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How We Will Grow:
Baseline Projections of the Growth of California's Urban Footprint through the Year 2100

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John D. Landis and Michael Reilly

1.0 INTRODUCTION

By 2020, most forecasters agree, California will be home to between 43 and 46 million residents—up from 35 million today. Beyond 2020, the size of California's population is less certain. Depending on the composition of the population, and future fertility and migration rates, California's 2050 population could be as little as 50 million or as much as 70 million. One hundred years from now, if present trends continue, California could conceivably have as many as 90 million residents.

Where these future residents will live and work is unclear. For most of the 20th century, two-thirds of Californians have lived south of the Tehachapi Mountains and west of the San Jacinto Mountains—in that part of the state commonly referred to as Southern California. Yet most of coastal Southern California is already highly urbanized, and there is relatively little vacant land available for new development. More recently, slow-growth policies in Northern California and declining developable land supplies in Southern California are squeezing ever more of the state's population growth into the San Joaquin Valley.

How future Californians will occupy the landscape is also unclear. Over the last fifty years, the state's population has grown increasingly urban. Today, nearly 95 percent of Californians live in metropolitan areas, mostly at densities less than ten persons per acre. Recent growth patterns have strongly favored locations near freeways, most of which were built in the 1950s and 1960s. With few new freeways on the planning horizon, how will California's future growth organize itself in space? By national standards, California's large urban areas are already reasonably dense, and economic theory suggests that densities should increase further as California's urban regions continue to grow. In practice, densities have been rising in some urban counties, but falling in others.

These are important issues as California plans its long-term future. Will California have enough land of the appropriate types and in the right locations to accommodate its projected population growth? Will future population growth consume ever-greater amounts of irreplaceable resource lands and habitat? Will jobs continue decentralizing, pushing out the boundaries of metropolitan areas? Will development densities be sufficient to support mass transit, or will future Californians be stuck in perpetual gridlock? Will urban and resort and recreational growth in the Sierra Nevada and Trinity Mountain regions lead to the over-fragmentation of precious natural habitat? How much water will be needed by California's future industries, farms, and residents, and where will that water be stored? Where should future highway, transit, and high-speed rail facilities and rights-of-way be located? Most of all, how much will all this growth cost, both economically, and in terms of changes in California's quality of life?

Clearly, the more precise our current understanding of how and where California is likely to grow, the sooner and more inexpensively appropriate lands can be acquired for purposes of conservation, recreation, and future facility siting. Similarly, the more clearly future urbanization patterns can be anticipated, the greater our collective ability to undertake sound city, metropolitan, rural, and bioregional planning.

Consider two scenarios for the year 2100. In the first, California's population would grow to 80 million persons and would occupy the landscape at an average density of eight persons per acre, the current statewide urban average. Under this scenario, and assuming that 10% percent of California's future population growth would occur through infill—that is, on existing urban land—California's expanding urban population would consume an additional 5.06 million acres of currently undeveloped land. As an alternative, assume the share of infill development were increased to 30%, and that new population was accommodated at a density of about 12 persons per acre—which is the current average density of the City of Los Angeles. Under this second scenario, California's urban population would consume an additional 2.6 million acres of currently undeveloped land. While both scenarios accommodate the same amount of population growth and generate large increments of additional urban development—indeed, some might say even the second scenario allows far too much growth and development—the second scenario is far kinder to California's unique natural landscape.

This report presents the results of a series of baseline population and urban growth projections for California's 38 urban counties through the year 2100. Presented in map and table form, these projections are based on extrapolations of current population trends and recent urban development trends. The next section, titled **Approach**, outlines the methodology and data used to develop the various projections. The following section, **Baseline Scenario**, reviews the projections themselves. A final section, entitled **Baseline Impacts**, quantitatively assesses the impacts of the baseline projections on wetland, hillside, farmland and habitat loss.

2.0 APPROACH

Developing short-term forecasts in a state as diverse and fluid as California is a difficult proposition. Developing long-term forecasts, whether for 20, 50 or 100 years, is harder still. Developing long-term forecasts that are spatially explicit—that project which lands are likely to be developed and which are not—is closer to art than science.

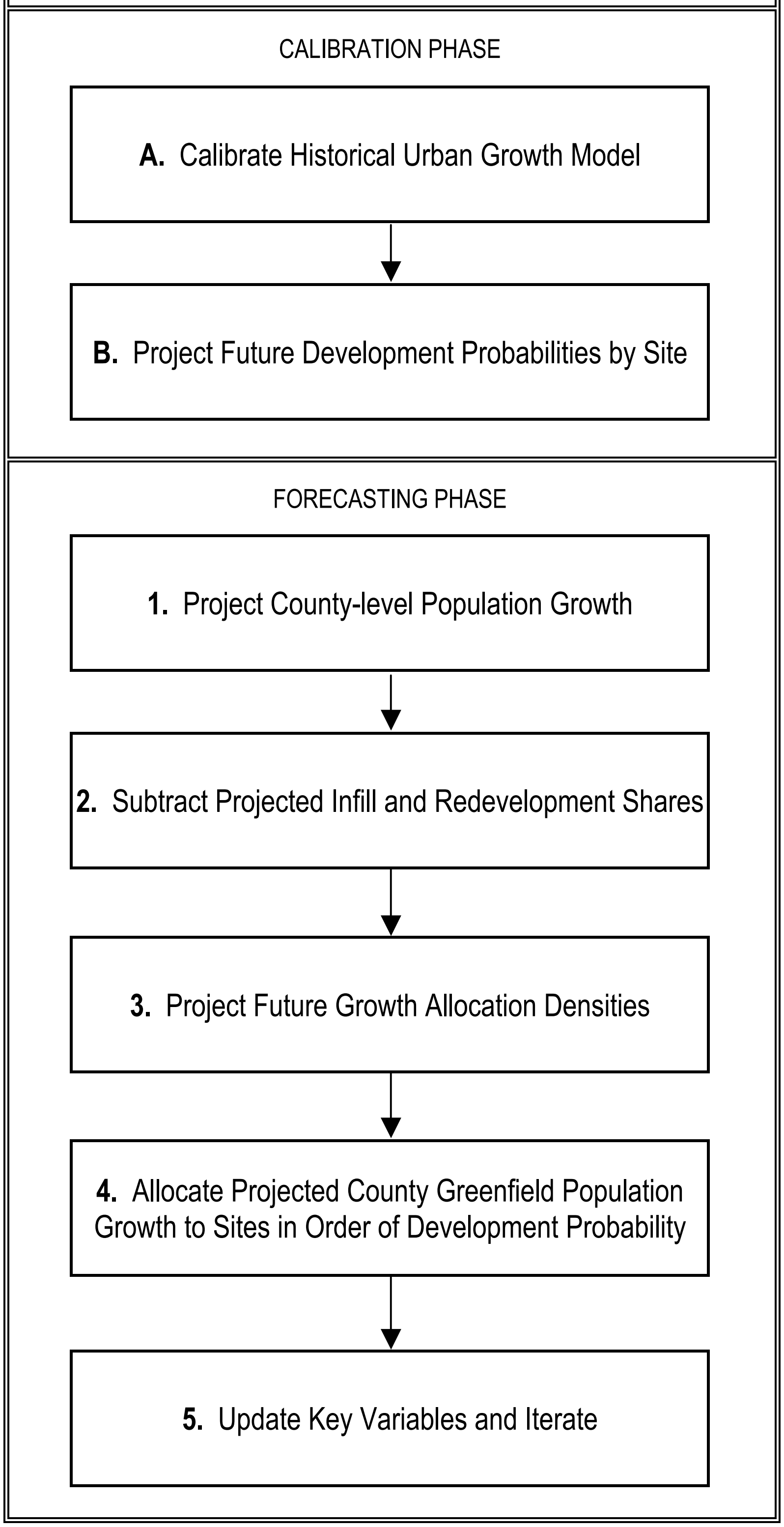
At a conceptual level, our forecasting methodology is actually quite simple (Figure 1). We begin by calibrating a spatial-statistical model of historical development patterns spanning the years 1988 to 1998 (Step A). The calibrated model parameters are then used with contemporary spatial data to generate a development probability surface describing the likelihood that particular undeveloped sites will subsequently be developed (Step B). This is the *where* part of the equation. *When* development happens is a function of state and county population growth pressures (Step 1), the share of population accommodated through infill development (Step 2), and the density at which development occurs (Step 4). Projected population growth, net of infill, is then allocated to allowable development sites in order of their projected development probability (from Step B) at a designated development density. Once a future allocation has been completed (e.g., for the 2000–2020 period), infill rates, densities, and development probabilities are updated to reflect any intervening changes. The model is then run again (Steps 1 through 5) for subsequent periods.

Alternative futures or scenarios can be tested any number of ways. Different growth increments can be postulated. Allocation densities can be adjusted up or down for regions, counties, or individual jurisdictions. More or less land can be excluded from development *a priori* through the specification of additional or fewer exclusion conditions. By changing a few input settings, for example, it is possible to compare a “business-as-usual” scenario, involving the extension of recent development trends, to an “environmental protection” scenario, in which development densities are increased and development is precluded from occurring on farmlands, wetlands, hillsides and sensitive habitats, to an “infrastructure investment” alternative in which new highways and transit systems are constructed. Subsequent reports will consider several such scenarios.

2.1 Growth Model Calibration

Before a statistical model can be used to generate future projections, it must be calibrated. With non-spatial models, this usually involves fitting a line or curve to historical data. With spatial data, this involves developing equations and estimating parameters that are sensitive

Figure 1: Urban Growth Forecasting Process



to locational as well as non-locational influences. In this case, the model being calibrated relates changes in the development status of particular sites between 1988 and 1998—measured as a matrix of one-hectare grid cells—and their various physical, locational, and administrative characteristics. As with all statistical models, the estimated parameters describe the relationship between a set of independent or explanatory variables and a single dependent variable:

$$\text{Prob [Undeveloped site}_{I} > \text{Developed]} = f(X1_{I}, X2_{I}, \ldots\ldots Xn_{I})$$

The dependent variable in this case is the change in development status between 1988 and 1998 of all potentially developable *sites*, measured as a matrix of one-hectare grid cells. Sites which were undeveloped in 1988 and remained that way through 1998 are assigned a value of "0." Sites which were developed between 1988 and 1998 are assigned a value of "1." Land use change information was obtained from the California Farmland Mapping and Monitoring Program (CFMMP), a division of the California Department of Conservation. Through a combination of remote-sensing and local ground-truthing, the CFFMP conducts detailed bi-annual land cover inventories for 38 California counties of urban development in 1988 and 1998. CFMMP data is generally accurate down to the one-hectare level.

The *X*s, or independent variables, are those attributes thought most likely to affect each site's conversion from non-urban to urban use. Independent variables can include physical site characteristics, locational and economic characteristics, the characteristics of nearby sites, and policy and administrative characteristics such as the presence of a local growth control and growth management (LGC&M) measure. Once measured, the dependent and independent variables are matched spatially using GIS.[1]

Because the dependent variable is categorical rather than continuous, the model is estimated using logistical regression, also known as *logit*, rather than linear regression. Model parameters are estimated using a maximum-likelihood procedure in which the error terms are presumed to follow a Weibull distribution. In this case, because the dependent variable takes on just two categorical values (e.g., indicating either a change in land use or no change in land use), the type of logit model presented above is known as a binomial logit model.[2]

The use of small grid-cells as surrogates for development sites exacerbates a problem known as *spatial auto-correlation*. Spatial auto-correlation refers to the fact that adjacent or nearby objects may influence each other. Some types of spatial auto-correlation are legitimate, as in the case of the rancher who observes his next-door neighbor selling to a developer and is influenced to do the same. Other types of spatial auto-correlation are artifacts, generated by the choice of the spatial unit of analysis. If, as in the current case, one-hectare grid cells are used to record land use change events, then any land use changes larger than one hectare will be recorded as multiple, adjacent events. The resulting over-counting of land use change will tend to bias the results of any statistical models calibrated on the basis of those changes. There is as yet no commonly available modeling package that corrects for spatial auto-correlation. As noted below, we attempt to do so through the explicit inclusion of *neighborhood-level* independent variables.

Four types of measures were included as independent variables:

1. <u>Demand Variables</u>, which measure the demand for sites as a function of their accessibility to job opportunities and job growth, as well local income levels. Two demand variables are included in each model: JOB_ACCESS90, which measures the number of jobs within 90 minutes of a given grid-cell, assuming travel times of 50 mph on freeways and limited access roads, and 25 mph on local roads; and INC_RATIO90, which is the ratio of community median household income to county median household income. All else being equal, we would expect sites with superior job accessibility to be more likely to be developed, and sites in upper income communities to be less likely to be developed.

2. <u>Own-site Variables</u>, which measure the physical and land use characteristics of each grid-cell as determinants of its development potential. Four own-site variables are modeled: FRWY_DISTSQ, a measure of the squared distance from each site to the nearest freeway; PRIME_FARM, a dummy variable which indicates whether the site is classified as prime farmland by the CFMMP; SLOPE, the average percentage slope of each site; and FLOOD, a dummy variable indicating whether the site falls within the FEMA-designated 100-year flood zone. Based on cost and market considerations, we would expect sites near freeways to be more likely to be developed, and sites classified as prime farmland or in flood zones to be less likely to be developed. Similarly, based on the higher cost of building on steep slopes, we would expect the probability of a site being developed to be inversely proportional to its slope.[3]

3. <u>Adjacency and Neighborhood Variables</u>, which summarize the environmental and land use characteristics of adjacent and neighboring grid-cells. Four neighborhood variables are modeled: SLOPE_1KM,

the average slope of the cells within one kilometer of each subject site; SLOPE_2-3KM, the average slope of sites within the two-to-three kilometer ring around each subject site; FLOOD_1KM, the share of sites within one kilometer of the subject site which are located in the FEMA 100-year flood zone; and FLOOD_2-3KM, the share of sites within the two-to-three kilometer ring around each subject site which are located in the FEMA 100-year flood zone. Including these variables in the model offers two benefits. It allows the characteristics of adjacent and neighboring sites to affect the development of subject sites (e.g., a flat site surrounded by steep slopes is presumed to be less likely to be developed), as well as reducing parameter bias due to potential spatial autocorrelation.

4. Regulatory and Administrative Variables, which are intended to capture the development-encouraging or development-constraining effects of different land use policies and regulations. With respect to land use policy, the dummy variable IN_CITY denotes whether or not a site is located within an incorporated city. Most California jurisdictions provide more services and a higher level of services within incorporated cities. Many California cities and counties work collaboratively to encourage city-centered development and discourage growth in unincorporated areas. We would thus expect sites located within incorporated cities to be more likely to be developed than unincorporated county lands. A second set of dummy variables, one for each county, is included to reflect inter-county differences in land use regulation.

The calibration sample consists of all one-hectare sites in a county which were undeveloped as of 1988, which were not publicly owned (and therefore could be developed), which had a slope of less than fifteen percent; and which were within fifteen kilometers (9 miles) of a major highway or existing urban development.

To better account for systematic regional variations, we tested separate models for Southern California, Northern California, the Sacramento region, and the San Joaquin Valley. The Northern California study area includes the nine counties of the Bay Area (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano and Sonoma) as well as five neighboring counties (Monterey, San Benito, San Joaquin, Santa Cruz, and Stanislaus) that now fall within commuting range of the Bay Area. The Southern California study area includes Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura counties. The Sacramento region includes Sacramento County as well as Yolo, Sutter, Yuba, El Dorado, and Placer counties. The San Joaquin Valley includes Kern, Fresno, Madera, Merced, Kings, and Tulare counties.

The results of the four regional models are presented in Figure 2. Overall, the four models fit the data extremely well, explaining more than 95% of urban land use between 1988 and 1998 in their respective regions.

We report both the standardized parameter estimate and the odds-ratio for each independent variable.[4] Except where noted, all of the parameter estimates are statistically significant, and most are of the expected signs. The importance of particular factors varies by region.

Among Southern California counties, the factors which most increased the likelihood of site development during the 1990s were freeway proximity (FRWY_DISTSQ), job accessibility (JOB_ACCESS), being located in a city (IN_CITY) and being located in Santa Barbara or San Diego counties. Steeply-sloped sites were less likely to be developed than flatter sites, and prime farmlands were somewhat less likely to be developed. Reflecting NIMBY pressures, sites in upper-income communities were significantly less likely to be developed than sites in middle- or lower-income communities. All else being equal, sites in San Bernardino County were less likely to be developed than sites elsewhere in Southern California.

Among Northern California counties, the factors which most increased the likelihood of site development during the 1990s were freeway proximity (FRWY_DISTSQ), being located in a city (IN_CITY), and being located in Napa, Sonoma, Santa Cruz, Monterey, and Stanislaus counties. Compared to Southern California, steeply sloped sites and prime farmlands in Northern California were far less likely to be developed than flatter and less fertile locations. Sites in Solano County were less likely to be developed than sites elsewhere in the Bay Area, as were sites in and around flood zones. Accessibility to jobs, while a positive influence on development, was far less significant in Northern California than Southern California. Surprisingly, sites in wealthy communities in Northern California were actually more likely to be developed than sites in poorer communities—the opposite situation than in Southern California.

Among Sacramento area counties, the factors which most affected the likelihood of site development during the 1990s were freeway proximity (FRWY_DISTSQ), whether the site was located in a flood zone (FLOOD), or on prime farmland (PRIME). Sites near freeways were much more likely to have been developed, while flood zone and prime farmland sites were much less likely to have been developed. Job accessibility (JOB_ACCESS) was also an important influence. Sites located in incorporated cities were only marginally more likely to be

Figure 2: Logistic Regression Model of 1988-98 Site-level Land Use Changes in Southern California, the Bay Area, the Sacramento Region, and the Southern San Joaquin Valley

Dependent Variable: Probability of site-level land use change, 1988-1998		Southern California Region		Northern California Region		Sacramento Region		S. San Joaquin Valley	
Independent Variables		Standardized Coefficient	Prob. Level	Standardized Coefficient	Prob. Level	Standardized Coefficient	Prob. Level	Standardized Coefficient	Prob. Level
All Regions									
Dummy Variable [Within incorporated city]	IN_CITY	0.185	0.00	0.179	0.00	0.017	0.00	0.146	0.00
Distance to freeway(km) - squared	FRWY_DISTSQ	-0.297	0.00	-0.305	0.00	-0.231	0.00	-0.0018	0.80
Regional job accessibility as of 1990	JOB_ACCESS	0.180	0.00	0.073	0.00	0.102	0.00	0.2070	0.00
Ratio of 1990 City-to-Region Median HH Income	INC_RATIO90	-0.032	0.00	0.005	0.00	-0.007	0.01	not entered	
Dummy Variable [CFMMP-designated Prime farmland]	PRIME	-0.007	0.02	-0.045	0.00	-0.131	0.00	-0.0018	0.68
Dummy Variable [FEMA Floodzone]	FLOOD	not entered		-0.023	0.01	-0.151	0.00	-0.038	0.00
Flood zone 1x Nbr. Percent	FLOOD_1X	not entered		-0.060	0.00	0.102	0.00	-0.024	0.02
Flood zone 2-3x Nbr. Percent	FLOOD_2X	not entered		-0.097	0.00	not entered		not entered	
Site slope	SLOPE	-0.031	0.00	-0.033	0.00	0.038	0.00	0.0127	0.38
Avg. slope of 1x adjacent sites	ADJ_SLOPE	-0.192	0.00	-0.291	0.00	-0.187	0.00	-0.455	0.00
Avg. slope of 1x-2x adjacent sites	NEIGH_SLOPE	0.031	0.00	-0.111	0.00	0.168	0.00	0.209	0.00
	P9098d0	0.438	0.00	not entered		0.487	0.00	0.357	0.00
	P9098d2	-0.032	0.00	not entered		0.082	0.00	-0.056	0.00
	P9010	not entered		not entered		0.101	0.00	not entered	
	P90D0M10	not entered		not entered		0.265	0.00	not entered	
	P90D2	not entered		not entered		-0.032	0.00	not entered	
Southern California County Dummy Variables									
Imperial County		0.037	0.00						
Orange County		0.018	0.00						
Riverside County		0.057	0.00						
Santa Barbara		0.127	0.00						
San Bernardino County		-0.010	0.09						
San Diego		0.076	0.00						
Ventura		0.064	0.00						

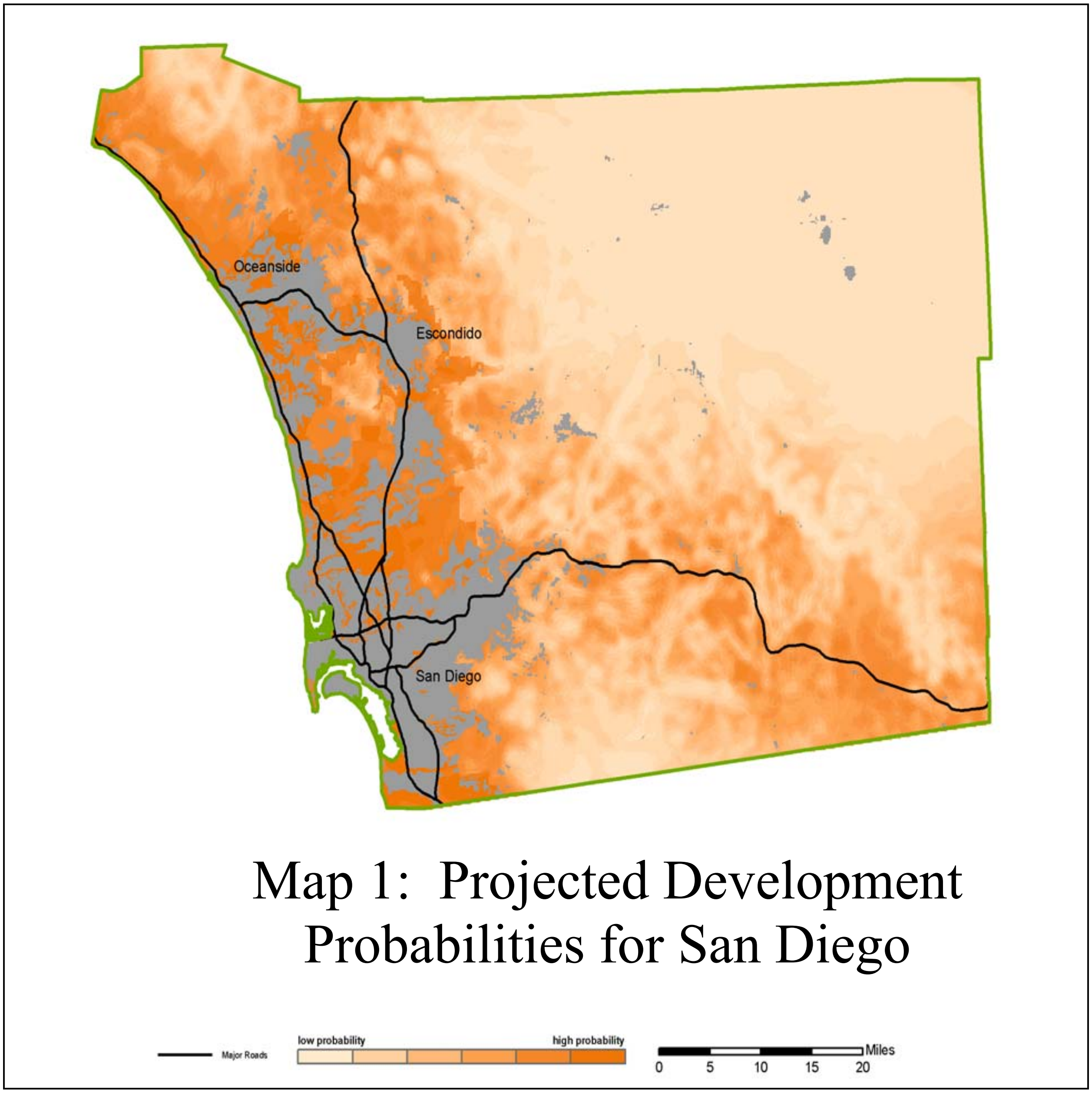
Figure 2: Logistic Regression Model of 1988-98 Site-level Land Use Changes in Southern California, the Bay Area, the Sacramento Region, and the Southern San Joaquin Valley

Dependent Variable: Probability of site-level land use change, 1988-1998	Southern California Region		Northern California Region		Sacramento Region		S. San Joaquin Valley	
Independent Variables	Standardized Coefficient	Prob. Level	Standardized Coefficient	Prob. Level	Standardized Coefficient	Prob. Level	Standardized Coefficient	Prob. Level
Northern California County Dummy Variables								
Contra Costa County			0.042	0.00				
Marin County			0.077	0.00				
Monterey County			0.099	0.00				
Napa County			0.144	0.00				
San Benito County			0.098	0.00				
San Mateo County			0.025	0.00				
Santa Clara County			0.047	0.00				
Santa Cruz County			0.126	0.00				
Solano County			-0.067	0.00				
Sonoma County			0.127	0.00				
Stanislaus County			0.119	0.00				
Sacramento Region County Dummy Variables								
El Dorado County					0.022	0.07		
Nevada County					0.111	0.00		
Placer County					0.011	0.14		
Sutter County					0.001	0.97		
Yolo County					-0.150	0.00		
Yuba County					-0.040	0.02		
South San Joaquin County Dummy Variables								
Merced County							0.029	0.00
Madera County							-0.011	0.06
Kings County							0.085	0.00
Tulare County							0.075	0.00
Kern County							-0.028	0.00
Intercept	-4.695	0.00	-5.349	0.00	-5.655	0.00	-6.463	0.00
Percent correct predictions							95.8%	
Number of Observations							3,510,148	

developed than unincorporated sites—a finding in contrast to the Southern and Northern California regions, where development strongly favored incorporated sites. The effect of community income on development activity, while negative, was also slight. Compared to sites in Sacramento County, sites in Nevada County were much more likely to have been developed between 1988 and 1998, whiles sites in Yolo County were much less likely to have been developed. Sites in El Dorado and Placer counties were marginally more likely to have been developed and sites in Yuba County were marginally less likely to have been developed.

Among counties in the San Joaquin Valley—including Fresno, Kern, Kings, Madera, Merced, and Tulare—the two factors which most affected the likelihood of site development during the 1990s were regional job accessibility (JOB_ACCESS) and whether the site was located in an incorporated city. Sites with good accessibility to jobs were much more likely to have been developed, as were sites in incorporated cities. As in the Sacramento region, hillside sites were slightly more likely to have been developed than valley sites. All else being equal, freeway accessibility had a much smaller effect on site developability in the southern San Joaquin Valley than elsewhere in the state. On the negative side, floodzone sites and sites located on prime farmland were less likely to have been developed than other, less environmentally sensitive sites, although the differences were not large. Compared to comparable sites in Fresno County, sites in Kings and Tulare counties were somewhat more likely to have been developed between 1988 and 1998, while sites in Madera and Kern counties were less likely to have been developed. Sites in Merced County were marginally more likely to have been developed than sites in Fresno County.

Once estimated, the various model parameters can be used to generate development probability scores for all remaining undeveloped sites. Map 1 presents a map of these scores for San Diego County. Use of these scores for forecasting requires assuming that the particular factors that influenced development in the recent past will continue to do so in the future, and in the same combination. To the extent that the future brings no large technological or land use policy changes, or significant shifts in household and business location preferences, the assumption that future land development trends will follow those of the past may be quite reasonable. On the other hand, to the extent that land use preferences, policies, and technologies *all change*, the usefulness of models calibrated using historical data is obviously reduced.



Map 1: Projected Development Probabilities for San Diego

2.2 Patterns of Job Growth

Depending on the region, job accessibility is either the second, third, or fourth most important determinant of urban growth patterns in California (see Figure 2). Having long-term, accurate and spatially disaggregate job projections is thus a prerequisite to developing accurate growth scenarios. This is easier said than done. The phrase “long-term, accurate, and spatially disaggregate job projections” is an oxymoron. Economies are by their very nature interdependent and unpredictable. Most available employment projections are therefore short-term and subject to constant revision. In terms of space, most job projections are undertaken at the metropolitan statistical area (MSA) or county level—as much for reasons of data availability as modeling capability.

Our approach to forecasting jobs and job accessibility is a little different. Rather than generating separate sectoral and county-level job forecasts and then aggregating them into a single regional total—as is common practice—we start with the presumption that there is a more or less regular relationship between the size of a region’s population and its employment base.[5] Acceptance of this assumption means that one can use believable regional population projections as a starting point for developing serviceable regional employment projections.

The major challenge for our purposes is not to project the total number of new jobs. Rather, it is to figure out where in each region those new jobs are most likely to locate. Fortunately, the long-term spatial trend is quite clear. Broadly speaking, we expect jobs in California to continue their historical pattern of intra-metropolitan decentralization. Prior to 1950, most basic[6] jobs in the U.S. economy were located in urban cores. Since 1950, job growth has increasingly favored suburban communities over urban cores. Since 1980, almost all basic job growth has occurred outside traditional central cities.[7] First the Los Angeles region and more recently the San Francisco Bay Area have been national leaders in the trend toward increased job decentralization.

To project future job decentralization, we start by comparing the 1990 and 2000 spatial distribution of jobs in each California metropolitan region. Employment estimates were obtained from multiple sources, most notably the Southern California Association of Governments (SCAG), the Association of Bay Area Governments (ABAG), the Sacramento Area Council of Governments (SACOG), and the San Diego Association of Governments (SANDAG). Job estimates for the South San Joaquin region were obtained from each county COG. 1990 and 2000 job totals were then mapped by city and Census Designated Place (CDP). Next, 10-kilometer-wide rings were generated outward from each regional center and used to count the number of job centers and total number of jobs in each ring. The resulting job and job center distributions are included as Figure 3.

Next, a spatial shift-share model was applied to decompose 1990–2000 city and CDP job changes into three components:

1. A Regional Growth Component (RGC), calculated as the percent change in regional jobs between 1990 and 2000:

   (2000 Regional Jobs/1990 Regional Jobs)

   The larger the regional growth component, the more vital the entire regional economy.

2. A Ring Change Component (RCC), calculated as the difference between the 1990–2000 percent change in jobs in each ring, and the Regional Growth Component:

   (2000 Ring $Jobs_i$/1990 Ring $Jobs_i$) – (2000 Regional Jobs/1990 Regional Jobs)

   Rings with RCC values greater than zero added jobs at a faster rate than the region as a whole. Rings with RCC values less than zero added jobs at a slower rate than the region as a whole.

3. A Local Change Component (LCC), calculated as the difference between the 1990–2000 percent change in jobs in each city or CDP, and the 1990–2000 percent change in jobs in its respective ring:

   (2000 Local $Jobs_j$/1990 Local $Jobs_j$) – (2000 Ring $Jobs_i$/1990 Ring $Jobs_i$)

   Localities with LCC values greater than zero added jobs at a faster rate than their rings. Localities with LCC values less than zero added jobs at a slower rate than their rings.

Generally speaking, the outer rings in each metropolitan area added jobs at a faster rate during the 1990s than the inner rings. (The inner-most Southern California ring actually lost jobs between 1990 and 2000, the only such ring to do so.) Among the four regions profiled in Figure 3, the rate of inner-ring job growth was highest in Northern California while the rate of outer-ring job growth was greatest in Southern California.

Using their own procedures, ABAG, SACOG, SANDAG, and SCAG have each developed their own job projections for the 2000–2020 period. To put these forecasts into context, we applied the same ring-identification procedures and spatial shift-share model calculations developed above to each set of projections. The results are presented in Appendix A. Generally speaking, all four COGs expect the pace of job

Figure 3: Calculation of Spatial Shiftshare Components by Job Ring and Region: 1990-2000

Region	10-kilometer Ring	Jobs			Spatial Shiftshare Components		
		1990	2000	Percent Change, 1990-2020F	Regional Growth Component	Ring Change Component	Average Local Change Component within Ring
Southern California	0	399,354	650,183	62.8%	5.4%	57.4%	-3.8%
	1	4,325,554	4,280,399	-1.0%	5.4%	-6.4%	3.7%
	2	1,186,648	1,115,063	-6.0%	5.4%	-11.4%	6.8%
	3	375,717	442,182	17.7%	5.4%	12.3%	7.8%
	4	406,355	478,972	17.9%	5.4%	12.5%	40.0%
	5	204,575	251,495	22.9%	5.4%	17.6%	60.2%
	6	202,274	263,317	30.2%	5.4%	24.8%	23.3%
	Regional Total	7,100,477	7,481,611	5.4%			
Nine-County San Francisco Bay Area	1	1,992,600	2,180,213	9.4%	13.5%	-4.1%	-5.4%
	2	490,930	560,260	14.1%	13.5%	0.6%	3.2%
	3	376,780	441,687	17.2%	13.5%	3.7%	-35.1%
	4	216,110	271,233	25.5%	13.5%	12.0%	-40.4%
	5	17,770	22,537	26.8%	13.5%	13.3%	-41.5%
	Regional Total	3,094,190	3,512,717	13.5%			
San Diego County	0	166,814	177,412	6.4%	4.5%	1.8%	8.7%
	1	836,025	863,568	3.3%	4.5%	-1.2%	3.6%
	2	133,673	140,002	4.7%	4.5%	0.2%	36.9%
	3	111,564	123,747	10.9%	4.5%	6.4%	107.6%
	Regional Total	1,248,076	1,304,729	4.5%			

decentralization to accelerate during the next 20 years. In no case are any rings expected to lose employment.

2.3 Forecasting Procedures

As previously noted, forecasting and scenario-building involves five distinct steps:

1. Project county-level population growth through 2100. County population projections for the year 2020 and 2040 were obtained from the California Department of Finance, Population Research Unit.[8] These projections were used to estimate annualized population growth rates (by county) spanning the periods 2000–2040 and 2020–2040. Projected forward, these growth rates were used in turn to forecast county population totals for the years 2050 and 2100.

2. Subtract projected infill and redevelopment shares. A significant share of projected population growth will occur within the existing urban footprint in the form of infill or redevelopment. Infill shares tend to rise over time as remaining greenfield areas are used up and as developers reconsider previously passed-over infill lands. A cross-sectional regression model was developed relating current county infill shares to remaining greenfield land supplies. This model was then used to project future infill and greenfield population shares for the years 2020, 2050, and 2100.

3. Project future allocation densities. The amount of greenfield land consumed by future population growth will depend both on the magnitude of growth and on its gross density. Marginal gross densities—that is, the gross densities of new development—were estimated for each county by dividing the change in the population between 1988 and 1998 by the change in urbanized land area for the same period. Theory suggests that densities should rise as available greenfield lands are used up, as developers seek to use remaining lands more intensely. A cross-sectional regression model was developed relating 1988–1998 marginal densities to remaining greenfield land supplies. This model was then used to project future allocation densities by county for the years 2020, 2050, and 2100.

4. Allocate projected greenfield population growth to undeveloped sites in each region in order of development probability. Starting with the hectare-scale development probability scores derived above, a series of exclusion conditions are developed identifying which sites are to be precluded from development. Projected population growth (from Step 2) for the period 2000–2020 is then allocated to sites at projected

densities (from Step 3) in order of development probability (from high to low) subject to any exclusion conditions.

5. Update key variables to reflect projected employment growth and allocated population growth.

Steps 4 and 5 are iterated for the periods 2020–2050, and 2050–2100. Thanks to the analytical power of GIS, different forecasting steps can be undertaken at different spatial scales and then reconciled. Population growth, greenfield shares, and allocation densities, for example, are all identified and projected (Steps 1,2, and 3) at the county level. Development probability scores, on the other hand, are estimated for individual one-hectare sites, accounting for differences among counties and regions. Employment projections, an input into the allocation procedure (Step 4), are developed for individual job centers. Distance to city boundaries, another input into the allocation procedure, is estimated and updated for incorporated cities.

The following sections explain and discuss each of the above procedures in greater detail.

2.4 Population Projections—Huge Growth Ahead

Forecasters project large area population growth in one of two ways, either by extrapolating a single long-term population growth trend, or by decomposing that trend into its two component parts—natural increase and net migration—and then projecting those. The California Department of Finance (DoF), which is required by state law to develop forty-year county-level population projections, takes the latter approach.

Natural increase is the difference between births and deaths, and generally follows fertility rate trends. Following accepted demographic practice, DoF identifies natural increase and fertility rate trends by age cohort and race and ethnicity. Fertility rates vary as well by immigration status and length of residency, although not always in predictable ways. Net migration measures the difference between in- and out-migration, and for the most part follows job growth trends—rising when the economy is booming and falling when it is in recession. Like fertility rates, net migration rates vary by population age. Higher for young adults, they typically decline with age. County—and to a lesser extent, state—migration rates also vary with the relative cost of living, as new migrants are often shunted into counties with more affordable housing. Some of these complications wash-out at the state level, but serve to make county-level forecasting all the more complicated.

Appendix B-1 reports the Department of Finance's E-6 county-level population projections for the years 2000, 2020 and 2040. These projections—which were developed using the cohort component method described above—were then used to calculate composite annual growth rates by county for the years 2000–2040. These rates (which are shown in column 5 of Appendix B-1) vary from a high of 3.0% per year for Imperial County to a low of -0.4% per year for San Francisco County. Annualized 2020–2040 growth rates (column 6) are somewhat lower and range from a high of 2.65%, also for Imperial County, to a low of -0.5% percent for San Francisco County.

High growth rates are rarely sustainable over the long-term. Similarly, the growth rates of low-growth counties located in high-growth states tend to pick-up over time. To better reflect this county–state convergence, we averaged each county's 2000–2040 and 2020–2040 growth rates with those of the state as a whole. These combined growth rates are reported in columns 7 and 8 of Appendix B-1.

Appendix B-2 projects each county's population forward to 2050 and 2100, based first on the lower 2020–2040 combined rate, and then second on the higher 2000–2040 combined rate. Based on this method, California's largest county, Los Angeles, will grow from 10 million people in 2000 to 15.5 million by 2050. The populations of Riverside, San Bernardino, and San Diego counties will each approach or exceed 5 million by 2050. The population of Orange County will grow from 2.8 million in 2000 to more than 4.5 million in 2050. Elsewhere, the 2050 population of the largest county in northern California, Santa Clara, will be just under 3 million. With a 2050 population of 2.4 million, Sacramento County will be the most populous in the Central Valley. Added up, the total 2050 population of California's 58 counties will exceed 66 million!

Projecting further forward to the year 2100 presents additional challenges. Given the immense size of California's population, even the lower 2020–2040 growth rates are likely to be unsustainable over time. To better reflect the natural tendency for growth rates to decline as the population increases, we reduced both the lower 2020–2040 composite growth rate and the higher 2000–2040 composite growth rate by fifty percent before applying them to the 2050–2100 period. County population projections for 2100 using these reduced growth rates are presented in the final two columns of Appendix B-2.

Figure 4 presents the final set of population projections for 2020, 2050 and 2100 in tabular form, organized by region, sub-region, and county; Figure 5 presents the same information graphically.

