OCTA

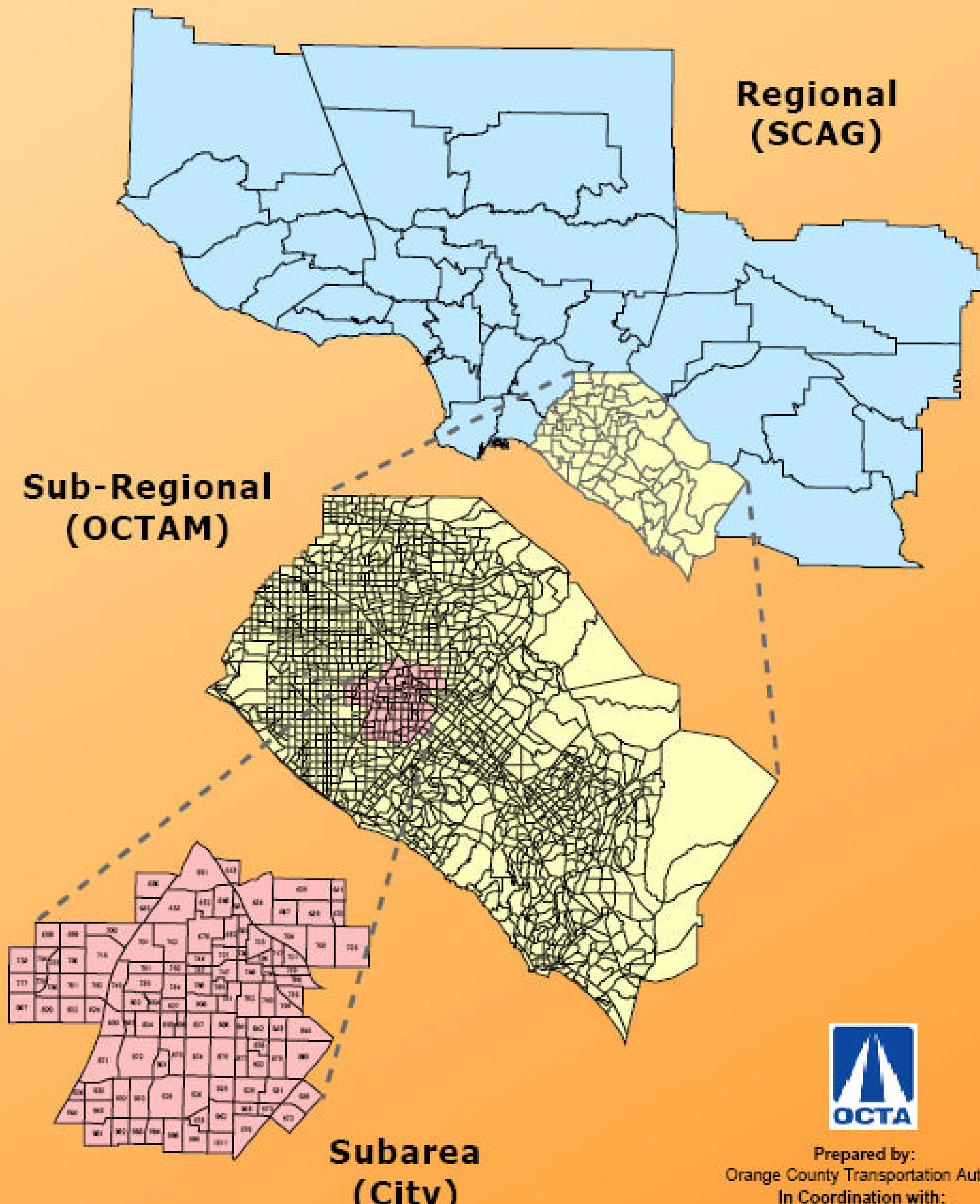
2009 Orange County Congestion Management Program

Appendix F: Orange County Subarea Modeling Guidelines

December 18, 2009

ORANGE COUNTY
SUBAREA MODELING GUIDELINES
MANUAL

July 2005



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1. INTRODUCTION

1.1 Purpose

The primary purpose of the Subarea Modeling Guidelines Manual is to promote consistency in transportation modeling within Orange County. The goal of the manual is to ensure consistency between local subarea models in Orange County and the Orange County Transportation Analysis Model (OCTAM), as well as with the Southern California Association of Governments' (SCAG) regional model.

The manual is also prompted by requirements of state and federal legislation including the Congestion Management Program (CMP), Transportation Equity Act for the twenty-first century (TEA-21), and both state and federal Clean Air Acts. The CMP requires consistency in databases and modeling, while the TEA-21 and Clean Air Acts require improved analytical capabilities to evaluate and monitor transportation improvements, policies, plans, and programs.

This manual is a living document that will be periodically updated with improved modeling procedures and updated databases. A secondary goal of this manual is to work towards a single set of models to be used by all modeling agencies in Orange County.

Notes:
1. All references to "OCTAM" are to the current version, **OCTAM 3.2**, unless stated otherwise.
2. All references to "OCP" (Orange County Projections) are to the current version, **OCP-2004**, adopted by the Orange County Council of Governments on February 26, 2004 and by the Orange County Board of Supervisors on May 11, 2004, unless stated otherwise.

1.2 Background

Transportation modeling in Southern California began in the early sixties by the California Department of Transportation (Caltrans), formerly the Division of Highways. Caltrans provided modeling support services to other agencies within the region, including SCAG, for future transportation and air quality planning. In the early eighties, SCAG, the designated Metropolitan Planning Organization, began its own modeling group and assumed responsibility for regional transportation modeling.

In the late seventies, the Orange County Transportation Commission[1], County of Orange Environmental Management Agency[2], and Caltrans jointly developed a sub-regional transportation model for the Orange County Multi-Modal Transportation Study (MMTS). The MMTS model was an extraction of the Caltrans regional model,

[1] Consolidated into the Orange County Transportation Authority in 1991.
[2] Now defunct, through major reorganization by the County of Orange.

supplemented with a higher level of detail in Orange County. The model was used to develop the first comprehensive transportation blueprint for Orange County.

These early transportation models were based on the Urban Transportation Planning System (UTPS) computer programs developed by the Urban Mass Transportation Administration (UMTA)[3]. The UTPS computer programs were specifically written for processing on IBM mainframe computers. The costs for processing on an IBM mainframe system were expensive, hence, only larger agencies had sufficient resources to use transportation models in their planning activities.

The advent of personal computers and availability of several transportation modeling software packages has provided the opportunity for smaller government agencies, as well as the private sector to develop their own transportation models. The proliferation of transportation models in Orange County has raised the need to establish modeling guidelines to promote consistency in traffic forecasts.

1.3 Current Modeling Practice in Orange County

There are two levels of transportation modeling in Orange County: regional and subarea. The Orange County Transportation Authority (OCTA) is responsible for regional transportation modeling in Orange County. This responsibility was transferred from the County of Orange to OCTA in May 1995. OCTA's role as the regional modeling agency is to evaluate multi-modal transportation alternatives to support regional planning activities in Orange County. Some major transportation programs, either directly or indirectly, supported by OCTAM include: the Orange County Master Plan of Arterial Highways, the Orange County Long-Range Transportation Plan, urban rail and corridor planning studies, input to SCAG's Regional Transportation Plan, State Transportation Improvement Program, State Implementation Plan, as well as transportation funding programs involving local (Measure M), state, and federal funds.

At the local level, many cities in Orange County have developed traffic models to analyze the land use and transportation components of their general plans, as well as development proposals, funding programs, and environmental documentation. Many of the cities' models contain detailed information to reflect local transportation conditions, and rely on OCTAM to provide regional travel patterns. OCTA provides local agencies with regional modeling data and assists cities in evaluating proposed transit alternatives through cooperative project agreements.

1.3.1 OCTAM Regional Model Overview

OCTAM is a regional model that is based on the traditional four-step sequential modeling methodology with "feedback loops" procedures to insure internal modeling consistency. The model incorporates multi-modal analytical capabilities to analyze the following modes of travel: local and express bus transit, urban rail, commuter rail, toll roads, carpools, truck traffic, as well as non-motorized transportation which includes

[3] Reorganized to the Federal Transit Administration

pedestrian and bicycle trips. The model responds to changes in land use types, household characteristics, transportation infrastructure, and travel costs such as transit fares, parking costs, tolls, and auto operating costs. OCTAM is a state-of-the-practice travel demand forecasting model designed to address transportation issues mandated by state and federal legislation. The model was developed and validated with data from the SCAG 1991 Origin and Destination Survey (AMPG, 1991), 1990 Census (U.S. Census Bureau, 1990), OCTA 2001 On-Board Bus Passenger Survey (OCTA, 1998), and the OCTA/EMA 1995/96 School Travel Survey (AMPG, 1996).

OCTAM is based on the TRANPLAN software and the original version of the model is fully documented in the *OCTAM III Model Documentation, June 1999, Parsons Transportation Group*. Since the development of the original model, OCTAM has been updated several times and documented in the following reports: 1) *OCTAM 3.0 Summary Documentation and Validation Report, March 2000, OCTA; 2) OCTAM 3.01 Addendum to the OCTAM 3.0 Summary Documentation and Validation Report, November 2000; 3) OCTA OCTAM 3.1 Summary Documentation and Validation Report, June 2001, OCTA*, *4) OCTAM 3.2 Addendum to the OCTAM 3.1 Summary Documentation and Validation Report, April, 2005.* A detailed discussion of the OCTAM methodology is presented in Section 1.4.2, Model Methodology Issues.

1.3.2 Subarea Model Overview

The cities' subarea models in Orange County are generally categorized as land use based traffic models designed to evaluate their general plan land use and traffic circulation system. These subarea models are typically based on a three-step sequential modeling methodology, which include trip generation, distribution and assignment. The sequential structure of these models is similar in concept to the regional model, with the exception of a mode choice model. Hence, the model estimates vehicle trips directly and does not address transit trips. These models focus on peak-hour link and intersection turn volumes, as well as average daily traffic (ADT).

It should be noted that since OCTA's adoption of the Subarea Modeling Guidelines Manual, June 2001, several of the cities' models have been restructured to follow the recommended procedure of this guidelines manual.

1.3.3 Regional - Subarea Model Comparison

Table 1-1 compares and contrasts the salient features between the regional and subarea model structure. The principle differences between these models are highly attributable to application differences between socioeconomic data versus land use data, and mode choice issues. These differences are discussed further in Section 1.4, Model Consistency Issues.

