. Cars have historically been allocated the most space on California roadways while bike lanes, sidewalks and bus lanes have been secondary in priority. Even features such as on-street vehicle parking have an influence on how people can access an area by different modes. The third element in transportation system design has been the creation of a hierarchical road network, with smaller minor roads leading to major arterial roads. The hierarchical roadway system allows for residential privacy and high roadway speeds but reduces network connectivity and local accessibility. The fourth element is the presence of infill developments in suburban areas. Infill developments tend to increase vehicle traffic and congestion, however it improves access by modes other than automobiles. All four of these elements

have tradeoffs that transportation planners and engineers must take into consideration when designing roadways. Analysis of these elements reveal that transportation planning that is solely dependent on LOS as a performance indicator tends to create an urban fabric that is automobile dependent. It also produces cities that are sprawled and inaccessible on a local level. However, it is just as important to understand that the elimination of LOS as a metric will not address the elements causing existing transportation problems directly. VMT does not measure the use of alternate modes of transport or its accessibility for different methods of travel. What VMT actually measures is the distance that a typical driver travels in order to his or her destination (Litman, 2014).

The new paradigm expands the range of modes, objectives, impacts and options considered in planning. The new shift in thinking as represented by SB 743 recognizes multi-modal transportation options and optimal accessibility for all modes and populations. Roadway connectivity and land use planning are key factors in determining the success of transportation infrastructure. The results are “parking facility cost savings [for developers], consumer savings, improved accessibility for non- drivers (which reduces motorists’ chauffeuring burdens), improved public fitness and health, reduced total traffic accident risk, energy conservation and pollution emission reductions” (LaPlante, 2010; Litman, 2003; & Poorman, 2005). The mitigation measures highlighted by OPR to be applied to SB 743 lay the foundation for smart growth planning but they do not necessarily represent practices that lessen VMT.

SB 743 is moving us toward a sustainable transportation policy. Urban transportation is a key link between the issue of urbanization, land use, energy use and climate change. Before change can happen, smart growth in today’s cities must be defined.

Smart growth is characterized by enlisting access based transportation policies that are focused around planning for proximity. “To control traffic congestion, smart growth cities used two tools: public transport (the “carrot”) and demand management (the “stick”)” (Changing Course, 2009). We often seek technological quick fixes instead of implementing fundamental policy changes. Shifting our transportation analysis towards VMT may reduce the overall vehicle miles travelled by commuters but the metric does not address the issues of smart growth and emission on the individual project level. The composers of SB 743 failed to integrate the existing value of LOS analysis with the existing goals of multi-modal transportation. The answer to California emission and accessibility problem may not be the removal of LOS but rather an expansion of the measure to include more modes of transportation. The development of LOS analysis to include alternative modes in combination with VMT measurement can offer a more scientifically appropriate method of conducting TIA.

Multi-modal LOS analysis goes beyond automobile LOS by measuring the travel delay among pedestrians, cyclists and public transportation passengers. Through capturing the delay experienced by these travelers it also factors in accessibility inadequacies such as missing sidewalks, transit delays, lack of transit corridors and heavy traffic. Failing grades for multi-modal levels of service will lead to mitigation improvements that will address these problems and reduce delay. The latest Highway Capacity Manual (Transportation Resource Board, 2010) provides guidance for multi-modal LOS analysis, and models are now available for automating this analysis. Multi-modal LOS analysis also captures factors related to convenience, safety and affordability (Florida Department of Transportation, 2012). For example, a pedestrian may have slow travel time or increased safety risk if there

is no sidewalk along a roadway travel route. There are some flaws with relying on multi-modal LOS analysis to improve land-use and transportation planning. Measuring travel delay does not account for accessibility issues when reaching destinations. A new type of data metric must be collected that measures roadway deficiencies such as missing sidewalks, bike lanes, transit service, and pedestrian pathways. All of these indicators are costly to collect and require a lot of time, but are necessary for network improvement (Litman, 2014). Alternate measures of transportation network efficiency are also in use or are being developed.

SB 743 may not be the final answer for solving California's emissions, multimodal and land-use problems but it should be used as template for the continued progression of TIAs in California. Politicians should be cautious about moving ahead with statewide implementation of the bill without properly studying its effectiveness over an extended period of time. This strategy would also require the creation of a procedure within a TIA that accurately compares the before and after conditions following the implementation of mitigation measures. With all of these factors considered, California can begin to move closer toward sustainable communities.