Figure 4: Population Projections by County, Sub-Region, and Region: 2000-2020, 2020-2050, 2050-2100

Major Region	County	Sub-Region	Population Estimates and Forecasts				Population Change			Percent Population Change			County Share of Regional Change		
			2000 (source: DOF)	2020F (source: DOF)	2050F (see Appendix B-2 for calculations)	2100F (see Appendix B-2 for calculations)	2000-2020	2020-2050	2050-2100	2000-2020	2020-2050	2050-2100	2000-2020	2020-2050	2050-2100
Southern California	Los Angeles	Central/North	9,838,861	11,575,693	15,497,560	20,400,280	1,736,832	3,921,867	4,902,719	17.7%	33.9%	31.6%	29.4%	31.3%	32.1%
	Ventura	Central/North	753,820	981,565	1,456,134	2,018,255	227,745	474,569	562,120	30.2%	48.3%	38.6%	3.9%	3.8%	3.7%
	Sub-regional Total	Central/North	**10,592,681**	**12,557,258**	**16,953,695**	**22,418,534**	**1,964,577**	**4,396,437**	**5,464,840**	**18.5%**	**35.0%**	**32.2%**	**33.3%**	**35.1%**	**35.8%**
	Imperial	Southcoast	154,549	298,700	612,914	1,000,884	144,151	314,214	387,969	93.3%	105.2%	63.3%	2.4%	2.5%	2.5%
	Orange	Southcoast	2,833,190	3,431,869	4,535,936	5,932,517	598,679	1,104,067	1,396,581	21.1%	32.2%	30.8%	10.1%	8.8%	9.1%
	San Diego	Southcoast	2,943,001	3,917,001	5,831,574	8,097,302	974,000	1,914,573	2,265,728	33.1%	48.9%	38.9%	16.5%	15.3%	14.8%
	Sub-regional Total	Southcoast	**5,930,740**	**7,647,570**	**10,980,424**	**15,030,702**	**1,716,830**	**3,332,854**	**4,050,278**	**28.9%**	**43.6%**	**36.9%**	**29.1%**	**26.6%**	**26.5%**
	Riverside	Inland Empire	1,570,885	2,773,431	5,335,081	8,431,480	1,202,546	2,561,650	3,096,399	76.6%	92.4%	58.0%	20.4%	20.4%	20.3%
	San Bernardino	Inland Empire	1,727,452	2,747,213	4,983,011	7,644,175	1,019,761	2,235,798	2,661,164	59.0%	81.4%	53.4%	17.3%	17.8%	17.4%
	Sub-regional Total	Inland Empire	**3,298,337**	**5,520,644**	**10,318,093**	**16,075,656**	**2,222,307**	**4,797,449**	**5,757,563**	**67.4%**	**86.9%**	**55.8%**	**37.6%**	**38.3%**	**37.7%**
	REGIONAL TOTAL		**19,821,758**	**25,725,472**	**38,252,211**	**53,524,892**	**5,903,714**	**12,526,739**	**15,272,681**	**29.8%**	**48.7%**	**39.9%**	**100.0%**	**100.0%**	**100.0%**
Northern California	Alameda	Central	1,470,155	1,793,139	2,287,126	2,938,378	322,984	493,987	651,251	22.0%	27.5%	28.5%	23.8%	22.4%	21.9%
	Contra Costa	Central	931,946	1,104,725	1,394,436	1,782,151	172,779	289,711	387,714	18.5%	26.2%	27.8%	12.8%	13.2%	13.0%
	San Francisco	Central	792,049	750,904	710,034	785,565	-41,145	-40,870	75,531	-5.2%	-5.4%	10.6%	-3.0%	-1.9%	2.5%
	San Mateo	Central	747,061	855,506	1,044,065	1,312,014	108,445	188,559	267,949	14.5%	22.0%	25.7%	8.0%	8.6%	9.0%
	Santa Clara	Central	1,763,252	2,196,750	2,884,875	3,760,965	433,498	688,125	876,089	24.6%	31.3%	30.4%	32.0%	31.2%	29.4%
	Sub-regional Total	Central	**5,704,463**	**6,701,024**	**8,320,538**	**10,579,072**	**996,561**	**1,619,514**	**2,258,535**	**17.5%**	**24.2%**	**27.1%**	**73.6%**	**73.5%**	**75.8%**
	Marin	North	248,397	268,630	325,152	406,920	20,233	56,522	81,768	8.1%	21.0%	25.1%	1.5%	2.6%	2.7%
	Napa	North	127,084	157,878	214,934	285,317	30,794	57,056	70,383	24.2%	36.1%	32.7%	2.3%	2.6%	2.4%
	Solano	North	399,841	552,105	789,742	1,074,736	152,264	237,637	284,993	38.1%	43.0%	36.1%	11.2%	10.8%	9.6%
	Sonoma	North	459,258	614,173	845,837	1,129,343	154,915	231,664	283,506	33.7%	37.7%	33.5%	11.4%	10.5%	9.5%
	Sub-regional Total	North	**1,234,580**	**1,592,786**	**2,175,666**	**2,896,317**	**358,206**	**582,880**	**720,650**	**29.0%**	**36.6%**	**33.1%**	**26.4%**	**26.5%**	**24.2%**
	REGIONAL TOTAL		**6,939,043**	**8,293,810**	**10,496,204**	**13,475,389**	**1,354,767**	**2,202,394**	**2,979,185**	**19.5%**	**26.6%**	**28.4%**	**100.0%**	**100.0%**	**100.0%**

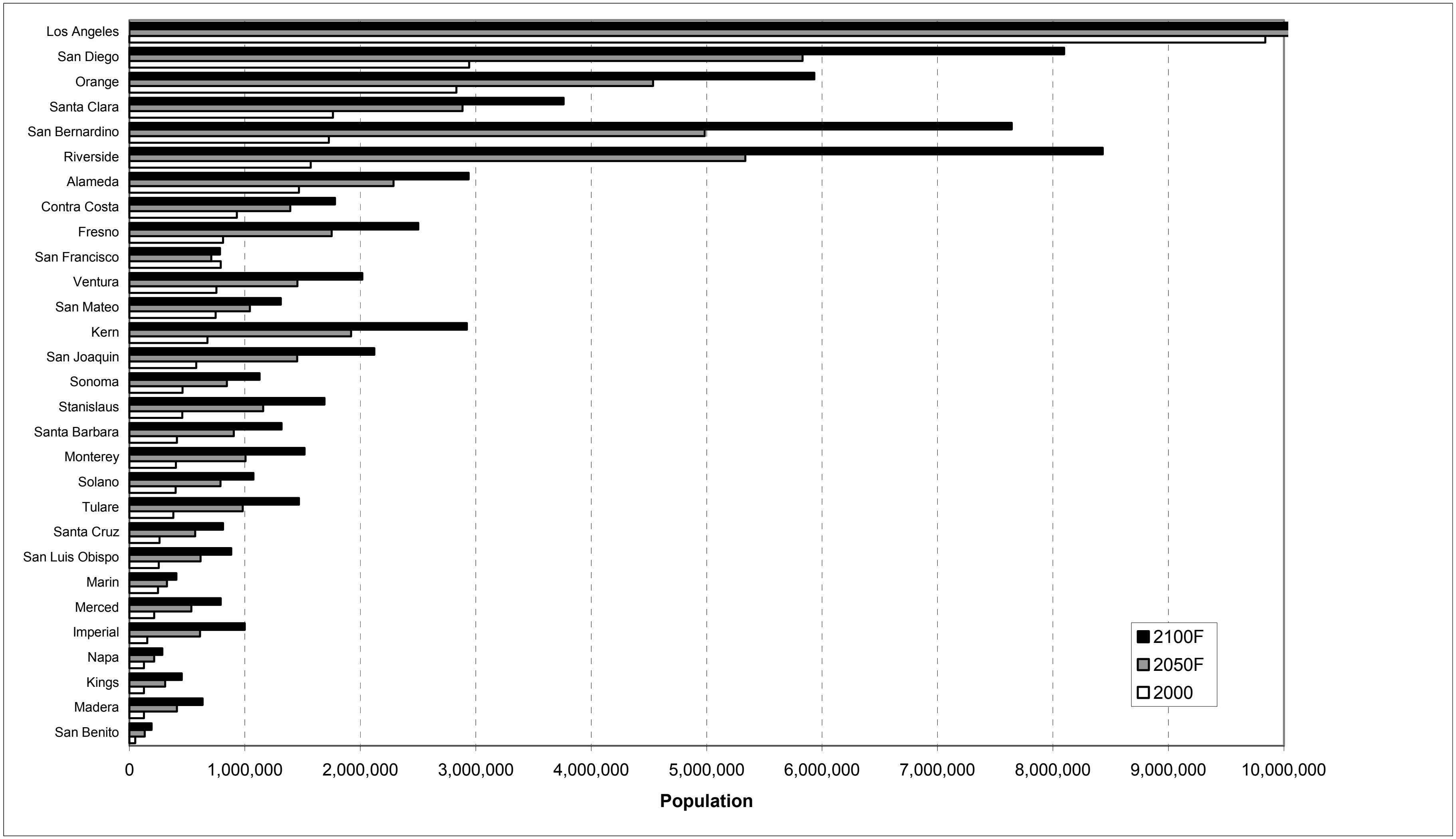
Figure 4: Population Projections by County, Sub-Region, and Region: 2000-2020, 2020-2050, 2050-2100

Major Region	County	Sub-Region	Population Estimates and Forecasts				Population Change			Percent Population Change			County Share of Regional Change		
			2000 (source: DOF)	2020F (source: DOF)	2050F (see Appendix B-2 for calculations)	2100F (see Appendix B-2 for calculations)	2000-2020	2020-2050	2050-2100	2000-2020	2020-2050	2050-2100	2000-2020	2020-2050	2050-2100
San Joaquin Valley	Merced	North	215,256	319,785	537,166	792,667	104,529	217,381	255,501	48.6%	68.0%	47.6%	6.1%	6.3%	6.3%
	San Joaquin	North	579,172	884,375	1,454,089	2,122,660	305,203	569,714	668,571	52.7%	64.4%	46.0%	17.9%	16.5%	16.5%
	Stanislaus	North	459,025	708,950	1,160,376	1,690,026	249,925	451,426	529,650	54.4%	63.7%	45.6%	14.6%	13.1%	13.0%
	Sub-regional Total	North	**1,253,453**	**1,913,110**	**3,151,631**	**4,605,353**	**659,657**	**1,238,521**	**1,453,722**	**52.6%**	**64.7%**	**46.1%**	**38.6%**	**35.9%**	**35.8%**
	Fresno	Central	811,179	1,114,403	1,753,356	2,503,297	303,224	638,953	749,941	37.4%	57.3%	42.8%	17.8%	18.5%	18.5%
	Madera	Central	126,394	224,567	411,713	635,019	98,173	187,146	223,305	77.7%	83.3%	54.2%	5.8%	5.4%	5.5%
	Sub-regional Total	Central	**937,573**	**1,338,970**	**2,165,070**	**3,138,316**	**401,397**	**826,100**	**973,246**	**42.8%**	**61.7%**	**45.0%**	**23.5%**	**24.0%**	**24.0%**
	Kern	South	677,372	1,073,748	1,919,849	2,923,829	396,376	846,101	1,003,980	58.5%	78.8%	52.3%	23.2%	24.5%	24.7%
	Kings	South	126,672	186,611	309,815	454,484	59,939	123,204	144,668	47.3%	66.0%	46.7%	3.5%	3.6%	3.6%
	Tulare	South	379,944	569,896	982,425	1,468,811	189,952	412,529	486,386	50.0%	72.4%	49.5%	11.1%	12.0%	12.0%
	Sub-regional Total	South	**1,183,988**	**1,830,255**	**3,212,090**	**4,847,123**	**646,267**	**1,381,835**	**1,635,033**	**54.6%**	**75.5%**	**50.9%**	**37.9%**	**40.1%**	**40.3%**
	REGIONAL TOTAL		**3,375,014**	**5,082,335**	**8,528,790**	**12,590,792**	**1,707,321**	**3,446,455**	**4,062,002**	**50.6%**	**67.8%**	**47.6%**	**100.0%**	**100.0%**	**100.0%**
Sacramento	**Sacramento**	Central	**1,212,527**	**1,651,765**	**2,409,784**	**3,312,096**	**439,238**	**758,019**	**902,312**	**36.2%**	**45.9%**	**37.4%**	**54.1%**	**56.0%**	**56.1%**
	El Dorado	Foothills	163,197	256,119	381,668	530,209	92,922	125,549	148,541	56.9%	49.0%	38.9%	11.4%	9.3%	9.2%
	Nevada	Foothills	120,000	136,405	185,998	247,103	16,405	49,593	61,105	13.7%	36.4%	32.9%	2.0%	3.7%	3.8%
	Placer	Foothills	243,646	391,245	598,462	842,385	147,599	207,217	243,923	60.6%	53.0%	40.8%	18.2%	15.3%	15.2%
	Sub-regional Total	Foothills	**526,843**	**783,769**	**1,166,127**	**1,619,697**	**256,926**	**382,358**	**453,570**	**48.8%**	**48.8%**	**38.9%**	**31.6%**	**28.2%**	**28.2%**
	Sutter	Northwest	82,040	116,408	173,672	241,405	34,368	57,264	67,732	41.9%	49.2%	39.0%	4.2%	4.2%	4.2%
	Yolo	Northwest	164,010	225,321	341,228	477,893	61,311	115,907	136,665	37.4%	51.4%	40.1%	7.5%	8.6%	8.5%
	Yuba	Northwest	63,983	84,610	124,998	172,890	20,627	40,388	47,892	32.2%	47.7%	38.3%	2.5%	3.0%	3.0%
	Sub-regional Total	Northwest	**310,033**	**426,339**	**639,898**	**892,187**	**116,306**	**213,559**	**252,290**	**37.5%**	**50.1%**	**39.4%**	**14.3%**	**15.8%**	**15.7%**
	REGIONAL TOTAL		**2,049,403**	**2,861,873**	**4,215,809**	**5,823,981**	**812,470**	**1,353,936**	**1,608,172**	**39.6%**	**47.3%**	**38.1%**	**100.0%**	**100.0%**	**100.0%**

Figure 4: Population Projections by County, Sub-Region, and Region: 2000-2020, 2020-2050, 2050-2100

Major Region	County	Sub-Region	Population Estimates and Forecasts				Population Change			Percent Population Change			County Share of Regional Change		
			2000 (source: DOF)	2020F (source: DOF)	2050F (see Appendix B-2 for calculations)	2100F (see Appendix B-2 for calculations)	2000-2020	2020-2050	2050-2100	2000-2020	2020-2050	2050-2100	2000-2020	2020-2050	2050-2100
Central Coast	Monterey		401,886	575,102	1,006,978	1,517,431	173,216	431,876	510,453	43.1%	75.1%	50.7%	29.4%	34.1%	34.3%
	San Benito		51,853	82,276	133,208	192,948	30,423	50,932	59,740	58.7%	61.9%	44.8%	5.2%	4.0%	4.0%
	San Luis Obispo		254,818	392,329	617,709	882,227	137,511	225,380	264,518	54.0%	57.4%	42.8%	23.4%	17.8%	17.8%
	Santa Barbara		412,071	552,846	905,294	1,318,823	140,775	352,448	413,529	34.2%	63.8%	45.7%	23.9%	27.9%	27.8%
	Santa Cruz		260,248	367,196	572,017	812,597	106,948	204,821	240,580	41.1%	55.8%	42.1%	18.2%	16.2%	16.2%
	REGIONAL TOTAL		**1,380,876**	**1,969,749**	**3,235,207**	**4,724,026**	**588,873**	**1,265,458**	**1,488,820**	**42.6%**	**64.2%**	**46.0%**	**100.0%**	**100.0%**	**100.0%**
NON-METROPOLITAN COUNTIES	Alpine		1,239	1,701	2,261	2,965	462	560	704	37.3%	32.9%	31.2%	0.1%	0.1%	0.1%
	Amador		34,853	40,129	46,935	57,739	5,276	6,806	10,804	15.1%	17.0%	23.0%	1.3%	1.0%	1.3%
	Butte		207,158	307,296	483,980	691,341	100,138	176,684	207,361	48.3%	57.5%	42.8%	24.7%	26.7%	25.5%
	Calaveras		42,041	62,688	91,124	125,014	20,647	28,436	33,891	49.1%	45.4%	37.2%	5.1%	4.3%	4.2%
	Colusa		20,973	41,398	82,055	131,662	20,425	40,657	49,607	97.4%	98.2%	60.5%	5.0%	6.1%	6.1%
	Del Norte		31,155	41,898	56,955	75,549	10,743	15,057	18,594	34.5%	35.9%	32.6%	2.6%	2.3%	2.3%
	Glenn		29,298	49,113	88,790	135,982	19,815	39,677	47,191	67.6%	80.8%	53.1%	4.9%	6.0%	5.8%
	Humboldt		128,419	141,092	158,279	190,693	12,673	17,187	32,414	9.9%	12.2%	20.5%	3.1%	2.6%	4.0%
	Inyo		18,437	20,694	27,538	36,140	2,257	6,844	8,602	12.2%	33.1%	31.2%	0.6%	1.0%	1.1%
	Lake		60,072	93,058	148,122	212,717	32,986	55,064	64,595	54.9%	59.2%	43.6%	8.1%	8.3%	8.0%
	Lassen		35,959	49,322	69,607	94,087	13,363	20,285	24,480	37.2%	41.1%	35.2%	3.3%	3.1%	3.0%
	Mariposa		16,762	23,390	32,101	42,785	6,628	8,711	10,685	39.5%	37.2%	33.3%	1.6%	1.3%	1.3%
	Mendocino		90,442	118,804	169,149	229,650	28,362	50,345	60,501	31.4%	42.4%	35.8%	7.0%	7.6%	7.4%
	Modoc		10,481	12,396	16,629	21,911	1,915	4,233	5,282	18.3%	34.1%	31.8%	0.5%	0.6%	0.7%
	Mono		10,891	14,166	19,434	25,897	3,275	5,268	6,463	30.1%	37.2%	33.3%	0.8%	0.8%	0.8%
	Plumas		20,852	23,077	26,612	32,507	2,225	3,535	5,895	10.7%	15.3%	22.2%	0.5%	0.5%	0.7%
	Shasta		175,777	240,975	329,849	439,059	65,198	88,874	109,209	37.1%	36.9%	33.1%	16.1%	13.4%	13.4%
	Sierra		3,457	3,575	3,678	4,245	118	103	566	3.4%	2.9%	15.4%	0.0%	0.0%	0.1%
	Siskiyou		45,194	53,676	68,588	88,199	8,482	14,912	19,611	18.8%	27.8%	28.6%	2.1%	2.3%	2.4%
	Tehama		56,666	83,996	131,321	186,892	27,330	47,325	55,571	48.2%	56.3%	42.3%	6.7%	7.1%	6.8%
	Trinity		13,490	15,594	18,300	22,549	2,104	2,706	4,250	15.6%	17.3%	23.2%	0.5%	0.4%	0.5%
	Tuolumne		56,125	77,350	106,662	142,505	21,225	29,312	35,842	37.8%	37.9%	33.6%	5.2%	4.4%	4.4%
	REGIONAL TOTAL		**1,109,741**	**1,515,388**	**2,177,969**	**2,990,087**	**405,647**	**662,581**	**812,118**	**36.6%**	**43.7%**	**37.3%**	**100.0%**	**100.0%**	**100.0%**
CALIFORNIA			**34,653,395**	**45,448,627**	**66,763,758**	**92,081,030**	**10,795,232**	**21,315,131**	**25,317,272**	**31.2%**	**46.9%**	**37.9%**	**100.0%**	**100.0%**	**100.0%**

Figure 5: Projected Population Growth Among Metropolitan California Counties, 2000–2100



Despite the imposed slowdown in growth rates, California's largest counties will continue to grow. California's largest county, Los Angeles, will grow from 15.5 million people in 2050 to 20.4 million by 2100. The populations of Riverside, San Bernardino, and San Diego counties will each approach or exceed 5 million by 2050 and 7.5 million by 2100. The population of Orange County will grow from 2.8 million in 2000 to 4.5 million by 2050 and nearly 6 million by 2100. Elsewhere, the 2100 population of the largest county in northern California, Santa Clara, will be about 3.8 million. With a 2100 population of 3.3 million, Sacramento County will still be the most populous in the Central Valley. Added up, the total 2100 population of California's 58 counties could very well exceed 92 million!

The huge size of these projections—particularly among southern California counties—clearly indicates the dangers implicit in the long-term use of average annual growth rates. Even so, as large as these projections may seem, they are not unbelievable. California's population in 1900 was just over one million. One hundred years later, the state's population stood at nearly 35 million.

2.5 Infill Shares and Growth Densities—Both Will Increase

In the most general of terms, the location and density of new urban development in California is shaped by two opposing forces. On the one hand, development has traditionally been attracted to California's coastal areas both for reasons of economics—that's where the ports are—and amenities—the climate along the coast is more moderate. Accordingly, housing and land prices in California have long formed a downward-sloping gradient eastward from the coastal centers of Los Angeles, San Francisco, and San Diego.

On the other hand, as California's coastal areas have grown ever more built-out and thus more expensive, developers have moved ever further inland in search of cheaper land. In addition to being less expensive, inland locations have traditionally been less subject to land use and environmental regulation than their coastal counterparts, making development cheaper and easier.

California was built by developers, and developers are nothing if not opportunistic. Even as they continue their inexorable eastward push, California's developers also continually look back over their shoulders to consider potential infill and redevelopment opportunities. Thus, at the same time that California's coastal metropolitan areas are growing eastward, they are also infilling and redeveloping. And to the extent that infill development tends to occur at higher-than-existing densities, overall urban densities also rise.

At least this is the theory. In practice, local land use controls and opposition from neighborhood groups often function to make infill and redevelopment proportionately more difficult than greenfield development, thereby breaking the link between growth at the urban fringe, increased infill activity, and rising urban densities. The result is less urban redevelopment and more sprawl.

Figures 6 and 7 graphically present these relationships for 38 predominantly-urban counties. Figure 6 compares the share of each county's land area that was urbanized in 1972 with the population density of subsequent new development. As predicted, marginal densities—measured as the change in population divided by change in urban land area— rise with the share of each county's land in urban use. Based on the fitted trend line, for every percent share of each county's land area in urban use in 1972, marginal development densities during the 1972–1996 period rose by 26 persons per acre.

Figure 7 compares the share of each county's land area that was urbanized as of 1972 with the share of new development occurring within the existing urban footprint in the form of infill. As expected, county infill shares rise (and greenfield shares fall) with the share of each county's land in urban use. Based on the fitted trend line, for every percent share of each county's land area in urban use in 1972, the share of subsequent urban development occurring as infill—that is, within the initial 1980 urban footprint—rose by 200 percent.

Neither the density trend line in Figure 6 nor the infill trend line in Figure 7 fits the observed data all that well, a fact confirmed by the middling goodness-of-fit statistics of the estimated regression lines (see Figure 8). Some counties, such as Los Angeles, Orange, Santa Clara, San Mateo, and Stanislaus developed at higher densities and with more infill than average. Others, most notably Alameda, Contra Costa and Sacramento developed at either lower densities or with less infill than expected.

Used with care, these two regression lines can be used to project future development densities and infill shares. In both cases, this involves incorporating additional information:

1. Incremental densities are projected by selecting the maximum of the recent incremental density for each county (denoted by the subscript i below) and the regression-based incremental density. This adjustment has the effect of preventing projected incremental densities from

Figure 6: Comparison of 1972 Urbanization Levels and 1972–1996 Development Densities for Selected California Counties

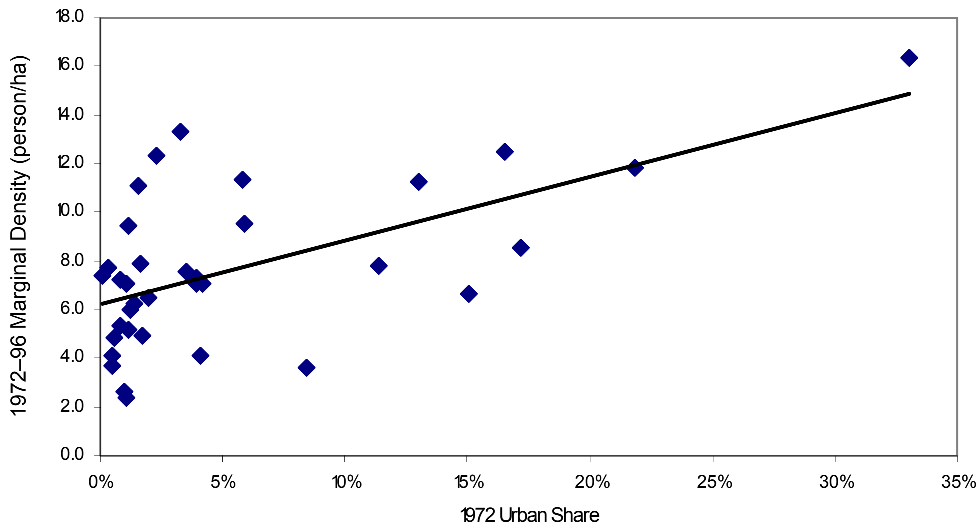


Figure 7: Comparison of 1972 Urbanization Shares and 1980–1998 Infill Shares for Selected California Counties

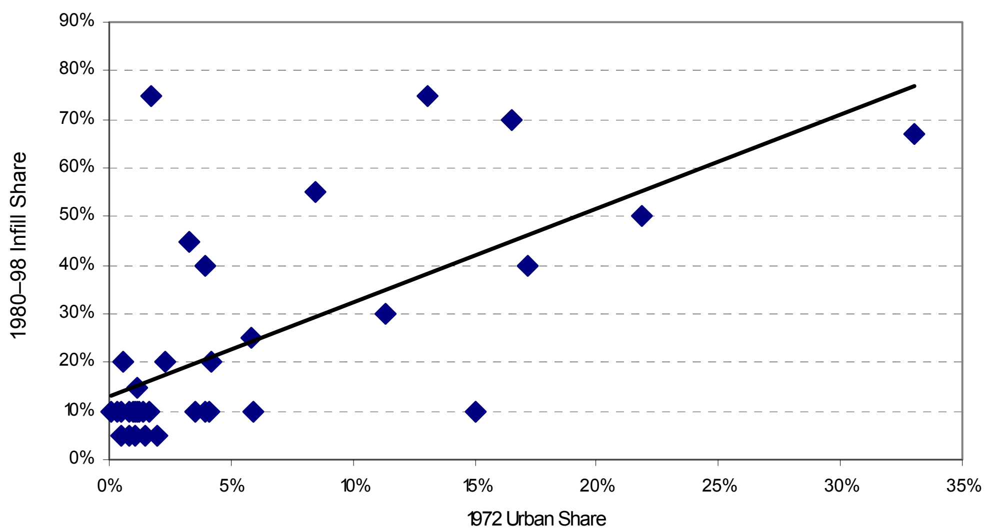


Figure 8: Regression Results Comparing County 1972 Urban Land Shares with 1972-1996 Development Densities and 1980-1998 Infill Rates

	Dependent Variable: 1972-1996 Development Densities		Dependent Variable: 1980-1998 Infill Rates	
	Coefficient	t-statistic	Coefficient	t-statistic
1972 Urban Land Share	26.29	4.27	1.94	4.88
Intercept	6.21	11.04	0.13	3.55
adjusted r-squared	0.34		0.40	
Number of Observations	35		235	

falling. Projected incremental densities are listed as columns 7 through 10 in Appendix C-1.

$$\text{Projected incremental density}_i = \text{MAX [recent incremental density}_i\text{, regression-based incremental density}_i]$$

2. County-level infill growth shares are projected as the average of the current infill share and the maximum of the current infill share and the regression-estimated infill share. This adjustment has the effect of preventing infill shares from either rising too quickly or else falling. Projected incremental densities are listed as columns 11 through 14 in Appendix C-1.

$$\text{Projected infill share}_i = \{\text{Current infill share}_i + \text{MAX [current infill share}_i\text{, regression-based infill share}_i]\} / 2$$

3. Projected greenfield population growth—that is, the amount of population growth not projected to take the form of infill development—is calculated by multiplying projected population growth for each county by 1.0 minus the projected infill share for that county. The result of this calculation is then multiplied by the projected incremental density to yield an estimate of the amount of additional projected greenfield development. The results of this sequence of calculations is presented in Appendix C-2.

$$\text{Projected Greenfield population growth}_i = \text{Population projection}_i * [\ 1 - \text{projected infill share}_i\ ]$$

$$\text{Projected greenfield development in acres}_i = \text{Projected Greenfield population growth}_i * [\text{Projected incremental density}_i] / 2.47$$

2.6 Updating the Inputs

Projected population growth is allocated to sites during three periods: 1997–2020, 2020–2050, and 2050–2100. Several parameters and data layers are updated prior to each successive allocation round. These include:

1. <u>Job Accessibility</u>: A job accessibility measure is calculated for each site based on its proximity via the highway network to all jobs—as located at discrete job centers. As noted in Figure 2, this measure is used in the logit model equation used to estimate future site-level development probabilities. Subsequent to each growth allocation, a new set of job accessibility measures is computed for each site based

on projected job growth by city or place (see Figure 3) and any changes in relative highway accessibility. For the baseline scenario (see Section 3, below), no changes in relative highway accessibility are assumed. Thus changes in site-level job accessibility reflect only change in the distribution and number of jobs. In subsequent scenarios, we expect to alter job accessibility by also adding new highway or rail links.

2. City Boundaries: Because development in California generally favors locations within cities—with some important differences among regions—it is essential to update city boundaries subsequent to each growth allocation, and to then estimate development probabilities accordingly. This does not present a problem for newly developed sites within existing city boundaries, but for sites outside existing boundaries, those boundaries must be stretched to accommodate the additional growth. This is done manually. In the most common case, increments of new development adjacent to or nearby existing cities are effectively "incorporated." In rarer cases, small, freestanding increments of new development are treated as unincorporated urban places. In rarer cases still, large, freestanding increments of new development are incorporated as new cities.

3. Physical Features: The physical features of sites—such as their slope, location in a flood zone, or status as prime farmland—do not change between allocation rounds.

4. Urban Share: Subsequent to each allocation round, the share of land area in each county in urban use is updated. The updated urban share is then used to estimate updated incremental development densities and infill shares for the next allocation round. This sequence of densities and infill shares is reported for each county in Appendix C-1.

2.7 Key Assumptions and Caveats

Numerous assumptions are embedded in this procedure and its components. Perhaps the most questionable is whether it is within the realm of human capability to accurately extrapolate current population and employment growth trends and urban settlement patterns far into the future—in this case, through the year 2100—and particularly in a state as changeable as California. If history teaches us anything, it is that the future is *always different* than we anticipate it will be, no matter how sophisticated our reasoning or projection techniques. For this reason, the projections developed here and in later efforts are best viewed not as forecasts, per se, but as scenarios—that is, as a set of illustrative futures designed to indicate how particular growth trends and development dynamics might play out upon California's diverse landscapes. Beyond this general caveat, there are five specific assumptions driving this analysis:

1. The same factors that shaped land development patterns in the recent past will continue to do so in the future, and in the same ways. As previously discussed, this procedure allocates future development to individual sites based on their projected development probability. These probabilities are estimated using the results of a statistical model calibrated for the period 1988–1998. While the exact role of particular factors varies by region, several influences are consistently important. These include proximity to freeways, access to jobs, site slope, and site incorporation status. Other factors such as farmland and wetland status vary more widely in their importance. To the extent that these factors are less important in the future or are important in different ways—or, as is even more likely, that other factors become important—the model results will vary widely from what is presented here.

2. Jobs will continue decentralizing within California's four major urban regions—Southern California, the greater San Francisco Bay Area, the Sacramento region, and the southern San Joaquin Valley. Taking advantage of improved freeway access, less expensive land, and lower development costs, job growth during the last 50 years has favored suburban locations over core cities. To the extent that this trend continues—given the increasing importance of telecommunications in shaping economic geography, and in the absence of countervailing policies, there is no reason to believe that it should not—decentralizing job growth will continue to pull population outward, leading to more decentralized growth patterns.

3. California's population will continue to grow, and at more or less the same rate and in the same spatial pattern as projected by the California Department of Finance. For consistency's sake, we rely on county population projections developed by the California Department of Finance through 2040. (DoF population projections are calculated by extrapolating current fertility and migration trends.) Thereafter, we extrapolate and trend downward the annualized county growth rates embedded in the DoF population projections. This approach yields a statewide population of 68 million in 2050 and 92 million in 2100.

   As large as these numbers are, they are hardly inconceivable. Since 1940, thanks to its robust economy, benign weather, and location on the Pacific Rim, California has been adding population at a steady rate of about 5 million persons every decade. Should this trend continue, California's 2100 population would exceed 85 million. On the flipside, should California's economy falter or the state's high cost of living start to choke off further job growth, the state's population could easily plateau around 50 million, and though it seems unthinkable today, perhaps even trend downward.

4. Average infill rates and population densities will increase with additional development. It is an axiom of economics that scarce resources are used more intensely than plentiful ones. Following this logic, as available supplies of developable land are used up, developers seek ways to use remaining land more intensely, either by increasing densities or through redevelopment. Thus, both development densities and infill activity should increase with population growth. Counteracting this tendency is the desire of many residents to preserve a rural or suburban lifestyle. Thus, there are many parts of California where infill activity and development densities are below what theory suggests they should be. For the purposes of constructing a baseline scenario, we assume that future infill activity and development densities will follow the upward trend lines reported in Figures 6 and 7. To the extent that it does not, additional greenfield sites will be needed to accommodate projected population growth.

5. With respect to the Baseline Scenario (see next section), no new freeways or intra- and inter-regional rapid transit systems will be developed. Freeway road travel speeds will remain at current levels. This is perhaps the least realistic assumption of all. It is abundantly clear that California's growing population will need additional transportation infrastructure. What is unclear is what the infrastructure should be, where it should go, and how it should be planned and financed. Lacking these specifics, and for the purposes of constructing a baseline scenario, we assumed no change in transportation technology or facilities beyond what is currently available. The effect of this assumption is to direct additional growth to locations already served by transportation infrastructure rather than to new or different areas. Additional scenarios beyond the baseline will be developed to evaluate the likely effects of specific planned or proposed transportation investments.

3.0 THE BASELINE SCENARIO

3.1 Building the Baseline Scenario

The function of the Baseline Scenario is to serve as a minimum-change alternative against which future scenarios, which posit more extensive policy, regulatory, or investment interventions can be compared. More succinctly, the Baseline Scenario assumes continued growth along the lines of past trends and patterns without significant policy change. Among the list of possible policy interventions *not envisioned* in the Baseline Scenario are additional infrastructure projects, additional environmental restrictions on land development, additional conservation and land preservation initiatives, and locally initiated changes in development densities and infill activities.

The Baseline Scenario as developed does not incorporate local planning concerns and issues as articulated in local general plans, zoning and subdivision ordinances, and other local planning documents. In this sense, the Baseline Scenario is neither explicitly "pro-market" nor "pro-planning." In counties where recent development patterns have principally been a function of market factors, that reality is projected to continue. On the other hand, in counties where recent development patterns have been more constrained by formal or ad hoc policies, that reality, too, is projected to continue.

The process of scenario building involves four steps. The first is to calculate a future development probability for each undeveloped site (see Map 1). This was undertaken using the land use change model results presented in Figure 2 and the job projections presented in Appendix A. For purposes of calculating future job and highway accessibility, no additions to the current highway system were assumed.

The second step is to specify a population growth increment to be allocated and an appropriate allocation density. For the Baseline Scenario, county population totals and allocation densities were drawn from Appendix C-1 and C-2.

The third step is to specify a list of absolute exclusion conditions denoting which sites may *not be developed* regardless of their development probability or the level of projected population growth. Four types of sites were excluded from development under the Baseline Scenario: (i) sites in public ownership; (ii) sites currently under water; (iii) sites identified as wetlands; and (iv) sites with an average slope in excess of 20%. Sites upon which development *is allowed* under the Baseline Scenario include floodzone sites, farmlands of all types, sites in riparian areas, and sites presumed to be habitat to one or more threatened or endangered species. The fact that development is allowed on this latter set of sites does not mean that it is to be encouraged, but rather that under the Baseline Scenario there are no policy or planning grounds for excluding development.

The fourth and final step is to allocate prospective population growth to non-excluded sites in order of their development probability.

3.2 Baseline Scenario Results

Statewide Baseline Scenario results for 2020, 2050, and 2100 are presented in tabular form by region and county in Figure 9 and in map form in Maps 2 through 14. Throughout the state, projected urban development will mostly occur on flat sites, follow freeways, and be located in and adjacent to existing cities and urban places (Maps 2 through 5). Beyond these commonalities, growth patterns will differ significantly by region and county. Starting in the south and moving north:

Southern California: San Diego, Orange, and Imperial Counties (Map 6): Urban development in the San Diego–Orange–Imperial County sub-region will increase from about 245,000 hectares in 1998, to 301,000 hectares in 2020, to 385,000 hectares in 2050, to 479,000 hectares in 2100. Urban growth in the San Diego–Orange–Imperial sub-region will account for about one-quarter of all new urban development in Southern California.

More than two-thirds of the region's projected urban growth will occur in San Diego County. Historically, most urban development in San Diego County has been located within ten miles of the Pacific coast. As these areas were built-out in the 1980s and 1990s, growth leapfrogged north into southwestern Riverside County, and to a lesser extent, east up the eastern foothills.

These trends will continue into the foreseeable future. If current trends continue, the I-15/Temecula area in southwestern Riverside County will be substantially built-out by about 2020, and development will have begun backfilling northern San Diego County. By 2050, Camp Pendleton, which separates San Diego and Orange counties, will be completely encircled by urban development. By 2100, if current trends continue, northern San Diego County and southwestern Riverside County will be completely urbanized, and intense urban growth will have moved eastward along Interstate I-10 into central San Diego County.