Table 1-1 Salient Features And Contrast Between Regional And Local Subarea Models

CATEGORY	OCTAM REGIONAL MODEL	LOCAL SUBAREA MODELS
Model Input Data	1. Socioeconomic data: population, workers, income, housing unit type, household size, school enrollment, university/college enrollment, retail, service and total employment. 2. Highway Networks: stratified into drive alone, 2-person carpool, 3 or more person carpool, and toll roads. 3. Transit Networks: local & express bus, urban & commuter rail, with walk & auto access.	1. Land uses by various categories. 2. Highway Network: most subarea models use a single purpose mixed-flow network. Recently developed models include HOVs[4] and toll roads.
Trip Generation	Regression/cross-classification with 14 trip purposes, of which one is work-at-home. The other 13 are split into peak and off-peak, with an auto ownership model to address accessibility using income, household size, and total employment accessible by transit.	Land use trip rates by land use categories. Some recently developed models use a form of linear regression.
Trip Distribution	1. Gravity model – HBW[5] based on composite impedance using congested travel times, costs and modes (logsum from mode choice), all other trip purposes use travel time. 2. The 13 trip purposes from trip generation are separated into peak and off-peak time periods and combined to 20 basic trip purposes by consolidating the HBW sub categories. 3. Each trip purpose is then distributed on their respective time period network, resulting in a total of 20 different trip distribution models.	1. Gravity model based on travel time. 2. Typically, three trip purposes. 3. HBW distributed on peak network, all others on off-peak network. Note: Recently developed models rely on the OCTAM trip distribution patterns. Growth factors are applied through a FRATAR process to reflect changes in land use.
Mode Choice	Nested logit model with the following modes: Drive alone; 2-person carpool; 3-or-more person carpool; toll roads, local & express bus, urban rail; commuter rail; transit with park-and-ride, kiss-and-ride, and walk access.	No mode choice.
Trip Assignment	Four time periods: AM, Midday, PM, and Night. Combined for ADT[6] and factored for peak-hour.	AM and PM peak-hours, off-peak and ADT. Recent models have incorporated the same time periods as OCTAM, in addition to AM and PM peak-hours.

4 High Occupancy Vehicles (Carpool: 2 or more persons)
5 Home-based work (HBW) trips
6 Average daily traffic (ADT)

1.4 Model Consistency Issues

The purpose of this section is to inform those not intimately familiar with regional and subarea modeling issues, on the underlying assumptions of these models so they can better understand how to evaluate results that these models produce. The intent of this section is to educate and not critique these models.

This section will address two basic modeling consistency issues: 1) socioeconomic data versus land use data, and 2) modeling methodology. Section 1.4.1, Socioeconomic Versus Land Use Data Issues, discusses the differences between socioeconomic and land use forecasts and how they can be modeled to satisfy their respective objectives. Section 1.4.2, Modeling Methodology Issues, describes the four-step sequential modeling process and identifies issues involved with each step of the process. Resolution of these issues is addressed in Section 3, Subarea Modeling Methodology.

1.4.1 Socioeconomic Versus Land Use Data Issues

Regional transportation models, such as the OCTAM and the SCAG model, use socioeconomic data to estimate trip generation, mode choice, as well as several sub-models to address complex travel behavior and multi-modal transportation issues. Local traffic models use city/county general plans and development plans, which are generally described in terms of land use data, to estimate trip generation. There are some fundamental differences in objectives on how socioeconomic and land use data are applied in their respective models.

Socioeconomic Data

Socioeconomic data projections are based on a market based approach, which links international, national, and state economic and demographic trends to regional growth at the county level. In Orange County, sub-county level data is developed by the Center for Demographic Research (CDR) at California State University, Fullerton, in coordination with cities' and county's general plans, as well as major land developers.

The CDR develops and maintains the Orange County Projections (OCP) of population, housing, and employment data at the lowest level geography, in a Geographic Information System (GIS), such that it can readily be aggregated to the OCTAM traffic analysis zones (TAZ). In addition to the three basic socioeconomic variables, the CDR develops several other modeling variables used in OCTAM. A complete list of the OCTAM modeling variables is included in Appendix A.

Land Use Data

The land use projections used in Orange County cities' traffic models are based on general plan land use data. Cities are required by state planning laws and regulations to assess the impact of their general plan land uses on the traffic circulation system. The land use designations are often influenced by policy decisions and may not be closely correlated with socioeconomic trends, especially across political jurisdictions. Actual land development, however, is driven by market forces that may or may not coincide with general plan land use designations, and often result in general plan amendments to accommodate these market demands.

In many jurisdictions, land use data often over states employment projections and intensity of use. A *Manual of Transportation-Air Quality Modeling for Metropolitan Planning Organizations* (Deakin/Harvey/Skabardonis, 1993) identified that it is not unusual for employment forecasts aggregated from local plans to total several times the growth estimates for the region. In addition, the *Travel Forecasting Guidelines* (JHK and Associates, 1992) indicated that there is a greater level of uncertainty with land use based models since not all non-residential building floor space is occupied and occupancy densities can vary widely within an area.

Bridging the Socioeconomic and Land Use Issue

While development of OCP is coordinated with cities'/county's general plans, it also contains major land use development plans, which may not yet be included in general plans. Additionally, because of the dynamics of changing land uses and land use plans, the most current information may not be reflected in OCP, which is updated approximately once every three years. Furthermore, build out of general plans typically occurs beyond the 25-year OCP projections.

The above issues suggest that it would be difficult, if not impractical from a model implementation perspective, to maintain the exact same database between OCP and city/county land use data. These issues should be dealt with on a project by project basis with the affected jurisdictions. For purposes of the modeling guidelines manual, the focus will be on developing a process/procedure where given the same socioeconomic and land use data input assumptions, the regional and subarea models would produce reasonably similar results.

Before socioeconomic and land use data can be compared, the land use data must first be converted to equivalent housing units and employment estimates. The housing units must be converted to occupied dwelling units and non-residential land uses must be converted to total employment. Dwelling unit vacancy rates applied in OCP are shown in Appendix B. Typical employment conversion factors are shown in Appendix C, with ranges of values to reflect variation in occupancy rates and land use categories. The employment conversion rates are the results of work efforts by Austin-Foust Associates and Urban Crossroads, in coordination with OCTA.

1.4.2 Modeling Methodology Issues

The modeling consistency issues are addressed below for each step of the modeling process, i.e., trip generation, trip distribution, mode choice (if applicable), and trip assignment. Some issues are related to differences in planning requirements and the degree of technical sophistication in the modeling methodology.

Trip Generation

Regional Model: The OCTAM trip generation model is composed of two sub-models: a trip production model and a trip attraction model. The trip production model is a cross-classification model that was developed using a Multiple Classification Analysis technique. The model was estimated using data from the SCAG 1991 Origin and Destination Survey (AMPG, 1991), 1990 Census (U.S. Census Bureau, 1990), OCTA 1990 On-Board Bus Passenger Survey (OCTA, 1990), and the OCTA/EMA 1995/96 School Travel Survey (AMPG, 1996). The model is sensitive to household variables such as population, number of workers, median household income, household size, housing unit type, school enrollment and university/college enrollment. The model also includes an auto ownership accessibility variable to reflect how congestion and the transportation system affect trip generation. The model has the following ten basic trip purposes:

- Home-based work-direct (HBW-D)
- Home-based work-strategic (HBW-S)
- Home-based elementary and high school (HBSch)
- Home-based college and university (HBUniv)
- Home-based shop (HBS)
- Home-based other (HBO)
- Home-based social-recreational (HBSR)
- Non-home-based work (NHBW)
- Non-home-based other (NHBO)
- Home-based work at home

The home-based work (direct and strategic) trips are further separated into low, medium, and high-income categories. All trip purposes are then segmented into peak and off-peak time periods, with the exception of home-based work-at-home trips, which are excluded from further processing in the model. Prior to trip distribution, the direct and strategic home-based work trip purposes are combined into their respective income categories. The resulting twenty (20) trip purposes are then processed through the trip distribution models.

The trip attraction model uses multi-variable linear regression equations to estimate relative trip attractions for each OCTAM TAZ. Depending upon trip purpose, the variables include retail, service, and total employment, as well as population, single and multi-family dwelling units. The composite OCTAM trip generation methodology incorporates advanced state-of-the-practice techniques that respond to modeling issues raised by federal reviewing agencies and environmental special interest groups, such as trip inducement, accessibility, and non-motorized trips.

Subarea Model: Trip generation models used by most cities in Orange County estimate trip generation by applying a separate trip rate factor to each land use category. The factors are typically taken from the Institute of Transportation Engineers (ITE) Trip Generation Manual or other relevant special traffic generation studies. Trip rates and land use categories incorporated into city models vary from city to city. Some of the more recent models developed by the cities convert their land use data to socioeconomic data and apply trip rates derived from relationships extrapolated from the regional model.

Issues: The two different approaches in trip generation could yield different results, due largely to the fundamental differences between the way in which regional socioeconomic data and city land use data are derived, and how they are applied in the different models. In large part, this issue has been addressed by converting land use data to socioeconomic data and applying appropriate trip rates. This approach has resulted in producing similar trip generation estimates between regional and subarea models, given the same input data assumptions.

Trip Attraction Balancing

Regional Model: The OCTAM trip generation model estimates trip productions and trip attractions independently of one another. Because they are calculated independently, it is unlikely that the total trip productions would match exactly with the total trip attractions. However, theoretically and mathematically, trip productions and trip attractions must be equal. As part of the OCTAM trip generation process, trip "balancing" is performed to insure that trip productions and trip attractions are equal. OCTAM balances trip attractions to match trip productions for all trip purposes. The *OCTAM 3.1 Model Description and Validation Report, June 2001,* provides additional information on the balancing procedures.

Subarea Model: Trip generation estimated by local subarea models, by design, assumes full "absorption" of the planned land use data. In order to accommodate the full intensity of planned land use data within the focus modeling area, trips are balanced outside the focus study area.

Issues: The balance between OCTAM productions and attractions is highly influenced by the employment to housing ratio of the input socioeconomic data. For example, in Base Year 2000, the Orange County productions and attractions are in relative balance, so balancing is not an issue. However, in forecast year 2025, the OCP-2000 employment grew at a faster rate than housing, which caused total trip attractions to be higher than trip productions by about 10%. This imbalance varies by trip purpose: the home-based work trips are in relative balance, but the other trip purposes are out of balance by approximately 12%. For these trip purposes, trip attractions were reduced to match trip productions. Two different inferences can be made from this reduction:

1. *Reduction in trip rate.* Since the HBW trips are in balance, it implies that the employment forecast is in balance with the number of workers. This translates to less trips per employee for non-HBW discretionary trips, a defacto reduction in trip rates for these trip purposes. This is a realistic possibility, explainable by a reduction in occupancy rates, decline of trips to an establishment because of

competition, or over saturation of a particular type of business. There are many current examples to support this hypothesis.

