
2018 Regional Growth Forecast

Technical Documentation

Association of Monterey Bay Area Governments
Scheduled for Adoption June 2018

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Executive Summary

As the Metropolitan Planning Organization (MPO), the Association of Monterey Bay Area of Governments (AMBAG) carries out many planning functions for the tri-county area including development and maintenance of the regional travel demand model (RTDM), long range transportation planning and programming and acting as a regional forum for dialogue on issues facing the region. Most of AMBAG's projects are carried out in support of these major functions, including but not limited to the regional growth forecast. AMBAG develops the forecast with a horizon year that matches the planning timeline of the Metropolitan Transportation Plan (MTP) and the model years for the Regional Travel Demand Model (RTDM). In addition to informing regional planning processes, the forecast is used by local jurisdictions and special districts to inform local and subregional planning.

The last regional growth forecast was adopted in 2014. AMBAG staff began the process of developing a new forecast in autumn 2015. This new forecast is referred to as the 2018 Regional Growth Forecast (2018 RGF).

In preparation for the 2014 forecast, AMBAG staff conducted a review of recently completed population, housing and employment forecasts. The results of this review indicated that most of the other MPOs in California are using a methodology that emphasizes employment growth as the primary driver of long-term population change at the regional scale. The traditional approach to forecasting population uses a cohort-component approach which considers three factors: births, deaths and migration. While birth and death data are readily available and trends are relatively predictable over time, migration tends to be much more difficult to track and to forecast as it is heavily influenced by political and economic climates. For the development of the new forecast AMBAG chose to progress towards a more contemporary approach which places a greater emphasis on employment. The assumption is that the economy is a reliable predictor of population growth.

AMBAG implemented an employment-driven forecast model for the first time in the 2014 forecast and contracted with the Population Reference Bureau (PRB) to test and apply the model again for the 2018 RGF. To ensure the reliability of the population projections, PRB compared the employment-driven model results with results from a cohort-component forecast, a growth trend forecast and the most recent forecast published by the California Department of Finance (DOF). All four models resulted in similar population growth trends. As a result of these reliability tests, AMBAG and PRB chose to implement the employment-driven model again for the 2018 RGF. The regional forecast figures – for population, jobs and housing - were accepted by the AMBAG Board of Directors at the April 13, 2016 meeting.

To disaggregate the forecast for each jurisdiction, AMBAG and PRB used the most current data available to update a series of shift-share models and replicate the methodology used in the prior forecast.

This technical document provides a description of the methodology for development of the regional growth forecast figures in addition to the methodology for disaggregation of those figures. The subregional forecast figures for population, jobs and housing was accepted by the AMBAG Board of Directors at the October 12, 2016 meeting.

Summary of the Forecast

The 2018 RGF projects that the region will add 57,400 jobs between 2015 and 2040, for a total of 395,000 jobs by 2040. The regional growth rate is similar to national forecasts, but slightly slower than state-level forecasts. Furthermore, job growth is expected across most employment sectors. The fastest growing industries include Transportation, Warehousing and Utilities, Professional and B services and Educational and Health services. Conversely, the slowest growing industries include Construction, Wholesale Trade and Information. Notably, while many models for the U.S. predict declines in agricultural job growth, the AMBAG region is experiencing steady agricultural job growth.

This forecast projects that the region's population will grow by approximately 120,600 people between 2015 and 2040, for a total population of 883,300 in 2040. This is slightly lower than prior forecasts and follows the slowing growth rates seen at both the state and national level. This revised growth trend also reflects the most current population estimate for the region. The 2015 population estimate was more than 3,000 lower than prior forecasts predicted. As such, an adjustment was made to account for the sharp fall in fertility rates and international migration that occurred during the recession years that have not fully rebounded. In addition to slower growth, the new forecast predicts an older age distribution, with a larger proportion of the population age 65 and older.

An aging population affects the household and housing unit forecasts. While population growth will slow, which reduces future housing demand, older people are more likely to live alone or in small households. This shift offsets the lower population forecast with a slight upward effect on housing demand. The net result is that the region is expected to build just over 42,600 housing units by 2040, for a total of approximately 305,300 units.

Section 1: Process for Forecast Completion

Following the preparation of the regional forecast figures, AMBAG staff began the process of disaggregating the figures to each of the jurisdictions using historical data to develop a baseline disaggregated forecast. The initial results were a purely quantitative application of the methodology.

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These preliminary draft disaggregated numbers were presented for discussion purposes at one-on-one meetings held by AMBAG staff with each of the jurisdictions, the Local Agency Formation Commissions, the Fort Ord Reuse Authority, the University of California, Santa Cruz and the California State University, Monterey Bay. AMBAG staff also provided materials for these meetings that outlining the data sources and methodology for the regional forecast figures as well as the preliminary draft disaggregated forecast figures. The intent of the first round of meetings was to gather information and data that was then used to make adjustments to the forecast. (See Attachment 1 for a list of meeting dates, times and attendees.)

These preliminary draft disaggregated numbers were adjusted based on information and feedback provided by each jurisdiction. In addition, new data became available. The release of revised 2015 estimates from the California Department of Finance showed 2015 population approximately 4,000 higher than in the preliminary estimate. Similarly, the California Employment Development Department issued revised employment estimates for all industries. These updates necessitated minor revisions to the regional forecast.

Staff updated the regional growth forecast to reflect the most current information. The entire revised forecast, regional and subregional, was re-circulated for a second round of comments. After the second round of comments were received, AMBAG staff incorporated additional input and prepared a revised draft of the disaggregated forecast figures. Staff circulated the revised population, employment and housing forecast which incorporated additional comments from the Board of Directors regarding institutional housing and planned development projects. The final draft was accepted for planning purposes only by the AMBAG Board of Directors at its meeting on October 12, 2016. The final growth forecast is scheduled for adoption along with the 2040 Metropolitan Transportation Plan/Sustainable Communities in June 2018.

Section 2: Development of the Regional Growth Forecast

In September 2015, AMBAG asked PRB to prepare regional employment, population and housing projections to 2040. This section documents the findings of the work by PRB and includes a summary of the methodology, a description of the projections and an explanation of past, current and projected job growth in the region.

Summary of the 2018 Regional Growth Forecast

The 2018 RGF projects that the region will add 57,400 jobs between 2015 and 2040, for a total of 395,000 jobs by 2040. (See Table 1) The regional growth rate is similar to national forecasts, but slightly slower than state-level forecasts. Furthermore, job growth is expected across most employment sectors. The fastest growing industries include transportation, warehousing and utilities, professional and business services, and educational and health services. Conversely, the slowest

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growing industries include construction, wholesale trade and information. Notably, while many models for the U.S. predict declines in agricultural job growth, the AMBAG region is experiencing steady agricultural job growth.

This forecast projects that the region’s population will grow by approximately 120,600 people between 2015 and 2040, for a total population of 883,300 in 2040. (See Table 1) This is slightly lower than prior forecasts and follows the slowing growth rates seen at both the state and national level. This revised growth trend also reflects the most current population estimate for the region. Despite an upward revision to the estimate, the revised DOF population estimate for 2015 was more than 3,000 lower than prior forecasts predicted. As such, an adjustment was made in this forecast of population growth to account for the sharp fall in fertility rates and international migration that occurred during the recession years that have not fully rebounded. In addition to slower growth, the new forecast predicts an older age distribution, with a larger proportion of the population age 65 and older.

An aging population affects the household and housing unit forecasts. While population growth will slow, which reduces future housing demand, older people are more likely to live alone or in small households. This shift offsets the lower population forecast with a slight upward effect on housing demand. The net result is that the region is expected to build just over 42,600 housing units by 2040, for a total of approximately 305,300 units. (See Table 1)

Table 1: Forecast Summary

	2000	2005	2010	2015	2020	2025	2030	2035	2040
Jobs	312,500	316,600	308,300	337,600	351,800	363,300	374,100	384,800	395,000
Change From Prior Period		4,100	-8,300	29,300	14,200	11,500	10,800	10,700	10,200
Change (%)		1%	-3%	10%	4%	3%	3%	3%	3%
Population	710,598	719,561	732,708	762,676	791,600	816,900	840,100	862,200	883,300
Change From Prior Period		8,963	13,147	29,968	28,924	25,300	23,200	22,100	21,100
Change (%)		1%	2%	4%	4%	3%	3%	3%	2%
Households	228,260	234,869	237,106	240,278	250,757	258,699	265,882	272,686	279,499
Change From Prior Period		6,609	2,237	3,172	10,479	7,942	7,183	6,804	6,813
Change (%)		3%	1%	1%	4%	3%	3%	3%	2%
Housing Units	247,080	256,467	261,394	262,660	273,606	282,368	290,225	297,851	305,293
Change From Prior Period		9,387	4,927	1,266	10,946	8,761	7,857	7,626	7,442
Change (%)		4%	2%	0%	4%	3%	3%	3%	2%

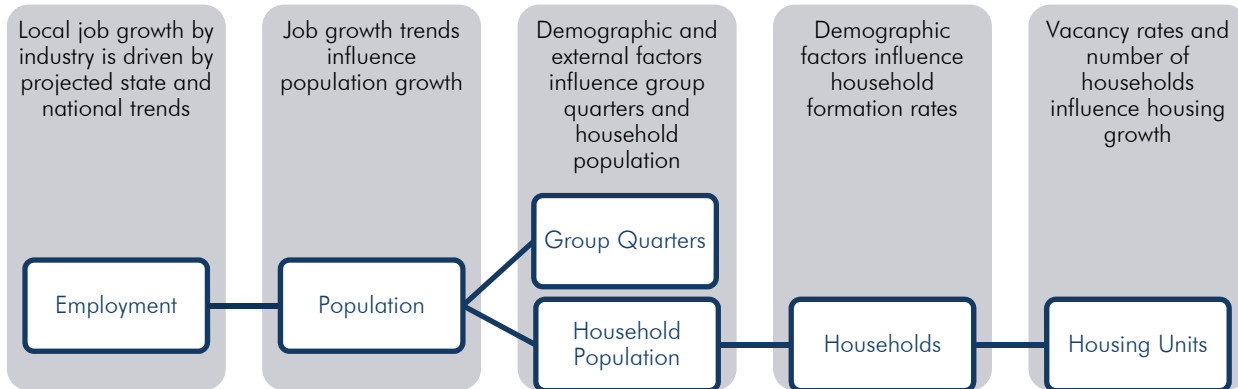
Sources: Data for years 2000-2015 are from the California Employment Development Department, California Department of Finance, and U.S. Census Bureau. Forecast years were prepared by PRB.

Regional Growth Forecast Methodology

As shown in the flow chart below, the forecast uses a model that predicts employment growth using a shift-share model based on local data as well as state and national trends. Population growth is then driven by employment growth. Household and housing growth are driven by population growth, demographic factors and external factors (explained below). This approach was vetted and approved

by the AMBAG Board of Directors in 2014 for use in the metropolitan transportation plan, Moving Forward 2035 Monterey Bay. While the methodology for the 2018 RGF remains the same, the models have been updated to include current data, a revised base year of 2015 and a new horizon year of 2040.

Figure 1: Regional Growth Forecast Process



1. Employment trends: Employment growth by industry is driven by projected national and statewide trends for all industries in the region (i.e., shift-share model).
2. Population trends: Job growth trends influence population growth. The forecast is based on historical trends in the ratio of population to employment in AMBAG region.
3. Household trends: Demographic factors (e.g., age, race/ethnicity) and external factors (e.g., major group quarters facilities like colleges and universities, correctional facilities, etc.) influence the household population and household formation rates (i.e., the number of people per household).
4. Housing Unit trends: Vacancy rates and the number of households influence housing growth.

Data sources include the California Department of Finance, California Employment Development Department, the U.S. Bureau of Labor Statistics and the U.S. Census Bureau.

Step 1: Employment

The AMBAG region is projected to add 57,400 jobs between 2015 and 2040, for a total of 395,000 by 2040. The region is projected to have 384,800 jobs in 2035, which is above the 372,800 jobs projected for the same year in the 2014 Regional Growth Forecast. (See Table 2 and Figure 2) The employment growth forecast is higher because the region grew faster in the 2010-2015 time period than had been anticipated given the slow recovery leading up to the prior forecast.