Figure 9: Summary of Urban Land Conversion Projections by County, Sub-Region, and Region: 1998–2020, 2020–2050, 2050–2100

Major Region	County	Sub-Region	Urbanized Land Area (Hectares)				Change in Urbanized Land Area (Hectares)			Pct.Change in Urbanized Land Area (Hectares)			County Share of Regional Change		
			1998	2020F	2050F	2100F	1998-2020	2020-2050	2050-2100	1998-2020	2020-2050	2050-2100	1998-2020	2020-2050	2050-2100
Southern California	Los Angeles	Central/North	307,205	318,174	342,037	360,808	10,969	23,863	18,771	3.6%	7.5%	5.5%	5.4%	6.9%	4.9%
	Ventura	Central/North	39,135	50,043	67,330	85,631	10,908	17,287	18,301	27.9%	34.5%	27.2%	5.4%	5.0%	4.8%
	Sub-regional Total	Central/North	**346,340**	**368,217**	**409,367**	**446,439**	**21,877**	**41,150**	**37,072**	**6.3%**	**11.2%**	**9.1%**	**10.8%**	**12.0%**	**9.8%**
	Imperial	Southcoast	9,682	19,834	38,365	59,615	10,152	18,531	21,250	104.9%	93.4%	55.4%	5.0%	5.4%	5.6%
	Orange	Southcoast	109,364	116,424	122,459	129,443	7,060	6,035	6,984	6.5%	5.2%	5.7%	3.5%	1.8%	1.8%
	San Diego	Southcoast	125,883	164,271	224,118	290,171	38,388	59,847	66,053	30.5%	36.4%	29.5%	18.9%	17.4%	17.4%
	Sub-regional Total	Southcoast	**244,929**	**300,529**	**384,942**	**479,229**	**55,600**	**84,413**	**94,287**	**22.7%**	**28.1%**	**24.5%**	**27.3%**	**24.6%**	**24.8%**
	Riverside	Inland Empire	97,760	162,938	270,893	389,620	65,178	107,955	118,727	66.7%	66.3%	43.8%	32.0%	31.4%	31.2%
	San Bernardino	Inland Empire	110,329	171,155	281,363	411,287	60,826	110,208	129,924	55.1%	64.4%	46.2%	29.9%	32.1%	34.2%
	Sub-regional Total	Inland Empire	**208,089**	**334,093**	**552,256**	**800,907**	**126,004**	**218,163**	**248,651**	**60.6%**	**65.3%**	**45.0%**	**61.9%**	**63.5%**	**65.4%**
	REGIONAL TOTAL		**799,358**	**1,002,839**	**1,346,565**	**1,726,575**	**203,481**	**343,726**	**380,010**	**25.5%**	**34.3%**	**28.2%**	**100.0%**	**100.0%**	**100.0%**
Northern California	Alameda	Central	56,562	63,453	70,471	79,053	6,891	7,018	8,582	12.2%	11.1%	12.2%	20.4%	17.6%	17.7%
	Contra Costa	Central	55,547	60,250	65,067	70,751	4,703	4,817	5,684	8.5%	8.0%	8.7%	13.9%	12.1%	11.7%
	San Francisco	Central	9,386	9,386	9,386	9,386	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	San Mateo	Central	28,473	29,769	31,682	34,300	1,296	1,913	2,618	4.6%	6.4%	8.3%	3.8%	4.8%	5.4%
	Santa Clara	Central	72,717	77,510	83,628	91,392	4,793	6,118	7,764	6.6%	7.9%	9.3%	14.2%	15.4%	16.0%
	Sub-regional Total	Central	**222,685**	**240,368**	**260,234**	**284,882**	**17,683**	**19,866**	**24,648**	**7.9%**	**8.3%**	**9.5%**	**52.3%**	**49.9%**	**50.8%**
	Marin	North	16,073	16,590	17,718	19,373	517	1,128	1,655	3.2%	6.8%	9.3%	1.5%	2.8%	3.4%
	Napa	North	8,313	9,861	11,924	14,411	1,548	2,063	2,487	18.6%	20.9%	20.9%	4.6%	5.2%	5.1%
	Solano	North	21,470	27,815	35,417	44,275	6,345	7,602	8,858	29.6%	27.3%	25.0%	18.8%	19.1%	18.2%
	Sonoma	North	26,762	34,494	43,614	54,514	7,732	9,120	10,900	28.9%	26.4%	25.0%	22.9%	22.9%	22.5%
	Sub-regional Total	North	**72,618**	**88,760**	**108,673**	**132,573**	**16,142**	**19,913**	**23,900**	**22.2%**	**22.4%**	**22.0%**	**47.7%**	**50.1%**	**49.2%**
	REGIONAL TOTAL		**295,303**	**329,128**	**368,907**	**417,455**	**33,825**	**39,779**	**48,548**	**11.5%**	**12.1%**	**13.2%**	**100.0%**	**100.0%**	**100.0%**
San Joaquin Valley	Merced	North	12,358	18,528	29,353	41,382	6,170	10,825	12,029	49.9%	58.4%	41.0%	7.6%	6.7%	6.8%
	San Joaquin	North	29,023	43,284	63,652	85,114	14,261	20,368	21,462	49.1%	47.1%	33.7%	17.6%	12.7%	12.2%
	Stanislaus	North	20,430	25,142	38,362	54,256	4,712	13,220	15,894	23.1%	52.6%	41.4%	5.8%	8.2%	9.0%
	Sub-regional Total	North	**61,811**	**86,954**	**131,367**	**180,752**	**25,143**	**44,413**	**49,385**	**40.7%**	**51.1%**	**37.6%**	**31.1%**	**27.6%**	**28.0%**
	Fresno	Central	37,765	48,893	81,243	119,323	11,128	32,350	38,080	29.5%	66.2%	46.9%	13.7%	20.1%	21.6%
	Madera	Central	9,025	15,348	24,970	35,827	6,323	9,622	10,857	70.1%	62.7%	43.5%	7.8%	6.0%	6.2%
	Sub-regional Total	Central	**46,790**	**64,241**	**106,213**	**155,150**	**17,451**	**41,972**	**48,937**	**37.3%**	**65.3%**	**46.1%**	**21.6%**	**26.1%**	**27.7%**
	Kern	South	40,840	65,117	111,187	159,400	24,277	46,070	48,213	59.4%	70.7%	43.4%	30.0%	28.7%	27.3%
	Kings	South	11,501	15,094	20,830	27,189	3,593	5,736	6,359	31.2%	38.0%	30.5%	4.4%	3.6%	3.6%
	Tulare	South	19,701	30,181	52,627	76,216	10,480	22,446	23,589	53.2%	74.4%	44.8%	12.9%	14.0%	13.4%
	Sub-regional Total	South	**72,042**	**110,392**	**184,644**	**262,805**	**38,350**	**74,252**	**78,161**	**53.2%**	**67.3%**	**42.3%**	**47.4%**	**46.2%**	**44.3%**
	REGIONAL TOTAL		**180,643**	**261,587**	**422,224**	**598,707**	**80,944**	**160,637**	**176,483**	**44.8%**	**61.4%**	**41.8%**	**100.0%**	**100.0%**	**100.0%**

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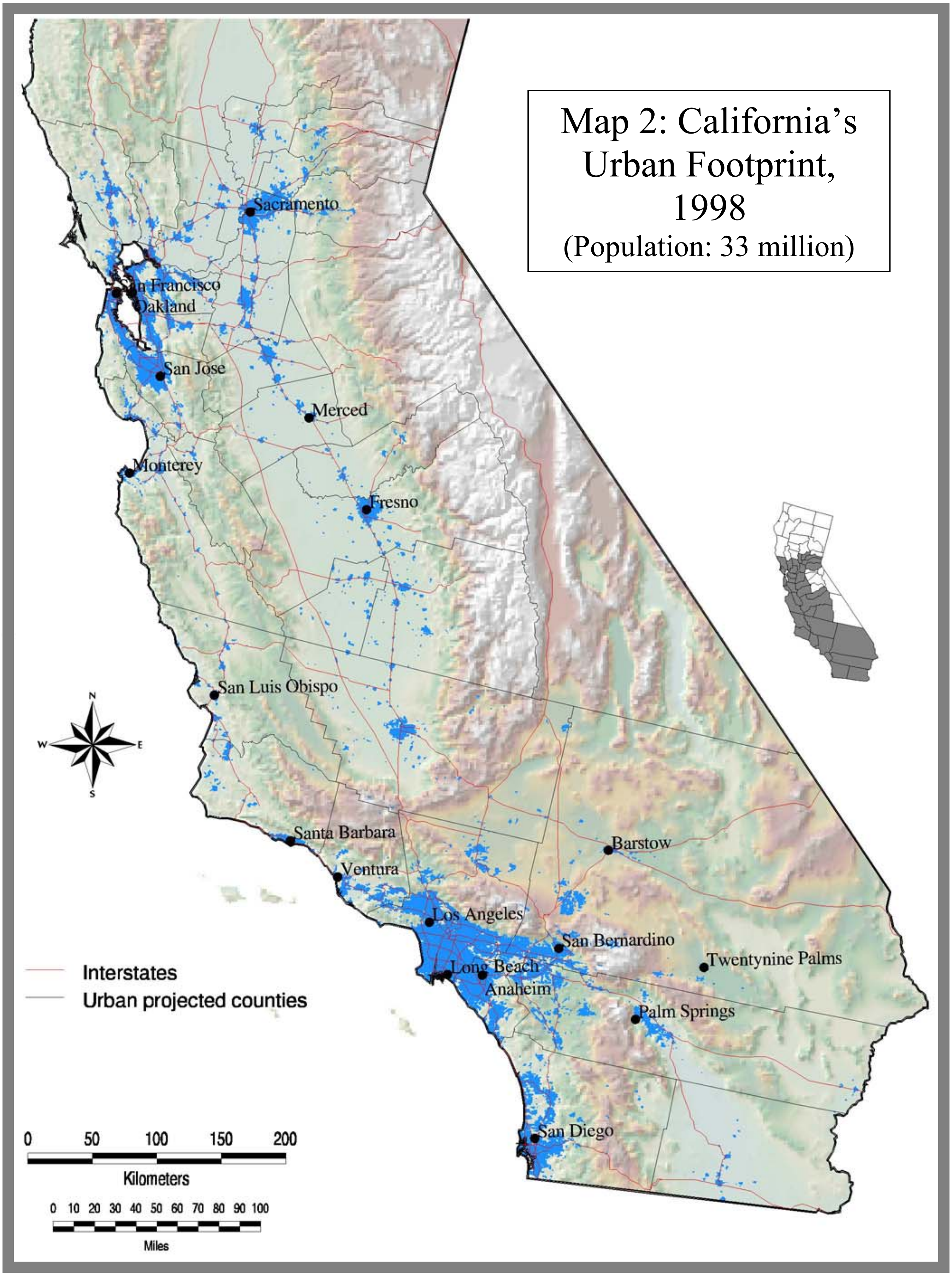
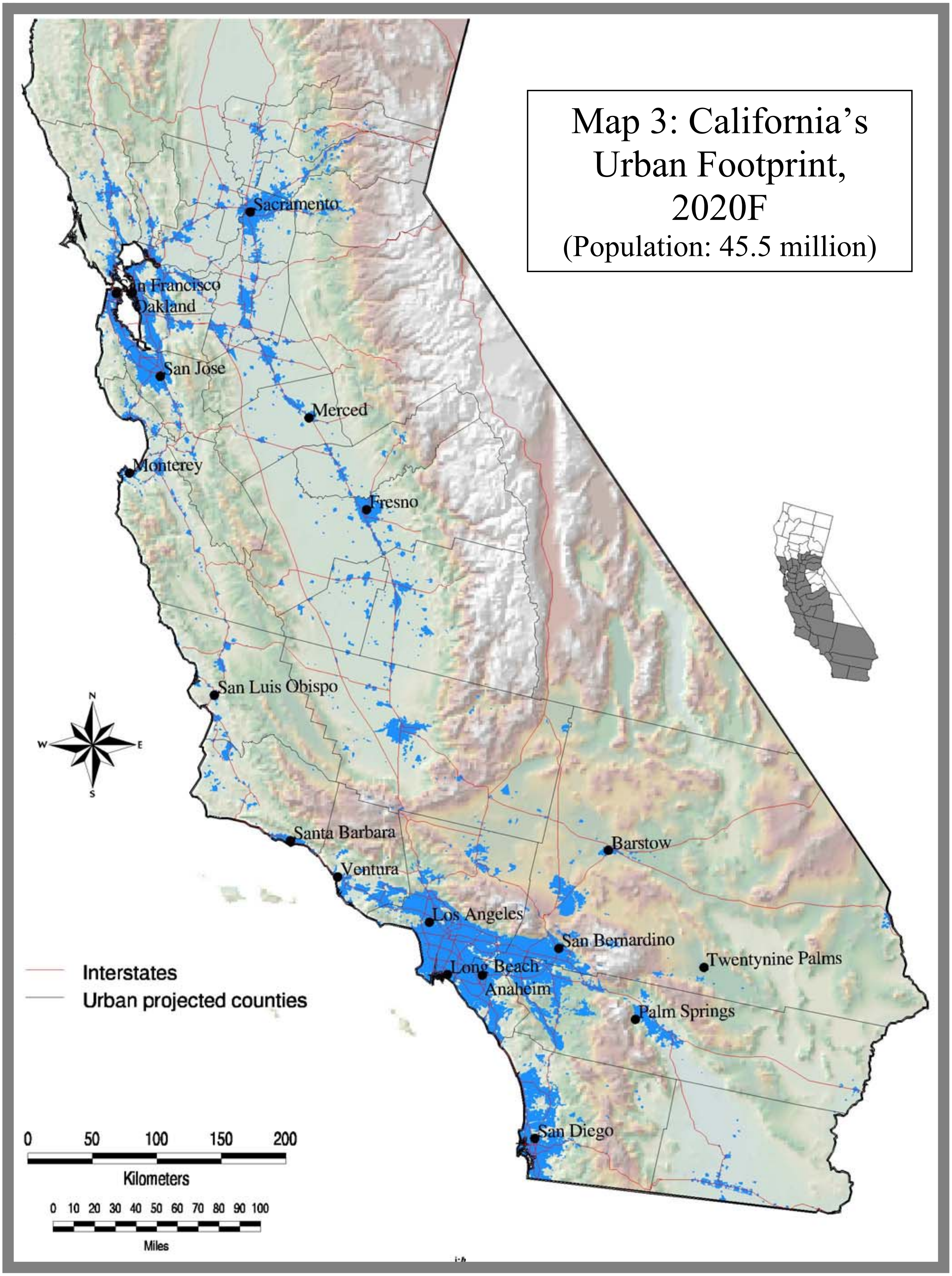
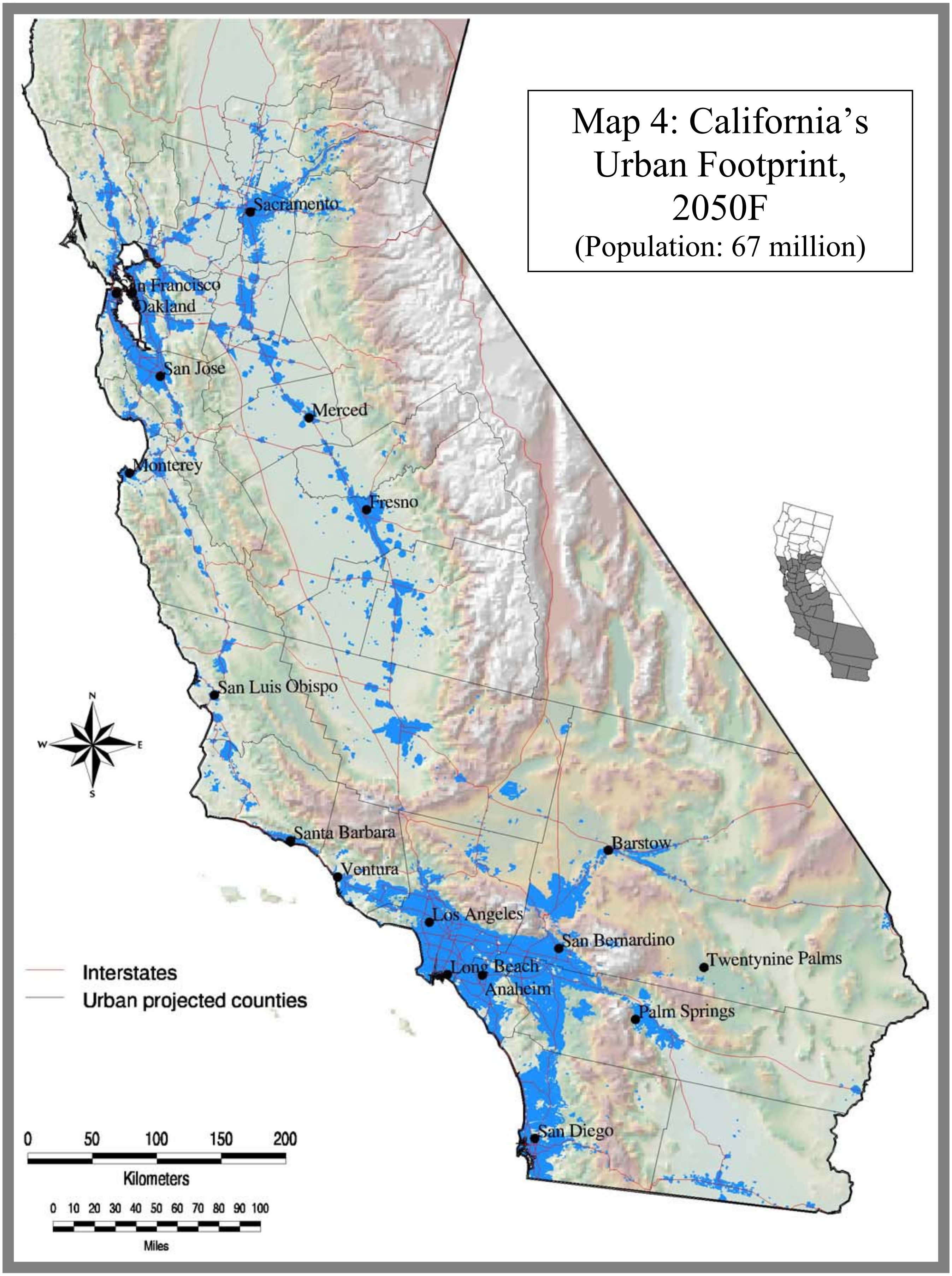
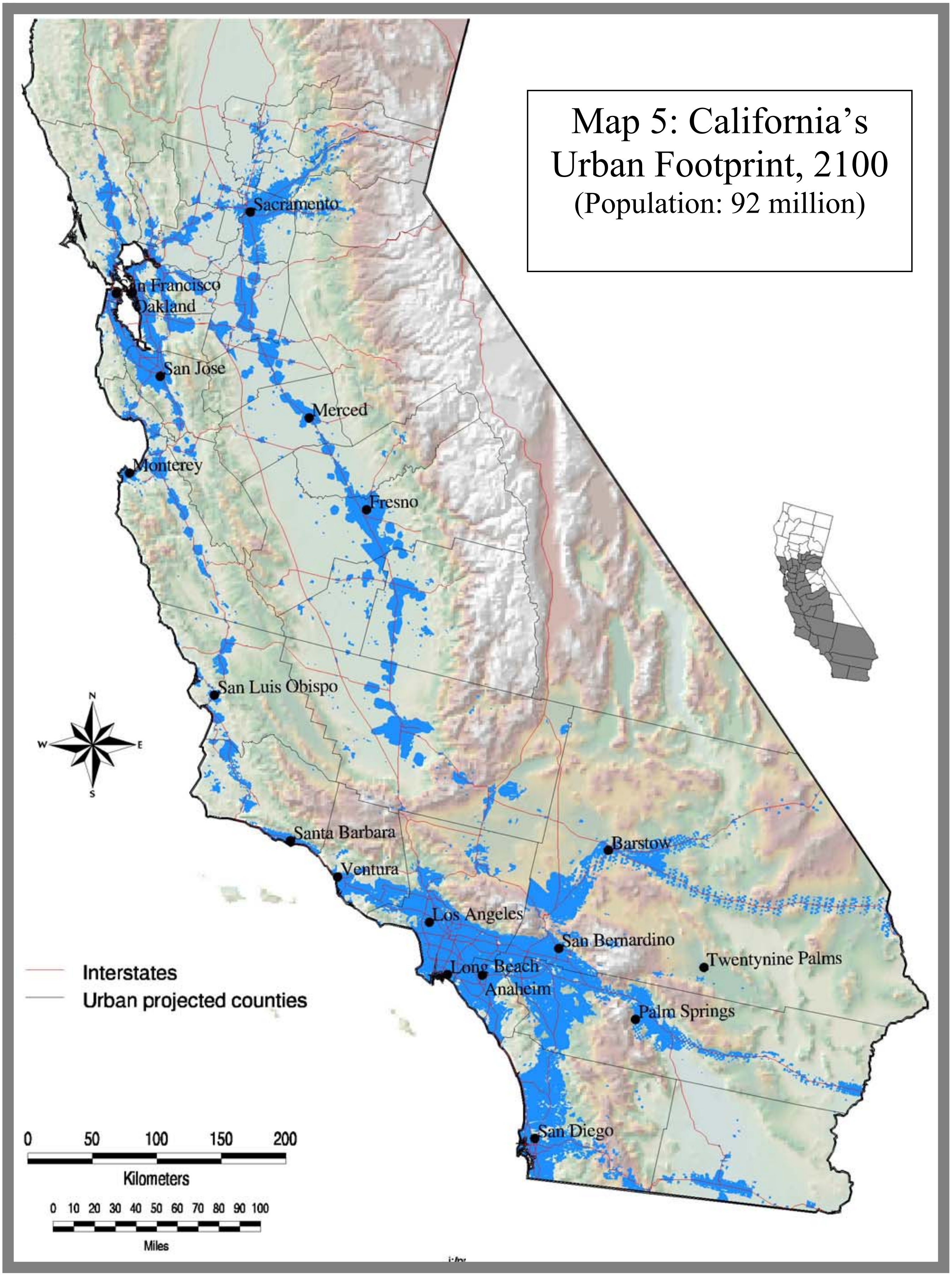
Major Region	County	Sub-Region	Urbanized Land Area (Hectares)				Change in Urbanized Land Area (Hectares)			Pct.Change in Urbanized Land Area (Hectares)			County Share of Regional Change		
			1998	2020F	2050F	2100F	1998-2020	2020-2050	2050-2100	1998-2020	2020-2050	2050-2100	1998-2020	2020-2050	2050-2100
Sacramento	**Sacramento**	Central	**61,009**	**71,950**	**85,317**	**100,003**	**10,941**	**13,367**	**14,686**	**17.9%**	**18.6%**	**17.2%**	**35.5%**	**35.9%**	**34.0%**
	El Dorado	Foothills	10,436	13,920	17,829	22,611	3,484	3,909	4,782	33.4%	28.1%	26.8%	11.3%	10.5%	11.1%
	Nevada	Foothills	5,924	7,935	9,905	12,367	2,011	1,970	2,462	33.9%	24.8%	24.9%	6.5%	5.3%	5.7%
	Placer	Foothills	15,284	23,776	33,099	44,089	8,492	9,323	10,990	55.6%	39.2%	33.2%	27.5%	25.0%	25.5%
	Sub-regional Total	Foothills	**31,644**	**45,631**	**60,833**	**79,067**	**13,987**	**15,202**	**18,234**	**44.2%**	**33.3%**	**30.0%**	**45.3%**	**40.8%**	**42.2%**
	Sutter	Northwest	4,311	6,385	9,202	12,333	2,074	2,817	3,131	48.1%	44.1%	34.0%	6.7%	7.6%	7.3%
	Yolo	Northwest	10,368	12,923	16,752	21,422	2,555	3,829	4,670	24.6%	29.6%	27.9%	8.3%	10.3%	10.8%
	Yuba	Northwest	4,531	5,821	7,834	10,290	1,290	2,013	2,456	28.5%	34.6%	31.4%	4.2%	5.4%	5.7%
	Sub-regional Total	Northwest	**19,210**	**25,129**	**33,788**	**44,045**	**5,919**	**8,659**	**10,257**	**30.8%**	**34.5%**	**30.4%**	**19.2%**	**23.3%**	**23.8%**
	REGIONAL TOTAL		**111,863**	**142,710**	**179,938**	**223,115**	**30,847**	**37,228**	**43,177**	**27.6%**	**26.1%**	**24.0%**	**100.0%**	**100.0%**	**100.0%**
Central Coast	Monterey		20,224	28,922	50,837	74,896	8,698	21,915	24,059	43.0%	75.8%	47.3%	37.0%	36.5%	41.3%
	San Benito		2,709	4,344	7,240	10,457	1,635	2,896	3,217	60.4%	66.7%	44.4%	7.0%	4.8%	5.5%
	San Luis Obispo		14,989	20,920	32,512	45,581	5,931	11,592	13,069	39.6%	55.4%	40.2%	25.2%	19.3%	22.4%
	Santa Barbara		24,061	28,142	45,317	63,227	4,081	17,175	17,910	17.0%	61.0%	39.5%	17.4%	28.6%	30.7%
	Santa Cruz		11,539	14,713	21,142	21,145	3,174	6,429	3	27.5%	43.7%	0.0%	13.5%	10.7%	0.0%
	REGIONAL TOTAL		**73,522**	**97,041**	**157,048**	**215,306**	**23,519**	**60,007**	**58,258**	**32.0%**	**61.8%**	**37.1%**	**100.0%**	**100.0%**	**100.0%**


Map 2: California's
Urban Footprint,
1998
(Population: 33 million)
Sacramento
San Francisco
Oakland
San Jose
Merced
Monterey
Fresno
San Luis Obispo
Santa Barbara
Ventura
Barstow
Los Angeles
San Bernardino
Twentynine Palms
Long Beach
Anaheim
Palm Springs
San Diego
N
S
E
W
Interstates
Urban projected counties
0 50 100 150 200
Kilometers
0 10 20 30 40 50 60 70 80 90 100
Miles



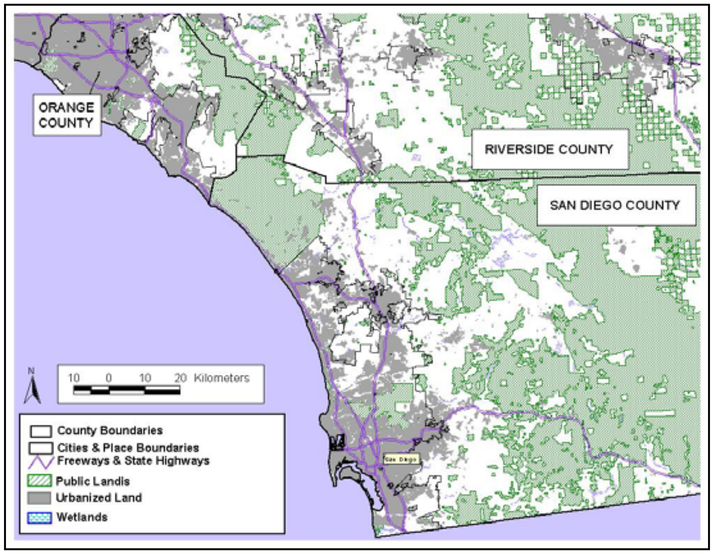
Map 3: California's
Urban Footprint,
2020F
(Population: 45.5 million)
Sacramento
San Francisco
Oakland
San Jose
Merced
Monterey
Fresno
San Luis Obispo
Santa Barbara
Ventura
Barstow
Los Angeles
San Bernardino
Twentynine Palms
Long Beach
Anaheim
Palm Springs
San Diego
N
W
E
S
Interstates
Urban projected counties
0 50 100 150 200
Kilometers
0 10 20 30 40 50 60 70 80 90 100
Miles


Map 4: California's
Urban Footprint,
2050F
(Population: 67 million)
Sacramento
San Francisco
Oakland
San Jose
Merced
Monterey
Fresno
San Luis Obispo
Santa Barbara
Ventura
Los Angeles
Barstow
San Bernardino
Twentynine Palms
Long Beach
Anaheim
Palm Springs
San Diego
N
W
E
S
Interstates
Urban projected counties
0 50 100 150 200
Kilometers
0 10 20 30 40 50 60 70 80 90 100
Miles

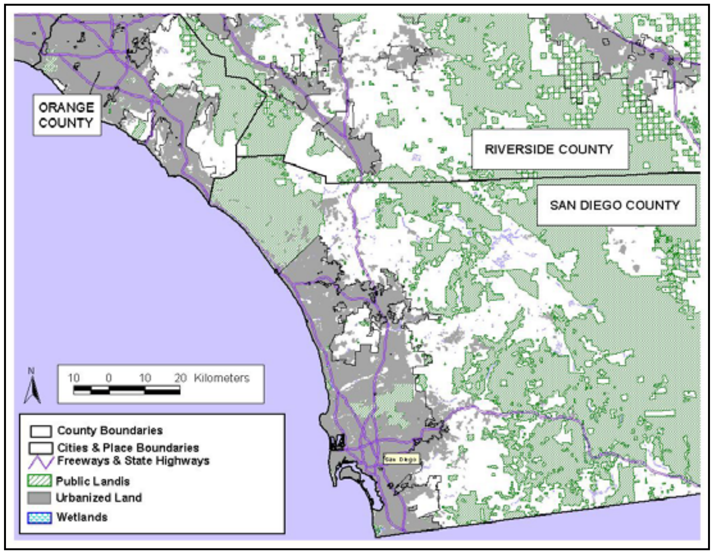

Map 5: California's
Urban Footprint, 2100
(Population: 92 million)
Sacramento
San Francisco
Oakland
San Jose
Merced
Monterey
Fresno
San Luis Obispo
Santa Barbara
Ventura
Barstow
Los Angeles
San Bernardino
Twentynine Palms
Long Beach
Anaheim
Palm Springs
San Diego
N
S
E
W
Interstates
Urban projected counties
0 50 100 150 200
Kilometers
0 10 20 30 40 50 60 70 80 90 100
Miles

Map 6

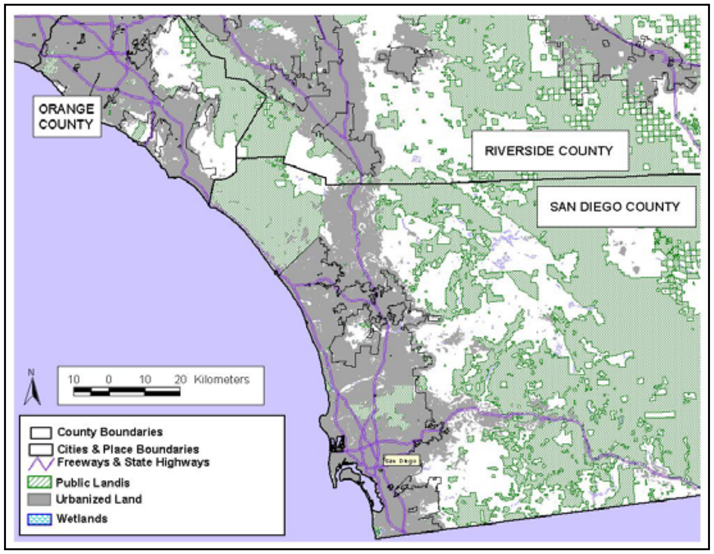
1998



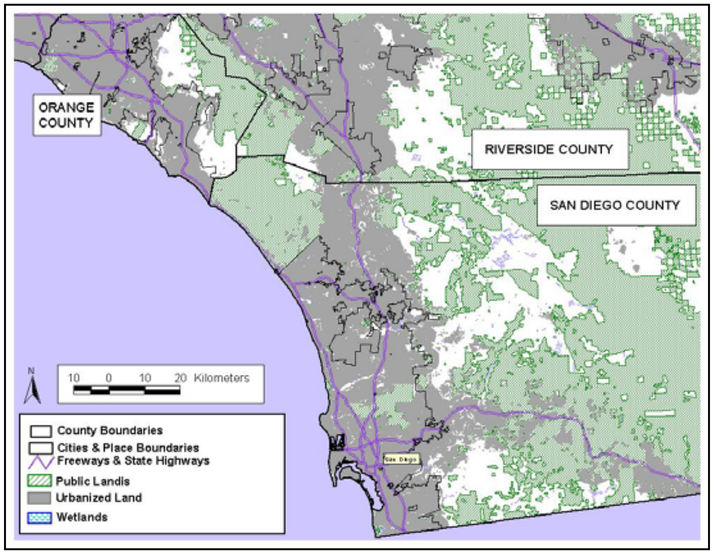
2020F



2050F



2100F



Most of Orange County's projected population growth will take the form of high-density infill. Thus, while Orange County will account for a significant share of Southern California's population growth by 2100, it will account for a far lesser share of the region's projected urban expansion—on the order of only 2% to 4%, depending on the period. By 2050, almost all undeveloped lands in Orange County west and north of the foothills will have been developed.

The situation is the opposite for Imperial County, which will account for only two percent of the region's population growth between 1998 and 2100, but about five percent of the increase in its urban land area. All of Imperial County's projected urban growth between 1998 and 2100 will occur along Interstate I-8, most of it within ten miles of El Centro.

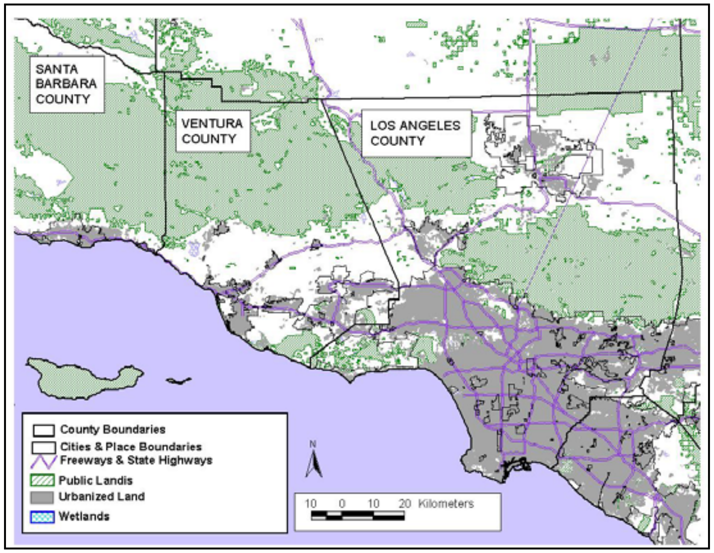
Southern California: Los Angeles County (Map 7): Except for a few areas in the San Fernando Valley, Los Angeles County is almost entirely built-out southwest of the San Gabriel Mountains. As a result, most of Los Angeles County's projected population growth during the 21st century will take the form of infill and redevelopment. Currently, Los Angeles County's urban and suburban footprint occupies about 307,000 hectares of land; by 2100, it will have grown to 361,000 hectares. Thus, while Los Angeles County will account for 31% of Southern California's population growth during the 21st Century, its share of the region's urbanized land area growth will be just under six percent. Spatially, Los Angeles County will continue its inexorable push northward and eastward, filling out all of eastern Los Angeles County by 2020, and most of the Santa Clarita Valley by 2050.

Southern California: Ventura and Santa Barbara Counties (Map 7): Urban development in Ventura and Santa Barbara counties will increase from about 63,000 hectares in 1998, to 78,000 hectares in 2020, to 113,000 hectares in 2050, to just under 150,000 hectares in 2100. Depending on the time period, growth in the Ventura and Santa Barbara sub-region will account for 7–10% of new urban development in Southern California during the 21st century.

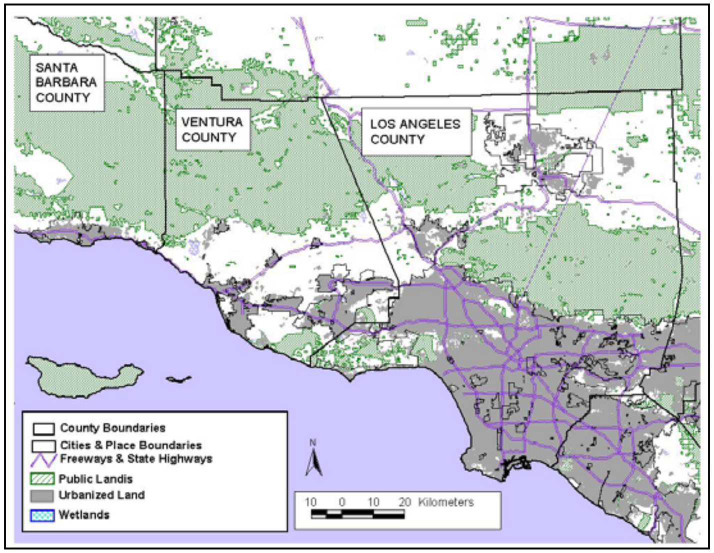
Being closer to Los Angeles, Ventura County will grow more and earlier. Ventura County's urban footprint will expand by 11,000 hectares between 1998 and 2020, 17,000 hectares between 2020 and 2050, and 18,000 hectares between 2050 and 2100. (These correspond to percentage increases of 28%, 35%, and 27%, respectively.) Spatially, Ventura County will continue growing in a northwestern direction. The Highway 101 corridor from Calabassas to Ventura and the Highway 118 corridor from Simi Valley to Moorpark will both be built-out by 2020. By 2050,

Map 7

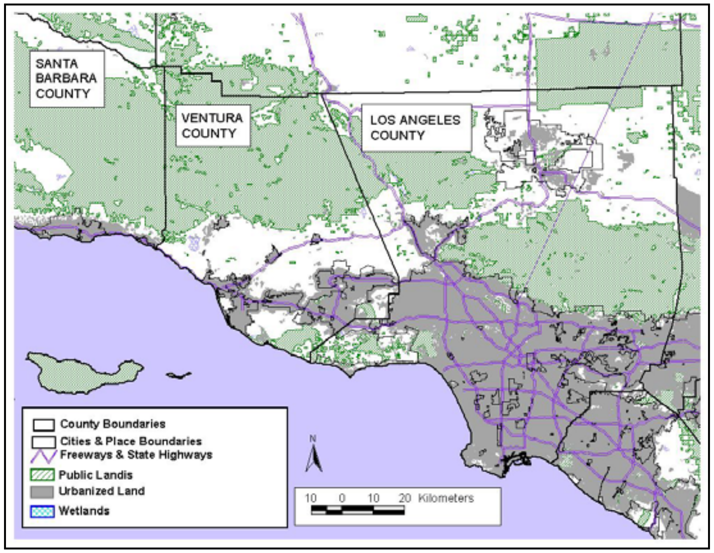
1998



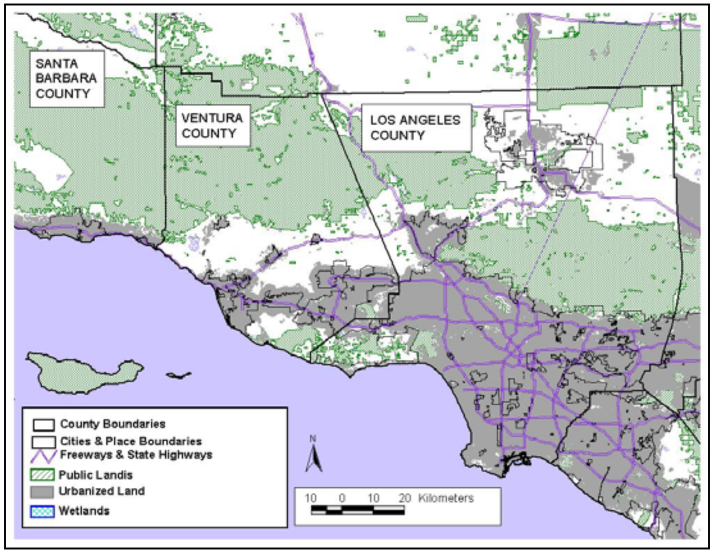
2020F



2050F



2100F



development along the Highway 101 and 118 corridors will have merged, creating a continuous 20-mile westward extension of the San Fernando Valley.

Santa Barbara County should be able to continue resisting Southern California's extreme growth pressures for about another 20 years, increasing its urban footprint by only 4,000 hectares. After 2020, develop activity should pick up: between 2020 and 2100, Santa Barbara's urban footprint should increase by over 200%. With growth in southeastern Santa Barbara County limited by the Santa Ynez Mountains, most new development will occur along the Highway 101 corridor north from Buellton north to Santa Maria. Indeed, by 2100, the entire Highway 101 corridor from downtown Los Angeles north to Santa Maria will be essentially built-out.

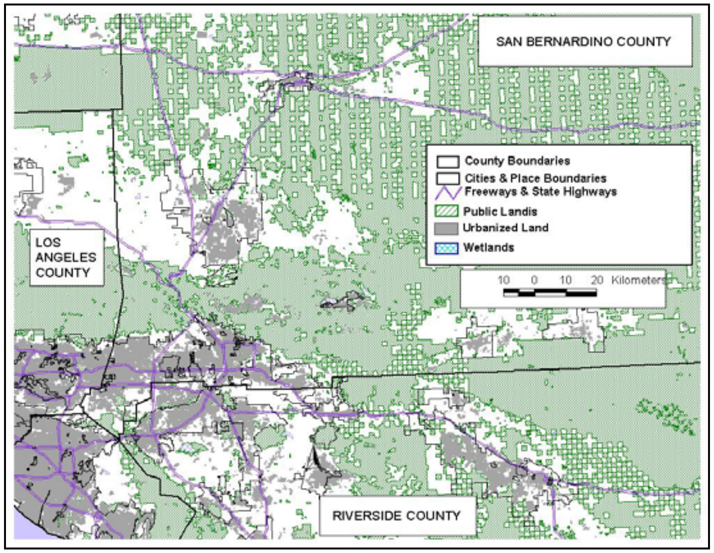
Southern California: The Inland Empire (Map 8): With coastal areas running out of buildable land, the real development action in Southern California during the 21st century will be in Riverside and San Bernardino counties—the Inland Empire. Urban development in the Inland Empire will increase from 208,000 hectares in 1998 to just over 800,000 hectares in 2100, an increase of nearly 400%. Sixty percent of new urban development in Southern California during this century will occur in the Inland Empire.

San Bernardino and Riverside counties will grow at about the same rate. Riverside County's urban footprint will increase in size from about 100,000 hectares in 1998 to just under 400,000 hectares by 2100. San Bernardino County's urban footprint will grow from 110,000 hectares in 1998 to 411,000 hectares by 2100.

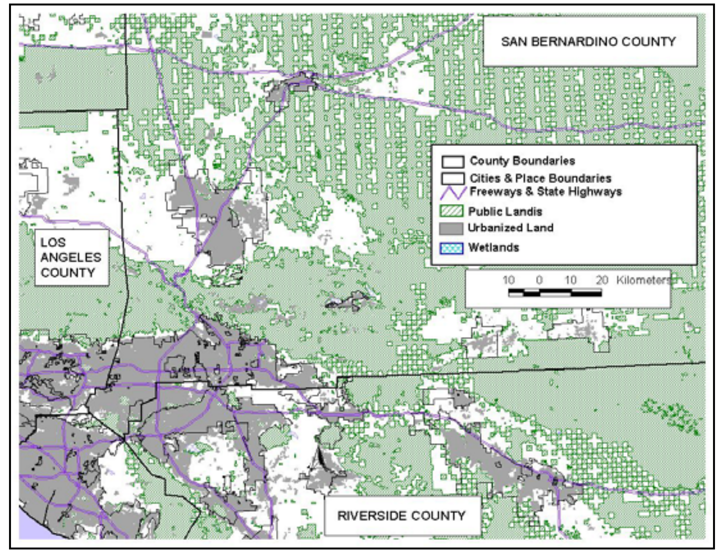
The two counties' growth patterns will also be similar: development will proceed west to east, along Interstates I-10 and I-215 in Riverside County, and along Interstates I-10, I-15, and I-40 in San Bernardino County. By 2020, almost all remaining developable lands within a ten-mile radius of the Ontario Airport—the current growth center of the Inland Empire—will be built-out, whether in San Bernardino or Riverside counties. Development will continue apace in the Victorville–Apple Valley–Hesperia area of San Bernardino County and the Perris–Hemet–Moreno Valley area of Riverside County. By 2050, both areas will have emerged as major metropolitan centers and the Inland Empire will be entirely built-out west of the line connecting Hemet in Riverside County and Yucaipa in San Bernardino County. North of the Cajon Pass, intense suburban development will reach the Barstow area and points east along Interstates I-5 and I-40 by 2030. By 2050, the Coachella Valley (stretching

Map 8

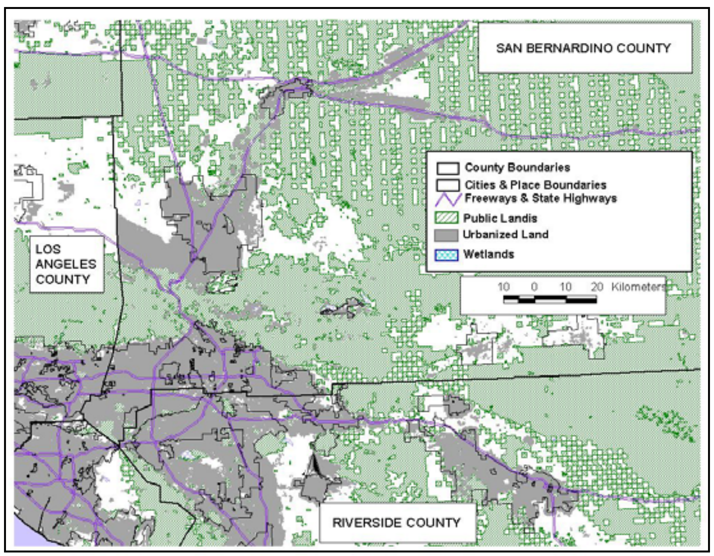
199 8



2020F



2050F



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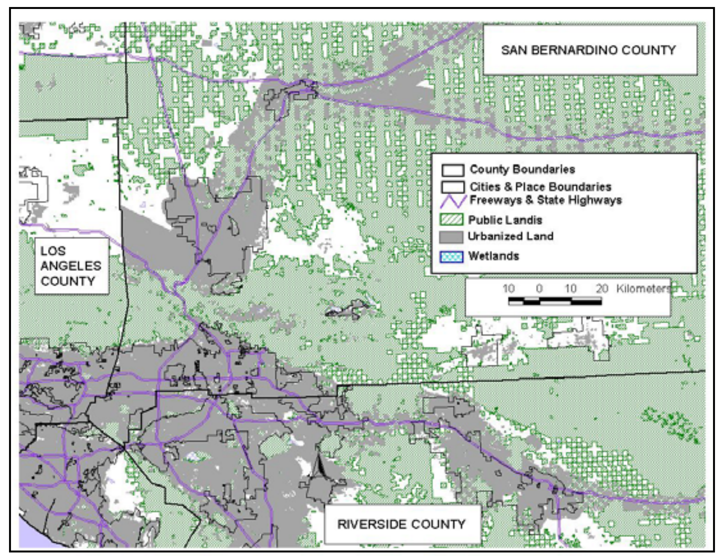


from Palm Springs to Indio) will be built-out south of Interstate I-10; by 2100, the north side of the Coachella Valley will have been developed.