2. *Reduction in employment.* The employment growth projection cannot be fully "absorbed" based on the estimated trip productions and trip attractions. Assuming that trip rates remain stable over time, this represents a defacto reduction in projected employment.

Trip Distribution

Regional Model: The OCTAM trip distribution model is based on the gravity model concept and consists of ten (10) trip purposes, where each trip purpose is divided into peak and off-peak components, resulting in twenty (20) different trip distribution models. The travel impedance in the OCTAM gravity model is based on travel time for all trip purposes except for the HBW trips. All HBW trips use composite impedance, where level of service for all travel modes are considered in the impedance function. The "logsum" from the mode choice model is used to develop the composite impedance, which provides an internally consistent relationship between the distribution and mode choice models.

Subarea Model: Most local subarea trip distribution models in Orange County are based on three trip purposes and apply the gravity model concept, using travel times for impedance. Typically, in these models, the home-based work trip purpose is distributed under peak-period traffic conditions and other trip purposes are distributed under off-peak traffic conditions. Trip distribution varies considerably between cities' models. In general, calibration of these models has taken a heuristic approach whereby travel time factors (friction factors) are adjusted to balance trip generation and trip assignment screenline results.

However, subarea models developed in the last 2 years, in Orange County, all follow the methodology in this guidelines manual, where OCTAM zonal trip tables are adjusted based on zonal changes in trip generation produced by the city's model.

Issues: OCTAM recognizes that for each trip purpose some of the trips occur during the peak-period and some during the off-peak period. For example, according to the SCAG 1991 Origin and Destination Survey, approximately 75 percent the home-based work trips occur during the peak period and 25 percent during the off-peak period. A significant number of non-work trips also occur during the peak-period. These differences in assumptions, along with different trip purposes, different zone structure, and different zonal impedance factors, could contribute towards significantly different trip tables between OCTAM and the subarea models.

Subarea models developed under the guidelines manual addresses this issue by maintaining the trip distribution patterns of the parent OCTAM model.

Mode Choice

Regional Model: OCTAM incorporates ten (10) mode choice models which includes a peak and off-peak model for each of the following five (5) trip purposes: home-based work, home-based school, home-based other, non-home-based work, and non-home-based other. These models are sensitive to changes in transit level of service, HOV facilities, auto ownership, and travel costs such as tolls, transit fare, parking costs, price of fuel, etc. Table 1-3 shows all of the modes included in the mode choice model.

Table 1-2 OCTAM Modes Of Travel

Transit Modes	***Auto Modes***
1. Auto Access – Express Bus	1. Non-Toll - Drive Alone
2. Auto Access – Urban Rail	2. Tolls – Drive Alone
3. Auto Access – Commuter Rail	3. Non-Toll - 2-Person Carpool
4. Auto Access – Local Bus	4. Tolls – 2-Person Carpool
5. Walk Access – Express Bus	5. Non-Toll - 3 or more Person Carpool
6. Walk Access – Urban Rail	6. Tolls – 3 or More Person Carpool
7. Walk Access – Commuter Rail	7. Auto Passenger
8. Walk Access – Local Bus	
9. Non-Motorized	
10. School Bus	

Subarea Model: Local traffic models estimate vehicle trips directly through their land use trip generation process. Chapter 3 proposes options on how various modes estimated by OCTAM (except transit) can be summarized for application in subarea models. Chapter 3 also proposes options on how transit forecast can be obtained for cities interested in analyzing transit.

Issues: Transit modeling issues generally extend far beyond the jurisdictional boundaries of a city and, as such, are more appropriately analyzed from a regional perspective. The complexities and dynamics of changes in transit level of service require frequent maintenance of the transit network. Adding mode choice modeling capabilities to a subarea model would significantly increase the complexity of the model and various model consistency issues must be addressed to maintain consistency.

Trip Assignment

Regional Model: OCTAM uses an iterative equilibrium assignment methodology that simultaneously assigns single occupant vehicles, 2-person carpool, 3 or more person carpool, and toll trips on the highway network. Vehicle trips are assigned separately to four (4) different time period networks: AM-Peak Period (6:00 a.m. to 9:00 a.m.), PM-Peak Period (3:00 p.m. to 7:00 p.m.), Mid-day Period (9:00 a.m. to 3:00 p.m.), and Night Period (7:00 p.m. to 6:00 a.m.). The purpose of this approach is to accurately reflect the different levels of congestion during the day for air quality analysis and to better measure system performance between alternatives; such as, vehicle emissions, vehicle miles traveled (VMT), average speed, and congestion delays. This approach also provides the framework for peak-hour and peak-spreading analyses.

OCTAM transit trips are assigned to two different networks, AM-Peak and Mid-day. The peak period trips are assigned to the AM transit network and the off-peak period trips are assigned to the Mid-day network. Future transit trip assignment may include assigning transit trips to four (4) time period networks.

Subarea Model: Local subarea models are generally structured for AM and PM peak-hour and ADT analyses. The models focus on roadway and intersection capacity analyses, which are ultimately used to identify deficiencies in the roadway system and the required mitigation. Some of the more recent subarea models have toll diversion and HOV capabilities but differ on how they are applied. Most subarea models use an incremental capacity restraint assignment methodology. Trip assignment methodologies vary considerably between cities' models. This wide variation is typically a reflection of when the model was developed and by whom.

Issues: Differences in toll road and HOV methodology between OCTAM and subarea models could result in different forecasts. OCTAM estimates toll trips as part of the mode choice process. The toll trips are then assigned to the highway network, with options to use the toll roads or non-toll facilities (only toll trips have the option to use the toll roads). Subarea models use one of two different divergence methodologies: 1) toll costs are directly incorporated into each toll link, 2) a cost utility function is used to estimate proportional shares between a toll and non-toll path.

The OCTAM mode choice model directly estimates HOV trips. Subarea models use a factoring approach to estimate HOV trips. These differences in methodology could produce different results.

Differences in assignment methodology could also result in differences in traffic forecasts. OCTAM uses an iterative equilibrium methodology and subarea models typically use an iterative incremental methodology.

2. MODEL INPUT DATA CONSISTENCY CRITERIA

This chapter prescribes the model input data consistency requirements for traffic analysis zone (TAZ) boundaries, socioeconomic and land use data, as well as the transportation modeling networks. The Orange County Congestion Management Program requires consistency in socioeconomic data and land use data.

2.1 Traffic Analysis Zone

Socioeconomic and land use data are grouped into TAZs, which are generally based on census tract boundaries and/or city general plan land use coverages. Regional models use census tracts as the general criteria for establishing TAZ boundaries, primarily because census tract level socioeconomic data are readily available from the U.S. Census Bureau and regional planning agencies. Depending on the level of detail in the transportation model, TAZs are subsets, equivalent to, or an aggregation of census tracts within a geographical area.

The TAZs in most subarea models were developed as subsets of the OCTAM regional model and therefore, are generally consistent with the OCTAM TAZs. However, it should be noted that subarea models developed with older versions of OCTAM may not be consistent with the current version because of changes in census tract boundaries, and due to the strict regional requirement that TAZs must be fully compatible with census tract boundaries.

TAZs of subarea models are often derived from city general plan land use coverages. In some cities, the census tract boundaries and the city's jurisdictional boundaries are not coterminous, causing similar inconsistencies with TAZ boundaries. These conditions make it difficult and time consuming to compare the regional socioeconomic data with city land use data.

> For purposes of consistency, TAZs shall be developed using a basic contiguous building block system, such that data from one TAZ system could be easily compared with data from another TAZ system by simply aggregating the lowest common denominator zonal data. TAZs in a Subarea model must be either a subset, equivalent, or aggregation of OCTAM. In cases of aggregation, the TAZ must also be contiguous with Community Analysis Area (CAA) and Regional Statistical Area (RSA) boundaries. In addition, the subarea model must define a "primary" modeling area where modeling results would be used in traffic studies. Typically, this would include all or a portion of the city's jurisdictional boundary.

2.2 Socioeconomic/Land Use

The socioeconomic data used in OCTAM is based on the Orange County Projections (OCP), which are formally adopted by the Orange County Council of Governments and the Orange County Board of Supervisors. The cities' land use data is based on their general plan land use and generally consistent with OCP, although disagreement sometimes exists in some jurisdictions. There are some fundamental differences in assumptions between the regional socioeconomic data and the cities' land use data, i.e., housing units and employment cannot be compared directly between the two databases. Housing units in the OCTAM socioeconomic data are defined as "occupied units", whereas, the land use data definition is "total units". When comparing housing units, appropriate vacancy rates (Appendix B) should be applied to the cities' land use data.

The non-residential categories in the land use data must first be converted to an equivalent employment estimate before they can be compared with the OCTAM employment data. The conversion rates shown in Appendix C should be used for purposes of this comparison, or an acceptable alternative as prescribed in the Orange County Congestion Management Program Guidelines Manual. Tables 2-1 and 2-2 are examples of formats for comparing socioeconomic and land use data. Comparisons shall be made for the OCTAM base year and horizon year projections.

It should be noted that socioeconomic/land use data are updated periodically as new demographic information and economic indicators becomes available, and as changes are made to general plan zoning. The OCP is updated every three years in coordination with the Regional Transportation Plan update cycle. Whereas, local general plans/zoning changes may occur more frequently. How these changes affect subarea models depend upon the location and degree of change.

Table 2-1 Socioeconomic/Land Use Data Comparison

(Primary Modeling Area)

OCTAM TAZ	Subarea TAZ	*Occupied Housing Units*			*Retail Employment*			*Service Employment*			*Other Employment*		
		OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.
Total Primary Area													

Table 2-2 Socioeconomic/Land Use Data Comparison

(External Modeling Area)

RSA	CAA	*Occupied Housing Units*			*Retail Employment*			*Service Employment*			*Other Employment*		
		OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.
Total External Area													

2.3 Transportation Modeling Networks

The OCTAM and the subarea model highway and transit (if applicable) networks must be consistent. Consistency checks should be made to compare the number of lanes on freeways and arterials. This evaluation should include high occupancy vehicles (HOV) carpool lanes, and whether these HOV lanes are modeled uniquely or included as mixed-flow traffic lanes. How HOV lanes are addressed in the model may vary based on the subarea model requirements. For example, models without HOV forecasting capabilities could include HOV lanes as mixed-flow lanes with a reduced capacity of 1,600 vehicles per hour per lane. All freeway ramps within the primary area should be included in the subarea network with all ramp movements coded.