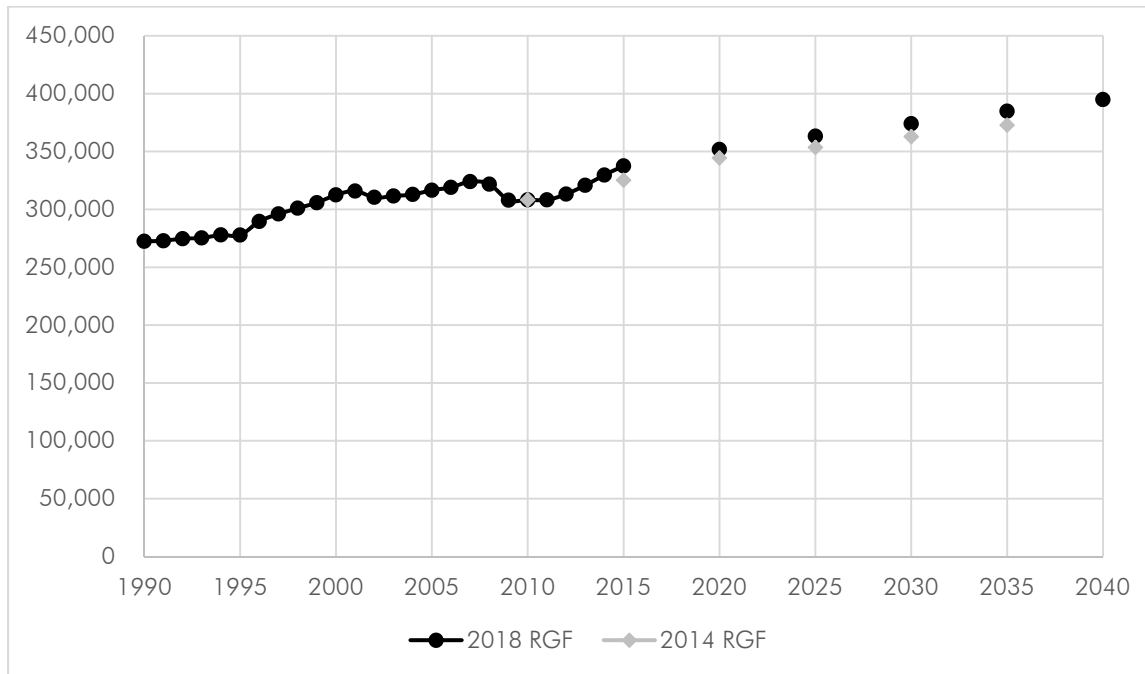
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Table 2: Forecast Comparison of Employment

Forecast by Year Released	2010	2015	2020	2025	2030	2035	2040
2014 RGF	308,400	326,000	344,500	353,600	362,900	372,800	N/A
Change From Prior Period (%)		6%	6%	3%	3%	3%	N/A
2018 RGF	308,300	337,600	351,800	363,300	374,100	384,800	395,000
Change From Prior Period (%)		10%	4%	3%	3%	3%	3%

Sources: Data for years 2010 and 2015 are from the California Employment Development Department. Forecast years were prepared by AMBAG and PRB.

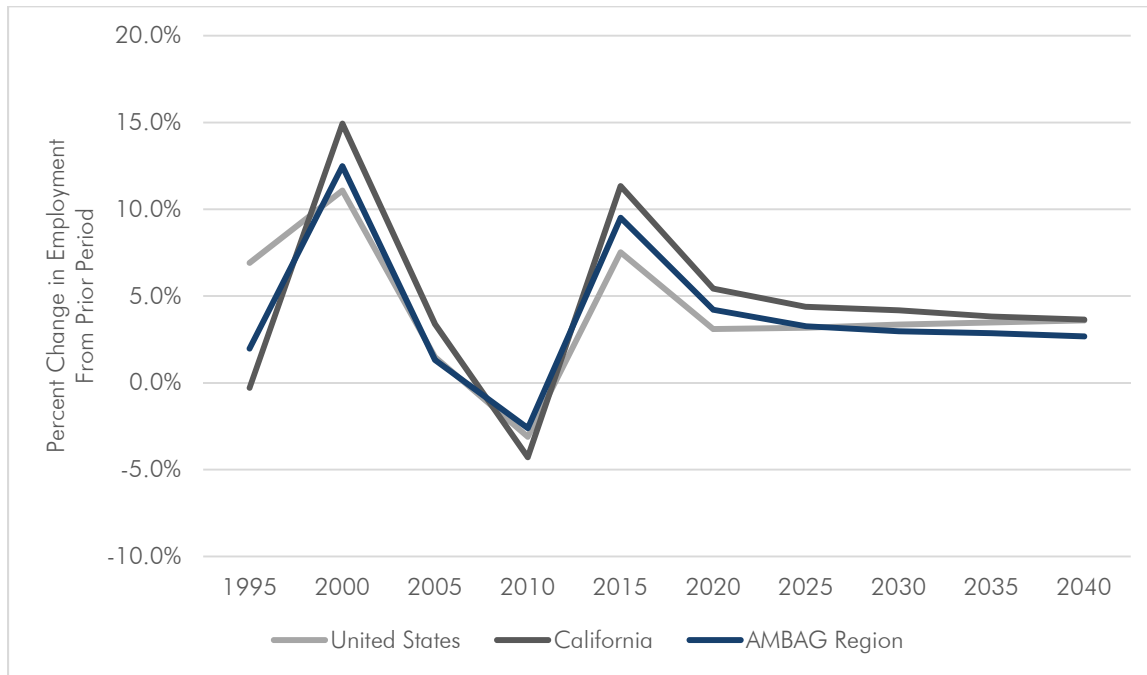
Figure 2: AMBAG Region Employment Forecast



Sources: Data for years 1990-2015 are from the California Employment Development Department. 2018 RGF was prepared by AMBAG and PRB.

The AMBAG region experienced job growth slower than the state, and similar to the nation between 2000 and 2015. This trend is expected to continue. The primary reason is that the region has a lower share than the state of California of jobs in high growth sectors including financial activities, professional, technical and scientific services as well as a low exposure to growth in foreign trade.

Figure 3: Employment Change



Sources: Data for years 2000-2015 from the U.S. Bureau of Labor Statistics and California Employment Development Department. Forecast years were prepared by AMBAG and PRB with input from U.S. Bureau of Labor Statistics, *Employment by Major Industry Sector: 2014-2024*; California Department of Transportation, *California County-Level Economic Forecast 2014-2040*, September 2014; and from the California Employment Development Department, *Industry Employment Projections*.

Job projections to 2040 were developed for each major industry category by projecting the AMBAG region share of state job growth based on the analysis of trends in the period from 1990 to 2010 and 2015. Industry categories are described in Attachment 2.

The region is projected to experience job growth at a slightly slower rate than the state and nation. The primary reasons for this below-average job growth is the region’s below-average concentration in fast-growing sectors such as information and professional services. The region also has a below-average exposure to growth in foreign trade.

Positive factors include above-average performance relative to state trends in tourism and in agriculture. Agriculture has shown strong growth for several years, and new crops such as cannabis as well as new investments in processing facilities, portend that the industry will continue to grow. However, any job growth due to new crops may be mitigated by losses due to increased mechanization in agriculture and agricultural processing.

Method for Producing the Employment Forecast

The AMBAG region job projections were developed using three guiding principles:

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1. The AMBAG region projections were based on projections of job growth in the nation and state. The national and state projections provide the **pool of job opportunities** and the AMBAG region projections reflect historical trends in the **share** of national and state job growth that will locate in the AMBAG region.
2. The AMBAG region **share** of national and state job growth is determined by the industry composition of job growth and the projected share of job growth locating in the AMBAG region. If national and state job growth is concentrated in sectors where the AMBAG region has a competitive advantage, the region's projected job growth will be higher than if national and state job growth is concentrated in sectors where the region has a below average share of jobs and a relatively poor competitive position.
3. The analysis of competitive advantage is focused on sectors in the AMBAG region **economic base**. The region's economic base consists of those sectors that sell a high proportion of goods and services to customers outside the region. They export goods and services to customers in world and national markets and markets throughout California. Key examples of economic base sectors in the AMBAG region are agriculture and tourism. The UC Santa Cruz campus and state prison are also examples of activities that do not primarily serve local residents.

U.S. and California Job Growth to 2040

The starting point for the AMBAG projections is an examination of future U.S. and California job growth for total jobs and for major industry sectors. The U.S. job growth projections are based on the most recent forecast from the U.S. Bureau of Labor Statistics and an extrapolation of growth trends to 2040. California job growth projections are based on an industry-level forecast published by the California Department of Transportation, as well as data from the California Employment Development Department and PRB.

The California industry projections identify the structure of job growth as an input to AMBAG region job projections. The resulting projections of job growth are shown below.

The nation is expected to add 27.0 million jobs between 2015 and 2040 for an increase of 18 percent. Growth, nationwide, is expected to be fairly constant throughout the forecast period. The state of California is projected to experience job growth that is slightly faster than the nation's job growth in the early years of the forecast, and to slow down to a rate more similar to the national growth rate by 2040.

The state is projected to see a 23 percent increase in total jobs between 2015 and 2040. The pattern of California industry job growth is shown below and was used in developing AMBAG region job projections. (See Table 3)

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Table 3: California Jobs by Major Industry (000s)

	2005	2010	2015	2020	2025	2030	2035	2040	Avg. Annual Growth Rate		
									2005-2010	2010-2015	2015-2040
Agriculture	378.2	382.8	423.3	440.0	442.0	443.0	445.0	446.0	0.2%	2.0%	0.2%
Mining	23.6	26.8	29.1	30.1	32.3	33.6	34.9	36.3	2.6%	1.7%	0.9%
Construction	905.3	559.8	727.4	760.0	772.0	794.0	806.0	816.0	-9.2%	5.4%	0.5%
Manufacturing	1,505.2	1,244.0	1,291.9	1,327.0	1,345.0	1,363.0	1,381.0	1,400.0	-3.7%	0.8%	0.3%
Wholesale	673.6	644.0	721.2	739.0	752.0	765.0	778.0	792.0	-0.9%	2.3%	0.4%
Retail	1,659.3	1,517.7	1,663.1	1,719.0	1,748.0	1,779.0	1,810.0	1,842.0	-1.8%	1.8%	0.4%
Transp., Warehousing, Utilities	487.1	466.3	554.0	584.0	638.0	696.0	761.0	831.0	-0.9%	3.5%	1.6%
Information	473.6	429.0	483.0	512.0	538.0	564.0	591.0	620.0	-2.0%	2.4%	1.0%
Financial Serv.	920.0	759.7	797.4	838.0	890.0	948.0	1,004.0	1,059.0	-3.8%	1.0%	1.1%
Prof. & Business Serv.	2,162.0	2,076.9	2,493.8	2,827.0	3,080.0	3,336.0	3,545.0	3,732.0	-0.8%	3.7%	1.6%
Educ. & Health Serv.	1,834.9	2,123.4	2,456.2	2,674.0	2,918.0	3,127.0	3,343.0	3,562.0	3.0%	3.0%	1.5%
Leisure & Hospitality	1,475.2	1,501.6	1,830.0	1,877.0	1,890.0	1,902.0	1,915.0	1,927.0	0.4%	4.0%	0.2%
Other services (excl. gov't)	505.5	484.9	545.7	570.3	596.1	623.0	651.1	680.5	-0.8%	2.4%	0.9%
Government	2,420.2	2,448.4	2,458.8	2,490.0	2,519.0	2,559.0	2,601.0	2,644.0	0.2%	0.1%	0.3%
Self Employed	1,144.8	1,192.6	1,180.9	1,226.5	1,267.6	1,307.1	1,348.0	1,390.0	0.8%	-0.2%	0.7%
Total Jobs	16,568.5	15,857.9	17,655.8	18,613.8	19,427.9	20,239.7	21,014.0	21,777.9	-0.9%	2.2%	0.8%

Sources: Data for years 2005, 2010 and 2015 from the Employment Development Department. Forecast years were prepared by PRB with input from California Department of Transportation, California County-Level Economic Forecast 2014-2040, September 2014 and from the California Employment Development Department, California Industry Employment Projections.

The projections do show substantial differences in the expected growth rate among industries between 2015 and 2040 and these differences tell a story about where job growth is expected and where job levels will remain flat or decline. These differences directly influenced the AMBAG region job projections described below.