The Southern San Joaquin Valley: Kern, Kings, Fresno, Madera and Tulare Counties (Map 9): Urban development in the southern end of the San Joaquin Valley will grow from 118,000 hectares in 1998 to 418,000 hectares in 2100—an increase of nearly 250%. Nearly three-quarters of new urban development in the entire San Joaquin Valley (stretching from Kern County in the south to San Joaquin County in the north) will be in the southern sub-region. As it has since the turn of the 20th century, new development in the southern San Joaquin Valley will be concentrated along the Highway 99 corridor—with or without the construction of a high-speed rail system. For the most part, development will occur north to south, connecting Fresno and Visalia by 2030, and extending south to Tulare and Corcoran by 2050. By 2100, the entire corridor will be urbanized, and active farmlands will have been pushed to the east and west. New development will also follow Highway 99 south of Bakersfield toward Los Angeles.

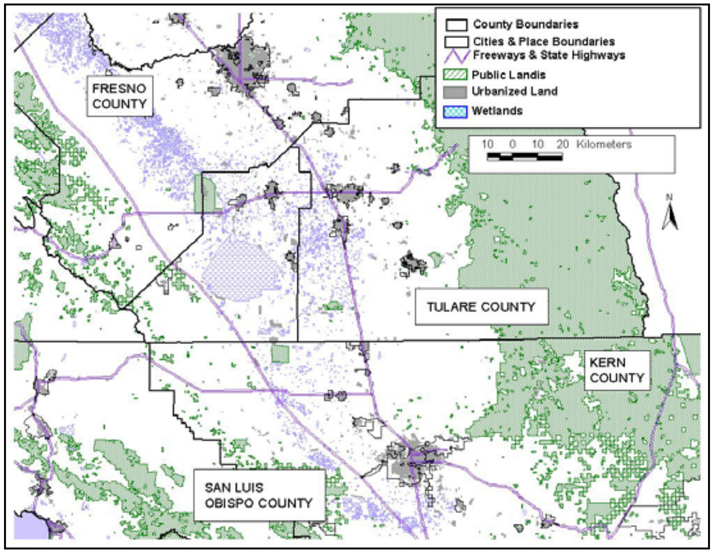
Almost one-third of the region's urban growth will occur in Kern County. Between 1998 and 2100, Kern County's urban footprint will expand from 65,000 hectares to nearly 160,000 hectares. Currently, almost all urban development in Kern County is concentrated in and around Bakersfield. With the city's urban footprint likely to grow three-fold by 2100, Bakersfield will continue to dominate Kern County's urban landscape. Even so, new and smaller urban nodes will also develop around the cities of Shafter and Delano by 2020, Wasco and Tehachapi by 2050, and Arvin and Mojave by 2100.

The other major locus of future urban growth in the southern San Joaquin Valley will be Fresno County. Between 1998 and 2100, Fresno County's urban footprint will expand three-fold, from 38,000 hectares to 119,000 hectares. Almost all new urban development in Fresno County will occur at the outskirts of the City of Fresno or along Highway 99.

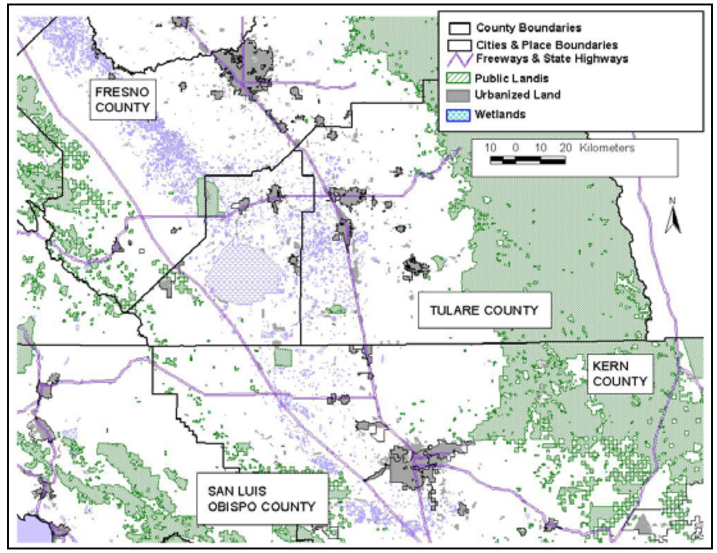
Tulare County, which lies along Highway 99 between Kern and Fresno counties will also grow significantly more urban during the 21st century. If current trends continue, Tulare's urban footprint will grow in size from 20,000 hectares in 1998 to 76,000 hectares in 2100. While initially clustered around Visalia and Tulare, by 2100, the entire Highway 99 corridor in Tulare County will be urbanized. Madera and Kings counties will also see significant, albeit somewhat lesser, amounts of additional urban growth throughout the 21st century.

Map 9

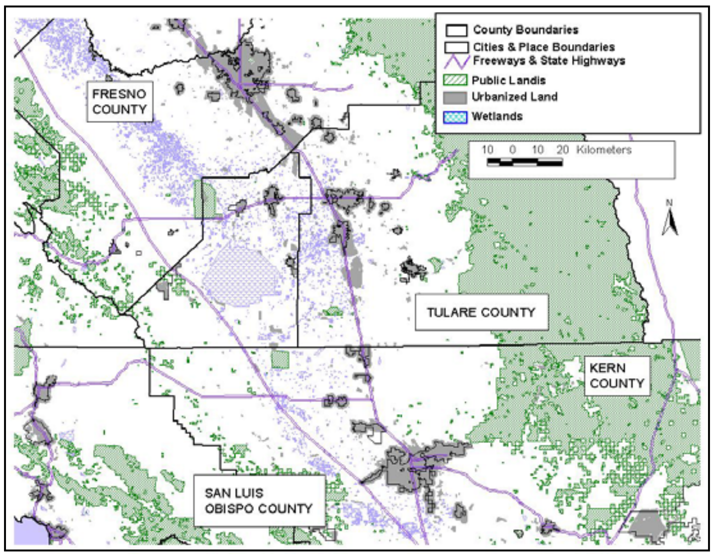
1998



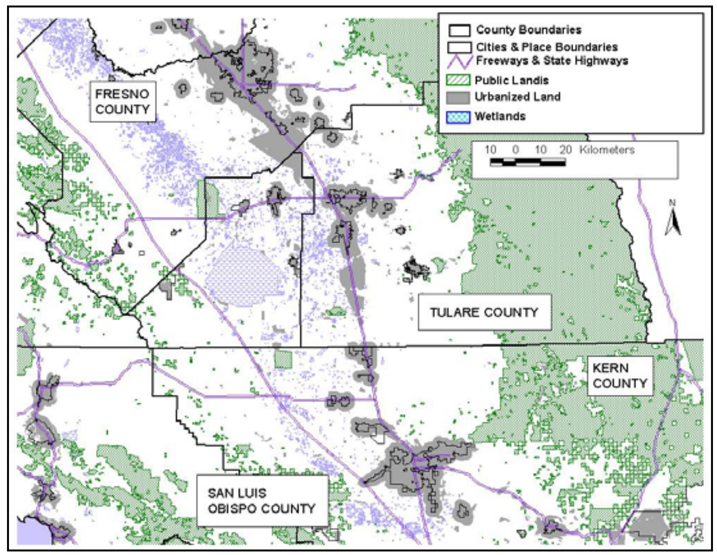
2020F



2050F



2100F



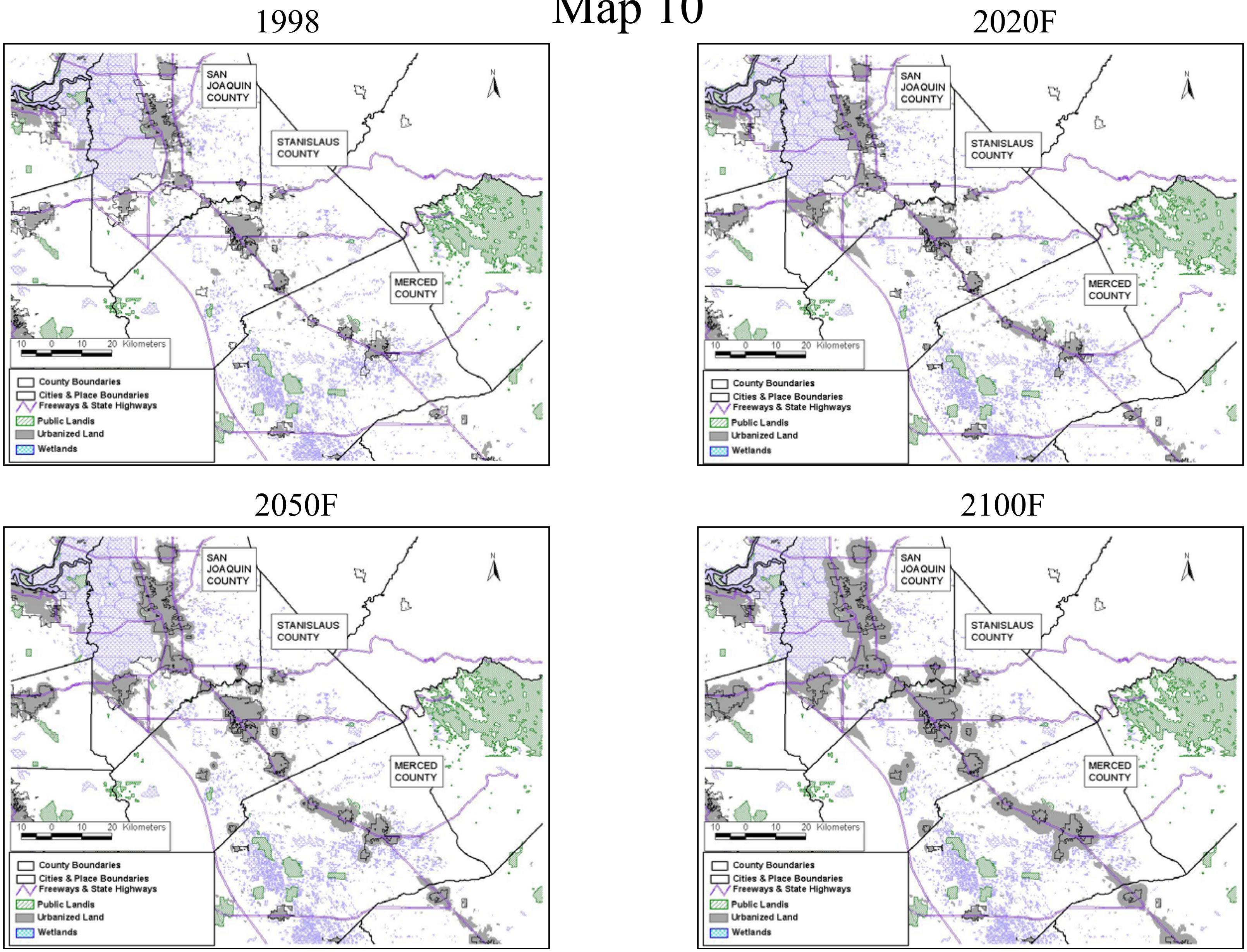
The Northern San Joaquin Valley: Kern, Kings, Fresno, Madera and Tulare Counties (Map 10): The northern San Joaquin Valley extends from Lodi and Stockton in San Joaquin County in the north; south along Highway 99 to Modesto, Ceres, and Turlock in Stanislaus County; and then further south to Livingston and Merced in Merced County. New development in the northern San Joaquin Valley sub-region will be principally fed by unaccommodated eastward overflow growth from Bay Area. Altogether, urban development in the northern San Joaquin Valley will grow from 62,000 hectares in 1998 to 180,000 hectares in 2100—an increase of nearly 200%. As in the southern part of the San Joaquin Valley, new development in the north will be concentrated along the Highway 99 corridor. By 2100, the entire Highway 99 corridor will be developed to a width of 10–20 miles in San Joaquin County, down to 5–10 miles in Merced County.

About half of the northern sub-region's urban growth will occur in San Joaquin County. Between 1998 and 2100, San Joaquin County's urban footprint will expand from 29,000 to 85,000 hectares. By 2020, the Interstate I-205 corridor connecting Tracy and Manteca will be mostly built-out. By 2050, urban development will extend continuously along the Highway 99/I-5 corridor from Lodi in the north to Ripon in the south. By 2100, San Joaquin County's urban footprint will rival Santa Clara's in size.

Stanislaus County will also grow substantially, adding 55,000 hectares of new urban development by 2100. Most of Stanislaus County's new development will occur in and around the cities of Modesto and Turlock. Further south, Merced County's urban footprint will expand from 12,000 hectares in 1998 to over 40,000 hectares by 2100. Growth in Merced County will generally proceed north to south: starting in Livingston, then moving south to Atwater and later to Merced. One wildcard in the future development of Merced County is the new University of California at Merced campus, the presence of which was not included in the baseline model runs. If, as is intended, UC Merced serves as an engine of economic development, urban growth in Merced County could well exceed these estimates.

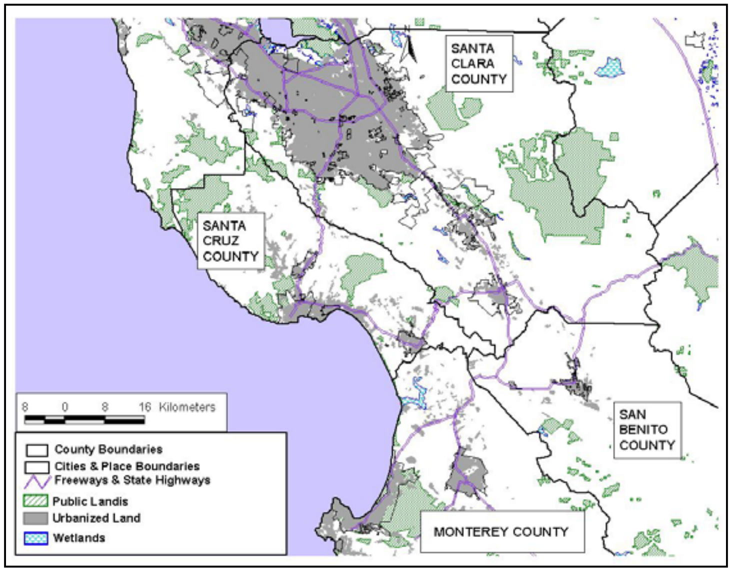
Northern California: The Monterey Bay Area and San Luis Obispo County (Map 11): We have included the Monterey Bay Area and San Luis Obispo County as a sub-region of Northern California, something that isn't usually done—at least not yet. More and more, however, as the Silicon Valley continues to grow southward, its economic sphere of influence will envelop Monterey, San Benito, Santa Cruz, and even the northern section of San Luis Obispo County.

Map 10

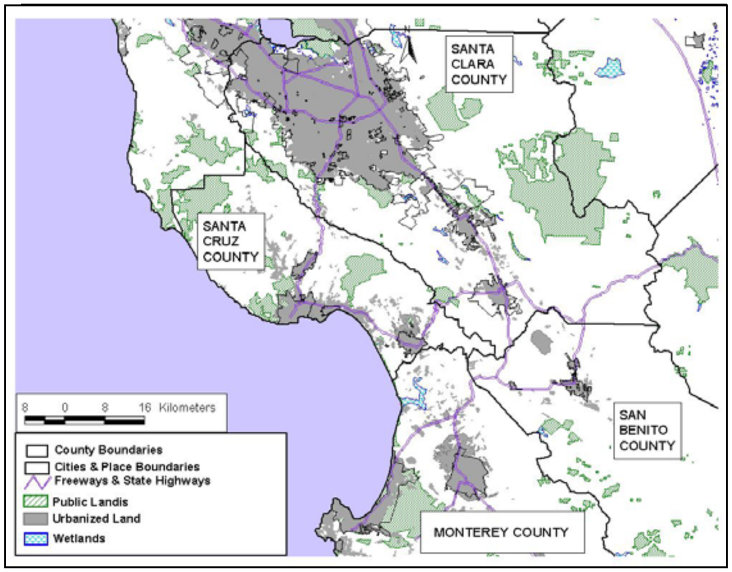

1998
2020F
2050F
2100F
SAN JOAQUIN COUNTY
STANISLAUS COUNTY
MERCED COUNTY
N
10 0 10 20 Kilometers
County Boundaries
Cities & Place Boundaries
Freeways & State Highways
Public Lands
Urbanized Land
Wetlands

Map 11

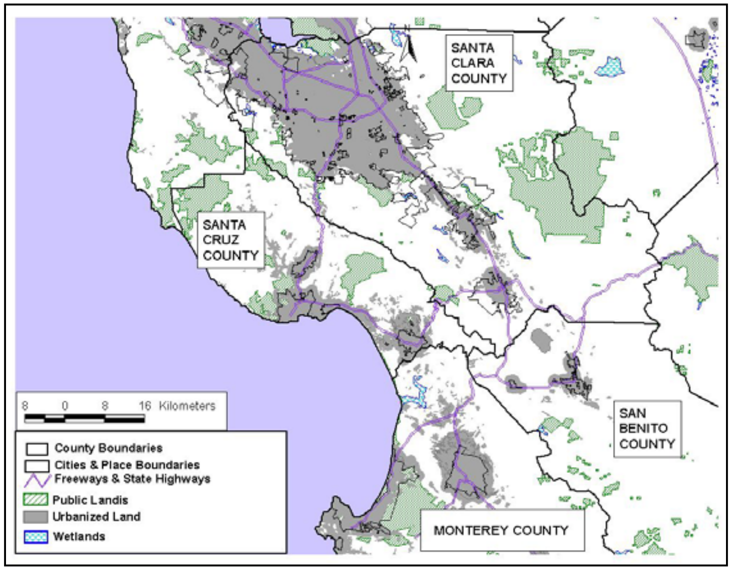
1998



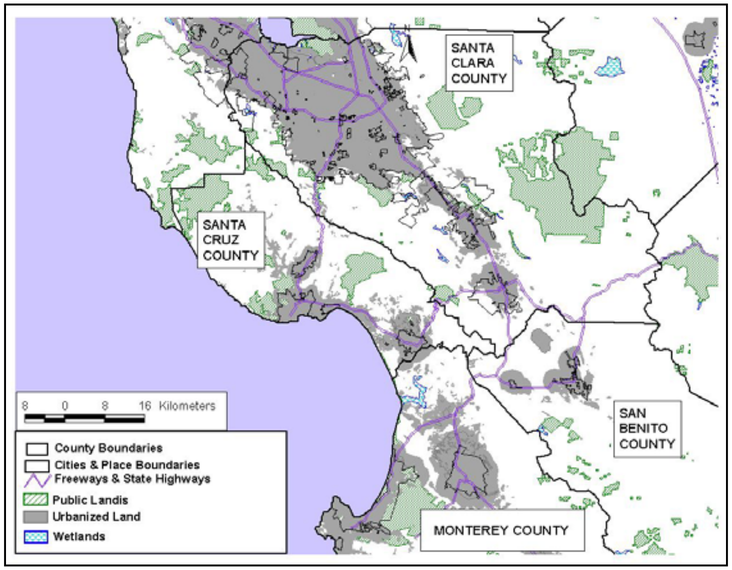
2020F



2050F



2100F



Urban development in these four counties will increase continuously from 49,000 hectares in 1998 to more than 150,000 hectares by 2100. Depending on the time period, urban growth in this sub-region will account for between a third and one-half of new urban development in Northern California during the 21st Century. Unlike the central Bay Area, where significant population growth will occur as infill, most population growth in the Monterey Bay Area and points south will occur as "greenfield" development.

Monterey County, being more directly connected to Santa Clara County along Highway 101, will grow more and earlier than its three sub-regional neighbors. From its current size of 20,000 hectares, Monterey County's urban footprint will expand to 51,000 hectares by 2050 and 75,000 hectares by 2100. Within Monterey County, the wave of urban development will move north to south, enveloping Prunedale and Salinas by 2020, Gonzales and Soledad by 2050, and reaching as far south as King City by 2100. Indeed, by 2050, the central spine of the Salinas River Valley—which includes some of the most fertile farmland in the world—will be essentially built-out.

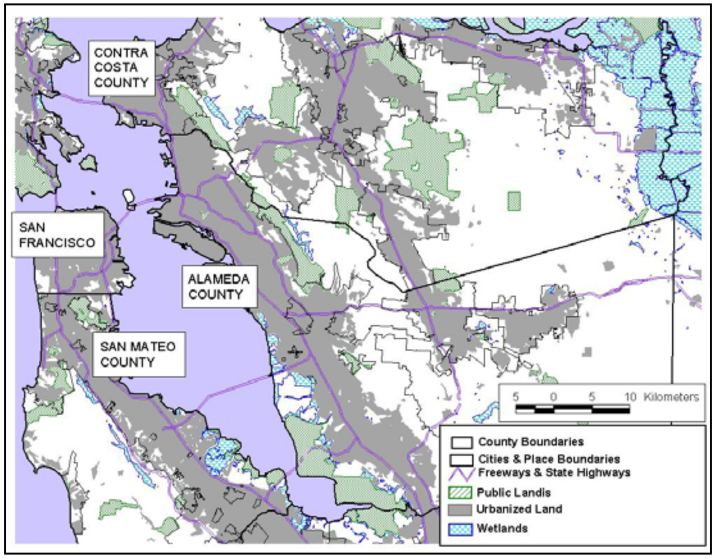
Further to the south, San Luis Obispo County's urban footprint will also expand significantly, from 15,000 hectares in 1998 to nearly 46,000 hectares by 2100. Growth will occur radially around the cities lining the Highway 101 corridor. These include Paso Robles, Atascadero, San Luis Obispo and Pismo Beach.

Because they lack flat, accessible, and easily-serviced raw land, Santa Cruz County and San Benito County will grow more moderately—at least in comparison to Monterey County and San Luis Obispo County. If current trends continue, Santa Cruz County's urban footprint will expand from 12,000 hectares in 1998 to over 20,000 hectares in 2100. Most of this growth will occur in the Watsonville area. To the east, San Benito County's urban footprint will grow from about 3,000 hectares in 1998 to 10,000 hectares in 2100.

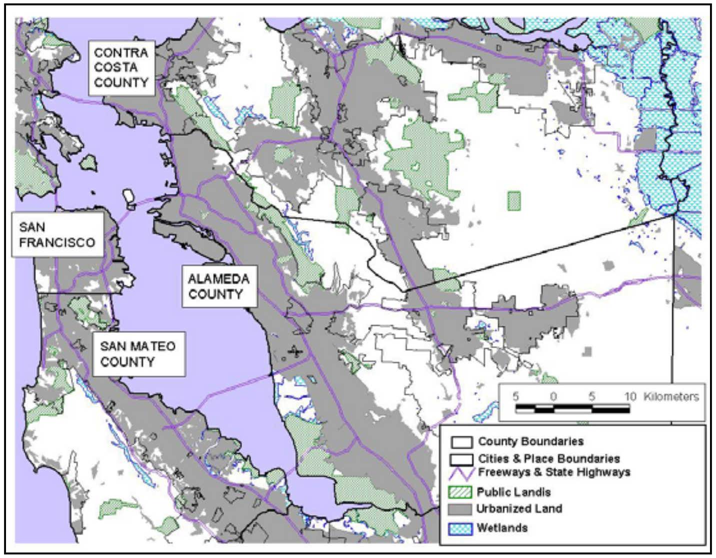
Northern California: The Central San Francisco Bay Area (Map 12): Urban development in the central San Francisco Bay Area—encompassing Alameda, Contra Costa, San Francisco, San Mateo, and Santa Clara counties—currently occupies a 220,000 hectare footprint. With so little undeveloped land remaining adjacent to the San Francisco Bay, most new development in this sub-region will occur east of the Oakland/East Bay Hills and south of San Jose. If current trends continue, the Central Bay Area's urban footprint will grow in size to 240,000 hectares by 2020, 260,000 hectares by 2050, and 284,000 hectares by 2100. This is a relatively modest level of growth compared to California's

Map 12

1998



2020F



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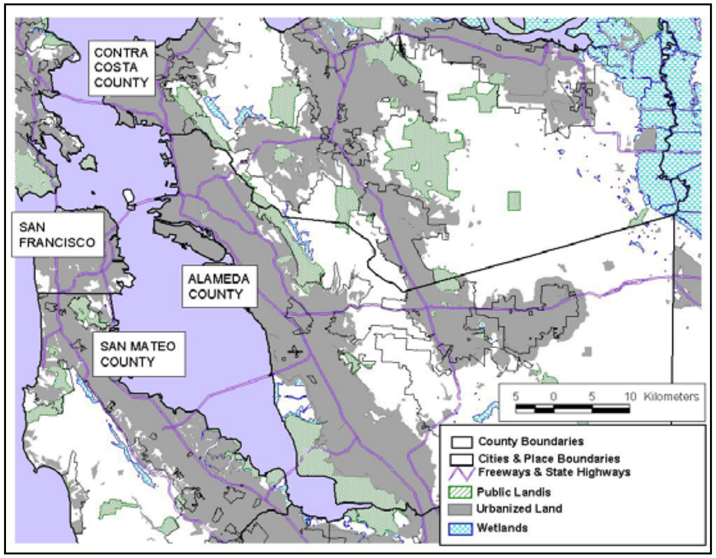

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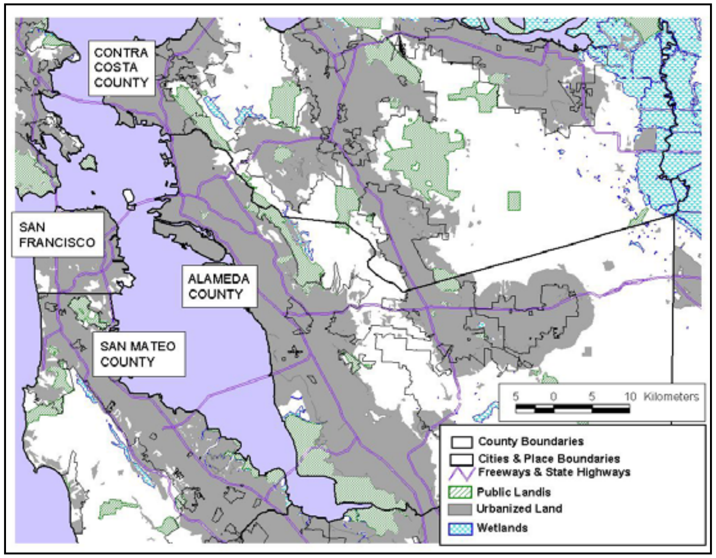


other urban areas, and reflects the fact that most of the sub-region's population growth will take the form of infill and redevelopment. Although it is currently home to more than 5 million residents and more than 75% of the Northern California region's population, over the next century the Central Bay Area will account for less than 30% of the region's projected urban growth.

Already mostly urbanized, Santa Clara County has little flat and accessible land available for future development; and most of what it does have is in the central and southern part of the county. As a result, Santa Clara County's urban footprint will grow from its current size of 73,000 hectares to 91,000 hectares by 2100. Almost all of this increase will occur within the Highway 101 corridor south of San Jose.

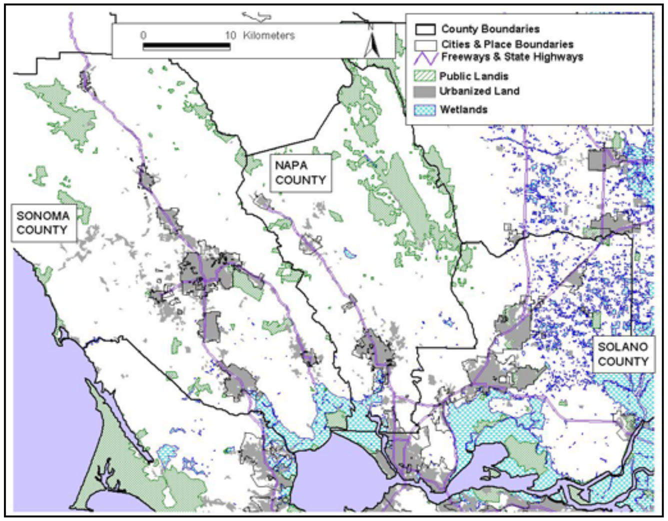
As is the case today, many of those who work in Santa Clara County will live in an adjacent county. Neighboring Alameda County's urban footprint, for example, will expand from its current size of 57,000 hectares to 79,053 hectares by 2100. Most of this increase will occur in and around three cities: Dublin, Pleasanton, and Livermore. Further north, Contra Costa County will also experience significant development pressure as its urban footprint grows from its current size of 56,000 hectares to 71,000 hectares in 2100. Contra Costa's new urban growth will be divided between the Interstate I-680 corridor connecting Martinez and Pleasanton, and the Highway 4 corridor connecting Concord and Brentwood. Development will also be continuously climbing the foothills of Mt. Diablo and the western side of the East Bay Hills. Should a major highway be built on the eastern side of Mt. Diablo—something we have not included in our projections—Mt. Diablo would soon be completely encircled by urban growth.

Over on the San Mateo Peninsula, San Francisco is already entirely built-out and will accommodate all its projected population growth through infill and redevelopment. San Mateo County will also grow principally via infill and redevelopment; between 1998 and 2100, its urban footprint will expand by less than 6,000 hectares. Most of this growth will occur adjacent to the San Francisco Bay or south of Pacifica along Highway 1.

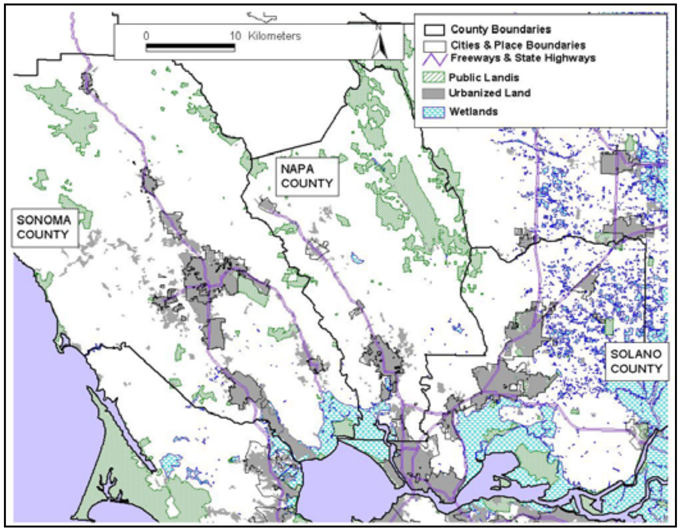
Northern California: The North Bay Area (Map 13): The north San Francisco Bay Area includes Marin, Sonoma, Napa, and Solano counties. Currently, urban development in this region is organized into a series of separate suburban valleys along Highway 101 in Marin and Sonoma counties, Highways 29 and 12 in Napa County, and Interstate I-80 in Solano County. As of 1998, the North Bay sub-region included 16% of the Northern California region's population and at 73,000

Map 13

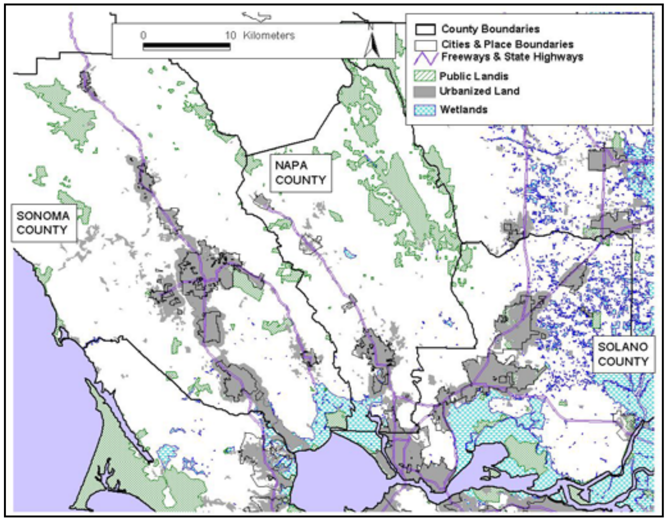
1998



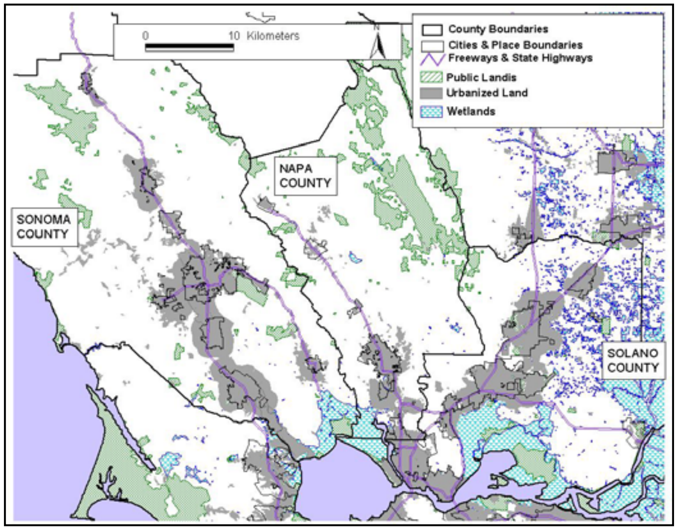
2020F



2050F



2100F



hectares, about 21% of its urbanized area. By 2100, should present trends continue, the urbanized area of the North Bay sub-region will have increased to 133,000 hectares.

Most of this increase will take place in Sonoma and Solano counties. Sonoma County's urban footprint will likely grow from its current size of 27,000 hectares to nearly 55,000 hectares by 2100. Almost all of this increase will occur within five miles of Highway 101. Indeed, by 2050, the Highway 101 corridor will be continuously developed from the Sonoma–Marin county line north through the city of Healdsburg.

A similar corridor-centric form will characterize urban growth patterns in suburban Solano County. Indeed, almost all Solano County's growth will occur within 10 kilometers of Interstate I-80. Altogether, Solano County's urban footprint will grow from its current size of 22,000 hectares to more than 44,000 hectares by 2100.

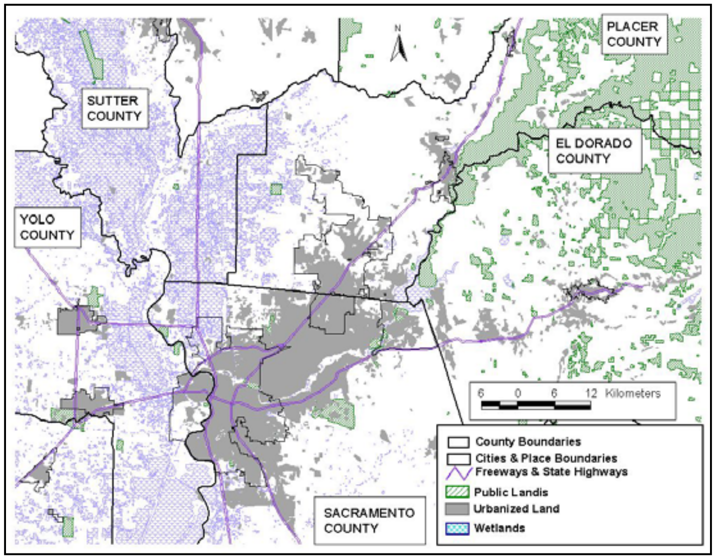
Compared to Sonoma and Solano counties, Marin and Napa counties will hardly grow at all—although their relative growth will seem sizeable. Marin County's urban footprint will expand from its current size of just over 16,000 hectares to 19,000 hectares by 2100. Most all of Marin's projected new development will occur along the Highway 101 corridor in and around Novato. Lacking good freeway access, Napa County will also experience only moderate growth, adding about 6,000 hectares of new urban development by 2100.

The Sacramento Region: Sacramento County (Map 14): The Sacramento Region extends from Yolo County in the west to Lake Tahoe in the east, from Sutter and Yuba counties in the north to Isleton (Sacramento County) in the south. By 2100 if current trends continue, the region's urban footprint will have more than doubled from its current size of 112,000 hectares to nearly 225,000 hectares.

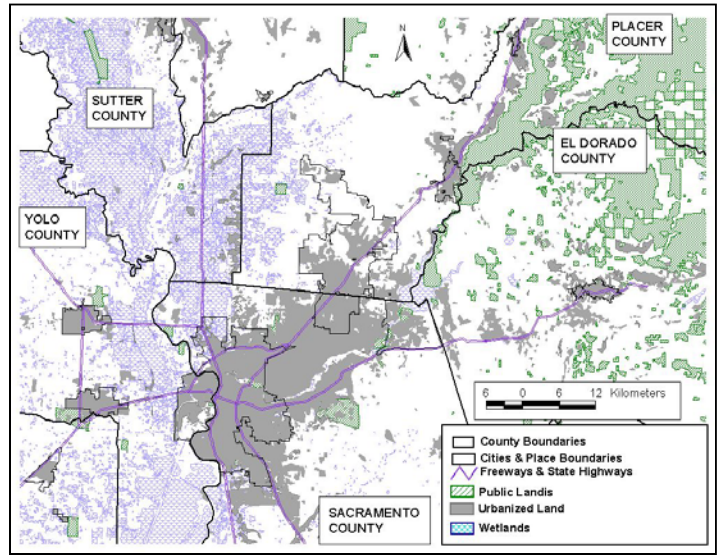
At 61,000 hectares, Sacramento County alone accounts for just over half of the region's total urban footprint. Located at the confluence of the Sacramento and American Rivers, Sacramento County still has ample flat land upon which to grow—mostly to the south and east—and by 2100, its urban footprint will likely exceed 100,000 hectares. Highway 50, which currently forms the southern boundary of development in eastern Sacramento County will be likely be breached by 2025, as urban growth continues pushing eastward. New growth will also extend northward along Interstate I-5 and California Highway 70. All told, Sacramento County will account for about one-third of the Sacramento region's growth during the 21st century.