The consistency criteria for arterial highways should be based on number of lanes, divided verses undivided, and smart street designation. Additional criteria should be developed for future consideration to address operational characteristics of arterial highways. Review of the OCTAM network assumptions by the cities would help facilitate resolution of network consistency issue.

3. RECOMMENDED SUBAREA MODELING METHODOLOGY

The intent of the subarea modeling methodology guidelines is to ensure consistency in subarea model development and application. The goal of this chapter is to establish procedures that would ultimately lead to models that yield similar results when the same set of socioeconomic/land use data and transportation system network are used.

While this chapter provides a definitive analytical approach, Chapter 4 allows for optional procedures and methodologies, provided guideline criteria are met. This flexible framework allows creativity and advancement in state-of-the-practice while maintaining an acceptable level of transportation modeling consistency in Orange County.

3.1 Subarea Modeling Approach

The proposed modeling methodology maintains consistency between the OCTAM regional model and the subarea model by instituting a hierarchical modeling approach. OCTAM provides the basic trip tables from which subarea models would refine upon to reflect the level of detail necessary to address specific local traffic issues. This concept establishes an OCTAM base year subarea trip table by converting the OCTAM trip tables to the subarea TAZ system. Likewise, an OCTAM forecast year (horizon year) subarea trip table would be converted to the subarea TAZ system. Since these subarea trip tables are a direct conversion of the OCTAM trip tables, they should produce similar results when assigned to the subarea network. These trip tables will serve as the basis for evaluating and comparing changes in subarea modeling methodologies and assumptions with OCTAM.

A conceptual flow chart of the proposed subarea modeling methodology is shown in Appendix E.

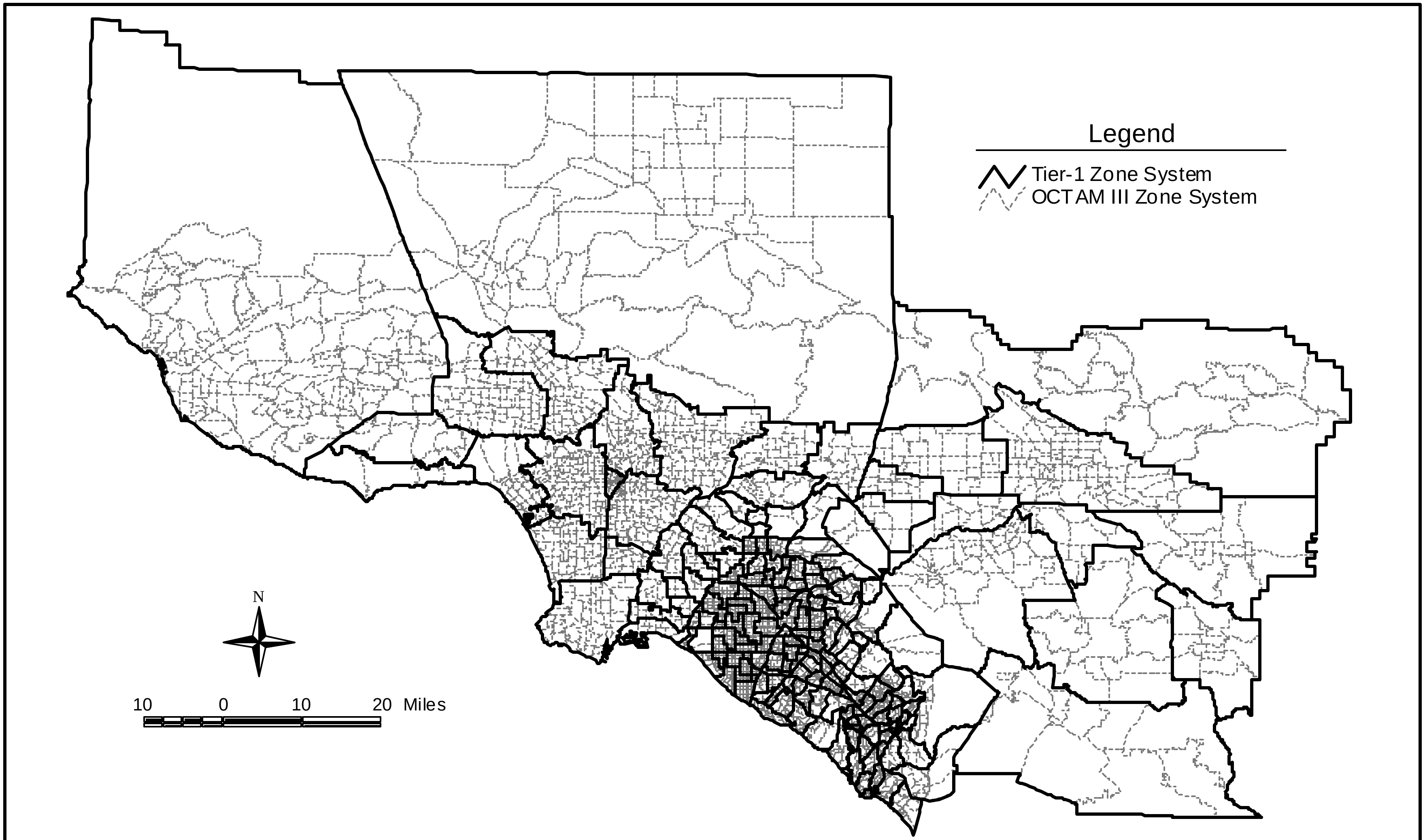
3.1.1 Tiered Zone Structure

The proposed subarea model zone structure would incorporate the following three-tiered approach:

- Tier-1 (Consolidated Area): This area is far removed from the focus of the subarea model, where the network and zone structure are highly conceptualized. In general, OCTAM TAZs in this area are aggregated to Community Analysis Areas (CAA) within Orange County, and to Regional Statistical Areas (RSA) for areas outside of Orange County. Figure 3-1 depicts the Tier-1 zone structure.
- Tier-2 (Buffer Area): Tier-2 serves as a transition between the coarse grained Tier-1 and the primary focus area of the subarea model. OCTAM TAZs are normally used in this area.
- Tier-3 (Primary Area): Tier-3 would typically include the jurisdictional boundary of a city, plus an extended area, with the intent of producing reasonably similar results with a neighboring city's traffic model on adjacent roadway links. Within the primary modeling area, OCTAM TAZs are subdivided into smaller zones to provide the

detail necessary to address local traffic circulation issues. The subarea TAZs within the extended primary modeling area should be consistent with the adjacent city's model.

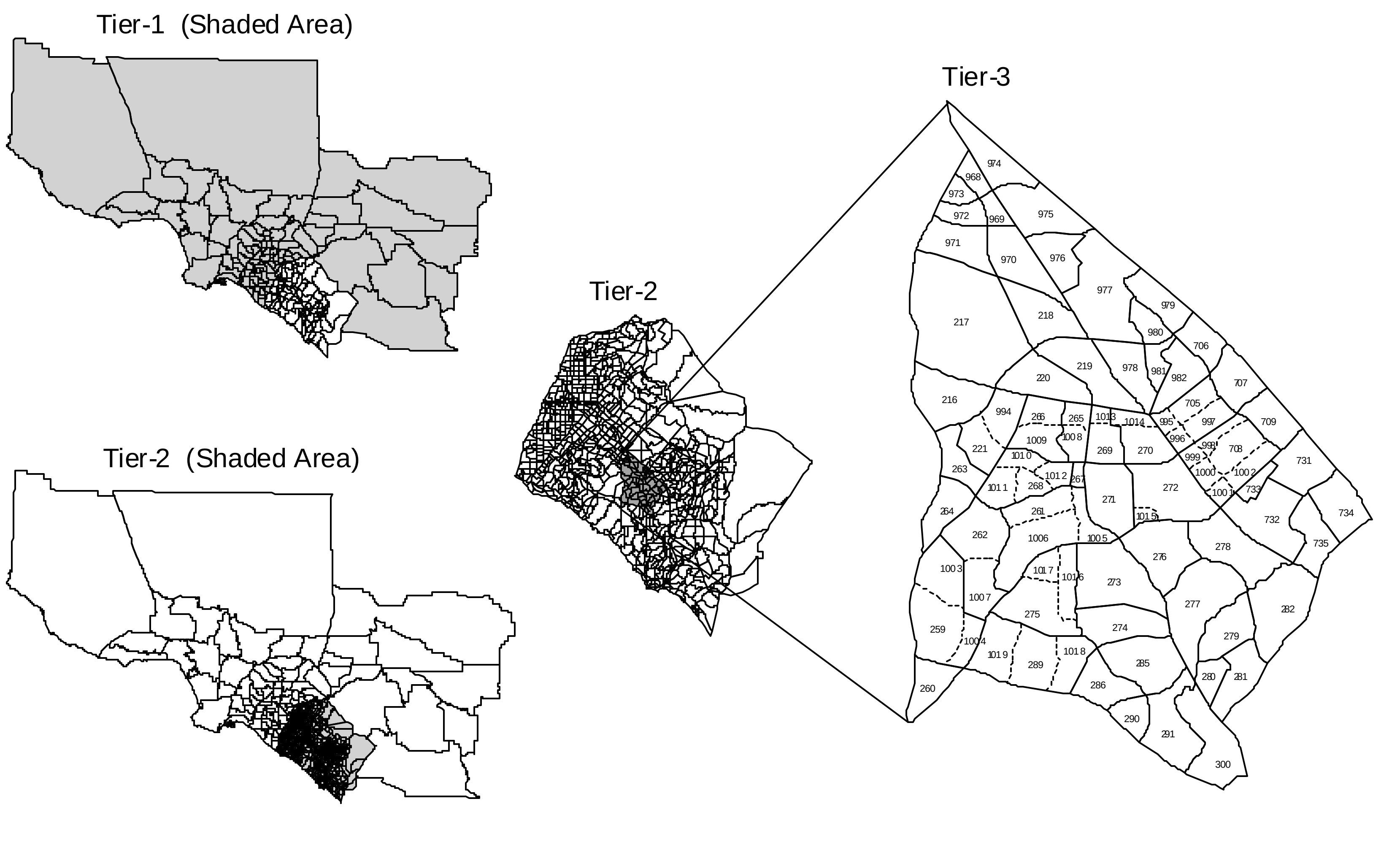
Figure 3-2 provides an example of the three-tier zone concept.