These projections also help to identify which industry job growth is due primarily to a regaining of jobs lost during the recession and which industries have long-term job growth potential. The industry-level trends in California are as follows:

- Agricultural job growth was strong, statewide, from 2010-2015, but this forecast projects a return to historical slower-growth trends between 2015 and 2040.
- Between 2010 and 2015, the construction sector recovered many, but not all, jobs lost during the recession. The industry is expected to have modest growth in future years.
- Manufacturing job growth is expected to be slow, as it has been in the past five years.
- By 2015, the Retail and Wholesale sectors had nearly, but not completely, returned to pre-recession levels. Job growth is expected to be slow in future years.

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- Transportation, warehousing and utilities jobs fully rebounded from the recession, and surpassed their 2007 level by 2015. Growth is expected to be robust in forecast years.
- The Information sector recovered recession-era job losses by 2015, and the sector is expected to have steady growth to 2040.
- Financial services suffered substantial job losses during the recession, and the sector is recovering slowly.
- Professional and Business services suffered some losses during the recession, but growth has been robust since 2010.
- Education and Health services has seen steady growth, even in recession years. This is expected to continue as the population ages and demand for health services increases.
- Leisure and Hospitality job growth slowed, but did not turn negative, during the recession. Growth has been robust since 2010.
- Other services suffered some losses during the recession, but growth has been robust since 2010.
- Government job growth has been slow for many years. Unlike all other sectors, government jobs declined between 2010-2015. This may reflect delayed results of the recession as local, state and federal agencies dealt with declining revenues.
- Self-employment tends to be counter-cyclical as people who lose their wage-and-salary job during a recession may turn to self-employment. Growth forecasts are based primarily on population growth.

It is important to note that the statewide projections listed above were completed before the passage of Proposition 64, the Adult Use of Marijuana Act. While new rules will not be fully implemented until 2018, the legalization of recreational cannabis in the state is widely expected to affect job growth in agriculture, manufacturing, and warehousing. However, any increase in jobs related to new products may merely offset the long-term trend of job losses due to increasing mechanization in these industries. The net result is unknown at this time, and projections will be updated as new information becomes available.

The AMBAG Region Economy and Job Growth

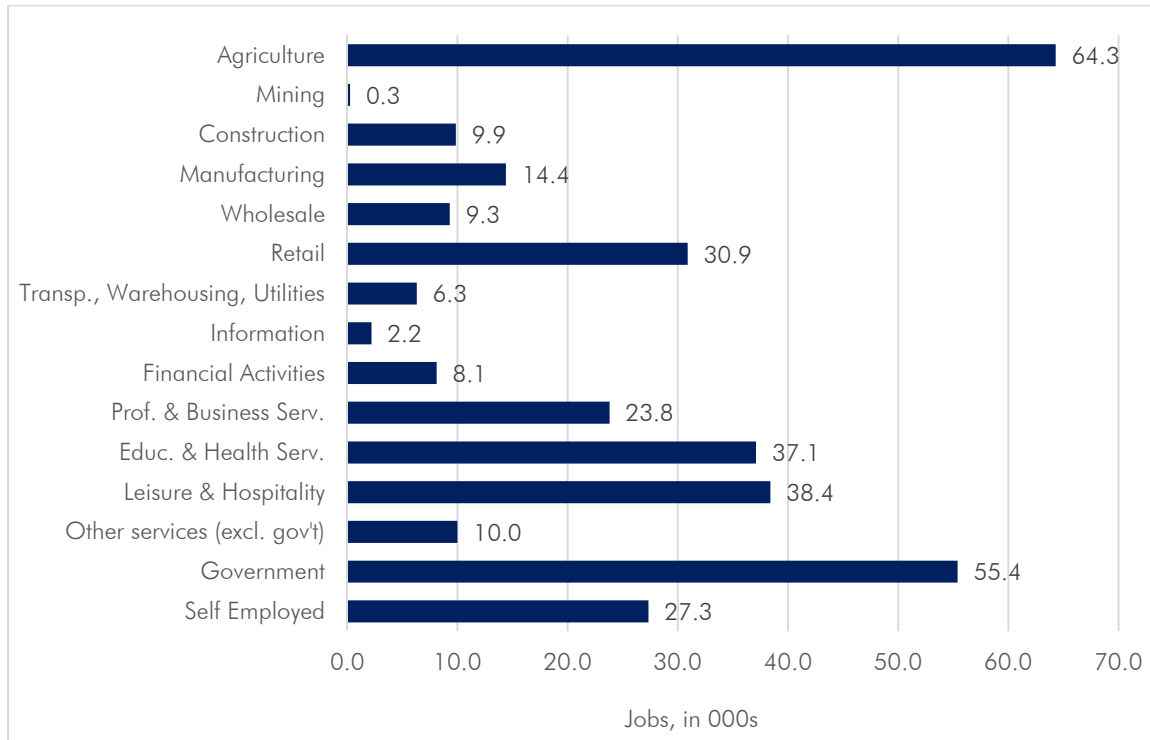
The previous section provided an overview of the current trends in the California economy. As previously noted the AMBAG region's job projections are based on an analysis of the regional economy and its relationship to the growth forecasted for California. The national and state projections provide the **pool of job opportunities** and the AMBAG region forecast reflects judgments about the **share** of national and state job growth that will locate in the AMBAG region. What follows is a description of the current structure of the regional economy as well as the resulting job projections based on the region's share of industries.

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The database used for analysis and projections consists of annual data from 1990 through 2015 for each of the three counties in the region and added together to produce an AMBAG region jobs database.

The largest sectors measured in terms of number of jobs in 2015 are Agriculture (64,300) and Government (55,400). The next largest sectors are Leisure and Hospitality (including hotels and restaurants), Education and Healthcare and Retail. (See Figure 4)

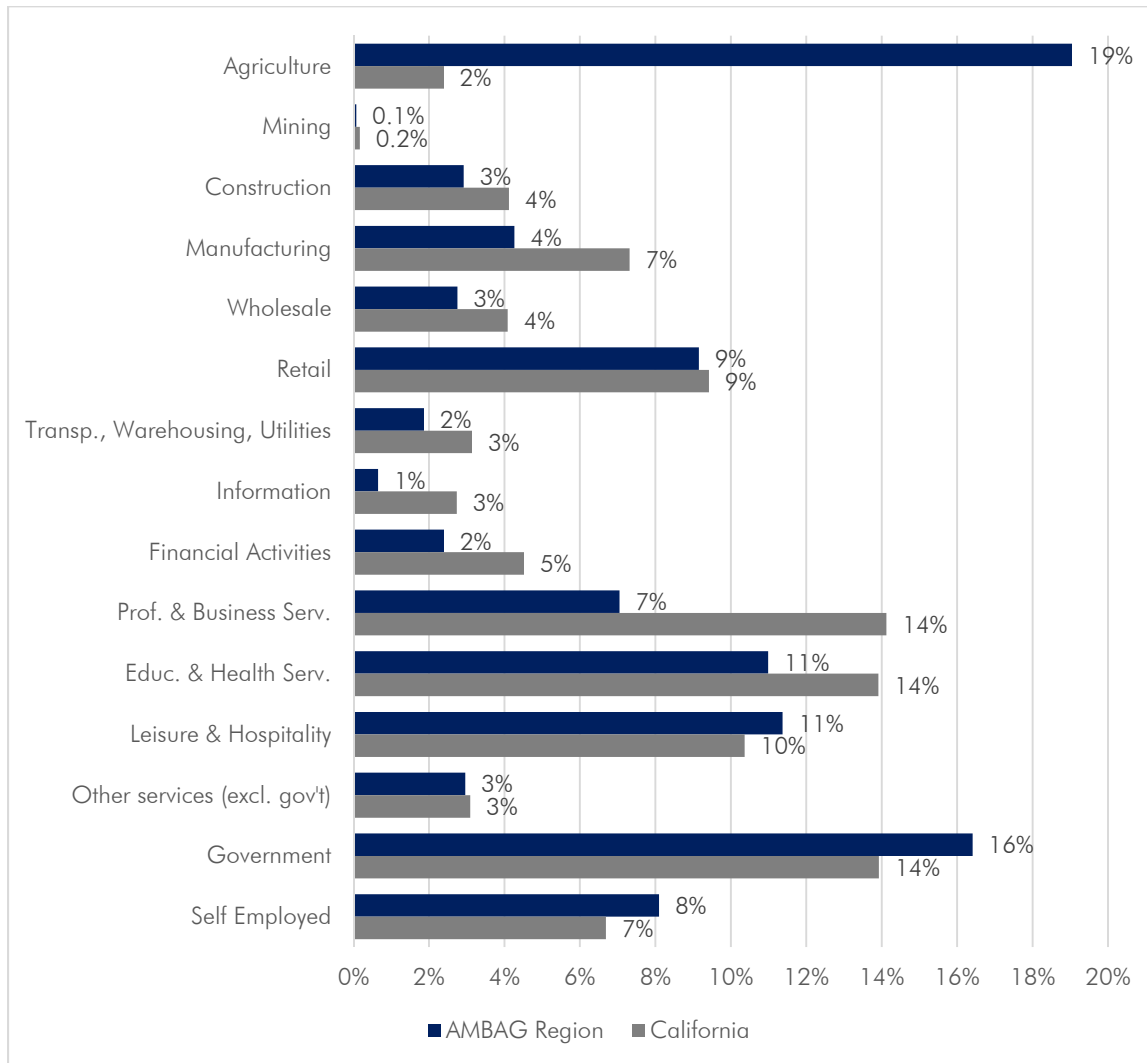
Figure 4: Jobs by Industry Sector in 2015, AMBAG Region



Source: Data from the California Employment Development Department.

The AMBAG regional economy has an industry structure that is quite different in some ways than the statewide structure or the industry structure in regions like Southern California or the San Francisco Bay Area. One difference is the large share of jobs in Agriculture. Nineteen percent of total jobs in the AMBAG region are in Agriculture compared to just over two percent statewide. Other sectors with above average shares in the region include Government, Leisure and Hospitality, and Self Employed. Conversely, the AMBAG region has a below average share of jobs in the fast-growing, high wage Information (internet services) and Professional Services sectors as well as in Finance, and in Transportation, Warehousing and Utilities. (See Figure 5)

Figure 5: Share of Total Jobs in 2015, California and AMBAG Region



Source: Data from the California Employment Development Department.

AMBAG Region Forecast Job Trends, by Industry

The AMBAG region is expected to have moderate job growth between 2015 and 2040.

Table 4: AMBAG Region Jobs by Major Industry (000s)

	2005	2010	2015	2020	2025	2030	2035	2040	Avg. Annual Growth Rate		
									2005-2010	2010-2015	2015-2040
Agriculture	52.7	56.3	64.3	69.0	69.3	69.5	69.9	70.0	1.3%	2.7%	0.3%
Mining	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.0%	8.4%	0.0%
Construction	14.3	7.9	9.9	9.9	10.1	10.3	10.4	10.5	-11.2%	4.4%	0.3%
Manufacturing	16.5	13.6	14.4	15.4	16.0	16.5	16.9	17.3	-3.8%	1.1%	0.7%
Wholesale	9.0	8.9	9.3	9.3	9.5	9.7	9.8	10.0	-0.2%	0.9%	0.3%
Retail	31.6	28.6	30.9	31.7	32.3	32.9	33.4	34.0	-2.0%	1.6%	0.4%
Transp Warehousing, Util.	5.1	5.1	6.3	7.0	7.8	8.6	9.4	10.2	0.0%	4.3%	1.9%
Information	4.1	2.7	2.2	1.9	1.9	1.9	1.9	1.9	-8.0%	-4.0%	-0.6%
Financial Serv.	10.1	7.9	8.1	8.4	8.8	9.2	9.7	10.1	-4.8%	0.5%	0.9%
Prof. & Business Serv.	22.4	21.3	23.8	25.1	27.2	29.3	31.1	32.8	-1.0%	2.2%	1.3%
Educ. & Health Serv.	27.3	31.3	37.1	40.7	44.4	47.6	50.9	54.2	2.8%	3.5%	1.5%
Leisure & Hospitality	33.2	32.0	38.4	38.9	39.3	39.8	40.2	40.5	-0.7%	3.7%	0.2%
Other services (excl. gov't)	8.7	8.7	10.0	10.7	11.2	11.7	12.2	12.8	0.0%	2.8%	1.0%
Government	54.6	55.9	55.4	55.5	56.1	56.9	57.7	58.6	0.5%	-0.2%	0.2%
Self Employed	26.8	27.9	27.3	28.1	29.0	30.0	30.9	31.9	0.8%	-0.4%	0.6%
Total Jobs	316.6	308.3	337.6	351.8	363.3	374.1	384.8	395.0	-0.5%	1.8%	0.6%

Sources: Data for years 2005-2015 from the California Employment Development Department. Forecast years were prepared by AMBAG and PRB with input from California Department of Transportation, California County-Level Economic Forecast 2014-2040, September 2014 and from the California Employment Development Department, California Industry Employment Projections.