Map 14

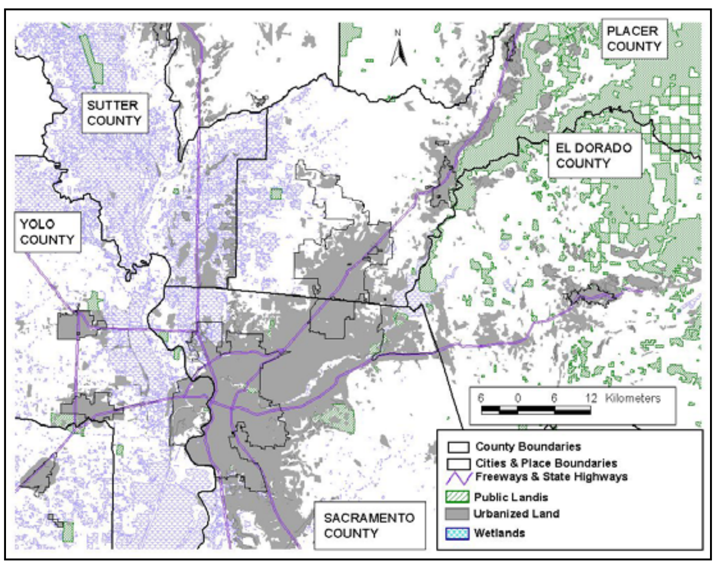
1998



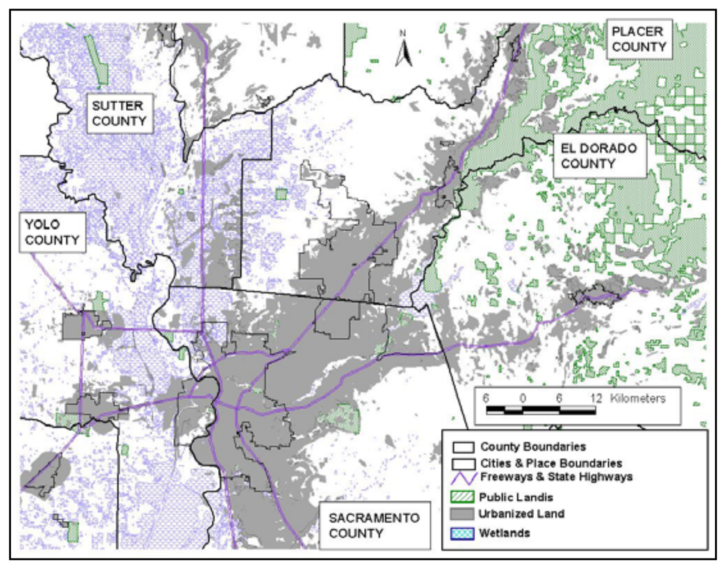
2020F



2050F



2100F



The Sacramento Region: Foothill Sub-region (Map 14): The Foothill sub-region consists of the western sides of El Dorado, Placer, and Nevada counties. Urban growth in these counties generally takes two or three forms. On the west side, adjacent to Sacramento County, urban development takes a mostly suburban form, consisting of large moderate density single-family subdivisions, retail strip and power centers, and the occasional free-standing office building. Ten miles to the east, along Interstate I-80 and Highway 50, in and around the hills of Auburn and Placerville, growth consists of smaller residential developments of larger lot sizes, sprinkled at the edges of existing cities and towns. Further off the beaten track, abutting local roads, new development typically takes the form of clusters of large houses on large lots, some with fenced-in grazing and farmlands. Known as "ranchettes," these developments occupy significant land areas but accommodate relatively few residents. The projections detailed in Figure 9 and Map 14 significantly undercount the number and area of ranchette developments.

Currently, the urban footprint of the Foothill sub-region, excluding ranchettes, exurban, and vacation development, total about 32,000 hectares. By 2050, urbanization in the Foothill sub-region will have nearly doubled; by 2100, it will be approaching 80,000 hectares. Most of the sub-region's growth will occur in Placer County along Interstate I-80. Indeed, by 2100, the I-80 corridor will be completely built-out to a width of five kilometers from Roseville, past Auburn to Meadow Vista. Lesser—although still sizeable—amounts of development are projected for El Dorado and Nevada counties. Growth in El Dorado County will be focused along Highway 50, in and around the Placerville area. In Nevada County, new urban development will favor the Grass Valley–Nevada City area. All together, the three-county Foothills sub-region will account for about 40% of the growth of the Sacramento Region during the 21st century.

The Sacramento Region: Yolo County (Map 14): Located at the western end of the Sacramento Region, Yolo is separated from Sacramento County and the rest of the region by the Sacramento River. Urban growth in Yolo County has long followed a city-centric pattern—the result of the county's long-standing commitment to conserving farmlands and discouraging sprawl. As of 1998, Yolo County's urban footprint occupied just over 10,000 hectares of land. By 2100, this total is projected to double to just over 21,000 hectares. Unless they act to limit growth—something the City of Davis is periodically wont to do—just about all of this increase will occur in and around the three cities that line Interstate I-80: Dixon, Davis, and West Sacramento. Woodland and Winters, Yolo's two other significant cities, will grow less dramatically.

Altogether, Yolo County will account for about ten percent of the Sacramento region's urban growth in the 21st century.

The Sacramento Region: Sutter and Yuba Counties (Map 14): Yuba and Sutter counties are the least populous, least urbanized counties in the Sacramento region. At just under 9,000 hectares, urban development in Yuba and Sutter counties currently account for only 10.9 percent of the region's total. If current trends continue, Yuba's and Sutter's urban footprint will swell to 17,000 hectares by 2050, and 23,000 hectares by 2100. These are big increases by the standards of Yuba and Sutter counties. They are less large when compared to the region as a whole: altogether, Yuba and Sutter counties will account for about twelve percent of the region's urban growth during the 21st century. Spatially, most of this sub-region's growth will occur in southeastern Sutter County, near the Sacramento County border.

4.0 BASELINE IMPACT ASSESSMENT

The conversion of undeveloped land to urban uses generates three types of effects on the landscape: (i) it reduces the amount of undeveloped land still available; (ii) it alters the patch size, shape and fragmentation level of the remaining undeveloped landscape; and, (iii) it alters both the amount and quality of the resource and environmental services provided by undeveloped lands.

This section undertakes to measure effects (i) and (ii) resulting from the Baseline Scenario for the periods 1997–2020, 2020–2050, and 2050–2100. Effects (i) and (ii) can be measured using many of the same digital data layers used to derive the Baseline Scenario. Consideration of the effects of urban growth on the supply and quality of resource and ecological services is beyond the scope of this effort.

It is important to note up front that measuring landscape change is not the same thing as valuing landscape change. Valuing landscape change requires incorporating human preferences regarding relative scarcity, accessibility, existence value, and a whole host of other attributes. Valuation can be undertaken through an analysis of market and non-market transactions, or through the use of survey research methods. Neither method is employed here.

4.1 Landscape Conversion

Hillsides and Steeply Sloped Land. Statewide, projected urban growth presents a relatively small threat to steep hillsides. Among the 45 counties for which we developed detailed urban growth projections, we project that an additional 8,200 hectares of steeply sloped land—that is, land with a slope in excess of 15%—will be developed by 2020 (see Figure 10). By 2050 and 2100, we project that urban growth will have consumed an additional 38,000 and 55,000 hectares of steeply sloped land. These growth increments account for only 0.1%, 0.4%, and 0.6% of the current hillside land area of these counties.

The counties projected to suffer the largest absolute hillside losses by 2050 and 2100 are all in Southern California. They are San Diego County (-14,600 hectares, or 4% of the county’s remaining steep hillsides), Riverside County (-13,900 hectares, or 3%), Los Angeles County (-8,800 hectares, or 3%, and San Bernardino County (-6,300 hectares, or 1%). The only non-Southern California counties projected to suffer significant hillside losses due to urbanization are Placer and El Dorado. Because it is extremely flat, Sacramento County is likely to suffer minimal absolute hillside losses, but significant relative losses.

Figure 10: Anticipated Losses in Steeply Sloped Land Area Due to Projected Urbanization, for Selected Counties, 1998-2100

County (sorted in order of absolute loss, 1998-2100)	Sites with Slope >15% (ha). Source: USGS 100m DEM	Projected Loss due to Urbanization, 1998-2020		Projected Loss due to Urbanization, 1998-2050		Projected Loss due to Urbanization, 1998-2100	
		Hectares	%	Hectares	%	Hectares	%
San Diego	329,233	1,566	0%	8,142	2%	14,563	4%
Riverside	410,745	968	0%	9,402	2%	13,916	3%
Los Angeles	312,987	380	0%	6,164	2%	8,838	3%
San Bernardino	792,543	1,049	0%	5,462	1%	6,287	1%
Ventura	215,297	787	0%	2,347	1%	3,423	2%
Kern	478,067	168	0%	582	0%	1,506	0%
Orange	34,877	86	0%	402	1%	1,276	4%
Santa Barbara	298,600	51	0%	435	0%	948	0%
Placer	152,427	1,378	1%	1,984	1%	915	1%
El Dorado	172,730	647	0%	1,119	1%	905	1%
Monterey	272,641	15	0%	327	0%	554	0%
Alameda	49,589	29	0%	82	0%	553	1%
Nevada	92,597	450	0%	655	1%	506	1%
Santa Cruz	45,919	113	0%	523	1%	410	1%
Santa Clara	128,831	26	0%	97	0%	233	0%
Contra Costa	35,107	69	0%	79	0%	191	1%
Napa	82,046	20	0%	71	0%	142	0%
Sonoma	152,606	140	0%	184	0%	127	0%
San Mateo	39,393	0	0%	0	0%	44	0%
Marin	45,870	5	0%	13	0%	42	0%
San Luis Obispo	179,069	25	0%	47	0%	41	0%
San Benito	130,608	0	0%	10	0%	17	0%
Sacramento	101	5	5%	12	12%	11	11%
Tulare	552,543	0	0%	0	0%	0	0%
Fresno	511,120	0	0%	0	0%	0	0%
Mariposa	166,912	0	0%	0	0%	0	0%
Madera	154,653	0	0%	0	0%	0	0%
Stanislaus	55,929	0	0%	0	0%	0	0%
Merced	33,315	0	0%	0	0%	0	0%
Yolo	30,106	17	0%	17	0%	0	0%
Yuba	28,218	0	0%	0	0%	0	0%
Solano	15,485	185	1%	185	1%	0	0%
San Joaquin	10,020	0	0%	0	0%	0	0%
Kings	9,378	2	0%	2	0%	0	0%
Sutter	3,808	0	0%	0	0%	0	0%

Readers should remember that these projections assume a continuation of current development trends and patterns. Should these patterns shift in ways which make hillside development easier from a regulatory perspective, less costly from a development perspective, or more attractive from a market perspective, it is quite conceivable that amounts of hillside loss could be much greater, particularly in counties like San Diego, Ventura, Orange, Santa Barbara, Santa Clara, and Marin, which are all running out of accessible flat land near urban centers.

Wetlands. Principally for planning and regulatory reasons, wetland development is growing increasingly difficult throughout California. Counties with large amounts of wetlands are in agricultural use and are looking for ways to keep them that way. Counties with few remaining wetland areas are vigorously trying to protect and enhance them.

Statewide, projected urban growth presents a small but significant threat to wetlands, particularly those identified as part of the National Wetland Inventory.[9] Among the 28 California counties with significant remaining wetlands, which are threatened by urban growth, we project that an additional 12,000 hectares of wetlands will be developed by 2020 (see Figure 11). By 2050 and 2100, respectively, we project that urban growth will have likely consumed an additional 26,000 and 42,000 acres of wetlands. In percentage terms, these growth increments account for only 1%, 2%, and 3% of the current wetlands inventory.

The counties projected to suffer the largest absolute hillside losses by 2050 and 2100 are mostly in the northern San Joaquin Valley, the southern Sacramento River Valley, or adjacent to the San Francisco Bay. They include San Joaquin County (-8,600 hectares, or 11% of the county's remaining wetlands), Sutter County (-4,300 hectares, or 7%), Sonoma County (-3,200 hectares, or 26%), Solano County (-2,500 hectares, or 5%), and Alameda County (-2,300 hectares, or 33%). A number of additional counties are facing moderate absolute wetland losses due to urbanization but large percentage losses: Marin County (-1,700 hectares, or 24%), San Mateo County (-1,300 hectares, or 42%), San Diego County (-1,200 hectares, or 15%), and Santa Clara (-700 hectares, or 15%). At the other extreme, Sacramento, Merced, and Yolo counties are all facing moderate absolute wetland losses but small relative losses.

Issues of wetland conservation and protection go well beyond consideration of absolute and percentage losses. Wetlands are typically prime habitat for a wide variety of plant and animal species, many of which are on the national threatened and endangered list.. Wetlands also play an important role in insuring the health of adjacent habitat areas and

Figure 11: Anticipated Losses in Wetlands Due to Projected Urbanization, for Selected Counties, 1998-2100

County (sorted in order of absolute loss, 1998-2100)	1998 Wetlands (ha). Source: NWI	Projected Loss due to Urbanization, 1998-2020		Projected Loss due to Urbanization, 1998-2050		Projected Loss due to Urbanization, 1998-2100	
		Hectares	%	Hectares	%	Hectares	%
San Joaquin	81,294	947	1%	4,686	6%	8,618	11%
Sutter	62,612	832	1%	2,904	5%	4,341	7%
Sonoma	12,288	2,976	24%	3,084	25%	3,239	26%
Solano	54,483	412	1%	991	2%	2,464	5%
Alameda	7,046	1,689	24%	1,937	27%	2,325	33%
Sacramento	40,678	492	1%	952	2%	1,934	5%
Merced	41,971	127	0%	1,096	3%	1,927	5%
Yolo	43,066	137	0%	515	1%	1,845	4%
Marin	7,294	130	2%	690	9%	1,722	24%
Yuba	19,816	283	1%	865	4%	1,568	8%
Tulare	12,087	364	3%	930	8%	1,552	13%
Contra Costa	23,597	250	1%	901	4%	1,391	6%
San Mateo	3,158	1,071	34%	1,243	39%	1,329	42%
Kern	21,787	284	1%	819	4%	1,223	6%
San Diego	8,291	341	4%	862	10%	1,221	15%
Napa	10,371	202	2%	590	6%	1,004	10%
Fresno	51,494	330	1%	522	1%	846	2%
Santa Clara	4,403	343	8%	418	9%	675	15%
Placer	33,594	130	0%	232	1%	604	2%
San Luis Obispo	7,151	148	2%	363	5%	537	8%
Los Angeles	5,994	148	2%	221	4%	265	4%
Kings	61,924	51	0%	126	0%	248	0%
Stanislaus	7,266	19	0%	102	1%	237	3%
Riverside	31,566	2	0%	63	0%	201	1%
Madera	3,424	38	1%	167	5%	190	6%
San Bernardino	9,159	152	2%	175	2%	175	2%
Nevada	6,525	21	0%	41	1%	65	1%
Orange	415	5	1%	5	1%	5	1%

in flood control. Because wetlands are not interchangeable, questions of how and where projected urbanization is likely to affect wetland quality may dominate questions of absolute loss.

Riparian Areas. Riparian zones are the land areas around rivers, streams, lakes, and permanent wetlands. They are typically, but not exclusively, characterized by woody, fast-growing vegetation and by water-oriented bird, animal, and insect species. Inventories of riparian areas have thus far been developed for the San Francisco Bay and San Joaquin Valley but not for the rest of the state. To augment these more limited data sources, we generated a statewide, 100-meter riparian zone data layer by buffering all inland rivers, streams, and lakes listed in the 2000 Census TIGER file. Although comprehensive and consistent, this method tends to over-estimate the total amount of riparian area while underestimating the area of specific riparian zones.

The counties projected to suffer the largest absolute riparian losses by 2050 and 2100 are mostly in southern and coastal California (see Figure 12). They include San Bernardino County (-52,200 hectares, or 6% of the county's remaining riparian zone land area), Riverside County (-51,000 hectares, or 13%), San Diego County (-22,000 hectares, or 11%), Imperial County (-14,000 hectares, or 6%), and Kern County (-14,000 hectares, or 3%). A number of additional counties are facing moderate-to-small absolute riparian zone losses due to urbanization but large percentage losses: Stanislaus County (-5,000 hectares by 2100, or 12%), San Joaquin County (-4,900 hectares or 12%), Sacramento County (-4,600 hectares, or 12%), Alameda County (-3,800 hectares, or 13%), Orange County (-2,700 hectares, or 11%), and Santa Cruz County (-2,400 hectares, or 10%). San Diego County (-1,200 hectares, or 15%), and Santa Clara (-700 hectares, or 15%).

As is the case for wetlands, riparian zone quality varies widely. Some provide rich habitats for a diverse variety of plant and animal species. Others are ecologically narrower. Most of the state's remaining riparian lands south of Sacramento and west of the Sierras border urban development, active farmlands, or grazing lands, and as a result, have suffered severe degradation. Thus, in many areas, riparian zone restoration is as important as riparian zone protection.

4.2 Farmland Conversion

Prime Farmlands. The California Farmland Mapping and Monitoring Project (CFMMP) bi-annually collects detailed spatial data regarding the status of different types of farmland in 47 California counties, including all urban counties except San Francisco. Prime

Figure 12: Anticipated Losses in 100m Riparian Zone Land Area Due to Projected Urbanization, for Selected Counties, 1998-2100

County (sorted in order of absolute loss, 1998-2100)	Lands in 100m Riparian Zone (ha)	Projected Loss due to Urbanization, 1998-2020		Projected Loss due to Urbanization, 1998-2050		Projected Loss due to Urbanization, 1998-2100	
		Hectares	%	Hectares	%	Hectares	%
San Bernardino	941,274	10,458	1%	30,267	3%	52,184	6%
Riverside	381,053	10,465	3%	29,892	8%	50,636	13%
San Diego	187,349	4,786	3%	11,825	6%	21,522	11%
Imperial	235,071	2,893	1%	7,633	3%	13,745	6%
Kern	459,260	3,085	1%	7,792	2%	13,659	3%
Santa Barbara	195,223	1,014	1%	5,296	3%	9,778	5%
San Luis Obispo	219,250	1,692	1%	5,164	2%	8,671	4%
Monterey	232,381	758	0%	3,597	2%	7,212	3%
Sonoma	88,819	2,643	3%	4,381	5%	6,394	7%
Ventura	113,836	1,240	1%	3,229	3%	5,555	5%
Stanislaus	43,679	574	1%	2,894	7%	5,419	12%
Placer	83,925	2,215	3%	3,816	5%	5,164	6%
Merced	130,553	824	1%	2,654	2%	5,148	4%
Tulare	210,905	1,098	1%	3,208	2%	5,147	2%
San Joaquin	41,079	1,147	3%	3,159	8%	4,932	12%
Los Angeles	76,804	1,844	2%	3,526	5%	4,902	6%
Sacramento	38,510	1,326	3%	2,887	7%	4,657	12%
Alameda	28,968	1,170	4%	2,305	8%	3,796	13%
Santa Clara	49,442	895	2%	1,667	3%	3,199	6%
Fresno	261,193	905	0%	1,956	1%	3,113	1%
El Dorado	119,694	866	1%	1,805	2%	2,872	2%
Solano	41,947	874	2%	1,553	4%	2,735	7%
Orange	24,168	1,271	5%	2,044	8%	2,686	11%
Santa Cruz	23,796	763	3%	2,373	10%	2,373	10%
Contra Costa	25,963	470	2%	1,285	5%	2,130	8%
Madera	106,266	399	0%	1,390	1%	1,989	2%
Nevada	67,846	638	1%	1,106	2%	1,759	3%
San Mateo	27,694	522	2%	925	3%	1,579	6%
Kings	31,182	179	1%	427	1%	1,526	5%
Yolo	31,720	527	2%	1,082	3%	1,484	5%
Napa	23,480	250	1%	846	4%	1,282	5%
San Benito	109,581	86	0%	603	1%	1,002	1%
Marin	28,980	97	0%	499	2%	935	3%
Yuba	44,443	142	0%	448	1%	811	2%
Sutter	25,941	144	1%	250	1%	659	3%
Mariposa	90,671	0	0%	0	0%	0	0%

farmland is defined by the CFMMP as land used for the production of irrigated crops at some time during the previous four years and which meets the highest soil moisture, pH, erodability and permeability, and soil rooting depth criteria. At the time of this work, the most recent year for which complete data were available was 1998.

Projected urban growth presents a significant threat to the state's remaining supplies of prime farmland, especially in the San Joaquin, Monterey, and Imperial Valleys. Among the 35 California counties in which prime farmlands are threatened by urban growth, we project that 52,000 hectares of prime farmland will have been converted to urban uses by 2020 (see Figure 13). By 2050 and 2100, respectively, we project that urban growth will have likely consumed an additional 165,000 and 297,000 hectares of riparian land area. In percentage terms, these growth increments account for 3%, 9%, and 17% of the current inventory of prime farmlands.

Most at risk from urban growth are prime farmlands in the San Joaquin and Monterey Valleys. Assuming present trends continue, Fresno County will lose 51,600 hectares of prime farmland by 2100, a drop of 35%. Nearby Kern County will lose 42,100 hectares of prime farmland to projected urban growth, a 19% decline. San Joaquin, Monterey, and Riverside counties will each lose in excess of 20,000 hectares. Five counties will lose more than half of the precious little prime farmland they still have: San Bernardino (78%), San Diego County (58%), Orange County (57%), Alameda County (51%), and Santa Clara County (50%). For counties in Southern California, these losses will be immediate—that is, they will mostly occur by 2020. Among Bay Area and coastal counties, they will occur over a longer period. Among San Joaquin Valley counties, prime farmland losses will be continuous throughout the century.

The situation may not be quite as bleak as these numbers would make it seem. If current trends continue, even as large amounts of prime farmland are lost to urban growth, farmers will likely be "developing" new prime farmlands in other locations, mostly by extending irrigation to grazing and secondary farmlands. While not of the soil quality of the prime farmlands being lost, assuming sufficient water is available at the right price, these new farmlands should easily sustain California's agricultural economy. Potential opportunities for new prime farmland development are most plentiful in San Joaquin Valley and Monterey Valley (where urbanization will pose less of a threat to grazing lands), but extremely limited in Southern California and the Bay Area. Thus, for purposes of protecting prime farmland from incursion by urban growth throughout the state, policymakers and farmland preservationists should

Figure 13: Anticipated Losses in Prime Farmland Due to Projected Urbanization, for Selected Counties, 1998-2100

County (sorted in order of absolute loss, 1998-2100)	1998 Prime Farmlands (ha). Source: CFMMP	Projected Loss due to Urbanization, 1998-2020		Projected Loss due to Urbanization, 1998-2050		Projected Loss due to Urbanization, 1998-2100	
		Hectares	%	Hectares	%	Hectares	%
Fresno	148,584	3,818	3%	25,589	17%	51,552	35%
Kern	217,093	7,930	4%	24,375	11%	42,081	19%
San Joaquin	173,331	5,678	3%	16,416	9%	29,088	17%
Monterey	69,068	3,025	4%	14,593	21%	26,559	38%
Riverside	64,517	9,533	15%	16,579	26%	24,710	38%
Stanislaus	67,478	1,077	2%	9,055	13%	18,842	28%
Imperial	80,722	53	0%	1,781	2%	12,844	16%
Merced	116,887	3,519	3%	8,351	7%	12,562	11%
San Bernardino	12,110	5,769	48%	7,016	58%	9,467	78%
Ventura	20,935	1,103	5%	4,617	22%	8,661	41%
Solano	60,730	673	1%	3,926	6%	8,079	13%
Santa Barbara	29,128	486	2%	4,056	14%	7,879	27%
Kings	57,624	1,853	3%	4,561	8%	7,402	13%
Madera	41,350	1,011	2%	3,502	8%	7,035	17%
Santa Clara	12,951	1,257	10%	4,095	32%	6,482	50%
San Benito	13,874	281	2%	1,954	14%	3,271	24%
Sonoma	14,450	95	1%	1,438	10%	2,848	20%
Yolo	107,582	104	0%	1,304	1%	2,837	3%
Orange	4,524	946	21%	2,139	47%	2,593	57%
San Diego	4,323	1,466	34%	2,257	52%	2,526	58%
Contra Costa	16,036	386	2%	1,473	9%	2,213	14%
Santa Cruz	6,960	427	6%	2,172	31%	2,172	31%
San Luis Obispo	16,159	255	2%	1,011	6%	2,080	13%
Alameda	3,081	573	19%	1,334	43%	1,573	51%
Tulare	34,365	347	1%	578	2%	788	2%
Los Angeles	9,949	212	2%	435	4%	636	6%
Napa	12,117	34	0%	161	1%	283	2%
Sacramento	49,317	1	0%	1	0%	9	0%
Yuba	18,465	0	0%	0	0%	0	0%
Placer	3,964	0	0%	0	0%	0	0%
San Mateo	1,082	0	0%	0	0%	0	0%
El Dorado	490	0	0%	0	0%	0	0%
Nevada	153	0	0%	0	0%	0	0%
Marin	71	0	0%	0	0%	0	0%
Mariposa	12	0	0%	0	0%	0	0%

perhaps concentrate their efforts in Riverside, Imperial, San Bernardino, Ventura, San Diego, Alameda, and Contra Costa counties, among others.

State and Locally Important Farmlands. Farmlands of "state importance" are those similar to prime farmland but with minor shortcomings, such as greater slopes or less ability to store soil moisture. Farmland of "local importance" is determined by each county's board of supervisors and a local advisory committee. For purposes of tracking farmland loss due to projected urbanization, we have grouped state and locally important farmland.

Projected urban growth presents a significant threat to the state's remaining supplies of state and locally important (S&LI) farmlands, especially in Riverside, Imperial, San Diego, Sacramento, and San Joaquin counties. Among the 36 California counties in which S&LI farmlands are threatened by urban growth, we project that an additional 74,000 hectares of S&LI farmland will have been converted to urban uses by 2020 (see Figure 14). By 2050 and 2100, respectively, we project that urban growth will have likely consumed an additional 173,000 and 268,000 hectares of S&LI farmland. In percentage terms, these growth increments account for only 4%, 9%, and 14% of the current inventory of S&LI farmlands.

Most at risk from urban growth are S&LI farmlands in the Inland Empire and in the central Sacramento–San Joaquin Valley. Assuming present trends continue, Riverside County will lose 66,000 hectares of S&LI farmland by 2100, a drop of 54%. Nearby Imperial County will lose 25,000 hectares to projected urban growth, an 18% decline. San Diego and Sacramento counties each lose in excess of 20,000 hectares, and San Joaquin will lose nearly that much. In addition to Riverside, seven counties will lose more than half of their S&LI farmlands by 2100: Alameda County (72%), San Bernardino County(62%), Monterey County (51%), San Diego County (51%), Sacramento County (50%), Orange County (57%), Alameda County (51%), and Santa Clara County (50%). While Bay Area and coastal counties will suffer significant relative losses, except for Monterey and Sonoma counties, their absolute losses will not be that great. In terms of timing, most losses will be continuous throughout the forecast period. Whether or not these losses will be offset through the irrigation and conversion of grazing land will depend on many factors: water availability, commodity prices, labor costs, and changing environmental regulations.

Unique Farmlands. The CFMMP identifies "unique farmland" as land of lesser-quality soils used for the production of the state's leading agricultural crops. Unique farmlands are typically irrigated, but may also include non-irrigated orchards or vineyards as found in some climatic

Figure 14: Anticipated Losses in State- and Locally-Important Farmland Due to Projected Urbanization, for Selected Counties, 1998-2100

County (sorted in order of absolute loss, 1998-2100)	1998 State and Locally-important Farmlands (ha). Source: CFMMP	Projected Loss due to Urbanization, 1998-2020		Projected Loss due to Urbanization, 1998-2050		Projected Loss due to Urbanization, 1998-2100	
		Hectares	%	Hectares	%	Hectares	%
Riverside	121,657	20,223	17%	44,162	36%	65,965	54%
Imperial	143,556	8,029	6%	17,620	12%	25,137	18%
San Diego	47,992	6,867	14%	16,576	35%	24,461	51%
Sacramento	40,908	6,673	16%	14,439	35%	20,374	50%
San Joaquin	60,776	5,398	9%	12,192	20%	18,731	31%
Sonoma	44,341	4,360	10%	8,697	20%	13,080	29%
Fresno	70,398	1,904	3%	6,047	9%	11,496	16%
Merced	84,233	1,668	2%	4,860	6%	10,044	12%
Madera	46,932	2,227	5%	5,531	12%	8,877	19%
Monterey	15,685	2,273	14%	4,992	32%	8,010	51%
Ventura	19,743	1,175	6%	4,317	22%	7,972	40%
Sutter	45,981	1,407	3%	4,094	9%	6,288	14%
Kings	176,253	596	0%	3,127	2%	6,058	3%
San Luis Obispo	78,154	944	1%	3,250	4%	6,032	8%
San Bernardino	6,949	2,175	31%	3,565	51%	4,327	62%
Kern	45,500	1,222	3%	2,846	6%	3,945	9%
Contra Costa	24,318	770	3%	2,218	9%	3,697	15%
Stanislaus	26,332	278	1%	1,540	6%	2,942	11%
Napa	11,660	919	8%	1,838	16%	2,746	24%
Yolo	32,110	1,096	3%	2,252	7%	2,708	8%
Santa Barbara	13,328	333	2%	1,742	13%	2,669	20%
El Dorado	33,216	1,067	3%	1,891	6%	2,632	8%
Placer	48,438	57	0%	639	1%	2,125	4%
San Benito	19,922	894	4%	1,155	6%	1,974	10%
Santa Clara	5,525	578	10%	1,353	24%	1,969	36%
Marin	27,203	25	0%	341	1%	1,092	4%
Yuba	4,470	172	4%	360	8%	692	15%
Solano	4,513	29	1%	281	6%	629	14%
Santa Cruz	1,573	233	15%	451	29%	451	29%
Alameda	548	43	8%	228	42%	393	72%
Nevada	8,633	100	1%	222	3%	350	4%
Tulare	40,242	213	1%	290	1%	345	1%
Orange	347	94	27%	128	37%	149	43%
Los Angeles	12,783	0	0%	0	0%	0	0%
San Mateo	1,686	0	0%	0	0%	0	0%
Mariposa	40	0	0%	0	0%	0	0%

zones in California. Despite their lower soil quality, many of California's highest value crops are grown on unique farmlands. Unique farmlands must have been cropped at some time during the four years prior to the mapping date.

Projected urban growth presents a significant threat to the state's remaining supplies of unique farmlands, especially in San Diego and Riverside counties. Among the 36 California counties in which unique farmlands are threatened by urban growth, we project that an additional 13,000 hectares of unique farmland will have been converted to urban uses by 2020 (see Figure 15). By 2050 and 2100, respectively, we project that urban growth will have likely consumed an additional 47,000 and 77,000 hectares of unique farmlands. In percentage terms, these growth increments account for only 2%, 5%, and 8% of the current inventory of unique farmlands in the counties studied.

Most at risk from urban growth are unique farmlands in and around the Inland Empire and in the central San Joaquin Valley. Assuming present trends continue, San Diego County will lose 20,000 hectares of unique farmlands by 2100, or three-quarters of its current stock. Nearby Riverside will lose 10,000 hectares to projected urban growth, a 59% decline. In the central San Joaquin Valley, Fresno and Madera counties will each lose in excess of 5,000 hectares. Nearby Merced County will lose 3,800 hectares.

Three counties in addition to San Diego and Riverside will lose more than half of their unique farmlands to urban development by 2100: San Bernardino County (86%), Alameda County (62%), and Orange County (62%). Indeed, because unique farmlands are often what's left over from cities, hillsides, and prime farmlands, all of California's coastal counties south of San Francisco and most of its Central Valley counties are facing significant losses of unique farmlands due to projected urban growth. Presumably, as in the case of prime farmlands and S&LI farmlands, it may be possible to offset some of these losses through irrigation of otherwise fertile lands currently in grazing use. The specific potential for such conversion is unknown.

Grazing Lands. The CFMMP identifies "grazing" lands as those on which the existing vegetation is suited to the grazing of livestock. This category is used only in California and was developed in cooperation with the California Cattlemen's Association, University of California Cooperative Extension, and other groups interested in the extent of grazing activities.

Projected urban growth presents a significant threat to grazing lands in Riverside, Placer, San Diego, and San Bernardino counties; a

Figure 15: Anticipated Losses in Unique Farmlands Due to Projected Urbanization, for Selected Counties, 1998-2100

County (sorted in order of absolute loss, 1998-2100)	1998 Unique Farmlands (ha). Source: CFMMP	Projected Loss due to Urbanization, 1998-2020		Projected Loss due to Urbanization, 1998-2050		Projected Loss due to Urbanization, 1998-2100	
		Hectares	%	Hectares	%	Hectares	%
San Diego	27,258	2,816	10%	15,038	55%	19,545	72%
Riverside	16,903	2,402	14%	6,082	36%	9,951	59%
Fresno	38,599	910	2%	3,617	9%	7,833	20%
Madera	65,134	1,508	2%	3,446	5%	6,229	10%
Santa Barbara	11,864	490	4%	2,530	21%	4,766	40%
Merced	39,084	338	1%	2,189	6%	3,821	10%
San Joaquin	21,401	159	1%	1,476	7%	2,793	13%
Monterey	6,118	597	10%	1,509	25%	2,735	45%
Yolo	22,264	272	1%	1,057	5%	2,679	12%
Ventura	9,120	180	2%	1,045	11%	2,346	26%
Yuba	14,957	434	3%	1,318	9%	2,200	15%
San Luis Obispo	12,149	127	1%	814	7%	1,754	14%
Orange	2,539	608	24%	1,049	41%	1,579	62%
San Bernardino	1,559	585	38%	1,209	78%	1,345	86%
Solano	5,658	150	3%	561	10%	1,278	23%
Sacramento	5,435	225	4%	522	10%	1,139	21%
Stanislaus	19,803	181	1%	527	3%	1,137	6%
Sonoma	10,163	16	0%	343	3%	786	8%
El Dorado	1,871	280	15%	535	29%	560	30%
Kern	21,846	26	0%	254	1%	421	2%
Santa Cruz	1,773	81	5%	410	23%	410	23%
Placer	9,155	26	0%	104	1%	406	4%
Alameda	640	251	39%	340	53%	399	62%
Sutter	8,954	119	1%	122	1%	257	3%
Napa	6,396	90	1%	130	2%	226	4%
Kings	9,904	56	1%	176	2%	208	2%
Los Angeles	380	74	19%	83	22%	145	38%
Contra Costa	2,677	28	1%	83	3%	101	4%
Santa Clara	562	4	1%	21	4%	95	17%
Nevada	118	19	16%	40	34%	40	34%
Tuolumne	2,951	3	0%	30	1%	36	1%
San Mateo	1,215	0	0%	0	0%	0	0%
Amador	1,137	0	0%	0	0%	0	0%
San Benito	364	0	0%	0	0%	0	0%
Mariposa	60	0	0%	0	0%	0	0%
Marin	9	0	0%	0	0%	0	0%

moderate threat in Orange, Ventura, Alameda, Solano, Sacramento, Los Angeles, Santa Cruz, and Santa Barbara counties; and a minor threat elsewhere in the state. Among the 35 California counties in which grazing lands are threatened by urban growth, we project that an additional 77,600 hectares of grazing land will have been converted to urban uses by 2020 (see Figure 16). By 2050 and 2100, respectively, we project that urban growth will have likely consumed an additional 216,300 and 329,600 hectares of grazing lands. In percentage terms, these growth increments account for only 1%, 2%, and 3% of the current inventory of grazing land in the counties studied.

Most at risk from urban growth are grazing lands in and around the Inland Empire. Assuming present trends continue, San Bernardino County will lose 132,400 hectares of grazing land by 2100, or about one-third of its current supply. Nearby Riverside and San Diego counties will lose 28,400 and 23,500 hectares respectively—declines of 52% and 41%. Six other counties will lose more than 10,000 hectares of grazing land to projected urban growth by 2100: Kern (22,600), Santa Barbara (16,400), San Luis Obispo (11,900), Ventura (11,600), Alameda (11,400), and Monterey (10,300).

The real threat to grazing lands may be well bigger than these numbers suggest. As urbanization consumes prime and unique quality farmlands in the San Joaquin, Monterey, and Imperial valleys, agricultural businesses may well attempt to convert grazing lands to cultivated use, mostly through the extension of irrigation. The potential for this "domino effect" to occur will depend on many factors, including land, water and agricultural product prices, and the costs of extending key infrastructure.

The trend toward ranchette and resort/vacation home development also threatens California's grazing lands. Ranchettes and rural subdivisions are typically developed at densities well below the threshold used by the CFMMP to identify urban and suburban development. As a result, it mostly goes uncounted during the CFMMP's bi-annual farmland inventories. In the absence of hard data, anecdotal evidence suggests that such activity is on the rise and that it is mostly occurring on grazing and ranchland. To the extent that California's urban areas continue to spin-off ranchettes and rural subdivisions, the potential threat of population growth to grazing land may be the greatest of all. Thus, while the geography of cultivated farmland in California in 2100 could very well be similar to that of today, the geography of California's grazing lands will almost certainly be different.

Figure 16: Loss in Grazing Land Area Due to Projected Urbanization, for Selected Counties, 1998-2100

County (sorted in order of absolute loss, 1998-2100)	1998 Grazing Lands (ha). Source: CFMMP	Projected Loss due to Urbanization, 1998-2020		Projected Loss due to Urbanization, 1998-2050		Projected Loss due to Urbanization, 1998-2100	
		Hectares	%	Hectares	%	Hectares	%
San Bernardino	385,995	32,905	9%	99,198	26%	132,403	34%
Riverside	54,523	5,289	10%	22,194	41%	28,367	52%
San Diego	57,737	7,456	13%	14,165	25%	23,468	41%
Kern	714,443	6,955	1%	13,204	2%	22,527	3%
Santa Barbara	238,539	1,439	1%	8,393	4%	16,434	7%
San Luis Obispo	267,659	2,386	1%	6,930	3%	11,886	4%
Ventura	84,145	3,015	4%	6,634	8%	11,550	14%
Alameda	100,358	1,480	1%	5,474	5%	11,372	11%
Monterey	435,161	1,286	0%	5,221	1%	10,289	2%
Solano	80,640	3,811	5%	5,839	7%	8,128	10%
Los Angeles	88,217	1,110	1%	5,170	6%	7,803	9%
Sacramento	66,897	1,780	3%	3,737	6%	6,831	10%
Placer	12,893	344	3%	3,339	26%	6,205	48%
Contra Costa	70,182	1,850	3%	2,889	4%	5,313	8%
Sonoma	177,400	551	0%	1,724	1%	4,610	3%
El Dorado	75,004	897	1%	2,108	3%	3,676	5%
Santa Clara	158,147	702	0%	1,245	1%	3,503	2%
Orange	15,587	259	2%	1,074	7%	2,288	15%
San Benito	240,099	408	0%	1,217	1%	2,047	1%
Napa	75,038	165	0%	754	1%	1,615	2%
Madera	161,602	689	0%	1,029	1%	1,549	1%
Yuba	58,006	252	0%	707	1%	1,342	2%
Merced	234,748	332	0%	821	0%	1,295	1%
Nevada	52,491	13	0%	354	1%	1,085	2%
Sutter	20,153	433	2%	487	2%	855	4%
San Joaquin	61,666	623	1%	642	1%	792	1%
Kings	98,776	354	0%	405	0%	657	1%
Yolo	57,992	147	0%	338	1%	622	1%
Santa Cruz	6,747	369	5%	564	8%	564	8%
Tulare	184,355	297	0%	425	0%	492	0%
Fresno	129,534	1	0%	4	0%	6	0%
Mariposa	165,152	0	0%	0	0%	0	0%
Stanislaus	47,126	0	0%	0	0%	0	0%
Marin	37,177	0	0%	0	0%	0	0%
San Mateo	18,461	0	0%	0	0%	0	0%

4.3 Habitat Loss

California is home to more threatened and endangered species than any other US state except Hawaii; and continued urban development represents a significant threat to plant and animal habitat for both threatened and non-threatened species. To gauge where the threat is greatest, we compared the locations of projected urban growth to a summary map of multi-species habitat quality for threatened and endangered terrestrial vertebrate species (Appendix D). Multi-species habitat quality is expressed as an index of habitat existence for individual species multiplied by habitat quality.

Habitat existence is determined by cross-comparing GAP vegetation maps and Wildlife–Habitat Relationships (WHR) for threatened and endangered animal species. In essence, WHR relationships identify which vegetation areas are typically home to which animal species based on food and reproductive chains. Habitat quality is expressed on a one-to-five scale, with values of one indicating poorer quality habitat (based on the presence of appropriate vegetation), and values of five indicating better quality habitat.

Individual Threatened and Endangered Species Act (TESA) scores are computed by multiplying habitat existence times habitat quality and summing the results over all terrestrial vertebrate species listed as threatened or endangered under the US Endangered Species Act as of 1998:

$$\text{TESA Score} = \Sigma_i \text{ (presence measure}_i \text{ * habitat quality}_i)$$

where: presence is measured as a 0/1 value
habitat quality varies on a scale of 1 to 5
and where **i** denotes each threatened or endangered species

TESA scores range from a minimum of 0, indicating that the location includes vegetation that is appropriate habitat for *no* threatened and endangered species, to a maximum of 66, indicating that the location includes vegetation which is appropriate habitat to 14 or more threatened and endangered species. TESA scores are problematic on a number of levels, not the least of which is that they are based on the presence of appropriate vegetation and not actual animals, and that they exclude birds, insects, or fish. Moreover, TESA scores say nothing of the presence or quality of habitat for non-endangered species. These problems notwithstanding—because good multi-species habitat tends to be good for all terrestial vertebrates, whether or not they are listed as threatened or endangered—as a simple one-dimensional indicator of multi-species habitat quality, TESA scores work fairly well.

Very Good Quality Habitat. Sites with TESA scores of ten or more constitute *very good quality* multi-species habitat. Statewide, California includes 37,537,000 hectares of developed and undeveloped land with a TESA score of 10 or more; the average TESA score for all developed and undeveloped land in California is 30.

Statewide, projected urban growth constitutes a significant cumulative threat to locations with TESA scores of 10 or more (see Figure 17). Among the counties listed in Figure 17, projected urban growth will result in a cumulative loss of 325,000 hectares of good quality habitat by 2020, 872,000 hectares by 2050, and 1,464,000 hectares by 2100. These correspond to percentage losses of 1%, 3%, and 4%, respectively.