OCTA

Tier-1 Zone System

Figure 3-1



Focused Modeling Concept

Figure 3-2

3.1.2 Highway Network

OCTA will provide the Tier-1 and Tier-2 OCTAM base year and future year highway networks for subarea model development. Modifications to the HOV facilities depicted in the OCTAM model may be necessary if the subarea model does not have provisions to assign HOV trips on exclusive HOV facilities. If HOV facilities are combined with mixed-flow lanes in the highway network, the capacity of the HOV lane should be reduced to reflect a lower operational capacity of a single lane roadway.

Subarea models that are directly impacted by the toll roads in Orange County should model them as toll roads. The toll road trip assignment must be consistent with OCTAM unless it can be demonstrated that better procedures and/or data are available to replace the OCTAM assumptions and procedures.

3.1.3 Transit Network

All transit planning and modeling should be coordinated with OCTA, the regional public transit agency in Orange County. This guideline document accommodates options to analyze transit alternatives for transportation infrastructure improvements and project mitigation. While regional transit planning is the responsibility of OCTA, local agencies may want to assess local transit alternatives that would be funded through local and/or private sources.

OCTA will make the OCTAM transit modules available to local agencies, either through staff resources or consultant services (funded by the requesting agency) under OCTA oversight.

3.1.4 Base Year and Forecast Year(s)

If a local agency requires special OCTAM model runs, this can be accommodated in one of two ways. One, the local agency, in collaboration with OCTA, would develop a work plan and schedule agreeable by both parties. The work efforts could range from local staff doing most of the work, under OCTA oversight, to OCTA doing the work with local staff support, or combination thereof.

Alternatively, OCTA would provide a list of consultants certified to run OCTAM using OCTA's facilities. The local agency requesting the model runs would contract directly with the consultant. OCTA will also consider other proposals for making OCTAM more accessible to local agencies.

3.2 Trip Generation

A socioeconomic based trip generation procedure is recommended. The procedure is a two-step process: 1) convert city land use data to socioeconomic data, and 2) apply appropriate trip rates. In the first step, city land use data are converted to socioeconomic data based on the housing vacancy rates shown in Appendix B, and the employment conversion factors shown in Appendix C. Initially, the mid-range employment conversion factors in Appendix C should be used, and if warranted, adjustments within the range may be necessary to reflect local conditions. The second step of the process is to apply appropriate socioeconomic trip rates, shown in Appendix D, by OCTAM trip purposes.

The concept of the proposed subarea modeling methodology is to use the local trip generation model to develop production and attraction factors, which will be used to update the OCTAM based subarea trip tables. Production and attraction growth factors would be developed based on changes in productions and attractions estimated by the subarea trip generation model. These factors would then be applied to the trip distribution component of the subarea model, using the FRATAR redistribution algorithm to adjust the trip table. This procedure would preserve the regional trip distribution patterns, while providing subarea models with the ability to analyze land use alternatives.

3.3 Trip Distribution

The trip distribution component of the subarea model would be based on the FRATAR redistribution procedure. The first step of the process is to transform the OCTAM trip tables to the subarea zonal structure by compressing and expanding the OCTAM TAZs to the appropriate subarea TAZs. In cases where OCTAM TAZs are subdivided into two or more subarea TAZs, the OCTAM trip ends will be proportioned based on the productions and attractions developed by the subarea trip generation model.

In order to evaluate land use alternatives, production and attraction growth factors need to be developed using the subarea trip generation process. The growth factors would then be applied using a FRATAR trip redistribution process. Under certain conditions, it may be necessary to run a new OCTAM benchmark to supplement the FRATAR redistribution process. The OCTAM trip distribution model should be rerun if any of the following conditions occur:

1. A change in land use of more than a 100%, in the subarea TAZ(s) corresponding to the relevant OCTAM TAZ.
2. Instances where the OCTAM TAZ has no trips and the corresponding subarea TAZ(s) has land use activity.
3. Addition of a freeway or major arterial highway; generally a roadway that would provide a significant change in travel time. Addition of a missing link in a gridded network probably would not fit this definition.

These guidelines are not hard and fast rules, and likely to change as the procedures are refined over time. Each guideline should be evaluated on its own merit.

3.4 Mode Choice (If Applicable)

Based on the level of analysis required to address specific local traffic circulation issues, there probably will not be a need for subarea models to incorporate a sophisticated mode choice model set such as the one included in OCTAM. If a local agency desires to evaluate modal alternatives, they should coordinate with OCTA. The OCTAM mode choice model would be made available either through OCTA staff resources or by OCTA approved consultants (funded by the requesting agency) under OCTA oversight.

The OCTAM trip tables can provide subarea models with any combination of the following modes: single occupant vehicles, 2-person carpool, 3-or-more person carpool, transit, and toll road users. Transit trips can be provided by sub-modes including local bus, express bus, urban rail, and commuter rail as well as by mode of access including walk, auto park-and-ride, and auto kiss-and-ride.

The OCTAM mode choice trip tables provide the subarea model with the capability to respond to inquiries pertaining to mode choice issues, albeit limited in ability to explore the full range of modal alternatives. The procedure is to first translate the OCTAM mode choice output to the subarea zone structure then calculate mode split percentages for each origin and destination pair or trip interchange. How the mode split percentages are calculated depends on whether the subarea trip generation model is based on person or vehicle trips.

The mode split percentages would then be applied to the appropriate subarea person or vehicle trip table. This procedure will allow subarea models to estimate modal shares based on changes in travel demand resulting from an increase or decrease in trip generation. Major changes in the transportation system may require running the OCTAM mode choice model to properly reflect mode shift. Examples of major changes include significant changes in transit level of service, adding a major roadway or HOV facility and/or modeling transportation control measures that target single occupant vehicle trip reduction.

3.5 Trip Assignment

The two most common capacity restraint trip assignment methodologies used in Orange County are the equilibrium and incremental algorithms. Both of these methods are based on an iterative capacity restraint procedure. OCTAM and a few subarea models use the equilibrium procedure, while other subarea models use the incremental approach. Since there are variations on how these procedures are applied, the guidelines will evaluate each method on a case-by-case basis during the certification process.

OCTA will provide OCTAM trip tables by five trip purposes (home-based work, home-based school, home-based other, work-based other and other-based other). OCTAM time-of-day and production-attraction to origin-destination factors should be applied to establish consistency with OCTAM. For subarea model applications, “peaking factors” could be applied based on traffic counts reflecting local peak-hour traffic characteristics.

3.5.1 Post-Assignment Model Adjustment Methodology

Traffic counts used to verify the trip assignment model should be substantiated for accuracy and rationalized for continuity before they are used in the trip assignment calibration/validation process. It should be recognized that traffic counts themselves have daily and seasonal fluctuations and could vary by as much as fifteen percent (15%) within a given day.

During the model base year validation process, it is common practice to calibrate the network model volumes with actual traffic counts. Some of the network calibration process includes verifying proper network access from zone centroid connectors, capacity assumptions, network speeds, as well as zonal productions and attractions. Caution must be exercised when making these network adjustments to avoid introducing biases in the network that might adversely affect future year forecasts. In spite of these adjustments, there may still be a need to adjust the "raw" model output to account for atypical network conditions and minor model aberrations.

The *Transportation Research Board National Cooperative Highway Research Program Report 255* (TRB NCHRP, 1991) established guidelines and procedures for adjusting transportation model outputs and developed criteria for acceptable levels of modeling accuracy. Specific model adjustment procedures following the NCHRP Report 255 guidelines should be fully documented if they are applied in the subarea model.

OCTAM incorporates a post-assignment model adjustment procedure that is consistent with the NCHRP 255. In adjusting the OCTAM future year forecast, the methodology compares the traffic assignment of the base year model with the forecast year model, and applies either their absolute difference or ratio, to the base year count data. If the link volume of the base year model is less than the base year count, the incremental difference between the base year and future year model is applied to the base year count volume, otherwise the ratio of base year and future year model is used.

4. OPTIONAL MODELING METHODOLOGY

The methodology presented in Chapter 3 is an integrated subarea modeling approach that promotes consistency with the OCTAM regional model. The methodology captures the full spectrum of the OCTAM capabilities, including use of the most current travel surveys and transportation data in the region. Implementing the methodology in Chapter 3 should help facilitate the consistency determination described in Chapter 5.

However, this manual acknowledges that there are many ways in which subarea modeling can be constructed. This Chapter sets general guidelines and requirements for an optional subarea modeling methodology.

4.1 General Consistency Requirements

Subarea models would be considered consistent with OCTAM provided that they meet criteria established in Chapter 5. A subarea model certification process has been established in Chapter 6.

4.2 Input Assumptions

Model input data must be consistent with the requirements set forth in Chapter 2.

4.3 Model Structure

All current travel demand forecasting models in the SCAG region, including Orange County, are based on the traditional sequential modeling approach, therefore, subarea models must be structured under this modeling framework. However, since there are many combinations of model structures within this framework, each subarea model structure will be evaluated on a case-by-case basis.

5. CONSISTENCY DETERMINATION

Each subarea model under consideration for consistency determination with OCTAM will need to meet the guidelines and criteria established in this chapter. Variances and final consistency determination will be made by OCTA with an appeal process as described in Chapter 6. Appendix F provides a detailed checklist that OCTA uses to determine consistency with OCTAM.

In the traditional four-step sequential modeling process, each modeling step is developed and validated independently. Consistency comparison between OCTAM and the subarea models should also be done for each step of the modeling process. However, the OCTAM trip generation and trip distribution models are based on person trips, and most subarea models are based on vehicle trips, therefore, direct comparison cannot be made with these modeling components. Instead, the trip generation and trip distribution components of the subarea models shall be compared with vehicle trips from the OCTAM mode choice model. The subarea trip generation model shall be compared with the OCTAM mode choice vehicle trip end summaries (productions and attractions) and the trip distribution model would be compared directly with the OCTAM vehicle trip table (mode choice output). If, however, person trips are used in the subarea model, then comparisons shall be made at the appropriate corresponding modeling steps.

Subarea consistency will be established by comparing OCTAM and the subarea model for each modeling step. This information will be used as a reference point for consistency findings and to provide a basis for comparing changes in the subarea modeling assumptions and input data. Consistency comparisons will be made for both the OCTAM base year and horizon year projections.

Base Year Consistency Comparison

1. Convert OCTAM base year (2000) trip tables to the subarea zone structure and assign to the subarea network.
   - *Compare results as specified in Section 5.4.*

   Intent: This comparison is to insure that there are no procedural and/or technical issues in the data conversion and application process.