Note: Parts may not sum to total due to independent rounding.

The industry-level trends in the AMBAG Region are as follows:

- Agricultural job growth has been strong for the past 10 years, and while the rate of growth is expected to slow, the region’s agricultural industry will still grow faster than state or national projections. As noted above, these trends may change as a result of Proposition 64, but the net effect on job growth is not yet known.
- Construction job losses were steep during the recession. The sector began to recover between 2010 and 2015. Future growth is expected to be slow.
- The region lost Manufacturing jobs during the recession, but recent years have seen a turnaround. Growth is expected to be steady in future years.
- The Wholesale and Retail sectors both lost jobs in recession years, and both saw modest growth between 2010 and 2015. Growth is expected to remain modest through the forecast.
- Transportation, Warehousing and Utilities jobs were stable during the recession and have grown rapidly since then. This sector is expected to continue growing.

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- Financial services suffered substantial job losses during the recession, and the sector is recovering slowly.
- Professional and Business services suffered some losses during the recession, but growth has been robust since 2010.
- Education and Health services has seen steady growth, even in recession years. This is expected to continue as the population ages and demand for health services increases.
- The Leisure and Hospitality lost jobs in the AMBAG region during the recession, but growth rebounded between 2010 and 2015.
- Other services remained stable during the recession, and the sector is expected to continue growing.
- The Government sector, locally, lost jobs between 2008 and 2013 as a result of the recession. Those losses began to reverse in 2014, and the sector is expected to see modest growth in the future.
- Self-employment tends to be counter-cyclical as people who lose their wage-and-salary job during a recession may turn to self-employment. Growth forecasts are based primarily on population growth.

Step 2: Population

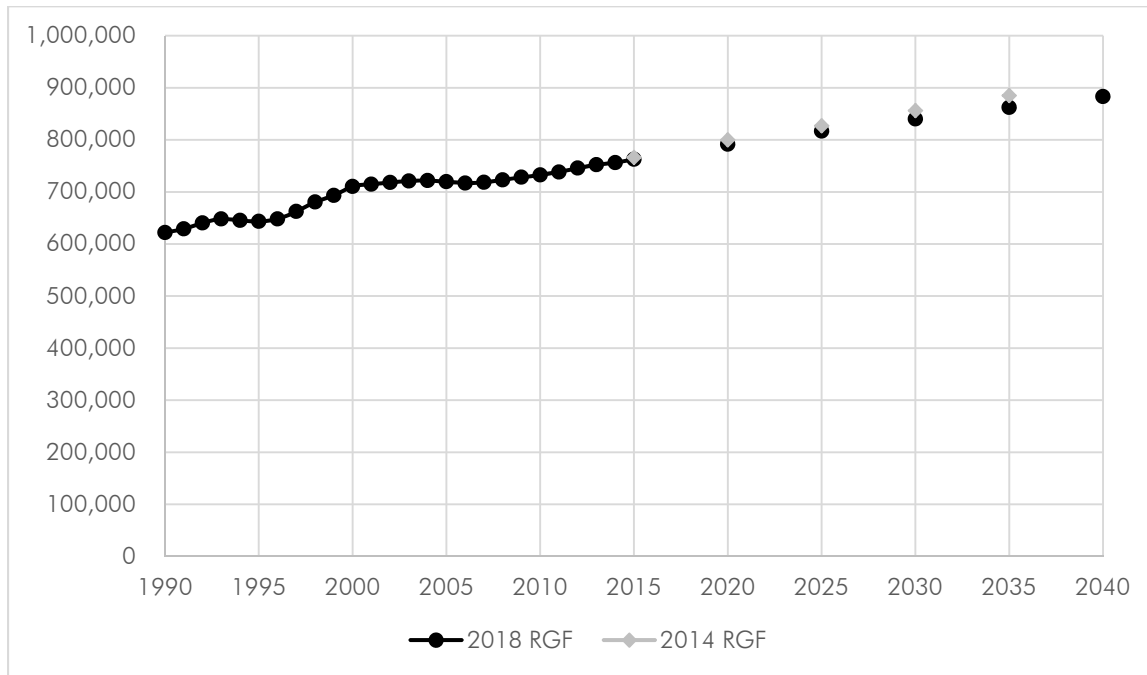
The region is projected to add 120,624 residents between 2015 and 2040 for an increase of 16 percent. The 2040 projected regional population of 883,300 is slightly lower than the 885,000 residents projected for year 2035 in the 2014 Regional Growth Forecast. (See Table 5 and Figure 6) This lower population forecast reflects slower growth than anticipated since the 2010 Census due to lower birth rates and lower migration rates. This slower growth in population is possible, despite faster growth in employment, due to changing unemployment and labor force participation rates.

Table 5: Comparison of Forecasts for Population

Forecast by Year Released	2010	2015	2020	2025	2030	2035	2040
2014 RGF	732,708	766,000	800,000	827,000	856,000	885,000	N/A
Change From Prior Period (%)		5%	4%	3%	4%	3%	--
2018 RGF	732,708	762,676	791,600	816,900	840,100	862,200	883,300
Change From Prior Period (%)		4%	4%	3%	3%	3%	2%

Sources: Data for years 2010 and 2015 are from the California Department of Finance. Forecast years were prepared by AMBAG and PRB.

Figure 6: AMBAG Region Population Forecast



Sources: Data for years 1990-2015 are from the California Department of Finance. Forecast years were prepared by AMBAG and PRB.

Despite the lower population forecast, it is expected that AMBAG will continue to see population and housing growth associated with job growth outside of the region. In particular, job growth in Silicon Valley, combined with high housing prices, is expected to lead to an increase in the number of commuters to Bay Area jobs that live in the AMBAG region.

Method for Producing the Population Forecast

In preparing for this forecast, PRB tested a variety of methods for the population forecast, each of which produced similar results. (Findings are summarized in Attachment 3.) As a result of this review, PRB and AMBAG staff determined that the employment-driven population growth forecast model used in the 2014 RGF was suitable for the 2018 RGF.

Benchmark Population

All population projections are benchmarked to the 2010 Census counts which include people whose primary residence on “Census Day” (April 1, 2010) is within the region, regardless of citizenship

status. It is recognized that the AMBAG region is home to a sizeable seasonal population (seasonal workers, who often work in agricultural occupations, and their families). Seasonal worker populations have historically been found to be “hard to count” (HTC) in official statistics.¹ In an encouraging development, the 2010 Census was more effective than prior decennial census efforts in reaching, and enumerating, HTC areas. Specifically, “Census 2010 coverage of households in the HTC tracts in the San Joaquin Valley and Central Coast counties... was significantly improved from previous decennials,” but some undercount remained a problem.²

The timing of data collection has also historically been a challenge for counting seasonal workers in the AMBAG region. Migratory workers are counted based on their location on Census Day. If the agricultural work cycle is in a lull in March and April, but ramps up at other times of the year, the worker population may be lower on Census Day than it is at other times of the year. However, it has been observed through informal surveys (i.e., for the AMBAG Regional Agricultural Vanpool Feasibility Study) that the seasonal population in the AMBAG region has been moving towards a trend of year-round residence, particularly with regard to agricultural jobs.

Given these two trends – better enumeration of HTC populations and a trend toward year-round residence – the seasonal population is increasingly likely to be counted in the decennial Census and in California Department of Finance demographic estimates. That said, seasonal workers who were not present on Census Day would not have been counted in the AMBAG region, and undercount remains a problem for seasonal populations, nationwide. Thus, to the extent that seasonal workers are present and counted in official statistics, they are also included in this forecast.

The AMBAG region population projections were benchmarked against prior decennial Census and employment data, and derived by anticipating that the regional population to job ratio will move in line with the statewide trend as it has in the past.

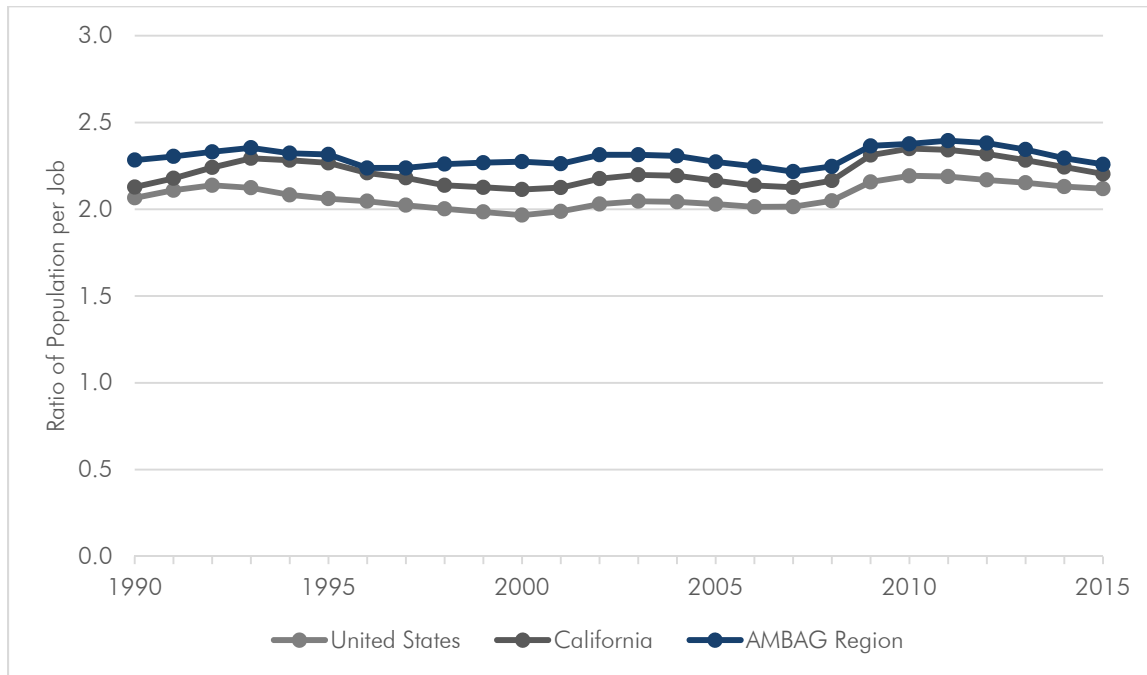
U.S., California and AMBAG Region Demographic Trends to 2040

The AMBAG region has more residents per job than the state or nation and that is expected to continue to 2040. (See Figure 7)

¹ U.S. General Accounting Office. “Key Efforts to Include Hard-to-Count Populations Went Generally as Planned; Improvements Could Make the Efforts More Effective for Next Census” (December 2010), accessed at <http://www.gao.gov/new.items/d11145.pdf> on October 4, 2016.

² California Rural Legal Assistance, Inc. “2010 Census Enumeration of Immigrant Communities in Rural California: Dramatic Improvements but Challenges Remain” (November 2010), accessed at <http://www.crla.org/sites/all/files/content/uploads/Census/Census10-JBS-CRLA.pdf> on October 4, 2016.