Measured in terms of land area, the greatest cumulative threat is to locations in Southern California, particularly San Bernardino County (which could lose as much as 286,000 hectares of good quality habitat by 2100 due to urban conversion), Riverside County (where 268,000 hectares are at risk), and San Diego County (where 163,000 hectares are at risk). In terms of percentages, Riverside and San Diego counties could each lose 15% of their good quality habitat to projected urban development by 2100; San Bernardino, being much larger, could lose as much as 6%.

Projected population growth threatens lesser but still significant amounts of good quality habitat—that is, between 40,000 and 100,000 hectares—in Kern, Fresno, Monterey, Los Angeles, Ventura, and San Joaquin counties. The threat in Santa Barbara and Stanislaus counties is just below this level.

Elsewhere in California, the statewide threat to good quality habitat is much less severe—although regional and local threats remain significant. Consider the cases of Sacramento and Orange counties, where projected urban growth by 2100 threatens about 20,000 hectares of good quality habitat per county. Compared to the state as a whole, these are modest amounts. Yet because many of the animal species that populate the Orange County landscape are different from those that populate the Sacramento County landscape, the localized threats to good quality habitat in Orange and Sacramento counties, measured on a percentage basis, are comparable to those in Riverside and San Diego counties. Put another way, all habitat areas are not spatially substitutable.

The counties where urban growth poses the smallest habitat threat, those that hug the central and north coasts and comprise the Sierra foothills, are those projected to grow the least. Note, however, that these projections do not include threats of habitat loss due to ex-urban growth—that is, development that occurs at densities below one housing unit per

Figure 17: Loss in Good Quality Multi-species Habitat Land Area Due to Projected Urbanization, for Selected Counties, 1998-2100

County (sorted in order of absolute loss, 1998-2100)	Habitat Area with Threatened & Endangered Species **Score >= 10**	Projected Loss due to Urbanization, 1998-2020		Projected Loss due to Urbanization, 1998-2050		Projected Loss due to Urbanization, 1998-2100	
		Hectares	%	Hectares	%	Hectares	%
San Bernardino	5,090,078	60,275	1%	165,301	3%	286,419	6%
Riverside	1,737,181	60,328	3%	161,567	9%	268,460	15%
San Diego	1,090,678	37,998	3%	97,580	9%	163,337	15%
Kern	1,850,782	19,108	1%	48,865	3%	83,105	4%
Fresno	1,005,230	7,499	1%	31,100	3%	55,318	6%
Monterey	854,286	8,677	1%	30,577	4%	54,640	6%
Los Angeles	1,014,847	10,970	1%	34,838	3%	53,472	5%
Ventura	472,617	10,917	2%	28,196	6%	46,525	10%
San Joaquin	299,953	12,908	4%	27,980	9%	45,325	15%
Santa Barbara	660,108	4,099	1%	21,295	3%	39,214	6%
Stanislaus	388,968	4,700	1%	17,683	5%	33,309	9%
San Luis Obispo	858,192	5,885	1%	17,455	2%	30,516	4%
Placer	364,607	8,465	2%	17,772	5%	28,734	8%
Sonoma	408,959	7,632	2%	16,752	4%	27,647	7%
Merced	462,953	3,101	1%	12,208	3%	22,196	5%
Sacramento	187,803	5,727	3%	13,303	7%	22,159	12%
Alameda	187,590	6,804	4%	13,252	7%	21,305	11%
Orange	206,590	7,060	3%	13,102	6%	20,091	10%
Madera	507,457	5,386	1%	11,814	2%	19,475	4%
Santa Clara	334,965	4,794	1%	10,895	3%	18,596	6%
Tulare	963,384	2,853	0%	9,710	1%	17,369	2%
Contra Costa	186,022	4,689	3%	9,505	5%	15,170	8%
El Dorado	436,903	3,484	1%	7,392	2%	12,174	3%
Solano	142,932	5,297	4%	8,311	6%	11,855	8%
Santa Cruz	115,626	3,176	3%	9,614	8%	9,614	8%
Imperial	826,451	1,093	0%	6,574	1%	8,480	1%
Sutter	146,619	2,101	1%	4,917	3%	8,066	6%
San Benito	359,907	1,635	0%	4,531	1%	7,748	2%
Nevada	248,467	1,990	1%	3,946	2%	6,393	3%
Napa	194,715	1,549	1%	3,619	2%	6,083	3%
San Mateo	117,334	1,303	1%	3,234	3%	5,820	5%
Yuba	157,961	1,150	1%	3,014	2%	5,355	3%
Kings	106,127	988	1%	2,081	2%	4,221	4%
Marin	134,875	524	0%	1,643	1%	3,302	2%
Yolo	169,114	1,202	1%	1,893	1%	2,671	2%
Mariposa	374,929	0	0%	0	0%	0	0%

two acres. Many habitat lands throughout California, but particularly in the Sierra foothills, are threatened by ex-urban development.

Outstanding Habitat. Sites with TESA scores of thirty or more constitute *outstanding* multi-species habitat. Statewide, California includes 17,754,000 hectares of developed and undeveloped land with a TESA score of 30 or more; percentage-wise, these sites make up 43% of California's urban and undeveloped lands.

Statewide, projected urban growth constitutes a significant but not widespread threat to locations with TESA scores of 30 or more (see Figure 18). Among the counties listed in Figure 18, projected urban growth will result in a cumulative loss of 109,000 hectares of outstanding habitat by 2020, 293,000 hectares by 2050, and 459,000 hectares by 2100. These correspond to percentage losses of 1%, 3%, and 5%, respectively.

Measured in terms of land area, the greatest cumulative threat is to locations in Southern California, particularly Riverside County (which could lose as much as 88,000 hectares of outstanding habitat by 2100 due to urban conversion), San Diego County (where 83,000 hectares are at risk), and San Bernardino County (where 76,000 hectares are at risk). In terms of percentages, Riverside and San Bernardino counties could each lose 20% of their outstanding habitat to projected urban development by 2100; Riverside County could loses as much as 15%.

Los Angeles and Ventura counties also face significant risks of outstanding habitat loss due to projected urbanization. Other counties in which urban growth could consume 10,000 or more hectares of outstanding habitat land include Kern, Santa Barbara, San Luis Obispo, Placer, and Orange. Bay Area counties, and those in the Sacramento region and the north and central San Joaquin Valley, face much lower risks.

Two caveats offered above bear repeating. Habitat areas are not spatially substitutable. In terms of the plants and animals at risk, 100 hectares of habitat loss in Yuba County is not the same thing as 100 acres of habitat loss in Imperial County. Second, these projections do not include threats of habitat loss due to ex-urban growth. Many outstanding habitat lands throughout California, particularly those in the Sierra foothills and the north Sacramento Valley, are significantly threatened by ex-urban development.

Irreplaceable Habitat. Sites with TESA scores of fifty or more constitute *irreplaceable* multi-species habitat. The loss of as little as 100 hectares of habitat land with a TESA score of 50 or more could put substantial survival pressure on one or more threatened or endangered

Figure 18: Loss in Outstanding Multi-species Habitat Land Area Due to Projected Urbanization, for Selected Counties, 1998-2100

County (sorted in order of absolute loss, 1998-2100)	Habitat Area with Threatened & Endangered Species **Score >= 30**	Projected Loss due to Urbanization, 1998-2020		Projected Loss due to Urbanization, 1998-2050		Projected Loss due to Urbanization, 1998-2100	
		Hectares	%	Hectares	%	Hectares	%
Riverside	442,618	13,002	3%	59,515	13%	88,109	20%
San Diego	554,918	17,310	3%	40,265	7%	82,765	15%
San Bernardino	378,575	26,067	7%	64,301	17%	76,187	20%
Los Angeles	433,268	3,636	1%	19,782	5%	32,408	7%
Ventura	347,861	7,443	2%	17,279	5%	26,140	8%
Kern	858,829	7,108	1%	14,663	2%	23,405	3%
Santa Barbara	554,831	1,505	0%	11,139	2%	21,701	4%
San Luis Obispo	752,309	4,304	1%	12,354	2%	21,556	3%
Placer	260,987	7,192	3%	12,244	5%	16,260	6%
Orange	81,850	2,348	3%	5,486	7%	10,496	13%
El Dorado	381,903	2,951	1%	6,156	2%	9,819	3%
Monterey	667,045	1,186	0%	5,077	1%	9,535	1%
Alameda	107,754	2,300	2%	3,935	4%	7,525	7%
Sonoma	297,921	2,549	1%	4,240	1%	6,443	2%
Nevada	205,831	1,512	1%	3,148	2%	5,398	3%
Napa	173,219	489	0%	1,500	1%	2,790	2%
Sacramento	14,624	879	6%	1,517	10%	2,742	19%
Santa Cruz	75,955	1,027	1%	2,738	4%	2,738	4%
Santa Clara	222,590	260	0%	710	0%	2,538	1%
Contra Costa	60,138	1,357	2%	1,585	3%	2,434	4%
Solano	32,762	1,889	6%	1,940	6%	2,179	7%
San Joaquin	54,479	1,447	3%	1,497	3%	1,676	3%
San Mateo	76,069	0	0%	236	0%	1,327	2%
San Benito	304,272	0	0%	114	0%	797	0%
Madera	293,933	212	0%	414	0%	614	0%
Marin	90,269	103	0%	240	0%	393	0%
Kings	70,025	341	0%	341	0%	341	0%
Merced	118,889	256	0%	338	0%	340	0%
Fresno	527,778	292	0%	297	0%	297	0%
Yuba	89,503	7	0%	35	0%	152	0%
Stanislaus	122,666	6	0%	71	0%	148	0%
Yolo	65,269	42	0%	110	0%	127	0%
Sutter	9,248	4	0%	4	0%	11	0%
Imperial	1,694	0	0%	0	0%	0	0%
Mariposa	306,671	0	0%	0	0%	0	0%

species. Statewide, California includes 2,892,000 hectares of developed and undeveloped land with a TESA score of 50 or more; percentage-wise, these sites make up 7% of California's urban and undeveloped lands.

Statewide, projected urban growth constitutes a series of regional threats to irreplaceable habitat lands (see Figure 19). Among the counties listed in Figure 19, projected urban growth will result in a cumulative loss of 11,000 hectares of outstanding habitat by 2020, 21,000 hectares by 2050, and 29,000 hectares by 2100. These correspond to percentage losses of 0.4%, 1%, and 1%, respectively.

The vast majority of these lands are in Southern California or along the Central Coast. Measured in terms of land area, the greatest cumulative threat to irreplaceable habitat lands is in Ventura County (which could lose as much as 6,000 hectares of irreplaceable habitat by 2100 due to urban conversion), Los Angeles County (where 5,000 hectares are at risk), Placer County (where 5,000 hectares are at risk), and Riverside County (where just over 4,000 hectares are at risk). Other counties facing significant threats from projected urban growth include El Dorado, San Luis Obispo, Santa Barbara, San Diego, and Nevada.

In terms of percentages, Riverside and Los Angeles counties could each lose 35% or more of their irreplaceable habitat lands to projected urban development by 2100; San Diego County could lose as much as 23%, and Ventura and Placer could lose in excess of 10%.

No county in the Bay Area or in the San Joaquin or Sacramento Valley regions faces significant threat risks. Because they do not include threats from ex-urban development or from road construction, logging, farming, and mining operations, almost certainly these projections understate the true risk to California's irreplaceable habitat lands.

4.4 Farmland Fragmentation

The effects of urban growth on farm and habitat lands go beyond simple acreage loss. To the extent that urban land conversion occurs in a patchwork fashion rather than contiguously, it may also serve to fragment remaining resource lands. Farmland patches that are too small, are too separated from other farmlands, or are surrounded by non-farm uses may be difficult to farm economically. Similarly, animal species with large "home ranges" may find their existence threatened by extensive habitat fragmentation. Exactly how much fragmentation constitutes too much is difficult to say. Some farmers can operate quite profitably on small isolated farms; others require large uninterrupted swaths of land. Similarly, some species spend their entire lives in micro-niches, while others need large areas of land for foraging, safety and reproduction.

Figure 19: Loss in Irreplaceable Multi-species Habitat Land Area Due to Projected Urbanization, for Selected Counties, 1998-2100

County (sorted in order of absolute loss, 1998-2100)	Habitat Area with Threatened & Endangered Species **Score > 50 (ha)**	Projected Loss due to Urbanization, 1998-2020		Projected Loss due to Urbanization, 1998-2050		Projected Loss due to Urbanization, 1998-2100	
		Hectares	%	Hectares	%	Hectares	%
Ventura	53,117	771	1%	3,582	7%	5,551	10%
Los Angeles	12,745	585	5%	2,933	23%	4,656	37%
Placer	31,084	2,631	8%	3,956	13%	4,628	15%
Riverside	10,876	3,139	29%	4,209	39%	4,297	40%
El Dorado	91,352	1,350	1%	2,130	2%	2,549	3%
San Luis Obispo	201,706	795	0%	1,540	1%	2,401	1%
Santa Barbara	152,888	110	0%	597	0%	1,773	1%
San Diego	4,506	1,028	23%	1,028	23%	1,028	23%
Nevada	21,463	119	1%	446	2%	829	4%
Alameda	12,623	51	0%	118	1%	397	3%
Contra Costa	10,232	171	2%	187	2%	315	3%
Kern	149,713	0	0%	2	0%	259	0%
Monterey	117,741	0	0%	37	0%	242	0%
Orange	2,461	102	4%	127	5%	157	6%
Santa Clara	7,106	0	0%	0	0%	11	0%
Solano	343	0	0%	0	0%	3	1%
Tulare	133,307	0	0%	0	0%	0	0%
Mariposa	93,954	0	0%	0	0%	0	0%
Madera	85,860	0	0%	0	0%	0	0%
Fresno	49,565	0	0%	0	0%	0	0%
San Benito	46,840	0	0%	0	0%	0	0%
Stanislaus	16,748	0	0%	0	0%	0	0%
Merced	8,339	0	0%	0	0%	0	0%
Kings	7,845	0	0%	0	0%	0	0%
San Mateo	5,406	0	0%	0	0%	0	0%
Marin	5,034	0	0%	0	0%	0	0%
Yuba	4,523	0	0%	0	0%	0	0%
San Joaquin	1,629	0	0%	0	0%	0	0%
Santa Cruz	501	0	0%	0	0%	0	0%
Sonoma	333	0	0%	0	0%	0	0%
San Bernardino	136	0	0%	0	0%	0	0%
Napa	1	0	0%	0	0%	0	0%
Sacramento	1	0	0%	0	0%	0	0%
Sutter	1	0	0%	0	0%	0	0%
Yolo	1	0	0%	0	0%	0	0%

The question of absolute fragmentation levels aside, it is relatively straightforward to compare initial levels of farmland and habitat fragmentation to the levels associated with projected urban growth. Figure 20 compares current projected fragmentation levels for 1998, 2050, and 2100 by geographic region and farmland type using two simple fragmentation measures: (i) the number of patches—or unconnected land areas of a single type; and, (ii) average patch size, measured in hectares. Generally speaking, a farmland or habitat pattern characterized by fewer large patches is thought to be preferred to one characterized by a greater number of small ones. Readers should note that the amalgamation sub-regions used in Figure 20 are slightly different than those used in Figures 4 and 9.

Prospective Fragmentation of Prime Farmlands. "Prime" farmland is defined by the California Farmland Mapping and Monitoring Program as land used for the production of irrigated crops at some time during the previous four years and which meets the highest soil moisture, pH, erodability and permeability, and soil rooting depth criteria. The extent of prime farmland fragmentation as of 1998 varied widely across California's urban regions: from extremely fragmented throughout Southern California (where the average patch was less than 100 hectares), to moderately fragmented in the Central Coast and Bay Area (where the average prime farmland patch ranged between 100 and 200 hectares), to mostly unfragmented in the Sacramento and San Joaquin Valleys (where the typical prime farmland patch is more than 250 hectares).

Based on the urban growth projections presented in Section 3.2, prime farmland will grow noticeably more fragmented in most of the state's urban regions and sub-regions. In some places, farming itself may be threatened.

Across the state, projected reductions in average patch size will generally follow projected reductions in land area. Measured in percentage terms, average prime farmland patch sizes by 2050 will decline by 15% or more in the Central Los Angeles sub-region, in the Inland Empire sub-region, in the Central Coast region, and in the Central Bay Area sub-region. By 2100, the average patch size of prime farmlands in these same regions and sub-regions will have declined by twenty to thirty percent. Indeed, the only areas of the state in which prime farmlands are *not projected* to become much more fragmented by 2050 are the Southcoast sub-region (including Imperial, Orange, and San Diego counties) and the Northwest Sacramento sub-region (including Sutter, Yolo, and Yuba counties).

Figure 20: Farmland Area and Patch Fragmentation, by Region and Farmland Type: 1998-2050, 1998-2100

	Region	Counties	Land Area			Average Patch Area			Number of Patches		
			1998 Hectares	1998-2050 %change	1998-2100 %change	1998 Avg. Area (ha)	1998-2050 %change	1998-2100 %change	1998 Patches	1998-2050 %change	1998-2100 %change
Prime Farmland	Southcoast	Imperial, Orange, San Diego	89,566	-6.9%	-20.1%	98.0	-2.7%	-12.0%	914	-4.3%	-9.2%
	Central LA	Los Angeles, Ventura	30,872	-16.4%	-30.1%	68.9	-24.3%	-33.0%	448	10.5%	4.2%
	Inland Empire	Riverside, San Bernardino	76,559	-30.7%	-44.5%	70.2	-16.6%	-18.8%	1,090	-17.0%	-31.7%
	Central Coast	Monterey, S.Benito, S.Luis Obispo, S.Barbara, S. Cruz	135,157	-16.9%	-29.5%	109.9	-18.8%	-30.2%	1,230	2.4%	1.1%
	S. San Joaquin Valley	Kern, Kings, Tulare	309,170	-9.6%	-16.3%	598.0	-6.7%	-7.1%	517	-3.1%	-9.9%
	C. San Joaquin Valley	Fresno, Madera	189,687	-15.3%	-30.8%	129.6	-10.3%	-22.9%	1,464	-5.6%	-10.3%
	N. San Joaquin Valley	Merced, S. Joaquin, Stanislaus	357,729	-9.5%	-16.9%	277.3	-6.0%	-12.0%	1,290	-3.6%	-5.6%
	Central Bay Area	Alameda, Contra Costa, S.Mateo, S.Clara	33,148	-20.8%	-35.5%	105.2	-24.0%	-29.2%	315	4.1%	-8.9%
	North Bay Area	Marin, Napa, Solano, Sonoma	87,177	-6.3%	-12.9%	162.9	-12.9%	-19.2%	535	7.5%	7.9%
	NW Sacramento	Sutter, Yolo, Yuba	194,743	-0.7%	-1.7%	439.6	-4.8%	-10.8%	443	4.3%	10.2%
	Sacramento & Foothills	El Dorado, Placer, Sacramento	53,818	-0.3%	-0.3%	140.2	10.4%	10.0%	384	-9.6%	-9.4%
State & Locally--Importants Farmland	Southcoast	Imperial, Orange, San Diego	191,880	-10.2%	-14.3%	160.4	-6.0%	-6.7%	1,196	-4.4%	-8.1%
	Central LA	Los Angeles, Ventura	32,507	-11.4%	-40.1%	68.9	-12.3%	-23.4%	472	1.1%	-21.8%
	Inland Empire	Riverside, San Bernardino	128,588	-6.0%	-6.5%	47.0	-2.1%	-0.9%	2,737	-3.9%	-5.6%
	Central Coast	Monterey, S.Benito, S.Luis Obispo, S.Barbara, S. Cruz	128,642	-5.4%	-5.4%	65.1	-2.1%	-2.1%	1,975	-3.4%	-3.4%
	S. San Joaquin Valley	Kern, Kings, Tulare	262,046	-2.3%	-2.3%	338.1	0.3%	0.3%	775	-2.6%	-2.6%
	C. San Joaquin Valley	Fresno, Madera	117,251	-7.2%	-7.2%	65.5	2.0%	2.0%	1,790	-9.0%	-9.0%
	N. San Joaquin Valley	Merced, S. Joaquin, Stanislaus	171,361	-7.4%	-7.4%	78.6	-5.2%	-5.2%	2,179	-2.3%	-2.3%
	Central Bay Area	Alameda, Contra Costa, S.Mateo, S.Clara	32,063	-4.3%	-4.3%	64.8	3.0%	3.0%	495	-7.1%	-7.1%
	North Bay Area	Marin, Napa, Solano, Sonoma	87,673	-2.2%	-2.2%	71.5	-1.9%	-1.9%	1,227	-0.2%	-0.2%
	NW Sacramento	Sutter, Yolo, Yuba	82,604	-6.8%	-6.8%	211.3	-20.3%	-20.3%	391	16.9%	16.9%
	Sacramento & Foothills	El Dorado, Placer, Sacramento	122,635	-8.5%	-8.5%	120.2	-20.5%	-20.5%	1,020	15.0%	15.0%

Figure 20: Farmland Area and Patch Fragmentation, by Region and Farmland Type: 1998-2050, 1998-2100

	Region	Counties	Land Area			Average Patch Area			Number of Patches		
			1998 Hectares	1998-2050 %change	1998-2100 %change	1998 Avg. Area (ha)	1998-2050 %change	1998-2100 %change	1998 Patches	1998-2050 %change	1998-2100 %change
Unique Farmland	Southcoast	Imperial, Orange, San Diego	29,789	-54.0%	-70.9%	45.9	-54.0%	-62.8%	649	0.0%	-21.7%
	Central LA	Los Angeles, Ventura	9,427	-11.1%	-25.6%	26.9	-8.7%	-15.0%	351	-2.6%	-12.5%
	Inland Empire	Riverside, San Bernardino	18,459	-39.5%	-61.2%	35.7	-13.1%	-33.8%	517	-30.4%	-41.4%
	Central Coast	Monterey, S.Benito, S.Luis Obispo, S.Barbara, S. Cruz	32,231	-13.8%	-24.6%	19.8	-3.8%	-10.7%	1,627	-10.4%	-15.6%
	S. San Joaquin Valley	Kern, Kings, Tulare	34,713	-1.3%	-1.9%	80.4	2.0%	4.4%	432	-3.2%	-6.0%
	C. San Joaquin Valley	Fresno, Madera	103,688	-6.8%	-13.6%	98.3	3.0%	8.8%	1,055	-9.5%	-20.6%
	N. San Joaquin Valley	Merced, S. Joaquin, Stanislaus	80,105	-5.8%	-9.5%	64.1	-2.1%	-2.8%	1,249	-3.8%	-6.9%
	Central Bay Area	Alameda, Contra Costa, S.Mateo, S.Clara	5,094	-9.3%	-18.1%	25.1	-1.5%	1.4%	203	-7.9%	-19.2%
	North Bay Area	Marin, Napa, Solano, Sonoma	22,208	-4.7%	-10.3%	21.7	-1.1%	-5.1%	1,023	-3.6%	-5.5%
	NW Sacramento	Sutter, Yolo, Yuba	46,225	-5.4%	-11.1%	92.5	-14.5%	-18.9%	500	10.6%	9.6%
	Sacramento & Foothills	El Dorado, Placer, Sacramento	16,460	-7.1%	-12.8%	40.3	4.5%	5.9%	408	-11.0%	-17.6%
Grazing Lands	Southcoast	Imperial, Orange, San Diego	73,304	-20.8%	-35.1%	257.2	-52.6%	-70.1%	285	67.0%	116.8%
	Central LA	Los Angeles, Ventura	172,473	-6.9%	-11.2%	1078.0	-60.8%	-70.8%	160	137.5%	203.8%
	Inland Empire	Riverside, San Bernardino	440,465	-27.5%	-36.5%	2048.7	-89.9%	-92.0%	215	614.4%	696.3%
	Central Coast	Monterey, S.Benito, S.Luis Obispo, S.Barbara, S. Cruz	1,188,105	-1.3%	-2.5%	818.3	-4.7%	-7.1%	1,452	3.6%	5.0%
	S. San Joaquin Valley	Kern, Kings, Tulare	997,770	-1.4%	-2.4%	2653.6	-5.9%	-10.0%	376	4.8%	8.5%
	C. San Joaquin Valley	Fresno, Madera	291,067	-0.4%	-0.6%	951.2	65.6%	73.8%	306	-39.9%	-42.8%
	N. San Joaquin Valley	Merced, S. Joaquin, Stanislaus	343,541	-0.5%	-0.6%	840.0	3.6%	5.6%	409	-3.9%	-5.9%
	Central Bay Area	Alameda, Contra Costa, S.Mateo, S.Clara	347,037	-2.8%	-31.6%	1262.0	-28.7%	-47.1%	275	36.4%	29.5%
	North Bay Area	Marin, Napa, Solano, Sonoma	370,047	-2.3%	-13.9%	743.1	-16.8%	-12.3%	498	17.5%	-1.8%
	NW Sacramento	Sutter, Yolo, Yuba	136,204	-1.2%	-2.1%	476.2	-7.9%	-10.6%	286	7.3%	9.4%
	Sacramento & Foothills	El Dorado, Placer, Sacramento	155,305	-6.2%	-11.0%	394.2	-35.4%	-42.6%	394	45.2%	55.1%

Projected changes in the number of prime farmland patches—a secondary measure of fragmentation—will not necessarily follow projected changes in average patch size. The number of prime farmland patches will increase in some sub-regions—notably Ventura County and the North Bay Area—while declining elsewhere.

To the extent that California's future farmers and agri-businesses will require large patches of prime farmland to remain competitive in world markets, those located in Contra Costa, Kern, Kings, Monterey, Santa Cruz, Tulare, and Ventura counties are likely to find their businesses under substantial pressure from urban growth throughout the 21st century.

Prospective Fragmentation of State and Locally Important Farmlands. Farmlands of "state importance" are similar to prime farmland but with minor shortcomings, such as greater slopes or less ability to store soil moisture. Farmlands of "local importance" are identified by each county's board of supervisors and a local advisory committee. For purposes of tracking changes in farmland fragmentation, we have grouped state and locally important farmland into a single category, S&LI farmlands.

As with prime farmlands, the extent of S&LI farmland fragmentation varies widely across California's urban regions: ranging from extremely fragmented in the Inland Empire; to moderately fragmented in the Bay Area, North and Central San Joaquin Valley; to un-fragmented in the South San Joaquin Valley and Sacramento areas.

Compared to prime and unique farmlands, S&LI farmlands face a reduced risk of fragmentation due to prospective urban growth. Among regions and sub-regions, the Sacramento region (including both the Northwest Sacramento and Sacramento & Foothills sub-regions) faces the greatest risk of S&LI farmland fragmentation—measured as reductions in average patch size and increases in patch number—followed by the Central Los Angeles sub-region, the Southcoast sub-region, and the North San Joaquin Valley sub-region. Elsewhere—including the Inland Empire, the Central Coast, the Bay Area, and the southern and central areas of the San Joaquin Valley—the risk of S&LI farmland fragmentation due to prospective urbanization is fairly modest during the first half of the 21st century, but increases thereafter.

Prospective Fragmentation of Unique Farmlands. Farmlands classified as "unique" by the California Farmland Mapping and Monitoring Program are of high productivity, just not as high as those classified as "prime." Compared across the state, unique farmlands are far more fragmented than prime farmlands, although the level of fragmentation varies less across regions.

As of 1998, the average patch size of unique farmlands ranged from a low of 19.8 hectares in the Central Coast region, to a high of 98.3 hectares in the Central San Joaquin Valley sub-region. (By contrast, among prime farmlands, the average patch size in 1998 varied from a low of 98 hectares to a high of nearly 600 hectares.) Put simply, patches of unique farmlands tend be both smaller and less varied in size than patches of prime farmland.

Based on the urban growth projections presented in Section 3.2, in the future, California's future unique farmlands will *be less fragmented*, even as they shrink in size and number. As with prime farmlands, changes in the landscape of unique farmlands will vary widely by region.

A number of sub-regions will experience very significant changes in farmland area and fragmentation level. Absolute losses in unique farmland will be concentrated in the Southcoast and Central San Joaquin Valley sub-regions. Percentage losses in unique farmlands will be greatest in the Southcoast, Inland Empire, and Central Coast sub-regions. Average patch sizes will decline the most in the Southcoast, Northwest Sacramento, and Inland Empire sub-regions. The number of patches will decline the most in the Inland Empire. As with prime farmlands, the largest declines will occur between 2000 and 2050.

Elsewhere, projected losses of unique farmland will be more moderate, with most regions losing 5%–10% of their unique farmlands by 2050, and 10%–20% by 2100. Most sub-regions will also experience a 5%–10% decline in the number of patches (i.e., they will actually grow less fragmented) by 2050. Alone among sub-regions, unique farmland in the Northwest Sacramento region will actually grow more fragmented.

Prospective Fragmentation of Grazing Lands. The CFMMP identifies "grazing" lands as those on which the existing vegetation is suited to the grazing of livestock. Most ranch and dairy operations require large patches (e.g., larger than 500 hectares) of contiguous grazing land to be profitable, however some smaller dairy operations can also operate with moderately sized patches.

Except in the Southcoast sub-region, California's grazing lands are relatively unfragmented. Excluding the Southcoast region, average grazing land patch sizes range from a low of 394 hectares in the Sacramento/Foothills sub-region, to a high of 2,653 hectares in the South San Joaquin Valley sub-region. Average patch sizes tend to be smaller near the coast and larger inland.

The risk of grazing land fragmentation generally follows the risk of grazing land loss. It is greatest in Southern California, where patch sizes could decline by 70% or more this century. Combined with a doubling of the number of patches, ranch and dairy operations in Southern California will find themselves increasingly at risk, especially in Riverside and San Bernardino counties

The risks of grazing land fragmentation due to declining patch size and increasing patch discontiguity are also substantial in the Central San Joaquin, Sacramento & Foothills, and Central Bay Area sub-regions. The situation is especially worrisome in the Sacramento & Foothills region where grazing lands are already highly fragmented.

Fragmentation risks are somewhat lower in the North Bay Area sub-region, Northwest Sacramento sub-region and the South San Joaquin Valley sub-region. They are lower still in the North San Joaquin Valley sub-region and along the central coast.

4.5 Summary

Figure 21 summarizes these different threats by landscape type and region. In characterizing the degree of risk as minor, moderate, or major, we are referring to entire landscapes, and not to single parcels or even clusters of parcels. An individual parcel or area may be at imminent risk of conversion, even as the larger landscape is mostly spared.

Among California's major urban regions, projected urbanization poses the greatest threat to the natural and agricultural landscapes of Southern California. This should not be too surprising given how much population growth Southern California will likely have to accommodate, how much of its natural landscapes have already been lost to urban growth, and the fragile nature of its remaining landscapes.

No other region faces comparable threats. In the San Francisco Bay Area, projected urban growth most threatens wetland areas. Bay Area prime farmlands and grazing lands face minor threats of land conversion, but increased risks of fragmentation. With most of the Bay Area's urban growth projected to occur in and around existing urban areas, the threat to hillsides and non-wetland habitats will be relatively minor.

The potential for prime farmland loss and increased fragmentation is highest in the San Joaquin Valley, as much of that region's best farmland is adjacent to Highway 99, which will continue to be the region's major urban growth corridor. Unique and state and local farmlands throughout the San Joaquin Valley face moderate risks of conversion (but not fragmentation), as do wetland areas in the north San Joaquin Valley.

Figure 21: Summary of Projected Urban Growth Threats to Environmental Landscapes, by Region, 1998-2100

Landscape	Threat	Threat Level by Region				
		Southern California	San Francisco Bay Area	San Joaquin Valley	Sacramento Region	Central Coast
Wetlands conversion	Land conversion	Minor	Major	Moderate	Moderate	Minimal
Hillside conversion	Land conversion	Minor	Minimal	Minimal	Minimal	Minimal
TESA Habitat Score >=10	Land conversion	Major	Minor	Moderate	Minimal	Moderate
TESA Habitat Score >=30	Land conversion	Major	Minimal	Minor	Minor	Moderate
TESA Habitat Score >=50	Land conversion	Major	Minimal	Minimal	Moderate	Minor
Prime Farmland	Land conversion	Moderate	Minor	Major	Minimal	Minor
Prime Farmland	Land fragmentation	Moderate	Moderate	Major	Moderate	Major
State & Local Farmland	Land conversion	Moderate	Minor	Moderate	Moderate	Minor
State & Local Farmland	Land fragmentation	Moderate	Minor	Minor	Major	Minor
Unique Farmland	Land conversion	Major	Minor	Moderate	Minor	Minor
Unique Farmland	Land fragmentation	Major	Minor	Minor	Moderate	Minor
Grazing Lands	Land conversion	Major	Minor	Minor	Minor	Minor
Grazing Lands	Land fragmentation	Major	Moderate	Minor	Major	Minor

In the Sacramento region, projected urban growth poses moderate risks of wetland conversion, and high-quality habitat loss. Among farmlands, it is the risk of increased fragmentation, not land conversion, that is greatest. State and local farmlands and grazing lands, in particular, face very high fragmentation risks.

With development pressures projected to be least severe along the Central Coast, the threat to natural and farming landscape is expected to be relatively minor.

5.0 CONCLUSIONS AND CAVEATS

5.1 Summary of Findings

The task of developing a reliable, understandable, and useable urban growth model for a state as large and varied as California can only be termed "daunting." Nonetheless, as this report makes clear, by cleverly combining various statewide GIS databases with spatial data on the extent of urbanization at multiple time periods, it is indeed possible to calibrate statistically reliable models of urban growth, and then to use those models to allocate projected population growth to specific sites.

Specifically, this procedure allocates future development to individual sites based on their projected development probability. These probabilities are estimated using the results of a statistical model calibrated for the period 1988–1998. While the exact role of particular factors varies by region, several influences are consistently important. These include proximity to freeways, access to jobs, site slope, and site incorporation status. Other factors such as farmland and wetland status vary more widely in their importance. To the extent that these factors are less important in the future or are important in different ways—or, as is even more likely, that other factors become important—the model results will vary widely from what is presented here.

The use of this procedure to develop believable forecasts rests on six assumptions. The first is that the same set of factors that shaped land development patterns in the recent past will continue to do so in the future, and in the same ways. This type of assumption is common to all population and land use forecasting efforts, but it bears repeating anyway.

A second embedded assumption is that jobs will continue decentralizing within and between California's four major urban regions—Southern California, the greater San Francisco Bay Area, the Sacramento region, and the southern San Joaquin Valley. To the extent that urban development tends to follow job growth, particularly along freeway corridors, this suggests that population and household growth—which accounts for about 70% of urban land—will also continue decentralizing.

A third assumption is that California's population will continue to grow, and at more or less the same rate and in the same spatial pattern as projected by the California Department of Finance. For consistency's sake, we rely on county population projections developed by the California Department of Finance through 2040. (DoF population projections are calculated by extrapolating current fertility and migration trends.) Thereafter, we extrapolate and trend downward the annualized county growth rates embedded in the DoF population projections. This approach yields a statewide population of 68 million in 2050 and 92 million in 2100.

Fourth, we assume that average infill rates and population densities will increase with additional development. It is an axiom of economics that scarce resources are used more intensely than plentiful ones. Following this logic, as available supplies of developable land are used up, developers seek ways to use remaining land more intensely, either by increasing densities or through redevelopment. Thus, both development densities and infill activity should increase with population growth.

Fifth, we assume that local general plans have little long-term effect on development patterns or rates.

Last, with respect to developing a baseline scenario, we make the assumption that there will be no additional freeways or intra- and inter-regional rapid transit systems developed beyond those that exist today. This is perhaps the least realistic assumption of all. It is abundantly clear that California's growing population will need additional transportation infrastructure. What is less clear is what forms that infrastructure should take, where it should go, how it should be planned and financed, and when it might be constructed.

Assuming all these assumptions to be valid, the urbanized land area of Southern California (including Imperial, San Diego, Orange, Riverside, San Bernardino, Los Angeles, and Ventura counties) will grow from approximately 800,000 hectares in 1998, to 1,000,000 hectares by 2020, to 1,347,000 hectares in 2050, to 1,727,000 hectares in 2100. Three-quarters or more of this growth will occur in three counties: Riverside, San Bernardino, and San Diego.

Four hundred miles to the north, the urbanized land area of the nine-county San Francisco Bay Area will swell from just under 300,000 hectares in 1998, to 329,000 hectares in 2020, to 369,000 hectares in 2050, to perhaps as much as 417,000 hectares in 2100. Half of the region's urban growth will occur in the East Bay and South Bay, and the other half will occur in the North Bay.

If present trends continue, the amount of urbanized land in the San Joaquin Valley will exceed that of the Bay Area by 2050. From 181,000 hectares in 1998, the amount of urbanized land in the eight-county San Joaquin Valley will grow to 262,000 hectares by 2020, 422,000 hectares by 2050, and 599,000 hectares by 2100. Compared to Southern California and the Bay Area, new urban development in the San Joaquin Valley will occur at far lower densities. As a result, more land area will be needed to accommodate less population growth.

To the north, the urbanized land area of the seven-county Greater Sacramento region will grow from its current footprint of 112,000 hectares in 1998, to 143,000 hectares in 2020, to 180,000 hectares in 2050, to 223,000 hectares in 2100. Just over half of this growth will occur in Sacramento and Placer counties.

Lastly, the urban footprint of the five counties along California's central coast—Monterey, San Benito, San Luis Obispo, Santa Barbara, and Santa Cruz—will grow from its current size of about 75,000 hectares to 97,000 hectares by 2020, 157,000 hectares by 2050, and 215,000 hectares by 2100. Much of this region's growth pressure will be focused on Monterey and San Luis Obispo counties.

5.2 Next Steps

By definition, models are simplifications of reality. As with any modeling effort, every step forward reveals new shortcomings and additional development needs. The procedures described herein, and the resulting projections suffer four significant shortcomings:

1. All projected urban growth within each county is allocated at a single countywide average density. In reality, urban densities vary widely within counties, often between neighboring sites. The effect of this simplification is to overstate the amount and footprint of urban growth in the higher-density areas of each county, and to understate the amount and footprint in the lower-density areas. Subsequent versions of the model will allocate population growth at local densities. This will have the effect of more accurately estimating the amount of land needed to accommodate a given increment of population growth.
2. A second shortcoming of the current procedure is that it does not specifically explain or allocate infill development—that is, urban growth likely to occur within the existing urban footprint. Instead, infill population growth (as a share of total county population growth) is subtracted from each county's projected population prior to its being allocated to undeveloped sites. In some counties, notably Los Angeles, Orange, and Santa Clara, this simplification has the effect of over-allocating future population growth to infill, and thus under-estimating the amount of required greenfield land. In other counties, notably those in the San Joaquin Valley and the Inland Empire, this simplification has the effect of under-estimating future infill and over-estimating greenfield development. Subsequent versions of the model will treat infill as one or more development categories on a density-of-development continuum and will model changes among categories over time.

3. The third, and perhaps most serious shortcoming of the current work, is that it does not consider prospective low-density exurban development—that is, development at densities below one dwelling unit per two hectares. (This is the minimum density tracked by the California Farmland Mapping and Monitoring Project.) Exurban and rural population growth are likely to account for a relatively small share of the state's projected population growth but a large share of its projected urban footprint, particularly in and around the Sierra Foothills. The exclusion of exurban development thus leads to a substantial under-estimation of the amount of additional human settlement and the resulting impacts of that settlement. This is particularly problematic for grazing lands and for species habitat. As with infill development, above, subsequent versions of the model will treat exurban and rural development as categories on a density-of-development continuum and will model changes among categories over time.
4. A final shortcoming lies in the formulaic way future job growth is estimated and allocated. Given the importance of job growth in shaping future urban development, subsequent versions of the model will pay far more attention to the determinants of spatial patterns and concentrations of job growth.

The cumulative effect of these changes will likely be to increase estimates of the size and impacts of the footprint of urban settlement on the California landscape.

NOTES

[1] Data on the extent of urbanization and farmland types was obtained for 1988 and 1998 from the Department of Conservation's Farmland Mapping and Monitoring Project; freeway distances and city and county boundaries were generated using 2000 Census Tiger Line files; floodzone boundaries were obtained from the FEMA Q3 maps; average site slopes were generated from USGS 100-meter Digital Elevation Model (DEM) data; public lands were identified from the State of California's Public Land data map and from GAP Analysis maps; wetlands were identified from the National Wetlands Inventory (NWI).