2. Apply subarea trip generation procedure to OCTAM base year (2000) socioeconomic data
   - *Compare results between OCTAM and Subarea trip generation models as specified in Section 5.1.*

   Intent: This comparison will illustrate differences in results between the subarea and OCTAM trip generation programs/methodologies, and help reconcile significant differences, if any.

3. Apply subarea trip generation procedure to local land use/socioeconomic data and run the entire subarea model set.
   - o *Compare results as specified in the following sections.*

   Intent: This comparison will show the impact of differences between the OCTAM and the subarea model using local land use/socioeconomic data.

Future Year Projections

Consistency procedures similar to the base year comparisons should be made to benchmark future year projections.

5.1 Trip Generation

The trip generation methodology and supporting computer programs shall be fully documented as described in Section 5.5. Trip generation shall be compared at two geographical levels: the primary modeling area and the entire modeling area. Table 5-1 provides a format for comparing trip generation between OCTAM and the subarea model for the primary modeling area. Table 5-2 compares OCTAM and subarea trip generation by RSAs and CAAs. This comparison is only necessary for RSAs and CAAs that are impacted by the subarea trip generation process. The trip productions and trip attractions of the subarea model shall be considered consistent with OCTAM if the Base Year 2000 is within ten percent (10%) of the OCTAM trip productions and attractions summaries.

Table 5-1 Trip Generation Comparison

(Primary Modeling Area)

OCTAM TAZ	SUBAREA TAZ	OCTAM		SUBAREA MODEL		% DIFFERENCE	
		PROD.	ATTR.	PROD.	ATTR.	PROD.	ATTR.
1500	100	7000	5750	2500	2000		
	101			2000	1500		
	102			3000	2500		
Subtotal		7000	5750	7500	6000	7.1%	4.3%
1550	103	5050	4500	2150	1975		
	104			3000	2650		
Subtotal		5050	4500	5150	4625	2.0%	2.8%

Table 5-2 Trip Generation Comparison

(RSAs and CAAs Impacted by Change)

RSA	CAA	OCTAM		SUBAREA		% DIFFERENCE	
		PROD.	ATTR.	PROD.	ATTR.	PROD.	ATTR.

5.2 Trip Distribution

The trip distribution modeling methodology and supporting computer programs shall be fully documented as described in Section 5.5. Tables 5-3, 5-4, and 5-5 provide a format for comparing the subarea vehicle trip table with OCTAM. The subarea trip distribution model shall be considered consistent with OCTAM if all trip interchanges in Table 5-5 are within ten percent (10%).

This comparison shall be made with the final subarea trip table for both the base year and horizon year projections. The purpose of this comparison is to evaluate and understand differences, if any, between OCTAM and the subarea model.

Table 5-3 Trip Distribution Summary
(Subarea Model)

[PROD¯][ATTR®]	RSA - A	RSA - B	RSA - C	RSA - D	RSA - E	RSA - F	RSA - G	RSA - H	RSA - I	RSA - J	TOTAL
RSA - A											
RSA - B											
RSA - C											
RSA - D											
RSA - E											
RSA - F											
RSA - G											
RSA - H											
RSA - I											
RSA - J											
TOTAL											

Table 5-4 Trip Distribution Summary
(OCTAM)

[PROD¯][ATTR®]	RSA - A	RSA - B	RSA - C	RSA - D	RSA - E	RSA - F	RSA - G	RSA - H	RSA - I	RSA - J	TOTAL
RSA - A											
RSA - B											
RSA - C											
RSA - D											
RSA - E											
RSA - F											
RSA - G											
RSA - H											
RSA - I											
RSA - J											
TOTAL											

Table 5-5 Trip Distribution Summary
(% Difference)

[PROD¯][ATTR®]	RSA - A	RSA - B	RSA - C	RSA - D	RSA - E	RSA - F	RSA - G	RSA - H	RSA - I	RSA - J	TOTAL
RSA - A											
RSA - B											
RSA - C											
RSA - D											
RSA - E											
RSA - F											
RSA - G											
RSA - H											
RSA - I											
RSA - J											
TOTAL											

5.3 Mode Choice (If Applicable)

The mode choice modeling methodology and supporting computer programs shall be fully documented as described in Section 5.5. The mode choice model outputs shall be summarized by RSAs, as well as by the primary modeling area. Comparison shall be made between the subarea model and OCTAM. Tables 5-6, 5-7, and 5-8 provide a format for this comparison. The subarea mode choice model (or factored modal shares) shall be considered consistent with OCTAM if all modal trips are within ten percent (10%).

Note: This comparison is not required if the subarea modeling methodology in Chapter 3 is followed.

Table 5-6 Mode Choice Model Comparison

(Subarea Model Summary)

ZONE	VEHICLE OCCUPANCY			TRANSIT	NON-MOTORIZED
	SINGLE	2-PERSON	3 OR MORE		
PRIMARY					
RSA - A					
RSA - B					
RSA - C					
RSA - D					
RSA - E					
RSA - F					
RSA - G					
RSA - H					
RSA - I					
RSA - J					
TOTAL					

Table 5-7 Mode Choice Model Comparison
(OCTAM Model Summary)

ZONE	VEHICLE OCCUPANCY			TRANSIT	NON-MOTORIZED
	SINGLE	2-PERSON	3 OR MORE		
PRIMARY					
RSA - A					
RSA - B					
RSA - C					
RSA - D					
RSA - E					
RSA - F					
RSA - G					
RSA - H					
RSA - I					
RSA - J					
TOTAL					

Table 5-8 Mode Choice Model Comparison
(% Difference)

ZONE	VEHICLE OCCUPANCY			TRANSIT	NON-MOTORIZED
	SINGLE	2-PERSON	3 OR MORE		
PRIMARY					
RSA - A					
RSA - B					
RSA - C					
RSA - D					
RSA - E					
RSA - F					
RSA - G					
RSA - H					
RSA - I					
RSA - J					
TOTAL					

5.4 Trip Assignment

The trip assignment modeling methodology and application of supporting computer programs shall be fully documented as described in Section 5.5. Trip assignment consistency findings shall be based on two concepts: 1) control points, and 2) screenlines, both of which are described in Sections 5.4.1 and 5.4.2, respectively. Control point and screenline comparisons shall compare OCTAM post-assignment model adjusted forecast traffic volumes to the subarea model forecast volumes. A clear distinction as to whether the subarea model forecast volumes have been adjusted must be provided. If a post-assignment model adjustment process is applied to subarea assignment results, the adjusted volumes shall be compared to OCTAM.

5.4.1 Control Point Validation

The control point concept compares average daily traffic (ADT) assignment model output between OCTAM and the subarea model at specific locations on the transportation network. These locations are at each leg of the designated CMP intersections as well as at selected locations on the freeway system (Figure 5-1). ADT from the subarea baseline and benchmark runs must agree within ten percent (10%) of OCTAM ADT, only at locations within the primary modeling area. Table 5-9 provides an example of how the control points shall be compared.

5.4.2 Screenline Validation

For comparison purposes, screenlines will be established at the westerly, easterly, northerly, and southerly extremes of the primary modeling area boundary. In addition, a longitudinal and latitudinal screenline crossing at approximately the center of the primary modeling area shall also be used to compare the subarea model ADT with OCTAM. Figure 5-2 shows an example of how the screenline locations should be established. The total ADT of each subarea screenline shall be within ten percent (10%) of the corresponding OCTAM screenline. Table 5-10 provides an example of how the screenlines shall be compared.

5.5 Full Disclosure Documentation

The subarea modeling methodology must be fully documented and include all the information necessary to replicate validation of the base year subarea model by OCTA. All information used for subarea model development and application are to be disclosed for purposes of corroborating model validation. No “black-box” model will be accepted. Since the current modeling methodology is based on application of independently developed sequential models, each model set must be validated independently. However, aggregate application of the sequential models may require the need to revalidate the models with empirical data using sound statistical procedures. In any event, the validation of the subarea model must be fully documented before any consistency findings can be made.

Control Point Locations

Figure 5-1

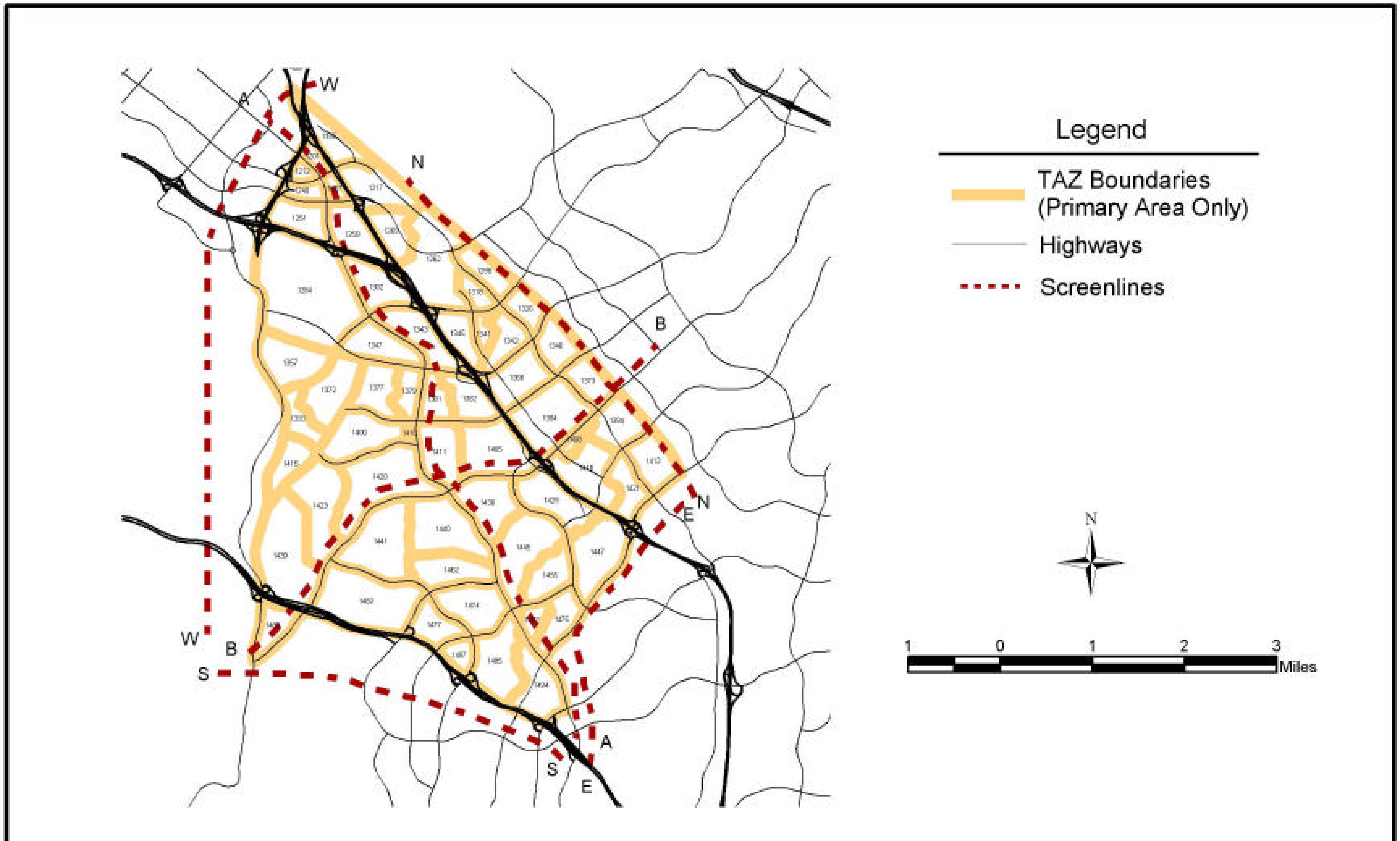
Table 5-9 Trip Assignment (Control Point) Comparison