Figure 7: Population per Job

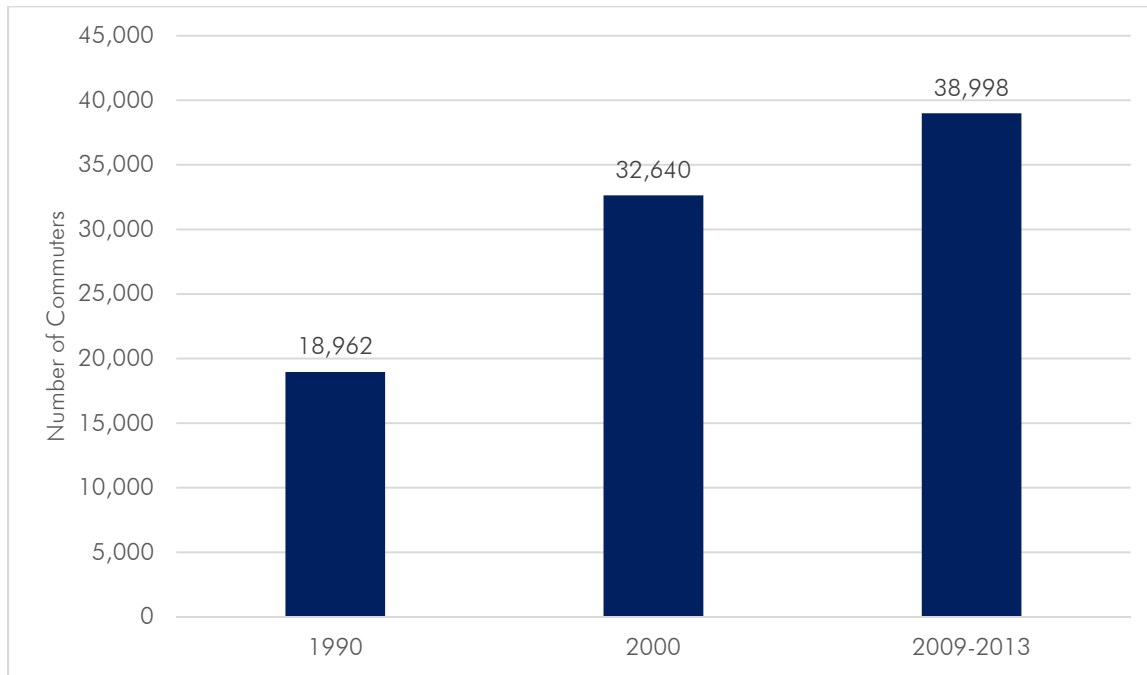


Sources: U.S. Census Bureau, U.S. Bureau of Labor Statistics, California Department of Finance, California Employment Development Department.

The AMBAG region has a higher population to jobs ratio than the state or nation for several reasons. The leading reasons are commuting patterns and “external” population forces (colleges, military and prisons).

AMBAG residents commute to jobs outside the region, principally to jobs in Santa Clara County. This net out-commuting means there are residents in the region not connected to AMBAG region job growth. Net out-commuting surged between 1990 and 2000 as the “dot.com boom” pushed Silicon Valley (Santa Clara County) job levels higher. Out-commuting declined after 2000 as jobs levels in Silicon Valley fell. (See Figure 8.) The Association of Bay Area Governments projected a 28.2 percent increase in Santa Clara County jobs between 2010 and 2035, which, combined with high housing prices in Santa Clara County, will increase the incentive for people to search for cheaper housing in portions of the AMBAG region.

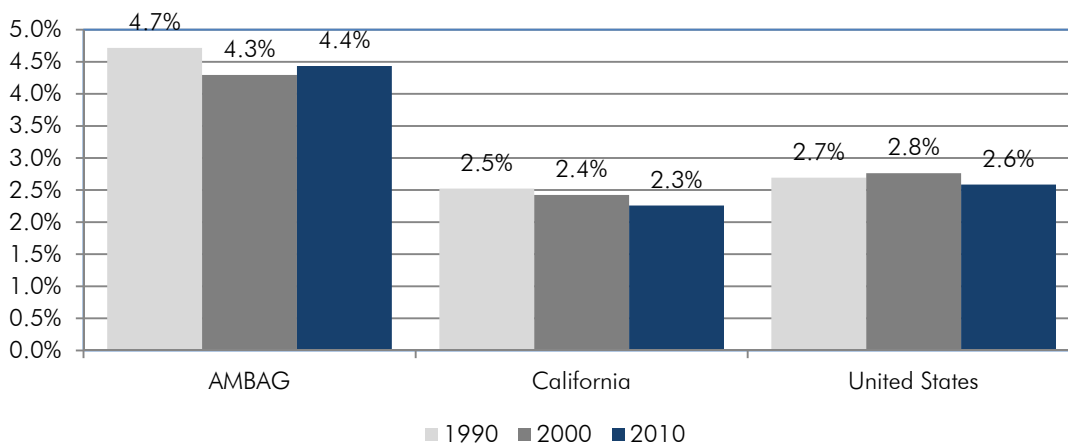
Figure 8: Net Out-Commuting from AMBAG Region



Sources: 1990 & 2000 - Census Journey to Work and 2009-2013 - American Community Survey Special Tabulations for the Census Transportation Planning Package.

Another major cause for the high ratio of people to jobs is that the AMBAG region has an above-average share of residents who live in group quarters and are not tied to the regional job market. This trend has continued since 1990 although the mix of group quarters residents has changed. (See Figures 9 and 10.)

Figure 9: Group Quarters as a Percent of Population

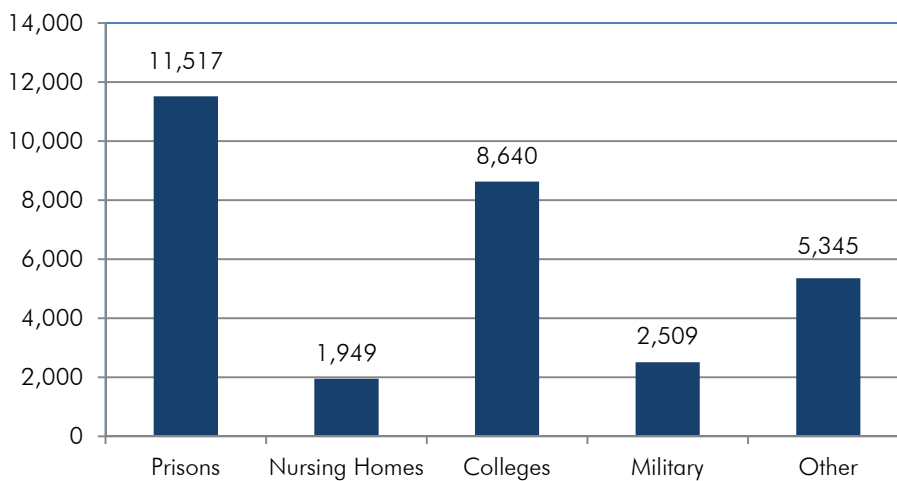


Sources: U.S. Census Bureau, California Department of Finance

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In 1990 there was a substantial military group quarters presence around the Fort Ord base. Since then the military population has declined due to the closure of the base, but that group quarters population has been offset by an increase at colleges (primarily UC Santa Cruz and CSU Monterey Bay) and an increase in state prison population. In future years it will be important to continue watching the development and growth of military institutions in the region. There is still a strong military and naval presence in Monterey County including the Presidio area as well as Fort Hunter Liggett in the southern portion of the County.³

Figure 10: AMBAG Group Quarters Population in 2010



Source: U.S. Census Bureau, Census 2010

AMBAG Region Forecast Population Trends

As described above (see Figure 5), the region is projected to add approximately 4,800 residents per year between 2015 and 2040. This is less than the average of just under 8,900 between 1990 and 2000 and above the recession-affected growth of 2,200 between 2000 and 2010. Recent growth from 2010-2015 has averaged 6,000 per year, close to the projected long-term growth rate.

³ While Fort Hunter Liggett has a small permanent population, they are a large training facility and host a substantial amount of trainees every year. Not only will it be important to follow the FHL plans for expansion from a population perspective, but it will also be important to consider the presence of the FHL in transportation planning given the Fort's heavy reliance on Highway 101.

Step 3: Housing and Households

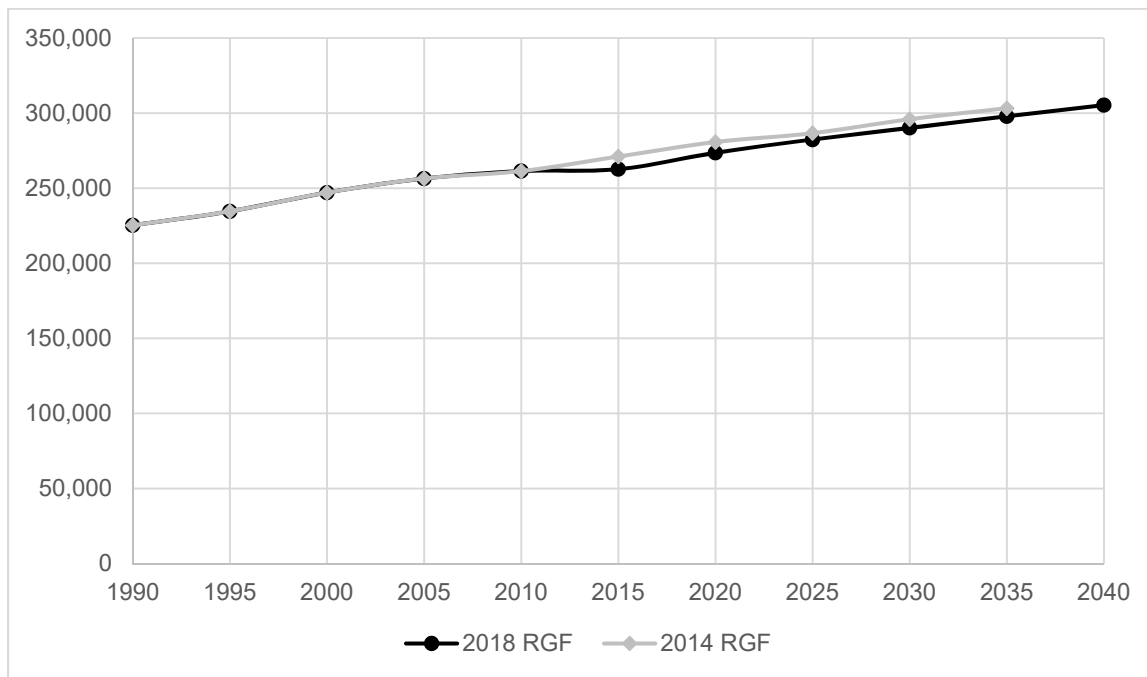
The region is projected to add approximately 42,600 housing units between 2015 and 2040 for an increase of 16 percent. The 2040 projected regional housing stock of 305,293 is slightly higher than the 303,245 housing units projected for year 2035 in the 2014 Regional Growth Forecast.

Table 6: Comparison of Forecasts for Housing

Forecast by Year Released	2010	2015	2020	2025	2030	2035	2040
2014 RGF	261,394	271,080	280,765	286,649	295,936	303,245	N/A
Change From Prior Period (%)		4%	4%	2%	3%	2%	--
2018 RGF	261,394	262,660	273,606	282,368	290,225	297,851	305,293
Change From Prior Period (%)		0%	4%	3%	3%	3%	2%

Sources: Data for years 2010 and 2015 are from the California Department of Finance. Forecast years were prepared by AMBAG and PRB.

Figure 11: AMBAG Region Housing Forecast



Sources: Data for 1990-2015 from the California Department of Finance. 2018 RGF prepared by AMBAG and PRB.

Method for Producing the Housing Forecast

The housing forecast begins with a household forecast, and the household forecast is driven by demographic factors such as the size and structure of the population. Demographic factors (e.g., gender, age and race/ethnicity) and external factors (e.g., major group quarters facilities like colleges and universities, correctional facilities, etc.) influence household population and household

formation rates (i.e., the number of people per household). Household formation rates predict future demand for housing. That predicted demand, combined with expected vacancy rates, drives the forecast for housing growth.

AMBAG Region Forecast Housing Trends

As described above (see Figure 11), the region is projected to add approximately 4,800 residents per year between 2015 and 2040. Taking average household size and vacancy rates into account, the resulting housing growth is expected to be approximately 1,700 per year between 2015 and 2040. This is slightly higher than the recession-affected growth of approximately 1,000 housing units per year between 2000 and 2015.

It is worth noting that several jurisdictions in the AMBAG region have historically had relatively high vacancy rates, reflecting a mix of vacation rentals and second homes, particularly in coastal communities. In recent years, there is some evidence that more homeowners may be participating in the vacation rental market via platforms such as Airbnb and VRBO. It is unclear whether these new services will result in higher vacancy rates as more housing units become primarily vacation rentals or lower vacancy rates as short-term rental units shift demand away from units that are intended to be available for rental most (or all) of the year. AMBAG will continue to monitor this trend for future forecasts.