[2] The use of logit models to analyze discrete choices at a single point in time is firmly grounded in micro-economic theory (McFadden 1974). The use of logit models to analyze discrete land use changes, particular changes identified from maps—while statistically feasible—introduces additional theoretical complications. In order for the estimated model parameters to be reliable—that is, to be free from bias—we must make two assumptions about the process of land use change itself. The first is that all participants in the land development process must act independently of each other. This includes landowners, developers, builders, brokers, homebuyers, renters, and businesses. This assumption is intended to rule out the possibility of oligopolistic or strategic behavior. A second assumption concerns the lack of presence of any identifiable participants, or agents. Discrete choice analysis has traditionally been used to model the behavior of identifiable agents such as voters, travelers and consumers. In the case of land use change, the agents of interest are land buyers and sellers. Models like the one identified above are known as reduced-form models because they include information on transaction outcomes but not on the agents involved in the transaction. In simple economic terms, there are no utility-maximizing buyers or profit-maximizing sellers present in the model to start or complete a transaction. This is only a problem to the extent that the characteristics of specific buyers and sellers might affect their actions. To deal with this problem, we invoke the idea of competition. Specifically, we argue that if land markets are competitive (e.g., there are no barriers to entry), then the characteristics and non-economic motivations of particular agents should not affect transaction outcomes. Whether developers are well-capitalized or poorly-capitalized, whether they specialize in residential development or retail development, whether their experience is local or national, in a competitive market, these factors should be of less importance than the strength of the demand for urban development and the availability of appropriate sites.

[3] In situations where views are rewarded in the marketplace with price and rent premiums, the probability of development may actually rise with slope.

[4] Standardized coefficients are calculated by dividing the parameter estimate by its standard deviation. This has the effect of re-scaling each independent from its original scale to a common scale, which facilitates direct magnitude comparisons.

[5] This approach requires defining regions in terms of commute sheds.

[6] Most regional economic studies divide employment into (1) *basic jobs*, which generate income to a region or metropolitan area through the sales of goods and services to customers outside the region; and, (2) *non-basic*, or service jobs, which provide goods and services to the resident population and businesses with the region.

[7] By net job growth, we mean the excess of job gains (through attraction and expansion) over losses (through contractions and firm death).

[8] The Department of Finance uses a modified cohort-component model, disaggregated by race and 1-year age cohort to project population.

[9] The NWI does not include vernal pools.

APPENDICES

Appendix A: Calculation of Spatial Shiftshare Components by Job Center, Ring, and Region: 1990-2020F

Region	Ring	County	Job Center	Jobs: 1990	Jobs: 2020F	Jobs: Percent Change, 1990-2020F	Jobs: Center Share of Jobs in Ring in 1990	Jobs: Center Share of Job Growth in Ring, 1990-2020F	Spatial Shiftshare Components: Regional Growth Component	Spatial Shiftshare Components: Ring Change Component	Spatial Shiftshare Components: Local Change Component	Spatial Shiftshare Components: Average Local Change Component within Ring
Southern California	0	LA		8,817	9,121	3.4%	2.2%	0.1%	33.6%	92.2%	-122.4%	-3.8%
	0	LA	(Raw Uninc)	205,670	360,874	75.5%	51.5%	30.9%	33.6%	92.2%	-50.4%	-3.8%
	0	LA	Avalon	2,825	4,673	65.4%	0.7%	0.4%	33.6%	92.2%	-60.4%	-3.8%
	0	OC	(Raw Uninc)	53,818	151,961	182.4%	13.5%	19.5%	33.6%	92.2%	56.5%	-3.8%
	0	RIV	(Raw Uninc)	48,650	194,304	299.4%	12.2%	29.0%	33.6%	92.2%	173.6%	-3.8%
	0	RIV	Blythe	6,352	11,773	85.3%	1.6%	1.1%	33.6%	92.2%	-40.5%	-3.8%
	0	SBD	(Raw Uninc)	27,481	84,715	208.3%	6.9%	11.4%	33.6%	92.2%	82.4%	-3.8%
	0	SBD	Needles	4,036	4,761	18.0%	1.0%	0.1%	33.6%	92.2%	-107.9%	-3.8%
	0	VEN	(Raw Uninc)	11,518	40,794	254.2%	2.9%	5.8%	33.6%	92.2%	128.3%	-3.8%
	0	VEN	Unincorporated	30,187	38,925	28.9%	7.6%	1.7%	33.6%	92.2%	-96.9%	-3.8%
	0	Ring Total		399,354	901,901	125.8%	100.0%	100.0%	33.6%	92.2%	0.0%	-3.8%
Southern California	1	LA	Alhambra	30,187	38,925	28.9%	0.7%	1.4%	33.6%	-19.5%	14.8%	3.7%
	1	LA	Bell	7,533	12,238	62.5%	0.2%	0.8%	33.6%	-19.5%	48.3%	3.7%
	1	LA	Bell Gardens	11,607	13,091	12.8%	0.3%	0.2%	33.6%	-19.5%	-1.3%	3.7%
	1	LA	Bellflower	23,975	23,666	-1.3%	0.6%	-0.1%	33.6%	-19.5%	-15.4%	3.7%
	1	LA	Beverly Hills	56,816	62,271	9.6%	1.3%	0.9%	33.6%	-19.5%	-4.5%	3.7%
	1	LA	Burbank	91,373	124,889	36.7%	2.1%	5.5%	33.6%	-19.5%	22.6%	3.7%
	1	LA	Carson	64,179	67,908	5.8%	1.5%	0.6%	33.6%	-19.5%	-8.3%	3.7%
	1	LA	Cerritos	30,399	31,236	2.8%	0.7%	0.1%	33.6%	-19.5%	-11.4%	3.7%
	1	LA	Commerce	57,293	62,581	9.2%	1.3%	0.9%	33.6%	-19.5%	-4.9%	3.7%
	1	LA	Compton	49,293	35,359	-28.3%	1.1%	-2.3%	33.6%	-19.5%	-42.4%	3.7%
	1	LA	Cudahy	3,525	4,166	18.2%	0.1%	0.1%	33.6%	-19.5%	4.1%	3.7%
	1	LA	Culver City	56,805	54,990	-3.2%	1.3%	-0.3%	33.6%	-19.5%	-17.3%	3.7%
	1	LA	Diamond Bar	14,079	18,157	29.0%	0.3%	0.7%	33.6%	-19.5%	14.8%	3.7%
	1	LA	Downey	54,370	58,596	7.8%	1.3%	0.7%	33.6%	-19.5%	-6.4%	3.7%
	1	LA	El Segundo	50,111	71,206	42.1%	1.2%	3.5%	33.6%	-19.5%	28.0%	3.7%
	1	LA	Gardena	32,982	34,979	6.1%	0.8%	0.3%	33.6%	-19.5%	-8.1%	3.7%
	1	LA	Glendale	88,557	104,665	18.2%	2.0%	2.6%	33.6%	-19.5%	4.1%	3.7%
	1	LA	Hawthorne	45,386	34,425	-24.2%	1.0%	-1.8%	33.6%	-19.5%	-38.3%	3.7%
	1	LA	Huntington Park	19,170	18,073	-5.7%	0.4%	-0.2%	33.6%	-19.5%	-19.8%	3.7%
	1	LA	Inglewood	48,732	54,052	10.9%	1.1%	0.9%	33.6%	-19.5%	-3.2%	3.7%
	1	LA	La Habra Heights	937	461	-50.8%	0.0%	-0.1%	33.6%	-19.5%	-64.9%	3.7%

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Region	Ring	County	Job Center	Jobs					Spatial Shiftshare Components			
				1990	2020F	Percent Change, 1990-2020F	Center Share of Jobs in Ring in 1990	Center Share of Job Growth in Ring, 1990-2020F	Regional Growth Component	Ring Change Component	Local Change Component	Average Local Change Component within Ring
Southern California	1	LA	La Mirada	18,334	17,537	-4.3%	0.4%	-0.1%	33.6%	-19.5%	-18.5%	3.7%
	1	LA	Los Angeles	1,914,531	1,989,380	3.9%	44.3%	12.3%	33.6%	-19.5%	-10.2%	3.7%
	1	LA	Lynwood	15,605	19,991	28.1%	0.4%	0.7%	33.6%	-19.5%	14.0%	3.7%
	1	LA	Maywood	6,389	5,082	-20.5%	0.1%	-0.2%	33.6%	-19.5%	-34.6%	3.7%
	1	LA	Montebello	28,608	26,529	-7.3%	0.7%	-0.3%	33.6%	-19.5%	-21.4%	3.7%
	1	LA	Monterey Park	25,244	24,290	-3.8%	0.6%	-0.2%	33.6%	-19.5%	-17.9%	3.7%
	1	LA	Norwalk	26,323	25,652	-2.5%	0.6%	-0.1%	33.6%	-19.5%	-16.7%	3.7%
	1	LA	Pico Rivera	19,262	25,612	33.0%	0.4%	1.0%	33.6%	-19.5%	18.8%	3.7%
	1	LA	Rosemead	20,035	24,805	23.8%	0.5%	0.8%	33.6%	-19.5%	9.7%	3.7%
	1	LA	San Dimas	15,463	19,031	23.1%	0.4%	0.6%	33.6%	-19.5%	9.0%	3.7%
	1	LA	San Gabriel	14,361	15,367	7.0%	0.3%	0.2%	33.6%	-19.5%	-7.1%	3.7%
	1	LA	San Marino	4,405	4,910	11.5%	0.1%	0.1%	33.6%	-19.5%	-2.7%	3.7%
	1	LA	Santa Monica	76,499	84,492	10.4%	1.8%	1.3%	33.6%	-19.5%	-3.7%	3.7%
	1	LA	South Gate	24,090	31,054	28.9%	0.6%	1.1%	33.6%	-19.5%	14.8%	3.7%
	1	LA	South Pasadena	8,755	9,170	4.7%	0.2%	0.1%	33.6%	-19.5%	-9.4%	3.7%
	1	LA	Torrance	107,289	130,638	21.8%	2.5%	3.8%	33.6%	-19.5%	7.6%	3.7%
	1	LA	Vernon	41,863	54,276	29.7%	1.0%	2.0%	33.6%	-19.5%	15.5%	3.7%
	1	LA	Walnut	7,210	7,261	0.7%	0.2%	0.0%	33.6%	-19.5%	-13.4%	3.7%
	1	LA	West Covina	29,380	33,321	13.4%	0.7%	0.6%	33.6%	-19.5%	-0.7%	3.7%
	1	LA	West Hollywood	30,370	32,498	7.0%	0.7%	0.3%	33.6%	-19.5%	-7.1%	3.7%
	1	LA	Westlake Village	10,209	3,200	-68.7%	0.2%	-1.1%	33.6%	-19.5%	-82.8%	3.7%
	1	LA	Whittier	41,092	38,934	-5.3%	0.9%	-0.4%	33.6%	-19.5%	-19.4%	3.7%
	1	OC	Anaheim	170,933	235,372	37.7%	4.0%	10.5%	33.6%	-19.5%	23.6%	3.7%
	1	OC	Brea	31,519	49,740	57.8%	0.7%	3.0%	33.6%	-19.5%	43.7%	3.7%
	1	OC	Buena Park	32,364	49,537	53.1%	0.7%	2.8%	33.6%	-19.5%	38.9%	3.7%
	1	OC	Costa Mesa	84,625	106,107	25.4%	2.0%	3.5%	33.6%	-19.5%	11.3%	3.7%
	1	OC	Cypress	16,062	51,727	222.0%	0.4%	5.8%	33.6%	-19.5%	207.9%	3.7%
	1	OC	Fountain Valley	28,891	37,310	29.1%	0.7%	1.4%	33.6%	-19.5%	15.0%	3.7%
	1	OC	Fullerton	69,748	76,266	9.3%	1.6%	1.1%	33.6%	-19.5%	-4.8%	3.7%
	1	OC	Garden Grove	57,328	52,808	-7.9%	1.3%	-0.7%	33.6%	-19.5%	-22.0%	3.7%
	1	OC	Irvine	119,802	248,919	107.8%	2.8%	21.1%	33.6%	-19.5%	93.7%	3.7%
	1	OC	La Habra	19,522	21,059	7.9%	0.5%	0.3%	33.6%	-19.5%	-6.3%	3.7%

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Southern California	1	OC	La Palma	6,357	10,524	65.5%	0.1%	0.7%	33.6%	-19.5%	51.4%	3.7%
	1	OC	Orange	97,941	118,500	21.0%	2.3%	3.4%	33.6%	-19.5%	6.9%	3.7%
	1	OC	Placentia	15,162	19,685	29.8%	0.4%	0.7%	33.6%	-19.5%	15.7%	3.7%
	1	OC	Santa Ana	170,869	181,816	6.4%	4.0%	1.8%	33.6%	-19.5%	-7.7%	3.7%
	1	OC	Stanton	9,501	11,318	19.1%	0.2%	0.3%	33.6%	-19.5%	5.0%	3.7%
	1	OC	Tustin	34,845	62,549	79.5%	0.8%	4.5%	33.6%	-19.5%	65.4%	3.7%
	1	OC	Villa Park	1,220	1,589	30.2%	0.0%	0.1%	33.6%	-19.5%	16.1%	3.7%
	1	OC	Westminster	24,348	34,563	42.0%	0.6%	1.7%	33.6%	-19.5%	27.8%	3.7%
	1	OC	Yorba Linda	11,891	18,156	52.7%	0.3%	1.0%	33.6%	-19.5%	38.6%	3.7%
	1	Ring Total		4,325,554	4,936,509	14.1%	100.0%	100.0%	33.6%	-19.5%	0.0%	3.7%
Southern California	2	LA	Arcadia	25,879	25,444	-1.7%	2.2%	-0.3%	33.6%	-19.2%	-16.1%	6.8%
	2	LA	Azusa	20,693	16,242	-21.5%	1.7%	-2.6%	33.6%	-19.2%	-35.9%	6.8%
	2	LA	Baldwin Park	18,993	22,012	15.9%	1.6%	1.8%	33.6%	-19.2%	1.5%	6.8%
	2	LA	Bradbury	192	253	31.8%	0.0%	0.0%	33.6%	-19.2%	17.4%	6.8%
	2	LA	Claremont	11,559	12,894	11.5%	1.0%	0.8%	33.6%	-19.2%	-2.8%	6.8%
	2	LA	Covina	30,250	29,754	-1.6%	2.5%	-0.3%	33.6%	-19.2%	-16.0%	6.8%
	2	LA	Duarte	6,988	12,829	83.6%	0.6%	3.4%	33.6%	-19.2%	69.2%	6.8%
	2	LA	El Monte	46,622	48,461	3.9%	3.9%	1.1%	33.6%	-19.2%	-10.4%	6.8%
	2	LA	Glendora	18,873	19,780	4.8%	1.6%	0.5%	33.6%	-19.2%	-9.6%	6.8%
	2	LA	Hawaiian Gardens	3,603	6,860	90.4%	0.3%	1.9%	33.6%	-19.2%	76.0%	6.8%
	2	LA	Hermosa Beach	7,785	9,444	21.3%	0.7%	1.0%	33.6%	-19.2%	6.9%	6.8%
	2	LA	Hidden Hills	356	330	-7.3%	0.0%	0.0%	33.6%	-19.2%	-21.7%	6.8%
	2	LA	Industry	61,860	71,277	15.2%	5.2%	5.5%	33.6%	-19.2%	0.9%	6.8%
	2	LA	Irwindale	12,773	49,648	288.7%	1.1%	21.6%	33.6%	-19.2%	274.3%	6.8%
	2	LA	La Canada Flintridge	11,904	13,893	16.7%	1.0%	1.2%	33.6%	-19.2%	2.3%	6.8%
	2	LA	La Puente	10,376	7,929	-23.6%	0.9%	-1.4%	33.6%	-19.2%	-38.0%	6.8%
	2	LA	La Verne	9,260	10,633	14.8%	0.8%	0.8%	33.6%	-19.2%	0.5%	6.8%
	2	LA	Lakewood	20,214	22,403	10.8%	1.7%	1.3%	33.6%	-19.2%	-3.5%	6.8%
	2	LA	Lawndale	8,233	8,018	-2.6%	0.7%	-0.1%	33.6%	-19.2%	-17.0%	6.8%
	2	LA	Lomita	7,218	8,475	17.4%	0.6%	0.7%	33.6%	-19.2%	3.0%	6.8%
	2	LA	Long Beach	235,825	219,735	-6.8%	19.9%	-9.4%	33.6%	-19.2%	-21.2%	6.8%
	2	LA	Malibu	7,000	8,030	14.7%	0.6%	0.6%	33.6%	-19.2%	0.3%	6.8%

Appendix A: Calculation of Spatial Shiftshare Components by Job Center, Ring, and Region: 1990-2020F

Region	Ring	County	Job Center	Jobs: 1990	Jobs: 2020F	Jobs: Percent Change, 1990-2020F	Jobs: Center Share of Jobs in Ring in 1990	Jobs: Center Share of Job Growth in Ring, 1990-2020F	Spatial Shiftshare Components: Regional Growth Component	Spatial Shiftshare Components: Ring Change Component	Spatial Shiftshare Components: Local Change Component	Spatial Shiftshare Components: Average Local Change Component within Ring
Southern California	2	LA	Manhattan Beach	14,223	14,942	5.1%	1.2%	0.4%	33.6%	-19.2%	-9.3%	6.8%
	2	LA	Monrovia	22,093	25,174	13.9%	1.9%	1.8%	33.6%	-19.2%	-0.4%	6.8%
	2	LA	Palos Verdes Estates	3,450	1,380	-60.0%	0.3%	-1.2%	33.6%	-19.2%	-74.4%	6.8%
	2	LA	Paramount	22,505	20,514	-8.8%	1.9%	-1.2%	33.6%	-19.2%	-23.2%	6.8%
	2	LA	Pasadena	101,166	103,584	2.4%	8.5%	1.4%	33.6%	-19.2%	-12.0%	6.8%
	2	LA	Pomona	52,582	57,386	9.1%	4.4%	2.8%	33.6%	-19.2%	-5.2%	6.8%
	2	LA	Rancho Palos Verdes	6,027	4,626	-23.2%	0.5%	-0.8%	33.6%	-19.2%	-37.6%	6.8%
	2	LA	Redondo Beach	23,253	26,385	13.5%	2.0%	1.8%	33.6%	-19.2%	-0.9%	6.8%
	2	LA	Rolling Hills	341	296	-13.2%	0.0%	0.0%	33.6%	-19.2%	-27.6%	6.8%
	2	LA	Rolling Hills Estates	6,006	5,017	-16.5%	0.5%	-0.6%	33.6%	-19.2%	-30.8%	6.8%
	2	LA	San Fernando	15,681	13,559	-13.5%	1.3%	-1.2%	33.6%	-19.2%	-27.9%	6.8%
	2	LA	Sierra Madre	3,390	3,873	14.2%	0.3%	0.3%	33.6%	-19.2%	-0.1%	6.8%
	2	LA	Signal Hill	14,301	15,870	11.0%	1.2%	0.9%	33.6%	-19.2%	-3.4%	6.8%
	2	LA	South El Monte	25,239	22,387	-11.3%	2.1%	-1.7%	33.6%	-19.2%	-25.7%	6.8%
	2	LA	Temple	7,337	7,479	1.9%	0.6%	0.1%	33.6%	-19.2%	-12.4%	6.8%
	2	OC	Huntington Beach	79,573	96,001	20.6%	6.7%	9.6%	33.6%	-19.2%	6.3%	6.8%
	2	OC	Laguna Beach	13,439	17,320	28.9%	1.1%	2.3%	33.6%	-19.2%	14.5%	6.8%
	2	OC	Laguna Hills	20,000	27,494	37.5%	1.7%	4.4%	33.6%	-19.2%	23.1%	6.8%
	2	OC	Laguna Niguel	12,222	30,528	149.8%	1.0%	10.7%	33.6%	-19.2%	135.4%	6.8%
	2	OC	Los Alamitos	13,610	16,674	22.5%	1.1%	1.8%	33.6%	-19.2%	8.1%	6.8%
	2	OC	Mission Viejo	22,323	28,752	28.8%	1.9%	3.8%	33.6%	-19.2%	14.4%	6.8%
	2	OC	Newport Beach	61,458	77,840	26.7%	5.2%	9.6%	33.6%	-19.2%	12.3%	6.8%
	2	OC	Seal Beach	12,314	13,500	9.6%	1.0%	0.7%	33.6%	-19.2%	-4.7%	6.8%
	2	RIV	Corona	32,137	65,475	103.7%	2.7%	19.6%	33.6%	-19.2%	89.4%	6.8%
	2	RIV	Norco	7,445	11,631	56.2%	0.6%	2.5%	33.6%	-19.2%	41.9%	6.8%
	2	SBD	Montclair	18,077	25,130	39.0%	1.5%	4.1%	33.6%	-19.2%	24.6%	6.8%
	2	Ring Total		1,186,648	1,357,161	14.4%	100.0%	100.0%	33.6%	-19.2%	0.0%	6.8%
Southern California	3	LA	Agoura Hills	11,867	12,011	1.2%	3.2%	0.1%	33.6%	35.7%	-68.1%	7.8%
	3	LA	Santa Clarita	45,122	55,179	22.3%	12.0%	3.9%	33.6%	35.7%	-47.0%	7.8%
	3	LA	Santa Fe Springs	59,423	65,440	10.1%	15.8%	2.3%	33.6%	35.7%	-59.2%	7.8%
	3	OC	Dana Point	8,245	17,681	114.4%	2.2%	3.6%	33.6%	35.7%	45.1%	7.8%
	3	OC	San Clemente	14,478	35,640	146.2%	3.9%	8.1%	33.6%	35.7%	76.8%	7.8%

Appendix A: Calculation of Spatial Shiftshare Components by Job Center, Ring, and Region: 1990-2020F

Region	Ring	County	Job Center	Jobs					Spatial Shiftshare Components			
				1990	2020F	Percent Change, 1990-2020F	Center Share of Jobs in Ring in 1990	Center Share of Job Growth in Ring, 1990-2020F	Regional Growth Component	Ring Change Component	Local Change Component	Average Local Change Component within Ring
Southern California	3	OC	San Juan Capistrano	10,690	20,444	91.2%	2.8%	3.7%	33.6%	35.7%	21.9%	7.8%
	3	SBD	Colton	18,267	32,138	75.9%	4.9%	5.3%	33.6%	35.7%	6.6%	7.8%
	3	SBD	Fontana	33,964	51,109	50.5%	9.0%	6.6%	33.6%	35.7%	-18.8%	7.8%
	3	SBD	Grand Terrace	2,652	4,459	68.1%	0.7%	0.7%	33.6%	35.7%	-1.2%	7.8%
	3	SBD	Ontario	54,592	114,188	109.2%	14.5%	22.9%	33.6%	35.7%	39.8%	7.8%
	3	SBD	Rancho Cucamonga	31,490	81,203	157.9%	8.4%	19.1%	33.6%	35.7%	88.5%	7.8%
	3	VEN	Simi Valley	31,629	62,349	97.1%	8.4%	11.8%	33.6%	35.7%	27.8%	7.8%
	3	VEN	Thousand Oaks	53,298	84,354	58.3%	14.2%	11.9%	33.6%	35.7%	-11.1%	7.8%
	3	Ring Total		375,717	636,195	69.3%	100.0%	100.0%	33.6%	35.7%	0.0%	7.8%
Southern California	4	LA	Calabasas	9,000	10,648	18.3%	2.2%	0.4%	33.6%	73.0%	-88.3%	40.0%
	4	RIV	Canyon Lake	1,500	2,733	82.2%	0.4%	0.3%	33.6%	73.0%	-24.4%	40.0%
	4	RIV	La Quinta	2,961	12,400	318.8%	0.7%	2.2%	33.6%	73.0%	212.2%	40.0%
	4	RIV	Moreno Valley	15,576	65,807	322.5%	3.8%	11.6%	33.6%	73.0%	215.9%	40.0%
	4	RIV	Riverside	94,712	215,701	127.7%	23.3%	27.9%	33.6%	73.0%	21.2%	40.0%
	4	RIV	Temecula	15,184	42,290	178.5%	3.7%	6.3%	33.6%	73.0%	71.9%	40.0%
	4	SBD	Chino	33,094	69,903	111.2%	8.1%	8.5%	33.6%	73.0%	4.6%	40.0%
	4	SBD	Chino Hills	6,500	23,970	268.8%	1.6%	4.0%	33.6%	73.0%	162.2%	40.0%
	4	SBD	Highland	5,176	15,976	208.7%	1.3%	2.5%	33.6%	73.0%	102.1%	40.0%
	4	SBD	Loma Linda	9,471	36,665	287.1%	2.3%	6.3%	33.6%	73.0%	180.6%	40.0%
	4	SBD	Rialto	15,187	47,481	212.6%	3.7%	7.5%	33.6%	73.0%	106.1%	40.0%
	4	SBD	San Bernardino	80,701	141,825	75.7%	19.9%	14.1%	33.6%	73.0%	-30.8%	40.0%
	4	SBD	Upland	29,086	41,397	42.3%	7.2%	2.8%	33.6%	73.0%	-64.3%	40.0%
	4	VEN	Camarillo	28,334	34,931	23.3%	7.0%	1.5%	33.6%	73.0%	-83.3%	40.0%
	4	VEN	Moorpark	8,525	11,897	39.6%	2.1%	0.8%	33.6%	73.0%	-67.0%	40.0%
	4	VEN	Oxnard	51,348	65,819	28.2%	12.6%	3.3%	33.6%	73.0%	-78.4%	40.0%
	4	Ring Total		406,355	839,443	106.6%	100.0%	100.0%	33.6%	73.0%	0.0%	40.0%
Southern California	5	LA	Palmdale	26,486	79,411	199.8%	12.9%	25.2%	33.6%	68.9%	97.3%	60.2%
	5	RIV	Banning	7,764	14,266	83.7%	3.8%	3.1%	33.6%	68.9%	-18.8%	60.2%
	5	RIV	Beaumont	3,422	19,772	477.8%	1.7%	7.8%	33.6%	68.9%	375.3%	60.2%
	5	RIV	Calimesa	1,000	4,740	374.0%	0.5%	1.8%	33.6%	68.9%	271.5%	60.2%
	5	RIV	Hemet	18,169	27,330	50.4%	8.9%	4.4%	33.6%	68.9%	-52.1%	60.2%
	5	RIV	Murrieta	5,000	25,116	402.3%	2.4%	9.6%	33.6%	68.9%	299.8%	60.2%

Appendix A: Calculation of Spatial Shiftshare Components by Job Center, Ring, and Region: 1990-2020F

Region	Ring	County	Job Center	Jobs					Spatial Shiftshare Components			
				1990	2020F	Percent Change, 1990-2020F	Center Share of Jobs in Ring in 1990	Center Share of Job Growth in Ring, 1990-2020F	Regional Growth Component	Ring Change Component	Local Change Component	Average Local Change Component within Ring
Southern California	5	RIV	Perris	9,967	29,084	191.8%	4.9%	9.1%	33.6%	68.9%	89.3%	60.2%
	5	SBD	Hesperia	14,680	42,742	191.2%	7.2%	13.4%	33.6%	68.9%	88.7%	60.2%
	5	SBD	Redlands	23,688	48,509	104.8%	11.6%	11.8%	33.6%	68.9%	2.3%	60.2%
	5	SBD	Yucaipa	9,089	13,232	45.6%	4.4%	2.0%	33.6%	68.9%	-56.9%	60.2%
	5	VEN	Fillmore	3,355	5,737	71.0%	1.6%	1.1%	33.6%	68.9%	-31.5%	60.2%
	5	VEN	Port Hueneme	15,221	23,634	55.3%	7.4%	4.0%	33.6%	68.9%	-47.2%	60.2%
	5	VEN	San Buenaventura	57,155	70,494	23.3%	27.9%	6.4%	33.6%	68.9%	-79.2%	60.2%
	5	VEN	Santa Paula	9,579	10,189	6.4%	4.7%	0.3%	33.6%	68.9%	-96.1%	60.2%
	5	Ring Total		204,575	414,256	102.5%	100.0%	100.0%	33.6%	68.9%	0.0%	60.2%
Southern California	6	LA	Lancaster	45,758	79,549	73.8%	22.6%	17.3%	33.6%	63.2%	-22.9%	23.3%
	6	RIV	Cathedral City	7,458	21,022	181.9%	3.7%	6.9%	33.6%	63.2%	85.1%	23.3%
	6	RIV	Coachella	3,675	11,229	205.6%	1.8%	3.9%	33.6%	63.2%	108.8%	23.3%
	6	RIV	Desert Hot Springs	2,819	6,929	145.8%	1.4%	2.1%	33.6%	63.2%	49.0%	23.3%
	6	RIV	Indian Wells	1,677	3,336	98.9%	0.8%	0.8%	33.6%	63.2%	2.1%	23.3%
	6	RIV	Indio	13,979	21,385	53.0%	6.9%	3.8%	33.6%	63.2%	-43.8%	23.3%
	6	RIV	Lake Elsinore	8,468	22,862	170.0%	4.2%	7.4%	33.6%	63.2%	73.2%	23.3%
	6	RIV	Palm Desert	17,984	36,585	103.4%	8.9%	9.5%	33.6%	63.2%	6.6%	23.3%
	6	RIV	Palm Springs	24,930	38,461	54.3%	12.3%	6.9%	33.6%	63.2%	-42.5%	23.3%
	6	RIV	Rancho Mirage	5,630	10,822	92.2%	2.8%	2.7%	33.6%	63.2%	-4.6%	23.3%
	6	RIV	San Jacinto	7,340	14,027	91.1%	3.6%	3.4%	33.6%	63.2%	-5.7%	23.3%
	6	SBD	Adelanto	2,118	6,441	204.1%	1.0%	2.2%	33.6%	63.2%	107.3%	23.3%
	6	SBD	Apple Valley town	9,231	18,724	102.8%	4.6%	4.8%	33.6%	63.2%	6.1%	23.3%
	6	SBD	Barstow	15,322	24,715	61.3%	7.6%	4.8%	33.6%	63.2%	-35.5%	23.3%
	6	SBD	Big Bear Lake	2,907	7,473	157.1%	1.4%	2.3%	33.6%	63.2%	60.3%	23.3%
	6	SBD	Twentynine Palms	4,366	7,038	61.2%	2.2%	1.4%	33.6%	63.2%	-35.6%	23.3%
	6	SBD	Victorville	21,674	56,903	162.5%	10.7%	18.0%	33.6%	63.2%	65.8%	23.3%
	6	SBD	Yucca Valley	1,900	6,316	232.4%	0.9%	2.3%	33.6%	63.2%	135.6%	23.3%
	6	VEN	Ojai	5,038	4,223	-16.2%	2.5%	-0.4%	33.6%	63.2%	-113.0%	23.3%
	6	Ring Total		202,274	398,040	96.8%	100.0%	100.0%	33.6%	63.2%	0.0%	23.3%
Regional Total				7,100,477	9,483,505	33.6%						

Appendix A: Calculation of Spatial Shiftshare Components by Job Center, Ring, and Region: 1990-2020F

Region	Ring	County	Job Center	Jobs: 1990	Jobs: 2020F	Jobs: Percent Change, 1990-2020F	Jobs: Center Share of Jobs in Ring in 1990	Jobs: Center Share of Job Growth in Ring, 1990-2020F	Spatial Shiftshare Components: Regional Growth Component	Spatial Shiftshare Components: Ring Change Component	Spatial Shiftshare Components: Local Change Component	Spatial Shiftshare Components: Average Local Change Component within Ring
Nine-County San Francisco Bay Area	1	ALA	Alameda	38,730	49,220	27.1%	1.9%	1.9%	40.6%	-12.3%	-1.2%	-5.4%
	1	ALA	Albany	4,680	7,620	62.8%	0.2%	0.5%	40.6%	-12.3%	34.6%	-5.4%
	1	ALA	Berkeley	73,580	78,520	6.7%	3.7%	0.9%	40.6%	-12.3%	-21.5%	-5.4%
	1	ALA	Castro Valley	8,800	10,010	13.8%	0.4%	0.2%	40.6%	-12.3%	-14.5%	-5.4%
	1	ALA	Emeryville	14,390	24,180	68.0%	0.7%	1.7%	40.6%	-12.3%	39.8%	-5.4%
	1	ALA	Fremont	75,100	118,120	57.3%	3.8%	7.6%	40.6%	-12.3%	29.0%	-5.4%
	1	ALA	Hayward	77,440	102,590	32.5%	3.9%	4.5%	40.6%	-12.3%	4.2%	-5.4%
	1	ALA	Oakland	178,340	196,120	10.0%	9.0%	3.2%	40.6%	-12.3%	-18.3%	-5.4%
	1	ALA	Piedmont	1,660	1,790	7.8%	0.1%	0.0%	40.6%	-12.3%	-20.4%	-5.4%
	1	ALA	San Leandro	47,330	52,270	10.4%	2.4%	0.9%	40.6%	-12.3%	-17.8%	-5.4%
	1	COCO	El Cerrito	7,400	8,250	11.5%	0.4%	0.2%	40.6%	-12.3%	-16.8%	-5.4%
	1	COCO	Richmond	39,660	61,110	54.1%	2.0%	3.8%	40.6%	-12.3%	25.8%	-5.4%
	1	COCO	San Pablo	7,350	7,770	5.7%	0.4%	0.1%	40.6%	-12.3%	-22.5%	-5.4%
	1	SCL	Campbell	25,670	28,660	11.6%	1.3%	0.5%	40.6%	-12.3%	-16.6%	-5.4%
	1	SCL	Cupertino	39,260	54,080	37.7%	2.0%	2.6%	40.6%	-12.3%	9.5%	-5.4%
	1	SCL	Los Altos	10,800	10,930	1.2%	0.5%	0.0%	40.6%	-12.3%	-27.0%	-5.4%
	1	SCL	Los Altos Hills	2,450	2,980	21.6%	0.1%	0.1%	40.6%	-12.3%	-6.6%	-5.4%
	1	SCL	Los Gatos	17,650	22,870	29.6%	0.9%	0.9%	40.6%	-12.3%	1.3%	-5.4%
	1	SCL	Milpitas	36,630	65,160	77.9%	1.8%	5.1%	40.6%	-12.3%	49.6%	-5.4%
	1	SCL	Monte Sereno	770	690	-10.4%	0.0%	0.0%	40.6%	-12.3%	-38.6%	-5.4%
	1	SCL	Mountain View	63,490	84,000	32.3%	3.2%	3.6%	40.6%	-12.3%	4.1%	-5.4%
	1	SCL	Palo Alto	98,370	98,110	-0.3%	4.9%	0.0%	40.6%	-12.3%	-28.5%	-5.4%
	1	SCL	San Jose	329,090	486,230	47.7%	16.5%	27.9%	40.6%	-12.3%	19.5%	-5.4%
	1	SCL	Santa Clara	108,020	153,520	42.1%	5.4%	8.1%	40.6%	-12.3%	13.9%	-5.4%
	1	SCL	Saratoga	7,050	730	-89.6%	0.4%	-1.1%	40.6%	-12.3%	-117.9%	-5.4%
	1	SCL	Sunnyvale	119,690	150,260	25.5%	6.0%	5.4%	40.6%	-12.3%	-2.7%	-5.4%
	1	SF	San Francisco	559,200	679,650	21.5%	28.1%	21.4%	40.6%	-12.3%	-6.7%	-5.4%
	1	Ring Total		1,992,600	2,555,440	28.2%	100.0%	100.0%	40.6%	-12.3%	0.0%	-5.4%
Nine-County SF Bay Area	2	ALA	Dublin	12,870	45,670	254.9%	2.6%	15.8%	40.6%	1.8%	212.5%	3.2%
	2	ALA	Newark	14,900	24,060	61.5%	3.0%	4.4%	40.6%	1.8%	19.1%	3.2%
	2	ALA	Pleasanton	33,710	63,130	87.3%	6.9%	14.1%	40.6%	1.8%	44.9%	3.2%
	2	ALA	Union City	14,380	18,430	28.2%	2.9%	1.9%	40.6%	1.8%	-14.2%	3.2%

Appendix A: Calculation of Spatial Shiftshare Components by Job Center, Ring, and Region: 1990-2020F

Region	Ring	County	Job Center	Jobs: 1990	Jobs: 2020F	Jobs: Percent Change, 1990-2020F	Jobs: Center Share of Jobs in Ring in 1990	Jobs: Center Share of Job Growth in Ring, 1990-2020F	Spatial Shiftshare Components: Regional Growth Component	Spatial Shiftshare Components: Ring Change Component	Spatial Shiftshare Components: Local Change Component	Spatial Shiftshare Components: Average Local Change Component within Ring
Nine-County San Francisco Bay Area	2	COCO	Hercules	2,410	7,130	195.9%	0.5%	2.3%	40.6%	1.8%	153.5%	3.2%
	2	COCO	Lafayette	9,340	9,720	4.1%	1.9%	0.2%	40.6%	1.8%	-38.3%	3.2%
	2	COCO	Moraga Town	3,810	4,410	15.7%	0.8%	0.3%	40.6%	1.8%	-26.6%	3.2%
	2	COCO	Orinda	4,640	5,400	16.4%	0.9%	0.4%	40.6%	1.8%	-26.0%	3.2%
	2	COCO	Pinole	5,080	7,190	41.5%	1.0%	1.0%	40.6%	1.8%	-0.8%	3.2%
	2	COCO	Walnut Creek	55,480	67,810	22.2%	11.3%	5.9%	40.6%	1.8%	-20.1%	3.2%
	2	MAR	Belvedere	330		-100.0%	0.1%	-0.2%	40.6%	1.8%	-142.4%	3.2%
	2	MAR	Belvedere-Tib	3,990	4,450	11.5%	0.8%	0.2%	40.6%	1.8%	-30.8%	3.2%
	2	MAR	Corte Madera	8,070	7,100	-12.0%	1.6%	-0.5%	40.6%	1.8%	-54.4%	3.2%
	2	MAR	Fairfax	1,790	2,010	12.3%	0.4%	0.1%	40.6%	1.8%	-30.1%	3.2%
	2	MAR	Larkspur	12,950	16,350	26.3%	2.6%	1.6%	40.6%	1.8%	-16.1%	3.2%
	2	MAR	Mill Valley	7,990	8,180	2.4%	1.6%	0.1%	40.6%	1.8%	-40.0%	3.2%
	2	MAR	Ross	1,150	1,280	11.3%	0.2%	0.1%	40.6%	1.8%	-31.1%	3.2%
	2	MAR	San Anselmo	3,870	3,970	2.6%	0.8%	0.0%	40.6%	1.8%	-39.8%	3.2%
	2	MAR	San Rafael	39,920	51,920	30.1%	8.1%	5.8%	40.6%	1.8%	-12.3%	3.2%
	2	MAR	Sausalito	5,730	6,610	15.4%	1.2%	0.4%	40.6%	1.8%	-27.0%	3.2%
	2	SCL	Morgan Hill	9,890	26,040	163.3%	2.0%	7.8%	40.6%	1.8%	120.9%	3.2%
	2	SMT	Atherton	2,830	3,050	7.8%	0.6%	0.1%	40.6%	1.8%	-34.6%	3.2%
	2	SMT	Belmont	12,160	14,340	17.9%	2.5%	1.0%	40.6%	1.8%	-24.4%	3.2%
	2	SMT	Brisbane	6,700	9,540	42.4%	1.4%	1.4%	40.6%	1.8%	0.0%	3.2%
	2	SMT	Burlingame	27,320	31,430	15.0%	5.6%	2.0%	40.6%	1.8%	-27.3%	3.2%
	2	SMT	Colma	1,140	2,230	95.6%	0.2%	0.5%	40.6%	1.8%	53.2%	3.2%
	2	SMT	Daly City	20,530	33,900	65.1%	4.2%	6.4%	40.6%	1.8%	22.8%	3.2%
	2	SMT	East Palo Alto	1,970	8,600	336.5%	0.4%	3.2%	40.6%	1.8%	294.2%	3.2%
	2	SMT	Foster City	12,740	20,800	63.3%	2.6%	3.9%	40.6%	1.8%	20.9%	3.2%
	2	SMT	Menlo Park	27,100	29,220	7.8%	5.5%	1.0%	40.6%	1.8%	-34.5%	3.2%
	2	SMT	Millbrae	5,960	6,920	16.1%	1.2%	0.5%	40.6%	1.8%	-26.3%	3.2%
	2	SMT	Portola Valley	1,140	1,140	0.0%	0.2%	0.0%	40.6%	1.8%	-42.4%	3.2%
	2	SMT	Redwood City	42,020	59,220	40.9%	8.6%	8.3%	40.6%	1.8%	-1.4%	3.2%
	2	SMT	San Bruno	15,330	18,030	17.6%	3.1%	1.3%	40.6%	1.8%	-24.8%	3.2%
	2	SMT	San Carlos	16,130	22,180	37.5%	3.3%	2.9%	40.6%	1.8%	-4.9%	3.2%
	2	SMT	South San Francisco	44,140	55,980	26.8%	9.0%	5.7%	40.6%	1.8%	-15.5%	3.2%

Appendix A: Calculation of Spatial Shiftshare Components by Job Center, Ring, and Region: 1990-2020F