CONTROL POINT LOCATION	(1) COUNTS	(2) OCTAM/ SUBAREA	(3) OCTAM	(4) SUBAREA	% DIFFERENCES				
					(1) Vs. (2)	(2) Vs. (3)	(1) Vs. (3)	(1) Vs. (4)	(3) Vs. (4)
TOTAL									

Table 5-10 Trip Assignment (Screenline) Comparison

SCREENLINE	(1) COUNTS	(2) OCTAM/ SUBAREA	(3) OCTAM	(4) SUBAREA	% DIFFERENCES				
					(1) Vs. (2)	(2) Vs. (3)	(1) Vs. (3)	(1) Vs. (4)	(3) Vs. (4)
TOTAL (Westerly)									
TOTAL (Easterly)									
TOTAL (Northerly)									
TOTAL (Southerly)									
TOTAL (Longitudinal)									
TOTAL (Latitudinal)									

Note: (2) OCTAM/SUBAREA is OCTAM Trip Tables applied to subarea network.



Subarea Model Screenline Locations

Figure 5-2

5.5.1 Computer Files/Programs (For Model Corroboration)

The purpose of this Section is to encourage standardization of subarea modeling procedures as well as the modeling software used in subarea models. Standardization facilitates OCTA review of subarea models and provides an environment to readily share data and software development products between agencies. OCTAM is based on the TRANPLAN modeling software system. SCAG, Los Angeles County Metropolitan Transit Authority, Caltrans Districts 7 and 12, and most models in Southern California also use this software.

In order to corroborate modeling results, the input highway network and trip tables used for trip assignment shall be provided in TRANPLAN binary or ASCII formats that are compatible with OCTA's computer environment. Other computer files (GIS layer of subarea TAZs, if available) that OCTA deems necessary to corroborate the subarea baseline and benchmark runs must also be provided. Subarea models that use modeling software other than TRANPLAN may be required to provide sensitivity test runs specified by OCTA for purposes of corroborating the subarea modeling results.

5.5.2 Future Modeling Software

SCAG continues to consider moving their regional model from the TRANPLAN environment; however, to date no firm decision has been made. They have insured the region that any new major model development efforts will be in an open system, such that it could operate in the TRANPLAN environment with minimal modifications.

OCTA has decided to convert to the TransCAD environment with the conversion process and parallel processing taking place over the next 12-18 months. This conversion should not affect how subarea models are applied in Orange County. OCTA will continue to support TRANPLAN based subarea models.

6. CERTIFICATION PROCESS

All subarea models sanctioned for use in OCTA's mandated programs must be certified by OCTA for consistency with OCTAM. The certification will be in effect until significant changes are made to either the OCTAM or the subarea model, whichever occurs first. For purposes of this guidelines manual, subarea models shall be updated with new OCTAM/OCP data if one of the following conditions are met:

A. If a change of greater than ± 10% occurs on roadway links at the subarea model primary area boundary, when comparing the OCP version used in the subarea model versus the most current OCP. OCTAM will be used to make this comparison.

   Notes:
   1. OCP will be compared for the horizon year projections, which may differ between OCP versions. For example, the horizon year for OCP-2000 is 2025 and the horizon year for OCP-2004 is 2030.
   2. For purposes of the ± 10% threshold criteria, only links with volumes greater that 10,000 will be compared.
   3. Certified subarea models that have been developed/updated within a year after OCTAM has been updated with the current OCP, may be exempt from the above requirements provided that the subarea model addresses the issue with an OCTA approved methodology.

B. Subarea model shall be updated at least once every five years with new OCTAM/OCP data and revalidated with current traffic counts.

OCTA will conduct triennial surveys (consistent with the OCP update schedule) to monitor changes made to subarea models. This will serve two purposes: 1) to insure that OCTAM is current with local modeling issues and 2) to verify that no significant changes have been made to the subarea model since its original certification.

Subarea models that are found consistent with OCTAM, as determined by requirements in Chapter 5, will receive a written certification of consistency. Subarea models that are found to be inconsistent with OCTAM will be provided with suggestions on how to make the model consistent. However, it is the cities' ultimate responsibility to resolve the consistency issues as outlined in this subarea modeling guidelines. The city may request that unresolved or disputed issues be referred to an appeal process.

6.1 Appeal Process

A Technical Review Committee will be established to review disputes on subarea model consistency findings and make recommendations to OCTA. The Technical Review Committee will be comprised of OCTA staff, representatives from two Orange County cities and two modeling consultants representing the private sector. OCTA will make the selection based on local/regional modeling knowledge and expertise, with concurrence from the Orange County Modeling Technical Advisory Committee.

Step 1

The agency/consultant provides OCTA with comprehensive documentation of the subarea model and submits the model for review by OCTA. If necessary, OCTA will meet with the agency/consultant to discuss any modeling/data issues. OCTA will provide a finding of consistency or document specific issues hindering a consistency finding following evaluation of the subarea model. If the subarea model is found to be inconsistent with OCTAM, it shall be modified to be consistent.

Timeline: Approximately four (4) weeks will be required to review the subarea model once all requested information has been provided.

<u>Step 2</u>

The agency/consultant that submitted a subarea model under dispute will be given an opportunity to present their case to the Technical Review Committee. The committee evaluates the issues and makes a recommendation to OCTA.

Timeline: Approximately two (2) to four (4) weeks, depending upon how soon the committee can meet, as well as the nature of the technical issue(s) and how soon the agency/consultant can provide supplemental information requested by the review committee.

<u>Step 3</u>

OCTA receives the Technical Review Committee's recommendation, reevaluates the issues, and makes a final decision on consistency findings.

Timeline: Approximately two (2) weeks.

REFERENCES

1. Applied Management and Planning Group, *SCAG 1991 Origin and Destination Survey*, Southern California Association of Governments, 1991.

2. Applied Management and Planning Group, *1995 School Travel Survey*, Orange County Transportation Authority and Orange County Environmental Management Agency, 1995.

3. Deakin/Harvey/Skabardonis, *A Manual of Transportation-Air Quality Modeling for Metropolitan Planning Organizations*, prepared for the National Association of Regional Councils, 1993.

4. Institute of Transportation Engineers, *Trip Generation*, 5th Edition, Washington, D.C., 1991.

5. JHK & Associates in association with Dowling Associates, *Travel Forecasting Guidelines*, California Department of Transportation, November 1992.

6. Orange County Transportation Authority, *1990 On-Board Bus Passenger Surveys*, OCTA, 1990.

7. Transportation Research Board National Cooperative Highway Research Program Report 255.

8. U.S. Census Bureau, *1990 Census*, 1990.

APPENDIX A

OCTAM Socioeconomic Zonal Variables

OCTAM SOCIOECONOMIC ZONAL VARIABLES

Resident Population: Total persons excluding institutionalized persons in census-defined group quarters.

Employed Residents: Total employed persons 16 years and over (including part-time workers, self-employed workers and unpaid family workers).

Median Income: Median household income in 1989 dollars.

Single-Family Dwelling Units (SDU): Occupied single-family detached housing units.

Multiple-Family Dwelling Units (MDU): Occupied multi-family housing units.

Total Dwelling Units: Total occupied housing units.

Group Quarters: Only persons in non-institutionalized group quarters. (Not used in OCTAM).

Household Size: Average persons per total occupied housing unit.

Auto Ownership: Total number of vehicles available per household. Only required for years 1990 and 1995 (OCTAM includes an auto ownership sub-model).

Total Employment: All employees including military personnel, civilian personnel and self-employed.

Retail Employment: All employees in occupation categories listed under Standard Industrial Classification (SIC) Division G, major groups 52-59.

Service Employment: All employees in occupation categories listed under SIC Divisions I, major groups 70-89.

Other Employment: Total Employment excluding Retail and Service Employment.

School Enrollment: Total number of students attending public and private elementary, junior high, and high schools.

University Enrollment: Total number of students attending major public and private colleges and universities.

Zonal Area: Total acreage of zone.

Licensed Drivers: Total number of licensed drivers. (Not used in OCTAM)

APPENDIX B

Housing Unit Vacancy By City

Note: The current vacancy rates used in OCP-2004 are based on the 2000 U.S. Census data and applied at the census tract level.