Section 3: Development of the Subregional Forecast

Following the preparation of the regional forecast figures, AMBAG staff began the process of disaggregating the figures to the county and city level using historical data. This section summarizes that process and the results.

Summary of the 2018 Subregional Forecast

The 2018 RGF projects that the region will add 57,400 jobs between 2015 and 2040, for a total of 395,000 jobs by 2040. Of that growth, 56 percent (approximately 32,300 jobs) is expected to be in Monterey County, 7 percent (approximately 3,900 jobs) is expected to be in San Benito County and 37 percent (approximately 21,200 jobs) is expected to be in Santa Cruz County.

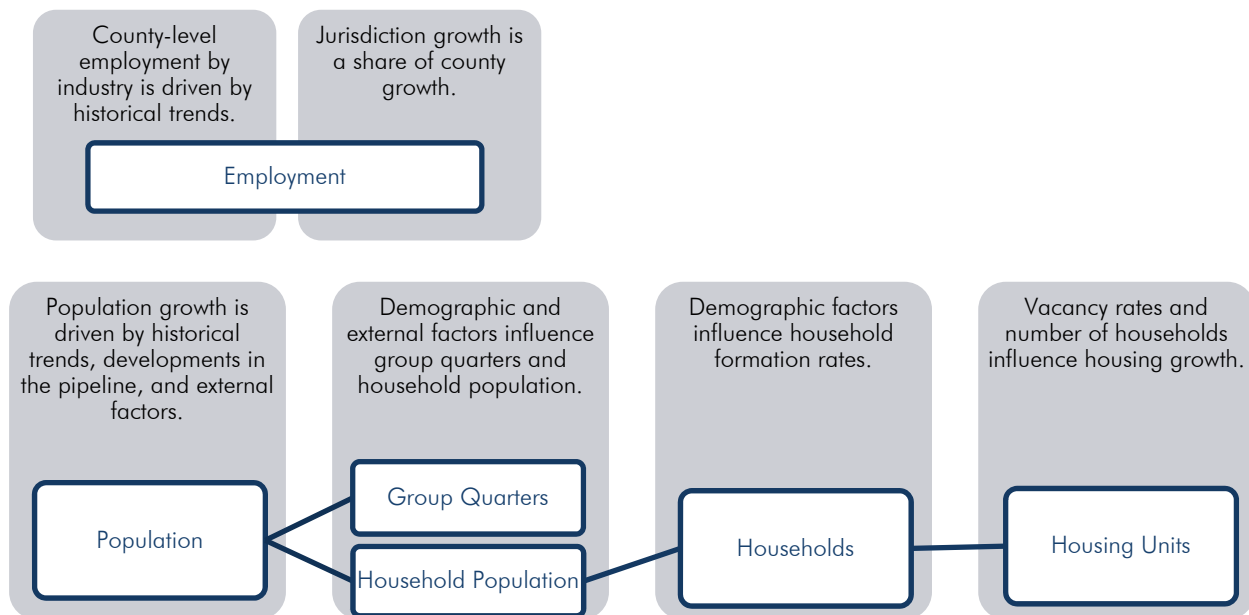
This forecast projects that the region's population will grow by approximately 120,600 people between 2015 and 2040, for a total population of 883,300 in 2040. Of that growth, 57 percent (approximately 69,100 people) is expected to be in Monterey County, 15 percent (approximately 18,200 people) is expected to be in San Benito County and 28 percent (approximately 33,300 people) is expected to be in Santa Cruz County.

To house the region’s expected population growth, this forecast shows an increase of 42,600 housing units by 2040, for a total of approximately 305,300 units. Of that growth, 56 percent (approximately 24,000 houses) is expected to be in Monterey County, 13 percent (approximately 5,700 houses) is expected to be in San Benito County and 30 percent (approximately 12,900 houses) is expected to be in Santa Cruz County. Housing growth rates do not exactly parallel population growth rates because of local variations in average household size and vacancy rate, and because some population (e.g., at UCSC and CSUMB) is expected to be housed in group quarters facilities.

Subregional Allocation Methodology

Unlike the regional forecast, in which employment growth drives population and housing growth, the employment forecast is separate from the population and housing forecast in the subregional allocation. This separation reflects differing economic and demographic forces at the regional and local levels.

Figure 12: Subregional Allocation Process



1. Employment trends: For the county-level forecast, employment growth by industry is driven by historical trends (i.e., shift-share model). Total growth across the three counties is constrained by the region-level forecast. For each jurisdiction (cities and unincorporated balance of county), employment growth by industry is a constant share of the jurisdiction’s parent county’s growth in that industry.
2. Population trends: The jurisdiction level forecast is driven by three factors:
 - a. Historical trends (i.e., shift-share model)

2018 Regional Growth Forecast

- b. Anticipated future developments such as housing projects under development that are likely to be occupied within the forecast horizon
- c. External factors (e.g., universities, military, correctional facilities)

Each county's population forecast is a sum of the jurisdiction-level forecasts. All levels (county, city, unincorporated area) are constrained by the region-level forecast.

3. Household trends: Demographic factors (e.g., age, race/ethnicity) and external factors (e.g., major group quarters facilities like colleges and universities, correctional facilities, etc.) influence the household population and household formation rates (i.e., the number of people per household).
4. Housing Unit trends: Vacancy rates and the number of households influence housing growth.

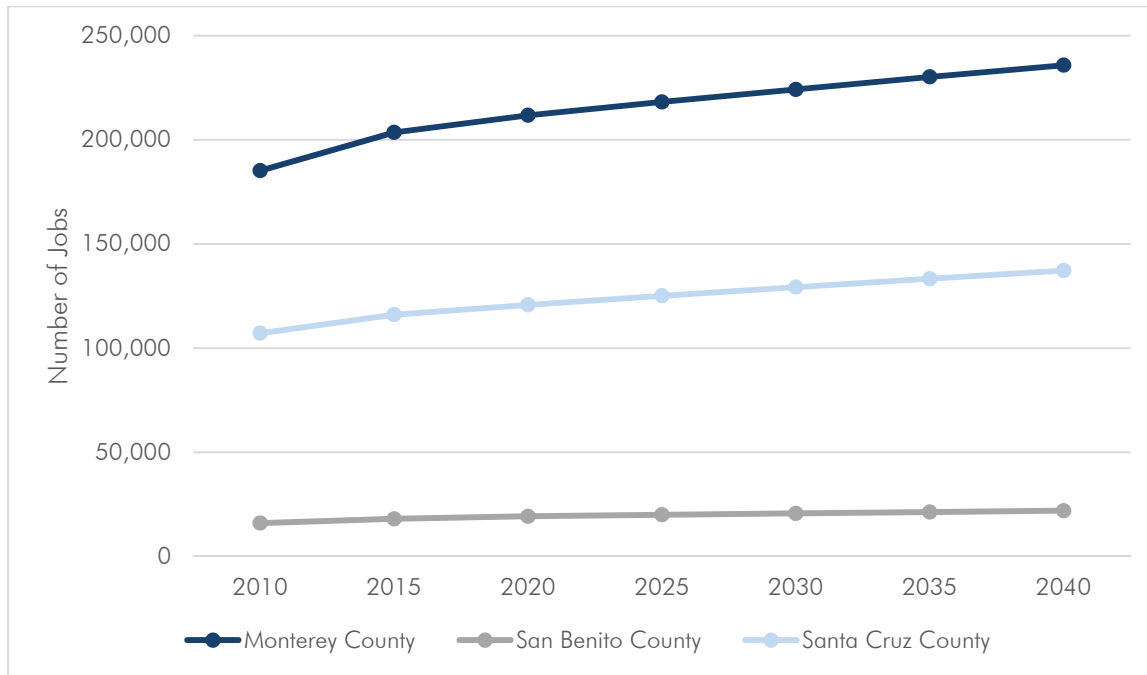
Data sources include the California Department of Finance, California Employment Development Department, InfoUSA and the U.S. Census Bureau.

This process resulted in draft estimates at the jurisdictional level that were used for discussion purposes with staff at each of the cities and counties within the region. In addition to the cities and counties, staff met with the Local Agency Formation Commissions (LAFCOs) for each county, the Fort Ord Reuse Authority, the University of California, Santa Cruz (UCSC) and California State University, Monterey Bay (CSUMB) to discuss the results. Adjustments were made to the forecast based on these conversations to incorporate growth on the basis of planned developments, specific and General Plan research and economic development plans. The process of revision and meeting with local jurisdictions one-on-one was repeated several times to reach a consensus on the forecast.

Step 1: Employment

The 2018 RGF projects that the region will add 57,400 jobs between 2015 and 2040, for a total of 395,000 jobs by 2040. Of that growth, 56 percent (approximately 32,300 jobs) is expected to be in Monterey County, seven percent (approximately 3,900 jobs) is expected to be in San Benito County and 37 percent (approximately 21,200 jobs) is expected to be in Santa Cruz County.

Figure 13: Employment Forecast by County



Sources: California Employment Development Department, forecast by PRB and AMBAG.

Method for Producing the County and Sub-County Employment Forecast

The subregional employment forecast incorporated a two-step process: a county-level forecast and a jurisdiction-level allocation.

In order to disaggregate the tri-county regional industry employment forecast by county, AMBAG staff selected what is known as a Classical Shift-Share model. The Classical Shift-Share formula is similar to the Implicit Shift-Share formula used to disaggregate the population forecast, except that it is comprised of three mathematical functions rather than two. In this case, they are referred to as the regional share, industry mix and competitive shift functions. The regional share function estimates what employment growth in a certain industry would look like in the local area (i.e., county), if it were to grow at the same rate as the total all-industry employment in the region as a whole. The second industry mix function then adjusts for the difference in the rate of employment growth in a certain industry, compared to all industry employment. The industry mix function is calculated using regional employment values. The third function, known as the competitive shift, adjusts the estimate to account for faster or slower industry employment growth in the county, compared to the region.

Figure 14: Classical Shift-Share Equation

$$E_i^{t+n} = E_i^t \left[\frac{R_A^{t+n}}{R_A^t} + \left(\frac{R_i^{t+n}}{R_i^t} - \frac{R_A^{t+n}}{R_A^t} \right) + \alpha \left(\frac{E_i^t}{E_i^{t-m}} - \frac{R_i^t}{R_i^{t-m}} \right) \right]$$

E = local Value R = Regional Value
 i = industry A = All industries

To produce this forecast, PRB and AMBAG used industry employment data from the California Employment Development Department (EDD). One important limitation of the EDD industry employment dataset is that it excludes all self-employed persons, unpaid family workers and private household employees. To supplement the industry employment dataset, staff used data from the EDD projection series (which contains historical and forecast self-employment numbers).

Sub-County Disaggregation Method for Employment

To develop the baseline disaggregation model for employment by jurisdiction, staff began by collecting historic employment data from InfoUSA. While originally the intent was to collect data from the EDD, EDD was unable to provide this data in a timely fashion. The InfoUSA data is based off of hundreds of different sources including but not limited to postal records, white pages listings, new business registrations, utility connections, real estate data (deeds & assessments) and industry directories. The database is then verified and supplemented with regular phone surveys. InfoUSA data is used by many other regional Councils of Governments to conduct forecast work and is a reputable source of data.

The InfoUSA data were used to calculate the share of employment for each industry in each jurisdiction in 2015. This percent share was then carried forward to future years in order to calculate the number of jobs located in each jurisdiction by industry. While the County level totals use the Classical Shift-Share method as described above, the sub-county level forecast is a constant share approach. However, because the sub-county level forecasts are based on the County totals by industry the Classical Shift-Share method does influence the sub-county trends.

A preliminary draft forecast was distributed to planning staff at each jurisdiction. AMBAG staff held one-on-one meetings to gather comments and additional information from planning staff at each jurisdiction. (See Attachment 1 for a list of meeting dates, times, locations and attendees.) Staff then used economic studies, entitled development, the establishment of enterprise zones and other information from local planners to supplement the employment assumptions at the jurisdictional level. These comments and additional pieces of information were incorporated into the current draft of the forecast. While there is flexibility built into the forecasting process at the subregional level, the total regional and county level employment figures were not changed.