Region	Ring	County	Job Center	Jobs					Spatial Shiftshare Components			
				1990	2020F	Percent Change, 1990-2020F	Center Share of Jobs in Ring in 1990	Center Share of Job Growth in Ring, 1990-2020F	Regional Growth Component	Ring Change Component	Local Change Component	Average Local Change Component within Ring
Nine-Cty SFBA	2	SMT	Woodside	1,420	1,480	4.2%	0.3%	0.0%	40.6%	1.8%	-38.1%	3.2%
	2	Ring Total		490,930	698,920	42.4%	100.0%	100.0%	40.6%	1.8%	0.0%	3.2%
Nine-County San Francisco Bay Area	3	ALA	Livermore	33,630	58,870	75.1%	8.9%	13.0%	40.6%	11.1%	23.4%	-1.9%
	3	COCO	Concord	58,110	76,800	32.2%	15.4%	9.6%	40.6%	11.1%	-19.5%	-1.9%
	3	COCO	Danville	8,800	9,900	12.5%	2.3%	0.6%	40.6%	11.1%	-39.2%	-1.9%
	3	COCO	Martinez	18,290	21,900	19.7%	4.9%	1.9%	40.6%	11.1%	-31.9%	-1.9%
	3	COCO	Pittsburg	16,420	30,050	83.0%	4.4%	7.0%	40.6%	11.1%	31.3%	-1.9%
	3	COCO	Pleasant Hill	16,900	24,670	46.0%	4.5%	4.0%	40.6%	11.1%	-5.7%	-1.9%
	3	COCO	San Ramon	32,490	56,320	73.3%	8.6%	12.2%	40.6%	11.1%	21.7%	-1.9%
	3	MAR	Novato	19,150	37,390	95.2%	5.1%	9.4%	40.6%	11.1%	43.6%	-1.9%
	3	NAP	Napa	27,220	40,480	48.7%	7.2%	6.8%	40.6%	11.1%	-3.0%	-1.9%
	3	SCL	Gilroy	18,010	36,610	103.3%	4.8%	9.6%	40.6%	11.1%	51.6%	-1.9%
	3	SMT	Half Moon Bay	2,860	3,610	26.2%	0.8%	0.4%	40.6%	11.1%	-25.5%	-1.9%
	3	SMT	Hillsborough	1,130	1,400	23.9%	0.3%	0.1%	40.6%	11.1%	-27.8%	-1.9%
	3	SMT	Pacifica	4,350	5,440	25.1%	1.2%	0.6%	40.6%	11.1%	-26.6%	-1.9%
	3	SMT	San Mateo	52,160	65,090	24.8%	13.8%	6.6%	40.6%	11.1%	-26.9%	-1.9%
	3	SOL	Benica	11,330	15,230	34.4%	3.0%	2.0%	40.6%	11.1%	-17.3%	-1.9%
	3	SOL	Vallejo	38,550	57,600	49.4%	10.2%	9.8%	40.6%	11.1%	-2.3%	-1.9%
	3	SON	Petaluma	17,380	30,140	73.4%	4.6%	6.6%	40.6%	11.1%	21.7%	-1.9%
	3	Ring Total		376,780	571,500	51.7%	100.0%	100.0%	40.6%	11.1%	0.0%	-1.9%
Nine-County San Francisco Bay Area	4	COCO	Antioch	13,980	29,650	112.1%	6.5%	9.5%	40.6%	35.9%	35.6%	32.0%
	4	COCO	Brentwood	2,970	19,970	572.4%	1.4%	10.3%	40.6%	35.9%	495.9%	32.0%
	4	COCO	Clayton	1,030	1,850	79.6%	0.5%	0.5%	40.6%	35.9%	3.1%	32.0%
	4	NAP	American Canyon	1,400		-100.0%	0.6%	-0.8%	40.6%	35.9%	-176.5%	32.0%
	4	NAP	Yountville	2,020	3,070	52.0%	0.9%	0.6%	40.6%	35.9%	-24.5%	32.0%
	4	SOL	Dixon	4,040	7,300	80.7%	1.9%	2.0%	40.6%	35.9%	4.2%	32.0%
	4	SOL	Fairfield	40,700	73,170	79.8%	18.8%	19.6%	40.6%	35.9%	3.3%	32.0%
	4	SOL	Suisun City	3,900	11,100	184.6%	1.8%	4.4%	40.6%	35.9%	108.1%	32.0%
	4	SOL	Vacaville	22,220	40,740	83.3%	10.3%	11.2%	40.6%	35.9%	6.8%	32.0%
	4	SON	Cotati	1,180	3,070	160.2%	0.5%	1.1%	40.6%	35.9%	83.6%	32.0%
	4	SON	Rohnert Park	17,920	39,140	118.4%	8.3%	12.8%	40.6%	35.9%	41.9%	32.0%
	4	SON	Santa Rosa	94,600	139,770	47.7%	43.8%	27.3%	40.6%	35.9%	-28.8%	32.0%

Appendix A: Calculation of Spatial Shiftshare Components by Job Center, Ring, and Region: 1990-2020F

Region	Ring	County	Job Center	Jobs: 1990	Jobs: 2020F	Jobs: Percent Change, 1990-2020F	Jobs: Center Share of Jobs in Ring in 1990	Jobs: Center Share of Job Growth in Ring, 1990-2020F	Spatial Shiftshare Components: Regional Growth Component	Spatial Shiftshare Components: Ring Change Component	Spatial Shiftshare Components: Local Change Component	Spatial Shiftshare Components: Average Local Change Component within Ring
Nine-Cty SFBA	4	SON	Sebastopol	5,500	7,190	30.7%	2.5%	1.0%	40.6%	35.9%	-45.8%	32.0%
	4	SON	Sonoma	4,650	5,460	17.4%	2.2%	0.5%	40.6%	35.9%	-59.1%	32.0%
	4	Ring Total		216,110	381,480	76.5%	100.0%	100.0%	40.6%	35.9%	0.0%	32.0%
Nine-County San Francisco Bay Area	5	COCO	Oakley	1,630	2,000	22.7%	9.2%	2.6%	40.6%	39.9%	-57.8%	36.5%
	5	NAP	Calistoga	2,600	3,530	35.8%	14.6%	6.5%	40.6%	39.9%	-44.7%	36.5%
	5	NAP	St. Helena	4,860	5,180	6.6%	27.3%	2.2%	40.6%	39.9%	-73.9%	36.5%
	5	SOL	Rio Vista	1,850	3,600	94.6%	10.4%	12.2%	40.6%	39.9%	14.1%	36.5%
	5	SON	Cloverdale	2,150	4,310	100.5%	12.1%	15.1%	40.6%	39.9%	20.0%	36.5%
	5	SON	Healdsburg	3,350	5,570	66.3%	18.9%	15.5%	40.6%	39.9%	-14.2%	36.5%
	5	SON	Windsor	1,330	7,880	492.5%	7.5%	45.8%	40.6%	39.9%	412.0%	36.5%
	5	Ring Total		17,770	32,070	80.5%	100.0%	100.0%	40.6%	39.9%	0.0%	36.5%
Regional Total				3,094,190	4,349,770	40.6%						
San Diego County	0	SDG	(Raw Uninc)	117,003	159,429	36.3%	70.1%	58.3%	32.6%	11.0%	-7.4%	8.7%
	0	SDG	Unincorporated	49,811	80,197	61.0%	29.9%	41.7%	32.6%	11.0%	17.4%	8.7%
	0	Ring Total		166,814	239,626	43.6%	100.0%	100.0%	32.6%	11.0%	0.0%	8.7%
	1	SDG	Chula Vista	49,811	80,197	61.0%	6.0%	17.9%	32.6%	-12.3%	40.6%	-13.4%
	1	SDG	Coronado	33,209	32,316	-2.7%	4.0%	-0.5%	32.6%	-12.3%	-23.0%	-13.4%
	1	SDG	Imperial Beach	3,751	4,232	12.8%	0.4%	0.3%	32.6%	-12.3%	-7.5%	-13.4%
	1	SDG	La Mesa	26,142	24,346	-6.9%	3.1%	-1.1%	32.6%	-12.3%	-27.2%	-13.4%
	1	SDG	Lemon Grove	7,731	7,534	-2.5%	0.9%	-0.1%	32.6%	-12.3%	-22.9%	-13.4%
	1	SDG	National City	31,395	30,155	-3.9%	3.8%	-0.7%	32.6%	-12.3%	-24.3%	-13.4%
	1	SDG	San Diego	668,512	807,161	20.7%	80.0%	81.5%	32.6%	-12.3%	0.4%	-13.4%
	1	SDG	Santee	15,474	20,268	31.0%	1.9%	2.8%	32.6%	-12.3%	10.6%	-13.4%
	1	Ring Total		836,025	1,006,209	20.4%	100.0%	100.0%	32.6%	-12.3%	0.0%	-13.4%
	2	SDG	Del Mar	2,909	3,176	9.2%	2.2%	0.7%	32.6%	-2.7%	-20.7%	11.8%
	2	SDG	El Cajon	41,931	46,016	9.7%	31.4%	10.2%	32.6%	-2.7%	-20.1%	11.8%
	2	SDG	Encinitas	23,123	24,243	4.8%	17.3%	2.8%	32.6%	-2.7%	-25.0%	11.8%
	2	SDG	Escondido	45,932	56,892	23.9%	34.4%	27.4%	32.6%	-2.7%	-6.0%	11.8%
	2	SDG	Poway	11,704	34,881	198.0%	8.8%	58.0%	32.6%	-2.7%	168.1%	11.8%
	2	SDG	Solana Beach	8,074	8,408	4.1%	6.0%	0.8%	32.6%	-2.7%	-25.7%	11.8%
	2	Ring Total		133,673	173,616	29.9%	100.0%	100.0%	32.6%	-2.7%	0.0%	11.8%

Appendix A: Calculation of Spatial Shiftshare Components by Job Center, Ring, and Region: 1990-2020F

Region	Ring	County	Job Center	Jobs					Spatial Shiftshare Components			
				1990	2020F	Percent Change, 1990-2020F	Center Share of Jobs in Ring in 1990	Center Share of Job Growth in Ring, 1990-2020F	Regional Growth Component	Ring Change Component	Local Change Component	Average Local Change Component within Ring
San Diego County	3	SDG	Carlsbad	34,220	77,095	125.3%	30.7%	33.4%	32.6%	82.5%	10.2%	3.4%
	3	SDG	Oceanside	32,333	61,229	89.4%	29.0%	22.5%	32.6%	82.5%	-25.7%	3.4%
	3	SDG	San Marcos	24,413	44,983	84.3%	21.9%	16.0%	32.6%	82.5%	-30.9%	3.4%
	3	SDG	Vista	20,598	56,682	175.2%	18.5%	28.1%	32.6%	82.5%	60.1%	3.4%
	3	Ring Total		111,564	239,989	115.1%	100.0%	100.0%	32.6%	82.5%	0.0%	3.4%
Regional Total				1,248,076	1,659,440	33.0%						

Appendix B-1: Projected Population Growth and Growth Rates, by County, 2000-2040

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
County	2000 Population (source: DOF)	2020F Population (source: DOF)	2040F Population (source: DOF)	Annual Population Growth Rate, 2000-2040	Annual Population Growth Rate, 2020-2040	Average of State and County Growth Rates, 2000-2040	Average of State and County Growth Rates, 2020-2040
Alameda	1,470,155	1,793,139	2,069,530	0.86%	0.72%	1.09%	1.00%
Alpine	1,239	1,701	2,029	1.24%	0.89%	1.28%	1.09%
Amador	34,853	40,129	43,210	0.54%	0.37%	0.93%	0.83%
Butte	207,158	307,296	419,856	1.78%	1.57%	1.55%	1.43%
Calaveras	42,041	62,688	80,329	1.63%	1.25%	1.48%	1.27%
Colusa	20,973	41,398	67,975	2.98%	2.51%	2.16%	1.90%
Contra Costa	931,946	1,104,725	1,264,400	0.77%	0.68%	1.05%	0.98%
Del Norte	31,155	41,898	50,885	1.23%	0.98%	1.28%	1.13%
El Dorado	163,197	256,119	334,786	1.81%	1.35%	1.57%	1.32%
Fresno	811,179	1,114,403	1,521,360	1.58%	1.57%	1.46%	1.43%
Glenn	29,298	49,113	74,926	2.38%	2.13%	1.85%	1.71%
Humboldt	128,419	141,092	146,933	0.34%	0.20%	0.83%	0.75%
Imperial	154,549	298,700	504,220	3.00%	2.65%	2.16%	1.97%
Inyo	18,437	20,694	24,708	0.73%	0.89%	1.03%	1.09%
Kern	677,372	1,073,748	1,623,671	2.21%	2.09%	1.77%	1.69%
Kings	126,672	186,611	265,944	1.87%	1.79%	1.60%	1.54%
Lake	60,072	93,058	128,225	1.91%	1.62%	1.62%	1.45%
Lassen	35,959	49,322	61,725	1.36%	1.13%	1.34%	1.21%
Los Angeles	9,838,861	11,575,693	13,888,161	0.87%	0.91%	1.10%	1.10%
Madera	126,394	224,567	346,451	2.55%	2.19%	1.94%	1.74%
Marin	248,397	268,630	297,307	0.45%	0.51%	0.89%	0.90%
Mariposa	16,762	23,390	28,625	1.35%	1.01%	1.34%	1.15%
Mendocino	90,442	118,804	149,731	1.27%	1.16%	1.30%	1.23%
Merced	215,256	319,785	460,020	1.92%	1.83%	1.62%	1.56%
Modoc	10,481	12,396	14,896	0.88%	0.92%	1.11%	1.11%
Mono	10,891	14,166	17,331	1.17%	1.01%	1.25%	1.15%
Monterey	401,886	575,102	855,213	1.91%	2.00%	1.62%	1.65%
Napa	127,084	157,878	191,971	1.04%	0.98%	1.18%	1.14%
Nevada	97,020	136,405	166,073	1.35%	0.99%	1.34%	1.14%
Orange	2,833,190	3,431,869	4,075,328	0.91%	0.86%	1.12%	1.08%
Placer	243,646	391,245	522,214	1.92%	1.45%	1.63%	1.37%
Plumas	20,852	23,077	24,569	0.41%	0.31%	0.87%	0.80%
Riverside	1,570,885	2,773,431	4,446,277	2.64%	2.39%	1.98%	1.84%
Sacramento	1,212,527	1,651,765	2,122,769	1.41%	1.26%	1.37%	1.28%
San Benito	51,853	82,276	114,922	2.01%	1.68%	1.67%	1.49%
San Bernardino	1,727,452	2,747,213	4,202,152	2.25%	2.15%	1.79%	1.72%
San Diego	2,943,001	3,917,001	5,116,228	1.39%	1.34%	1.36%	1.32%
San Francisco	792,049	750,904	681,924	-0.37%	-0.48%	0.48%	0.40%
San Joaquin	579,172	884,375	1,250,610	1.94%	1.75%	1.64%	1.52%
San Luis Obispo	254,818	392,329	535,901	1.88%	1.57%	1.60%	1.43%
San Mateo	747,061	855,506	953,089	0.61%	0.54%	0.97%	0.92%
Sanat Barbara	412,071	552,846	779,247	1.61%	1.73%	1.47%	1.51%
Santa Clara	1,763,252	2,196,750	2,595,253	0.97%	0.84%	1.15%	1.06%
Santa Cruz	260,248	367,196	497,319	1.63%	1.53%	1.48%	1.41%
Shasta	175,777	240,975	294,289	1.30%	1.00%	1.31%	1.15%
Sierra	3,457	3,575	3,474	0.01%	-0.14%	0.67%	0.57%
Siskiyou	45,194	53,676	62,040	0.80%	0.73%	1.06%	1.01%
Solano	399,841	552,105	698,430	1.40%	1.18%	1.37%	1.24%
Sonoma	459,258	614,173	753,729	1.25%	1.03%	1.29%	1.16%
Stanislaus	459,025	708,950	998,906	1.96%	1.73%	1.65%	1.51%
Sutter	82,040	116,408	152,304	1.56%	1.35%	1.44%	1.32%
Tehama	56,666	83,996	114,090	1.76%	1.54%	1.55%	1.42%
Trinity	13,490	15,594	16,836	0.56%	0.38%	0.94%	0.84%
Tulare	379,944	569,896	836,973	1.99%	1.94%	1.66%	1.62%
Tuolumne	56,125	77,350	95,023	1.33%	1.03%	1.33%	1.16%
Ventura	753,820	981,565	1,278,426	1.33%	1.33%	1.33%	1.31%
Yolo	164,010	225,321	298,350	1.51%	1.41%	1.42%	1.35%
Yuba	63,983	84,610	109,834	1.36%	1.31%	1.34%	1.30%
CALIFORNIA	**34,653,395**	**45,448,627**	**58,731,006**	**1.33%**	**1.29%**	**1.33%**	**1.29%**

Appendix B-2: Projected Population Growth by County, 2000-2100

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
County	2000 Population (source: DOF)	2020F Population (source: DOF)	2040F Population (source: DOF)	2050F Population based on 2000-2040 State and County Avg. Growth Rate	2050F Population based on 2020-2040 State and County Avg. Growth Rate	2100F Population based on 2000-2040 State and County Avg. Growth Rate/2	2100F Population based on 2020-2040 State and County Avg. Growth Rate/2
Alameda	1,470,155	1,793,139	2,069,530	2,307,210	2,287,126	3,030,028	2,938,378
Alpine	1,239	1,701	2,029	2,305	2,261	3,175	2,965
Amador	34,853	40,129	43,210	47,416	46,935	59,843	57,739
Butte	207,158	307,296	419,856	489,893	483,980	721,522	691,341
Calaveras	42,041	62,688	80,329	93,039	91,124	134,506	125,014
Colusa	20,973	41,398	67,975	84,133	82,055	143,797	131,662
Contra Costa	931,946	1,104,725	1,264,400	1,403,147	1,394,436	1,821,563	1,782,151
Del Norte	31,155	41,898	50,885	57,791	56,955	79,522	75,549
El Dorado	163,197	256,119	334,786	391,225	381,668	578,408	530,209
Fresno	811,179	1,114,403	1,521,360	1,757,985	1,753,356	2,526,621	2,503,297
Glenn	29,298	49,113	74,926	90,013	88,790	142,691	135,982
Humboldt	128,419	141,092	146,933	159,633	158,279	196,480	190,693
Imperial	154,549	298,700	504,220	624,597	612,914	1,069,779	1,000,884
Inyo	18,437	20,694	24,708	27,377	27,538	35,404	36,140
Kern	677,372	1,073,748	1,623,671	1,934,808	1,919,849	3,004,843	2,923,829
Kings	126,672	186,611	265,944	311,681	309,815	464,186	454,484
Lake	60,072	93,058	128,225	150,589	148,122	225,448	212,717
Lassen	35,959	49,322	61,725	70,540	69,607	98,593	94,087
Los Angeles	9,838,861	11,575,693	13,888,161	15,488,480	15,497,560	20,358,311	20,400,280
Madera	126,394	224,567	346,451	419,856	411,713	680,373	635,019
Marin	248,397	268,630	297,307	324,821	325,152	405,465	406,920
Mariposa	16,762	23,390	28,625	32,692	32,101	45,619	42,785
Mendocino	90,442	118,804	149,731	170,341	169,149	235,392	229,650
Merced	215,256	319,785	460,020	540,335	537,166	809,247	792,667
Modoc	10,481	12,396	14,896	16,627	16,629	21,901	21,911
Mono	10,891	14,166	17,331	19,619	19,434	26,777	25,897
Monterey	401,886	575,102	855,213	1,003,988	1,006,978	1,501,628	1,517,431
Napa	127,084	157,878	191,971	215,910	214,934	289,896	285,317
Nevada	97,020	136,405	166,073	189,723	185,998	264,942	247,103
Orange	2,833,190	3,431,869	4,075,328	4,555,623	4,535,936	6,023,483	5,932,517
Placer	243,646	391,245	522,214	613,612	598,462	919,840	842,385
Plumas	20,852	23,077	24,569	26,790	26,612	33,278	32,507
Riverside	1,570,885	2,773,431	4,446,277	5,410,127	5,335,081	8,856,860	8,431,480
Sacramento	1,212,527	1,651,765	2,122,769	2,431,894	2,409,784	3,420,199	3,312,096
San Benito	51,853	82,276	114,922	135,604	133,208	205,440	192,948
San Bernardino	1,727,452	2,747,213	4,202,152	5,016,658	4,983,011	7,827,504	7,644,175
San Diego	2,943,001	3,917,001	5,116,228	5,856,124	5,831,574	8,217,815	8,097,302
San Francisco	792,049	750,904	681,924	715,163	710,034	805,635	785,565
San Joaquin	579,172	884,375	1,250,610	1,470,860	1,454,089	2,210,085	2,122,660
San Luis Obispo	254,818	392,329	535,901	628,199	617,709	936,084	882,227
San Mateo	747,061	855,506	953,089	1,049,599	1,044,065	1,336,596	1,312,014
Santa Barbara	412,071	552,846	779,247	901,379	905,294	1,298,862	1,318,823
Santa Clara	1,763,252	2,196,750	2,595,253	2,909,443	2,884,875	3,874,714	3,760,965
Santa Cruz	260,248	367,196	497,319	576,018	572,017	832,769	812,597
Shasta	175,777	240,975	294,289	335,267	329,849	464,937	439,059
Sierra	3,457	3,575	3,474	3,714	3,678	4,390	4,245
Siskiyou	45,194	53,676	62,040	68,949	68,588	89,839	88,199
Solano	399,841	552,105	698,430	799,913	789,742	1,124,197	1,074,736
Sonoma	459,258	614,173	753,729	856,546	845,837	1,180,410	1,129,343
Stanislaus	459,025	708,950	998,906	1,175,972	1,160,376	1,771,336	1,690,026
Sutter	82,040	116,408	152,304	175,768	173,672	251,808	241,405
Tehama	56,666	83,996	114,090	133,011	131,321	195,492	186,892
Trinity	13,490	15,594	16,836	18,490	18,300	23,385	22,549
Tulare	379,944	569,896	836,973	986,845	982,425	1,492,208	1,468,811
Tuolumne	56,125	77,350	95,023	108,406	106,662	150,864	142,505
Ventura	753,820	981,565	1,278,426	1,458,787	1,456,134	2,031,211	2,018,255
Yolo	164,010	225,321	298,350	343,439	341,228	488,874	477,893
Yuba	63,983	84,610	109,834	125,519	124,998	175,441	172,890
CALIFORNIA	**34,653,395**	**45,448,627**	**58,731,006**	**67,011,271**	**66,763,758**	**93,286,986**	**92,081,030**

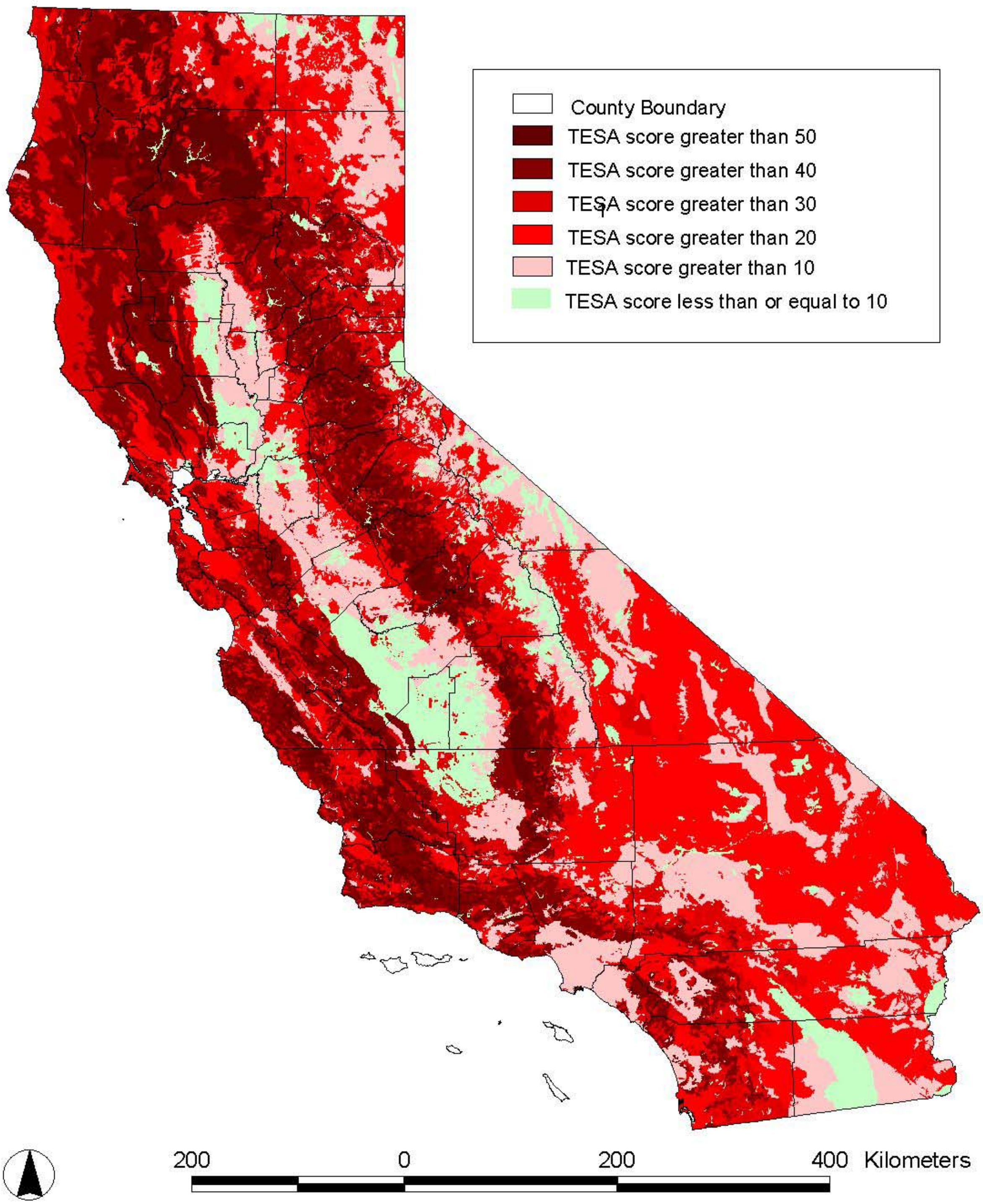
Appendix C-1: Baseline and Projected Urban Land Shares, Incremental Densities, and Infill Shares, by County, 1972-2100

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10	Column 11	Column 12	Column 13	Column 14
County	Urban Share of County Land Area					Incremental Density (persons/acre)				Infill Share 1980-1998			
	1972	1996	2020F	2050F	2100F	1972-1996	1997-2020F	2020-2050F	2050-2100F	1980-1998	1997-2020	2020-2050	2050-2100
Alameda	17.2%	22.5%	23.6%	24.8%	26.2%	8.5	12.1	12.9	12.9	40.0%	48.2%	55.1%	58.0%
Alpine	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Amador	0.5%	1.8%	1.9%	2.0%	2.1%	3.7	6.7	6.7	6.7	10.0%	13.2%	14.9%	15.8%
Butte	na	na	1.0%	2.0%	2.0%	na	6.2	6.5	6.6	na	6.4%	10.6%	13.7%
Calaveras	na	na	1.0%	2.0%	2.0%	na	6.2	6.5	6.6	na	6.4%	10.6%	13.7%
Colusa	na	na	1.0%	2.0%	2.0%	na	6.2	6.5	6.6	na	6.4%	10.6%	13.7%
Contra Costa	15.0%	22.3%	23.1%	23.9%	24.8%	6.7	12.1	12.8	12.8	10.0%	33.1%	47.4%	53.3%
Del Norte	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
El Dorado	0.6%	2.2%	2.6%	3.1%	3.7%	4.8	6.8	6.9	7.0	20.0%	20.0%	20.0%	20.0%
Fresno	1.5%	2.3%	2.5%	3.0%	3.6%	11.1	11.1	11.1	11.1	5.0%	11.1%	14.5%	16.6%
Glenn	na	na	1.0%	2.0%	2.0%	na	6.2	6.5	6.6	na	6.4%	10.6%	13.7%
Humboldt	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Imperial	na	na	1.0%	2.0%	2.0%	na	6.2	6.5	6.6	na	6.4%	10.6%	13.7%
Inyo	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Kern	0.8%	1.8%	2.3%	3.1%	4.0%	5.3	6.7	6.8	6.9	5.0%	10.7%	14.0%	16.4%
Kings	1.0%	3.0%	3.3%	4.0%	4.7%	2.6	7.0	7.1	7.2	10.0%	14.3%	17.0%	18.8%
Lake	na	na	1.0%	2.0%	2.0%	na	6.2	6.5	6.6	na	6.4%	10.6%	13.7%
Lassen	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Los Angeles	32.2%	39.1%	39.7%	40.8%	41.7%	16.3	16.5	16.5	16.7	67.0%	77.8%	77.8%	84.8%
Madera	0.5%	1.6%	2.0%	2.7%	3.5%	4.1	6.6	6.8	6.8	5.0%	10.5%	13.8%	16.0%
Marin	8.4%	10.6%	10.7%	11.0%	11.5%	3.6	9.0	9.1	9.1	55.0%	55.0%	55.0%	55.0%
Mariposa	0.1%	0.2%	0.3%	0.3%	0.4%	7.4	7.4	7.4	7.4	10.0%	11.7%	12.5%	13.0%
Mendocino	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Merced	1.2%	2.3%	2.8%	3.6%	4.6%	6.0	6.8	7.0	7.1	10.0%	13.7%	16.1%	18.0%
Modoc	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Mono	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Monterey	1.7%	2.3%	2.7%	3.5%	4.5%	7.9	7.9	7.9	7.9	10.0%	13.6%	15.9%	17.8%
Napa	4.1%	7.1%	7.7%	8.4%	9.3%	4.1	8.1	8.3	8.4	10.0%	18.3%	23.4%	26.3%
Nevada	1.0%	2.3%	2.6%	3.0%	3.5%	7.0	7.0	7.0	7.0	10.0%	13.6%	15.8%	17.3%
Orange	21.8%	34.0%	34.9%	35.7%	36.6%	11.8	15.1	16.7	16.7	50.0%	64.4%	77.3%	79.7%
Placer	1.2%	3.5%	4.4%	5.3%	6.3%	5.2	7.1	7.4	7.5	10.0%	14.8%	18.3%	20.7%
Plumas	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Riverside	2.0%	4.7%	6.0%	8.2%	10.6%	6.5	7.5	7.9	8.1	5.0%	13.5%	19.3%	24.0%
Sacramento	11.3%	19.0%	20.4%	22.1%	24.0%	7.8	11.2	12.1	12.1	30.0%	39.8%	48.1%	51.9%
San Benito	0.3%	0.7%	0.9%	1.1%	1.4%	7.7	7.7	7.7	7.7	10.0%	12.1%	13.3%	14.2%
San Bernardino	1.0%	1.8%	2.2%	3.1%	4.1%	2.4	6.7	6.9	6.9	5.0%	10.7%	14.2%	16.5%
San Diego	5.9%	10.2%	11.5%	13.4%	15.5%	9.5	9.5	9.5	9.6	10.0%	21.3%	28.7%	33.8%
San Francisco	82.3%	85.0%	76.6%	77.1%	75.5%	na	28.6	28.6	28.6	na	88.8%	125.0%	143.6%
San Joaquin	4.0%	7.1%	8.6%	10.6%	12.9%	7.3	8.1	8.6	8.8	10.0%	18.3%	24.3%	28.9%
San Luis Obispo	1.2%	1.7%	2.0%	2.4%	2.8%	9.5	9.5	9.5	9.5	15.0%	15.6%	16.2%	16.8%
San Mateo	22.8%	26.8%	27.3%	28.0%	28.9%	12.5	13.3	13.3	13.4	70.0%	70.0%	70.0%	70.0%
Santa Barbara	2.3%	2.9%	3.1%	3.7%	4.3%	12.3	12.3	12.3	12.3	20.0%	20.0%	20.0%	20.0%
Santa Clara	13.0%	17.5%	18.0%	18.6%	19.4%	11.3	11.3	11.3	11.3	75.0%	75.0%	75.0%	75.0%
Santa Cruz	5.8%	8.8%	9.8%	11.5%	13.3%	11.3	11.3	11.3	11.3	25.0%	27.5%	30.0%	32.6%
Shasta	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Sierra	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Siskiyou	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Solano	4.2%	8.6%	9.7%	11.0%	12.5%	7.1	8.5	8.9	9.0	20.0%	24.8%	28.8%	31.5%
Sonoma	3.5%	5.9%	6.7%	7.5%	8.5%	7.6	7.8	8.0	8.1	10.0%	17.2%	21.7%	24.5%
Stanislaus	3.3%	4.8%	5.3%	6.0%	6.9%	13.3	13.3	13.3	13.3	45.0%	45.0%	45.0%	45.0%
Sutter	1.4%	2.7%	3.2%	3.8%	4.6%	6.2	6.9	7.1	7.1	10.0%	14.0%	16.6%	18.4%
Tehama	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Trinity	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Tulare	0.8%	1.5%	1.8%	2.4%	3.2%	7.2	7.2	7.2	7.2	10.0%	12.9%	14.6%	16.1%
Tuolumne	na	na	1.0%	1.0%	1.0%	na	6.2	6.5	6.5	na	6.4%	10.6%	12.7%
Ventura	4.0%	7.4%	8.2%	9.6%	11.1%	na	8.1	8.7	8.7	na	13.6%	22.4%	26.9%
Yolo	0.2%	0.3%	0.4%	0.4%	0.5%	7.1	7.1	7.2	7.2	40.0%	40.0%	40.0%	40.0%
Yuba	na	2.0%	2.0%	2.0%	2.0%	4.9	6.7	6.7	6.7	10.0%	13.4%	15.1%	15.9%
CALIFORNIA	**3.4%**	**5.1%**	**5.7%**	**6.7%**	**7.7%**								

Appendix C-2: Projected Greenfield Population and Urban Acreage by County, 1997-2100

County	Population Projections (from Figure 4 and Appendix B-2)				Projected Greenfield Population Growth			Projected Greenfield Development (acres)		
	2000	2020F	2050F	2100F	1997-2020F	2020-2050F	2050-2100F	1997-2020F	2020-2050F	2050-2100F
Alameda	1,470,155	2,069,530	2,287,126	2,938,378	204,218	222,009	273,841	6,818	6,991	8,623
Alpine	1,239	2,029	2,261	2,965	464	500	615	30	31	38
Amador	34,853	43,210	46,935	57,739	5,814	5,789	9,092	352	349	547
Butte	207,158	419,856	483,980	691,341	101,810	157,918	178,989	6,641	9,882	10,978
Calaveras	42,041	80,329	91,124	125,014	23,199	25,415	29,253	1,513	1,590	1,794
Colusa	20,973	67,975	82,055	131,662	21,404	36,339	42,819	1,396	2,274	2,626
Contra Costa	931,946	1,264,400	1,394,436	1,782,151	139,568	152,354	181,154	4,678	4,803	5,711
Del Norte	31,155	50,885	56,955	75,549	12,638	13,458	16,230	824	842	1,016
El Dorado	163,197	334,786	381,668	530,209	86,986	100,439	118,833	5,196	5,871	6,896
Fresno	811,179	1,521,360	1,753,356	2,503,297	298,374	546,416	625,224	10,875	19,916	22,788
Glenn	29,298	74,926	88,790	135,982	20,794	35,463	40,734	1,356	2,219	2,498
Humboldt	128,419	146,933	158,279	190,693	14,056	15,362	28,292	917	961	1,770
Imperial	154,549	504,220	612,914	1,000,884	145,986	280,841	334,884	9,522	17,574	20,539
Inyo	18,437	24,708	27,538	36,140	2,276	6,117	7,508	148	383	470
Kern	677,372	1,623,671	1,919,849	2,923,829	392,438	727,326	839,010	23,773	43,179	49,106
Kings	126,672	265,944	309,815	454,484	59,014	102,202	117,471	3,420	5,790	6,608
Lake	60,072	128,225	148,122	212,717	35,577	49,216	55,757	2,321	3,080	3,420
Lassen	35,959	61,725	69,607	94,087	14,535	18,131	21,367	948	1,135	1,337
Los Angeles	9,838,861	13,888,161	15,497,560	20,400,280	454,519	869,151	743,699	11,156	21,332	18,020
Madera	126,394	346,451	411,713	635,019	99,451	161,373	187,657	6,074	9,644	11,092
Marin	248,397	297,307	325,152	406,920	11,398	25,435	36,796	513	1,131	1,636
Mariposa	16,762	28,625	32,101	42,785	6,550	7,620	9,296	359	417	509
Mendocino	90,442	149,731	169,149	229,650	30,734	44,998	52,809	2,005	2,816	3,305
Merced	215,256	460,020	537,166	792,667	101,681	182,461	209,554	6,035	10,612	12,015
Modoc	10,481	14,896	16,629	21,911	2,100	3,783	4,611	137	237	289
Mono	10,891	17,331	19,434	25,897	3,353	4,708	5,642	219	295	353
Monterey	401,886	855,213	1,006,978	1,517,431	170,378	363,391	419,643	8,768	18,700	21,595
Napa	127,084	191,971	214,934	285,317	30,041	43,686	51,883	1,505	2,123	2,509
Nevada	97,020	166,073	185,998	247,103	41,489	41,737	50,546	2,389	2,403	2,910
Orange	2,833,190	4,075,328	4,535,936	5,932,517	258,926	250,263	284,056	6,922	6,061	6,880
Placer	243,646	522,214	598,462	842,385	149,669	169,256	193,373	8,499	9,236	10,426
Plumas	20,852	24,569	26,612	32,507	2,484	3,160	5,145	162	198	322
Riverside	1,570,885	4,446,277	5,335,081	8,431,480	1,167,292	2,067,287	2,352,480	63,425	106,433	117,394
Sacramento	1,212,527	2,122,769	2,409,784	3,312,096	303,777	393,104	433,825	10,980	13,130	14,490
San Benito	51,853	114,922	133,208	192,948	31,755	44,143	51,260	1,673	2,325	2,700
San Bernardino	1,727,452	4,202,152	4,983,011	7,644,175	1,009,410	1,919,091	2,221,226	61,228	113,283	129,546
San Diego	2,943,001	5,116,228	5,831,574	8,097,302	907,963	1,365,013	1,500,807	38,686	58,160	63,193
San Francisco	792,049	681,924	710,034	785,565	-2,987	10,216	-32,912	-42	145	-467
San Joaquin	579,172	1,250,610	1,454,089	2,122,660	279,451	431,534	475,607	14,004	20,421	21,933
San Luis Obispo	254,818	535,901	617,709	882,227	133,080	188,964	220,102	5,688	8,077	9,408
San Mateo	747,061	953,089	1,044,065	1,312,014	43,135	56,568	80,385	1,317	1,727	2,426
Santa Barbara	412,071	779,247	905,294	1,318,823	121,646	281,959	330,783	3,993	9,255	10,858
Santa Clara	1,763,252	2,595,253	2,884,875	3,760,965	131,335	172,031	219,022	4,719	6,182	7,870
Santa Cruz	260,248	497,319	572,017	812,597	86,958	143,326	162,231	3,111	5,127	5,803
Shasta	175,777	294,289	329,849	439,059	72,720	79,435	95,324	4,743	4,971	5,965
Sierra	3,457	3,474	3,678	4,245	153	92	494	10	6	31
Siskiyou	45,194	62,040	68,588	88,199	8,867	13,328	17,117	578	834	1,071
Solano	399,841	698,430	789,742	1,074,736	130,404	169,198	195,239	6,226	7,688	8,778
Sonoma	459,258	753,729	845,837	1,129,343	150,247	181,489	213,936	7,832	9,177	10,701
Stanislaus	459,025	998,906	1,160,376	1,690,026	155,999	248,284	291,307	4,743	7,548	8,856
Sutter	82,040	152,304	173,672	241,405	34,718	47,781	55,242	2,036	2,742	3,134
Tehama	56,666	114,090	131,321	186,892	27,483	42,299	48,505	1,793	2,647	3,035
Trinity	13,490	16,836	18,300	22,549	2,198	2,418	3,709	143	151	232
Tulare	379,944	836,973	982,425	1,468,811	184,307	352,140	407,974	10,359	19,791	22,929
Tuolumne	56,125	95,023	106,662	142,505	23,577	26,199	31,285	1,538	1,639	1,958
Ventura	753,820	1,278,426	1,456,134	2,018,255	219,810	368,311	410,834	10,928	17,147	19,093
Yolo	164,010	298,350	341,228	477,893	42,254	69,544	81,999	2,419	3,937	4,642
Yuba	63,983	109,834	124,998	172,890	21,319	34,306	40,277	1,282	2,063	2,422
CALIFORNIA	**34,653,395**	**58,731,006**	**66,763,758**	**92,081,030**	**8,228,794**	**13,374,379**	**15,083,844**	**398,883**	**636,679**	**716,627**

Appendix D: Threatened and Endangered Species Act (TESA) Scores by 100m Grid Cell (Terrestrial Vertebrates Only)



See text for a discussion of how scores were constructed.