HOUSING UNIT VACANCY BY CITY

CITY	2000 Vacancy	2030 Vacancy
ALISO VIEJO	2.7%	1.7%
ANAHEIM	2.7%	1.6%
BREA	1.9%	1.3%
BUENA PARK	2.1%	1.3%
COSTA MESA	2.9%	1.5%
CYPRESS	2.3%	1.3%
DANA POINT	8.1%	3.5%
FOUNTAIN VALLEY	1.6%	0.8%
FULLERTON	2.6%	1.4%
GARDEN GROVE	1.9%	1.2%
HUNTINGTON BEACH	2.6%	1.4%
IRVINE	4.8%	2.3%
LA HABRA	2.5%	1.4%
LA PALMA	2.0%	1.1%
LAGUNA BEACH	11.2%	4.9%
LAGUNA HILLS	2.9%	1.4%
LAGUNA NIGUEL	2.8%	1.4%
LAGUNA WOODS	7.5%	4.2%
LAKE FOREST	2.1%	1.1%
LOS ALAMITOS	1.8%	1.4%
MISSION VIEJO	1.7%	1.1%
NEWPORT BEACH	10.9%	4.4%
ORANGE	2.3%	1.2%
PLACENTIA	1.8%	1.1%
RANCHO SANTA MARGARITA	1.7%	0.9%
SAN CLEMENTE	6.0%	2.9%
SAN JUAN CAPISTRANO	3.1%	1.8%
SANTA ANA	2.1%	1.3%
SEAL BEACH	8.5%	4.4%
STANTON	2.2%	1.2%
TUSTIN	5.9%	1.6%
Unincorporated	4.9%	2.2%
VILLA PARK	3.5%	1.6%
WESTMINSTER	2.0%	1.1%
YORBA LINDA	1.5%	1.2%

Source: OCP 2004

APPENDIX C

Typical Employment Conversion Factors

TYPICAL EMPLOYMENT CONVERSION FACTORS
(June 2001)

Land Use Category	Conversion Rates Range	Employment Type (Percentage Ranges)		
		Retail	Service	Other
Commercial	2.25 –2.75 employees/TSF[1]	60% - 90%	10% - 40%	0% – 5%
Office/Office Park	3.00 – 4.00 employees/TSF	0% – 5%	20% – 30%	65% - 80%
R&D/Light Industrial/Business Park	2.50 – 3.50 employees/TSF	0% – 5%	0% - 30%	60% - 100%
Heavy Industrial	2.00 – 2.50 employees/TSF	0%	0%	100%
Warehouse	1.00 – 2.00 employees/TSF	0%	0%	100%
Restaurant	3.00 – 5.00 employees/TSF	100%	0%	0%
Medical Office/Post-Office/Bank	3.50 – 4.50 employees/TSF	0% - 10%	70% - 100%	0% – 20%
Government Office/Civic Center	3.00 – 4.00 employees/TSF	0% – 5%	50% - 70%	25% – 50%
Hospital	2.50 – 3.00 employees/TSF	0%	70% - 80%	20% – 30%
Library/Museum	1.50 – 2.50 employees/TSF	0%	100%	0%
Hotel/Motel	0.75 – 1.25 employees/room	0% - 10%	70% - 80%	10% – 30%
Schools	0.08 – 0.12 employees/student	0%	0%	100%
Golf Course	0.50 – 0.70 employees/acre	0% - 10%	90% - 100%	0%
Developed Park/Athletic Fields	0.20 – 0.40 employees/acre	0%	80% - 100%	0% – 20%
Park	0.05 – 0.10 employees/acre	0%	80% - 100%	0% – 20%
Agricultural	0.01 – 0.05 employees/acre	0%	0%	100%

[1] Thousands of Square Feet

APPENDIX D

Socioeconomic Data Trip Rates

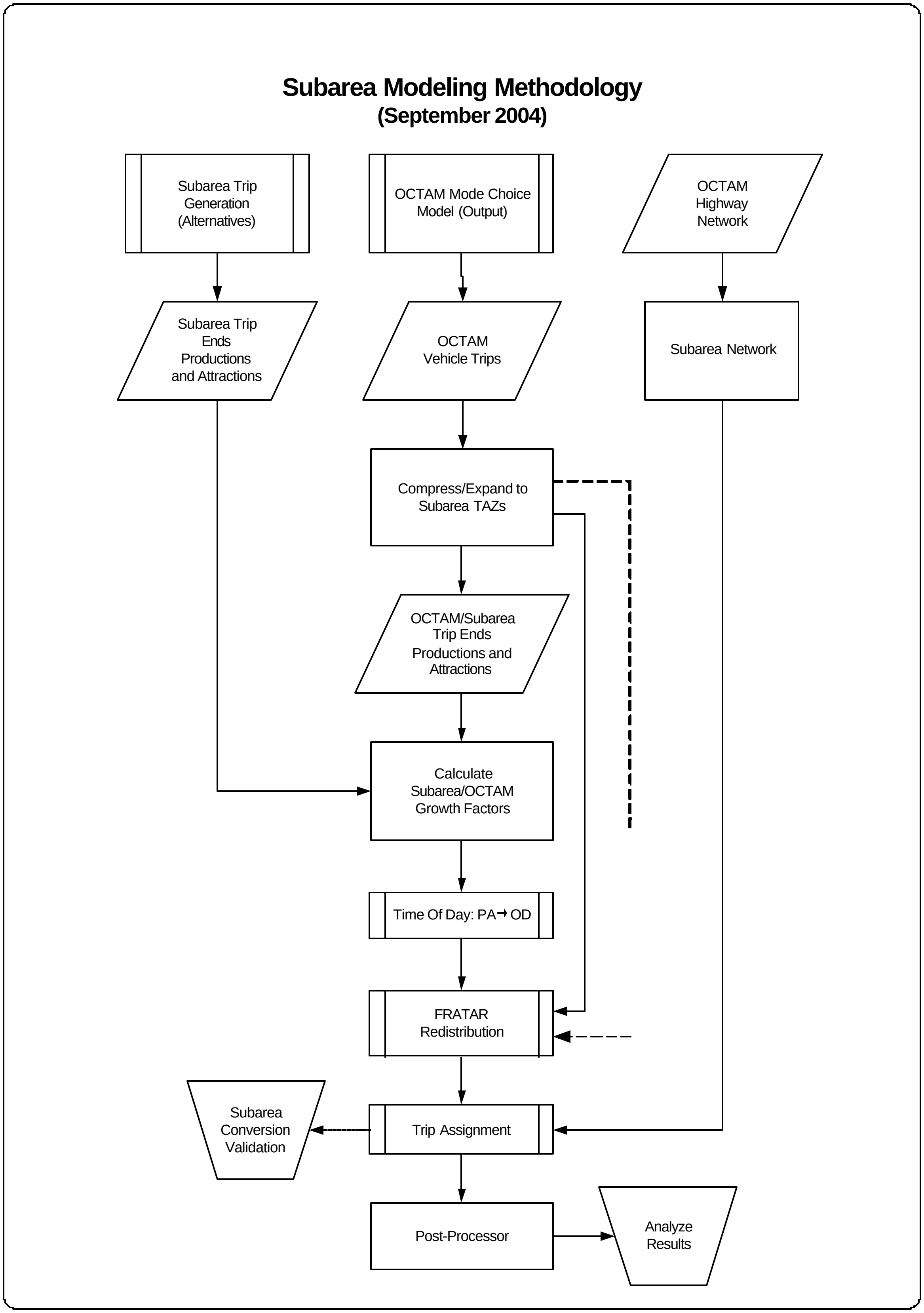
SOCIOECONOMIC DATA TRIP RATES
(June 2001)

VARIABLE	Single Family Residential	Multi Family Residential	Population	Employed Residents	Income (Million $)	Retail Employment	Service Employment	Other Employment	School Enrollment (Student)	Univ./College Enrollment
PRODUCTION TRIP RATES										
HBW	0.00	0.00	0.00	1.27	0.00	0.00	0.00	0.00	0.00	0.00
WBO	0.00	0.00	0.00	0.00	0.00	1.83	1.07	1.01	0.00	0.00
HBO	1.05	0.60	0.24	0.00	13.00	0.00	0.00	0.00	0.00	0.00
HBS	0.89	0.46	0.11	0.00	11.00	0.00	0.00	0.00	0.00	0.00
OBO	0.44	0.43	0.00	0.00	2.00	5.20	1.08	0.24	0.00	0.20
HBUniv	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HBSch	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ATTRACTION TRIP RATES										
HBW	0.10	0.10	0.00	0.00	0.00	1.24	1.24	1.26	0.00	0.00
WBO	0.25	0.25	0.00	0.00	0.00	3.44	0.60	0.54	0.00	0.20
HBO	0.40	0.39	0.00	0.00	1.00	3.46	0.90	0.10	0.00	0.00
HBS	0.00	0.00	0.00	0.00	0.00	5.54	0.00	0.00	0.00	0.00
OBO	0.41	0.45	0.00	0.00	2.00	4.84	1.10	0.20	0.00	0.20
HBUniv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91
HBSch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.00
DAILY	**3.54**	**2.68**	**0.54**	**1.27**	**29.00**	**25.55**	**5.99**	**3.35**	**0.88**	**1.51**

Note: These trip rates were developed by Urban Crossroads in corroboration with Austin-Foust Associates and OCTA.

APPENDIX E

Subarea Modeling Methodology (Flow Chart)


Subarea Modeling Methodology
(September 2004)
Subarea Trip Generation (Alternatives)
OCTAM Mode Choice Model (Output)
OCTAM Highway Network
Subarea Trip Ends Productions and Attractions
OCTAM Vehicle Trips
Subarea Network
Compress/Expand to Subarea TAZs
OCTAM/Subarea Trip Ends Productions and Attractions
Calculate Subarea/OCTAM Growth Factors
Time Of Day: PA→OD
FRATAR Redistribution
Subarea Conversion Validation
Trip Assignment
Post-Processor
Analyze Results

APPENDIX F

Subarea Model Consistency Review Checklist

OCTA

Subarea Model Consistency Review Checklist

City Traffic Analysis Model -- DATE

Consistency Areas	Included	Meets Consistency Requirement	Comments
I. Existing Subarea Infrastructure Verification			
1. Model Input Data Consistency			
a. Zone Structure			
b. Existing Model Network			
c. Future Model Network			
2. Screenline Comparison To OCTAM*			
a. Existing			
b. Future			
II. Subarea Existing Baseline Model			
1. Socioeconomic Data			
a. Comparison to OCTAM 3.1 (Primary Modeling Area)			
b. Comparison to OCTAM 3.1 (External Modeling Area)			
2. Trip Generation			
a. Comparison to OCTAM 3.1 (Primary Modeling Area)			
b. Comparison to OCTAM 3.1 (RSAs and CAAs)			
3. Trip Distribution			
a. Comparison to OCTAM 3.1			
4. Mode Choice			
a. Comparison to OCTAM 3.1			
5. Trip Assignment			
a. Screenline Comparison to OCTAM 3.1			
b. Control Point Comparison to OCTAM 3.1			
III. Subarea Future Baseline Model			
1. Trip Generation			
a. Comparison to OCTAM 3.1 (Primary Modeling Area)			
b. Comparison to OCTAM 3.1 (RSAs and CAAs)			
2. Trip Distribution			
a. Comparison to OCTAM 3.1			
3. Mode Choice			
a. Comparison to OCTAM 3.1			
4. Trip Assignment			
a. Screenline Comparison to OCTAM 3.1			
b. Control Point Comparison to OCTAM 3.1			
c. Post-Processing Methodology			
IV. Full Subarea Model Disclosure Documentation			
a. Computer Files/Programs			

*Assignment of OCTAM Trip Tables (disaggregated to the Subarea zone structure) to the Subarea Network