Table 7: Subregional Employment Forecast

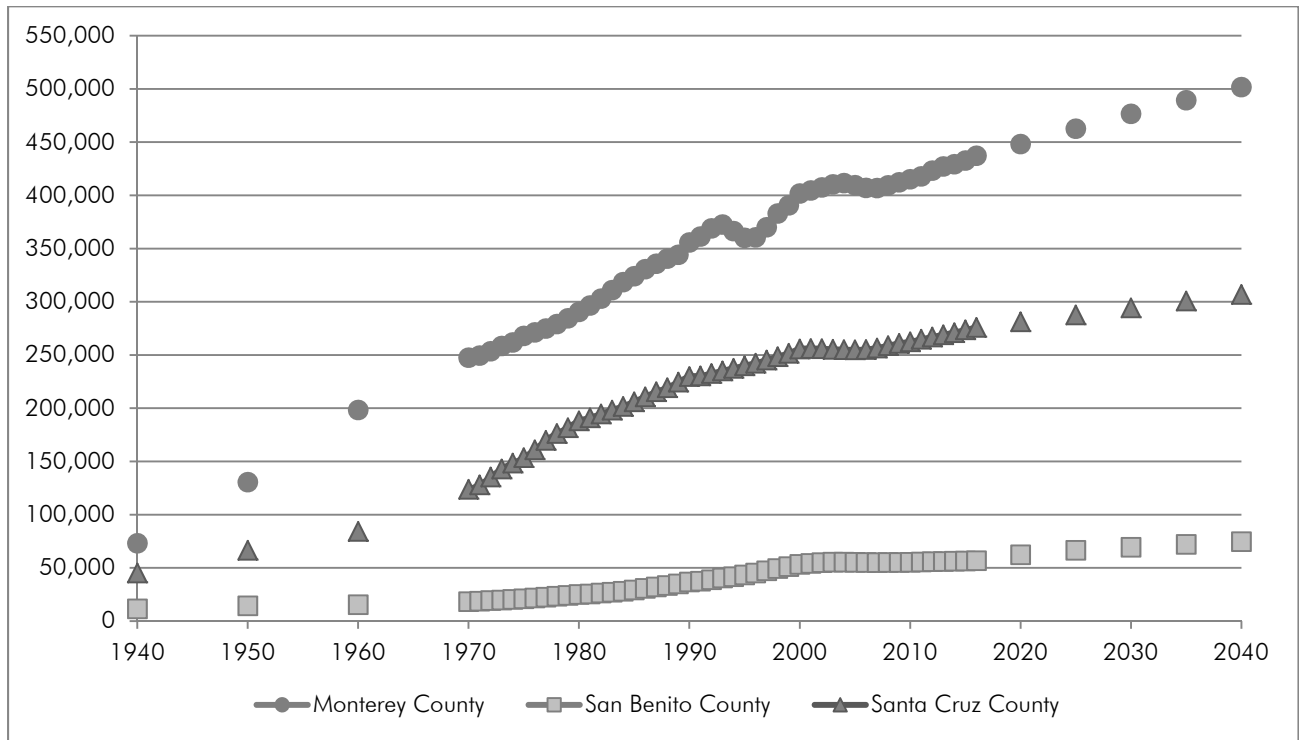
Geography	2015	2020	2025	2030	2035	2040	Change 2015-2040	
							Numeric	Percent
AMBAG Region	337,600	351,800	363,300	374,100	384,800	395,000	57,400	17%
Monterey County	203,550	211,799	218,203	224,207	230,212	235,822	32,272	16%
Carmel-By-The-Sea	2,935	2,998	3,096	3,195	3,289	3,378	443	15%
Del Rey Oaks	359	371	387	404	418	432	73	20%
Gonzales	4,477	4,963	5,064	5,166	5,278	5,371	894	20%
Greenfield	7,024	7,552	7,729	7,813	7,911	7,982	958	14%
King City	4,441	4,692	4,862	5,013	5,154	5,287	846	19%
Marina	6,340	6,649	6,886	7,140	7,373	7,620	1,280	20%
Monterey	34,030	34,434	35,970	37,405	38,814	40,173	6,143	18%
Pacific Grove	5,000	5,093	5,272	5,466	5,637	5,808	808	16%
Salinas	64,396	67,270	69,660	71,958	74,160	76,294	11,898	18%
Sand City	1,517	1,569	1,633	1,698	1,758	1,810	293	19%
Seaside	9,650	10,161	10,455	10,726	11,020	11,299	1,649	17%
Soledad	3,442	3,584	3,694	3,786	3,885	3,978	536	16%
Balance Of County	59,939	62,503	63,497	64,438	65,516	66,390	6,451	11%
San Benito County	18,000	19,240	19,957	20,617	21,264	21,913	3,913	22%
Hollister	13,082	14,035	14,608	15,132	15,650	16,172	3,090	24%
San Juan Bautista	559	591	615	639	662	685	126	23%
Balance Of County	4,359	4,614	4,734	4,846	4,951	5,056	697	16%
Santa Cruz County	116,050	120,761	125,141	129,275	133,324	137,265	21,215	18%
Capitola	7,062	7,199	7,464	7,727	7,979	8,228	1,166	17%
Santa Cruz	40,986	43,090	44,647	46,153	47,616	49,085	8,099	20%
Scotts Valley	7,475	7,612	7,820	8,004	8,180	8,349	874	12%
Watsonville	22,644	23,482	24,382	25,200	26,008	26,772	4,128	18%
Balance Of County	37,883	39,339	40,826	42,191	43,541	44,831	6,948	18%

Sources: Data for 2015 from InfoUSA and the California Employment Development Department. Forecast years were prepared by AMBAG and PRB.

Step 2: Population

This forecast projects that the region’s population will grow by approximately 120,600 people between 2015 and 2040, for a total population of 883,300 in 2040. Of that growth, 57 percent (approximately 69,100 people) is expected to be in Monterey County, 15 percent (approximately 18,200 people) is expected to be in San Benito County and 28 percent (approximately 33,300 people) is expected to be in Santa Cruz County.

Figure 15: Population in Monterey, San Benito and Santa Cruz Counties 1940-2040



Sources: Data for years 1940-2015 are from the U.S. Census Bureau and California Department of Finance. Forecast years were prepared by AMBAG and PRB.

Table 8: Subregional Population Forecast

Geography	2015	2020	2025	2030	2035	2040	Change 2015-2040	
							Numeric	Percent
AMBAG Region	762,676	791,600	816,900	840,100	862,200	883,300	120,624	16%
Monterey County	432,637	448,211	462,678	476,588	489,451	501,751	69,114	16%
Carmel-By-The-Sea	3,824	3,833	3,843	3,857	3,869	3,876	52	1%
Del Rey Oaks	1,655	1,949	2,268	2,591	2,835	2,987	1,332	80%
Gonzales	8,411	8,827	10,592	13,006	15,942	18,756	10,345	123%
Greenfield	16,947	18,192	19,425	20,424	21,362	22,327	5,380	32%
King City	14,008	14,957	15,574	15,806	15,959	16,063	2,055	15%
Marina	20,496	23,470	26,188	28,515	29,554	30,510	10,014	49%
Marina balance	19,476	20,957	22,205	22,957	23,621	24,202	4,726	24%
CSUMB (portion)	1,020	2,513	3,983	5,558	5,933	6,308	5,288	518%
Monterey	28,576	28,726	29,328	29,881	30,460	30,976	2,400	8%
Monterey balance	24,572	24,722	25,324	25,877	26,456	26,972	2,400	10%
DLI & Naval Postgrad	4,004	4,004	4,004	4,004	4,004	4,004	0	0%
Pacific Grove	15,251	15,349	15,468	15,598	15,808	16,138	887	6%
Salinas	159,486	166,303	170,824	175,442	180,072	184,599	25,113	16%
Sand City	376	544	710	891	1,190	1,494	1,118	297%
Seaside	34,185	34,301	35,242	36,285	37,056	37,802	3,617	11%
Seaside balance	26,799	27,003	27,264	27,632	28,078	28,529	1,730	6%
Fort Ord (portion)	4,450	4,290	4,340	4,490	4,690	4,860	410	9%
CSUMB (portion)	2,936	3,008	3,638	4,163	4,288	4,413	1,477	86%
Soledad	24,809	26,399	27,534	28,285	29,021	29,805	4,996	20%
Soledad balance	16,510	18,100	19,235	19,986	20,722	21,506	4,996	30%
SVSP & CTF	8,299	8,299	8,299	8,299	8,299	8,299	0	0%
Balance Of County	104,613	105,361	105,682	106,007	106,323	106,418	1,805	2%
San Benito County	56,445	62,242	66,522	69,274	72,064	74,668	18,223	32%
Hollister	36,291	39,862	41,685	43,247	44,747	46,222	9,931	27%
San Juan Bautista	1,846	2,020	2,092	2,148	2,201	2,251	405	22%
Balance Of County	18,308	20,360	22,745	23,879	25,116	26,195	7,887	43%
Santa Cruz County	273,594	281,147	287,700	294,238	300,685	306,881	33,287	12%
Capitola	10,087	10,194	10,312	10,451	10,622	10,809	722	7%
Santa Cruz	63,830	68,381	72,091	75,571	79,027	82,266	18,436	29%
Santa Cruz balance	46,554	49,331	51,091	52,571	54,027	55,266	8,712	19%
UCSC	17,276	19,050	21,000	23,000	25,000	27,000	9,724	56%
Scotts Valley	12,073	12,145	12,214	12,282	12,348	12,418	345	3%
Watsonville	52,562	53,536	55,187	56,829	58,332	59,743	7,181	14%
Balance Of County	135,042	136,891	137,896	139,105	140,356	141,645	6,603	5%

Sources: Data for 2015 are from the U.S. Census Bureau and California Department of Finance. Forecast years were prepared by AMBAG and PRB.

Method for Producing the County and Sub-County Population Forecast

In order to disaggregate the tri-county regional population forecast, PRB and AMBAG implemented the Implicit Shift-Share method. This particular technique was chosen because it provides a relatively simple, yet rigorous, method for estimating the future geographic distribution of the regional population based on historic estimates of local and regional population growth.

The Implicit Shift-Share formula is comprised of two distinct mathematical functions. These are sometimes known as the regional share and the local shift. The regional share function calculates what the total population growth in the local area (i.e., a city or county) would be if that area were to grow at the same rate as the region as a whole. The second function then adjusts for historic changes in the local area’s share of the total regional population. Combined with an accurate estimate of the size of the base population obtained from the 2010 Decennial Census, the regional share and local shift functions provide a reasonable estimate of the future local area population, taking into account past changes in the percentage share of the regional population. Historical data are from the Department of Finance. The Department of Finance does benchmark their historical estimates to the Decennial Census for 1990, 2000 and 2010.⁴

Figure 16: Implicit Shift-Share Equation

$$E^{t+n} = E^t \left(\frac{R^{t+n}}{R^t} \right) + \alpha R^{t+n} \left(\frac{E^t}{R^t} - \frac{E^{t-m}}{R^{t-m}} \right) \quad \begin{array}{l} E = \text{Local Value} \\ R = \text{Regional Value} \end{array}$$

To produce jurisdiction-level forecast, AMBAG and PRB compiled a database of historical population by jurisdiction. This database included information on population growth (or decline) as well as details for “special” populations (e.g., college students, military personnel, prisoners). (Special populations are described in more detail in the section “Adjustments for Special Populations,” below.)

AMBAG and PRB compiled historical data⁵ to track trends in, and relied upon institutional/facility plans to produce the population forecast for the following areas:

- Marina:
 - Fort Ord (portion)
 - CSUMB (portion)
- Monterey
 - Defense Language Institute and Naval Postgraduate School

⁴ Department of Finance, E-8 Historical Population and Housing Estimates for Cities, Counties and the State, 1990-2000, August 2008; Department of Finance, E-4 Population Estimates for Cities, Counties and the State, 2001-2010, September 2011 and Department of Finance, E-1 Population Estimates for Cities, Counties and the State, 2011 and 2012, August 2009.

⁵ Sources include the California Department of Finance, U.S. Census Bureau and institutional records.