APPENDIX

Exhibit A VMT Formulation

The greenhouse gas emissions from a typical vehicle include carbon dioxide (CO₂), methane (CH₄), and nitrogen dioxide (N₂O) (U.S. Environmental Protection Agency, 2005). Air pollutant amounts from California's light vehicle for every mile travelled are: 0.00079g of N₂O, 0.0147g of NH₄, 2.784g of CO, 0.272g of NO_x and 0.237g of reactive organic gases (Emission Facts: Greenhouse Gas Emissions From a Typical Passenger Vehicle, 2014 & California Green House Gas Emissions Inventory, 2015).

Example Trip-Based VMT Calculation

In this example, we will take a 50 unit residential subdivision that is being proposed in a low-density land use area. In this case, the suburban city municipal code states that a low-density residential development has one housing unit per 4 acres of land. Similar types of development areas have no mixed uses and are heavily automobile-dependent.

Neighborhood destinations such as grocery stores and schools often require driving long distances. This means that no internal vehicle trips are expected and will therefore not be factored into the VMT calculation.

Step 1: Multiply the number of residential units by an average vehicle daily trip rate. This rate can be obtained by conducting local surveys of at least three similar sites. If this data is not readily available then a transportation analyst can use the Institute of Transportation Engineers (ITE) Trip Generation Manual to find an average daily vehicle trip rate for single-

family detached homes. This number is 9.52. Planners should keep in mind that this rate only captures trip to/from the home (i.e., home-based work (HBW) and home-based other (HBO)) and not all trips made by the residents of the home.

50 single-family detached residential dwelling units x 9.52 vehicle trips per unit =
476 daily vehicle trips

(Center for Transportation Research, USF: Exploring Changing Travel Trends)

Step 2: Next, multiply the number of home-based trips by trip lengths. If trip lengths for different trip purposes are available, then the trip generation estimate should be divided into purposes based on household survey data or travel forecasting model estimates.

Potential sources for trip lengths by purpose are available through the California Household Travel Survey, the National Household Travel Survey, and MPO model estimates. In this simple estimate, only one trip length is assumed to be available and it represents the average weekday trip length for California based on the California Household Travel Survey.

476 daily vehicle trips x 10 miles per trip = 4,760 daily VMT

4,760 daily VMT/50 residential units = 95.2 daily VMT per residential unit

Step 3: Next, divide the daily VMT per residential unit by the expected average project household occupancy. An estimate based on project characteristics (i.e. unit sizes and number of bedrooms) and location is preferable because it is more specific. In this example we will use the average household occupancy for Orange County, 2.95 persons per household:

95.2 daily VMT generated per residential unit / 2.95 persons per unit = 32.3
daily VMT per capita

(Summary Guide to Population Projections and Buildout Analysis, 2010)

Step 4: Annual VMT can be calculated by taking the sum of a VMT scenario multiplied by its probability of occurrence. That sum is then multiplied by the total number of days in the reliability space being evaluated.

Summary:

$$\text{Formula: } AVMT = N * \sum_s VMT(s) * P(s)$$

Where: AVMT = Annual total vehicle miles traveled

N = Number of days within the reliability analysis space.

VMT(s) = VMT estimate for scenario "s."

P(s) = Probability of scenario "s."

(Guide for Highway Capacity and Operations Analysis of Active Transportation and Demand Management Strategies, 2013)

GLOSSARY

- CEQA – The California Environmental Quality Act, is a statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible.
- EIR – Environmental impact report, is a study of all the factors which a land development or construction project would have on the environment in the area, including population, traffic, schools, fire protection, endangered species, archeological artifacts, and community beauty. Many states require such reports be submitted to local governments before the development or project can be approved, unless the governmental body finds there is no possible impact, which finding is called a "negative declaration."
- Delay – A method of quantifying several factors, including lost travel time.
- Infill – Development of vacant or underutilized land in areas surrounded by existing development and where traffic already exists.
- LOS – The average total vehicle delay of all movements through an intersection.
- OD – Origin and Destination for a single trip.
- Sprawl – Development of vacant land in areas not surrounded by existing development and where traffic volume is low.
- TIA – Traffic impact analysis, is a study which assesses the adequacy of the existing or future transportation infrastructure to accommodate additional trips generated by a proposed development, redevelopment or land rezoning.
- VMT – Vehicle miles travelled.
- HBW – Home based work trip.
- HBO – Home based other trip.

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