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- Seaside
 - Fort Ord (portion)
 - CSUMB (portion)
- Soledad
 - SVSP & CTF
- Balance of County
 - CSUMB (portion)
- Santa Cruz
 - UCSC

AMBAG and PRB then applied the implicit shift-share methodology to the balance of population in each jurisdiction to produce a draft of the first forecast increment. The benchmark period for the shift-share model was 2010-2015, and the model was applied to produce the draft 2020 forecast.

Forecast years 2025-2040, for this initial draft, presumed that each jurisdiction maintained a constant share of the region's population. This approach, using shift-share for the first increment, and constant-share thereafter, was implemented in the 2014 RGF to ensure that jurisdictions that experienced population loss during the benchmark period would not continue to decline. This forecast assumption is reasonable given that any jurisdiction may experience a period of temporary population decline, even when the long-term trend has been stability or growth.

Further initial adjustments were made to reflect population growth associated with housing under construction or in the permit pipeline.

AMBAG staff then met with representatives from each jurisdiction to ground truth the forecast with respect to anticipated future growth and development in the pipeline. (See Appendix A for a full list of meetings.)

Step 3: Housing

To house the region's expected population growth, this forecast shows an increase of 42,600 housing units by 2040, for a total of approximately 305,300 units. Of that growth, 56 percent (approximately 24,000 houses) is expected to be in Monterey County, 13 percent (approximately 5,700 houses) is expected to be in San Benito County and 30 percent (approximately 12,900 houses) is expected to be in Santa Cruz County.

Table 9: Subregional Housing Forecast

Geography	2015	2020	2025	2030	2035	2040	Change 2015-2040	
							Numeric	Percent
AMBAG Region	262,660	273,606	282,368	290,225	297,851	305,293	42,633	16%
Monterey County	139,177	144,491	149,032	153,708	158,151	163,186	24,009	17%
Carmel-By-The-Sea	3,417	3,432	3,436	3,441	3,456	3,462	45	1%
Del Rey Oaks	741	874	1,020	1,180	1,297	1,361	620	84%
Gonzales	1,987	2,109	2,508	3,083	3,792	4,456	2,469	124%
Greenfield	3,794	4,140	4,403	4,635	4,863	5,081	1,287	34%
King City	3,283	3,672	3,863	4,058	4,210	4,276	993	30%
Marina	7,334	8,172	8,776	9,324	9,692	10,014	2,680	37%
Marina balance	--	8,021	8,463	8,793	9,138	9,414	--	--
CSUMB (portion)	--	151	313	531	554	600	--	--
Monterey	13,637	13,846	14,126	14,322	14,627	14,908	1,271	9%
Monterey balance	13,637	13,846	14,126	14,322	14,627	14,908	1,271	9%
DLI & Naval Postgrad	0	0	0	0	0	0	0	--
Pacific Grove	8,184	8,271	8,303	8,343	8,431	8,516	332	4%
Salinas	43,001	44,797	46,683	48,805	50,505	53,043	10,042	23%
Sand City	176	238	298	371	493	619	443	252%
Seaside	10,913	11,126	11,264	11,517	11,878	12,342	1,429	13%
Seaside balance	--	8,932	8,984	9,132	9,288	9,447	--	--
Fort Ord (portion)	1,579	1,678	1,731	1,835	2,039	2,343	764	48%
CSUMB (portion)	--	516	549	550	551	552	--	--
Soledad	3,927	4,338	4,552	4,735	4,926	5,107	1,180	30%
Soledad balance	3,927	4,338	4,552	4,735	4,926	5,107	1,180	30%
SVSP & CTF	0	0	0	0	0	0	0	--
Balance Of County	38,783	39,476	39,800	39,894	39,981	40,001	1,218	3%
San Benito County	18,262	19,936	21,285	22,191	23,155	23,955	5,693	31%
Hollister	10,757	11,690	12,177	12,643	13,114	13,522	2,765	26%
San Juan Bautista	750	817	846	870	894	914	164	22%
Balance Of County	6,755	7,429	8,262	8,678	9,147	9,519	2,764	41%
Santa Cruz County	105,221	109,179	112,051	114,326	116,545	118,152	12,931	12%
Capitola	5,537	5,601	5,642	5,703	5,762	5,823	286	5%
Santa Cruz	23,535	26,365	27,706	28,634	29,443	30,167	6,632	28%
Santa Cruz balance	--	24,601	25,732	26,468	27,052	27,573	--	--
UCSC	--	1,764	1,974	2,166	2,391	2,594	--	--
Scotts Valley	4,691	4,750	4,818	4,869	4,887	4,895	204	4%
Watsonville	14,131	14,615	15,121	15,614	16,053	16,426	2,295	16%
Balance Of County	57,327	57,848	58,764	59,506	60,400	60,841	3,514	6%

Sources: Data for 2015 are from the U.S. Census Bureau and California Department of Finance. Forecast years were prepared by AMBAG and PRB.

Method for Producing the County and Sub-County Housing Forecast

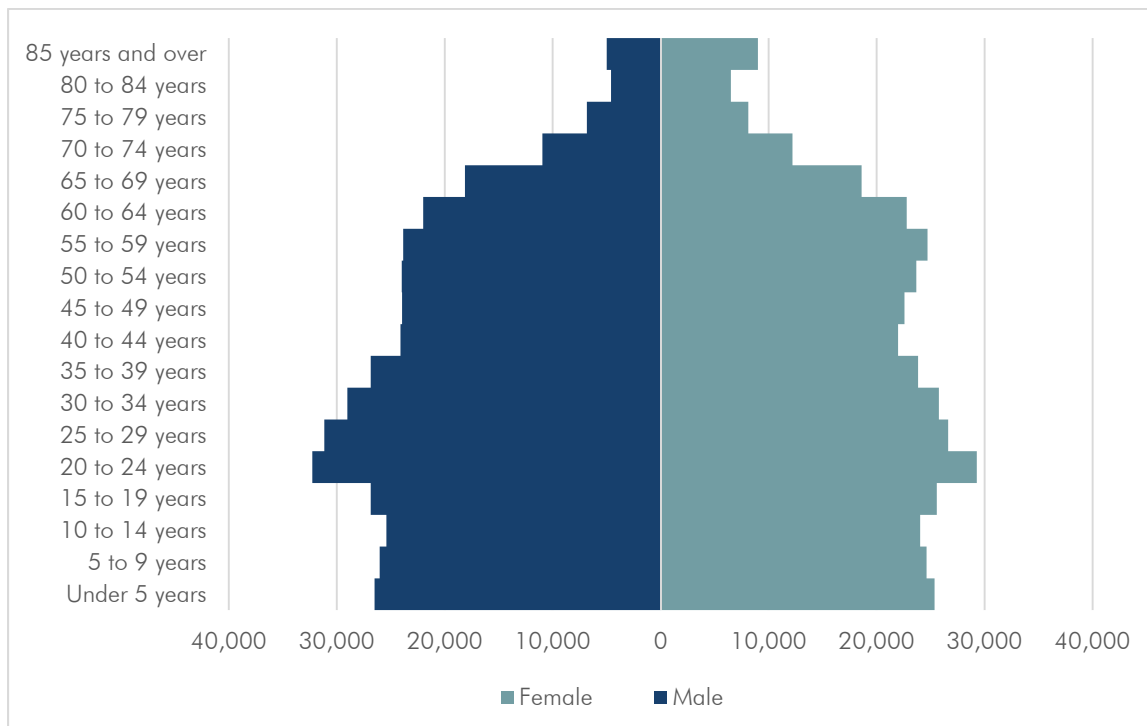
In order to convert county level population forecast figures into the forecast of housing units, staff created a set of demographic profiles that describe the age, sex, race, and ethnicity characteristics of the future population. The basis for the demographic profiles is a set of detailed population

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projections developed by the California Department of Finance in 2014.⁶ The profiles were developed by calculating the share of total projected population growth within each county that may be attributed to each age, sex, race and ethnic category. Age and sex are shown below in Figures 16 and 17 below.

The next step was to calculate the total population change forecasted within each category during each five-year increment. By dividing the projected population change within each category by the total population change for each county, staff was able to derive a set of growth shares, or growth coefficients, for each age, sex, race and ethnicity category. Finally the new disaggregated county level estimates were multiplied by this set of growth shares to generate estimates of the regional and county-level population by detailed age, sex, race and ethnicity category.

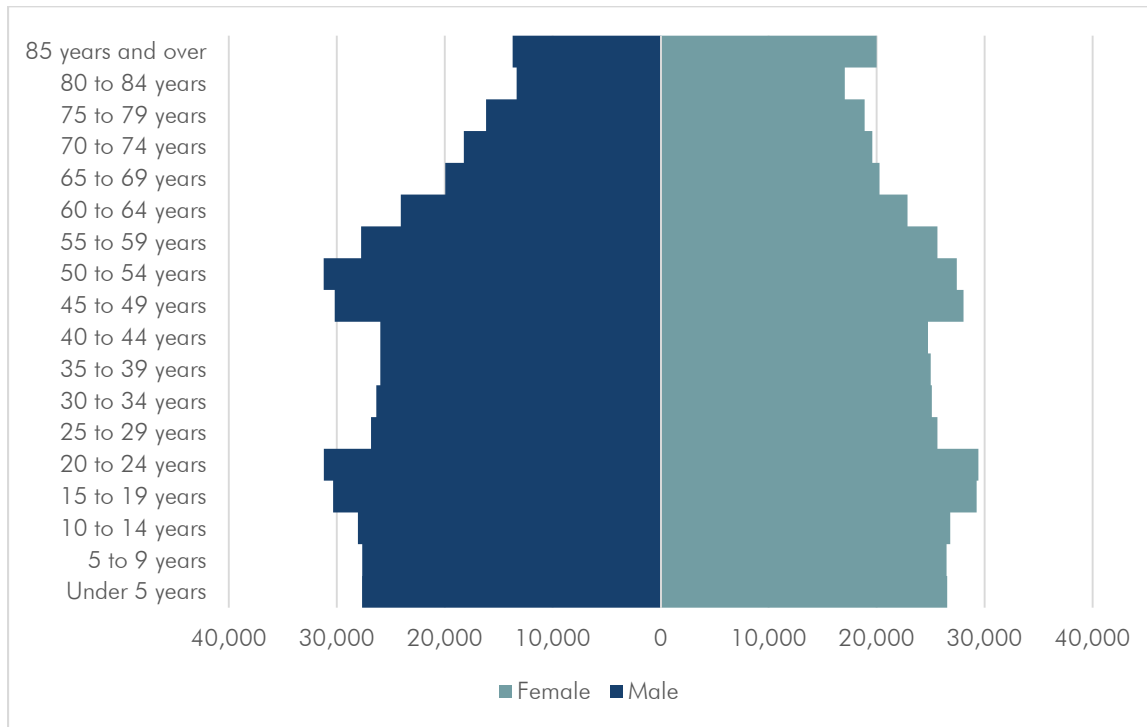
Figure 17: Population Size and Age Structure of AMBAG Region in 2015



Source: California Department of Finance.

⁶ In December 2014, DOF published State and County Population Projections - Race/Ethnicity and 5-Year Age Groups. As of July 2016, that was the most current forecast available.

Figure 18: Population Size and Age Structure of AMBAG Region in 2040



Source: Forecast prepared by AMBAG and PRB.

The first step toward translating the county demographic profiles into estimates of total housing units was to subtract the group quarters population from the total population. (For an explanation of Group Quarters, see Attachment 4.) Staff calculated a set of group quarters rates by dividing the group quarters population in each age, sex, race and ethnic category as provided by the 2010 Census⁷ by the total 2010 age, sex, race and ethnic population in each county. The team then updated these 2010 rates to reflect 2015 population and group quarters population estimates from the Department of Finance. In order to estimate the group quarters population in each county, staff multiplied the group quarters rates within each category by the total population in each category. This population was then removed from the total population to provide an estimate of the number of people living in households.

Next, to generate estimates of the total number of households in each county, staff calculated a set of head of householder rates. These also are frequently referred to as “headship rates” or

⁷ U.S. Census Bureau, 2010 Decennial Census, Summary File 1, Table QTP-12.

“household formation rates.” As with the group quarters rates, these are derived from 2010 Census data.⁸ To generate the head of householder rates, staff divided the 2010 estimates of the number of individuals within each age, race and ethnic category who were reported to be the head of a household by the total number of individuals within each age, race, and ethnic population category less the group quarters population.⁹ By multiplying the base-year household population estimates for each category by the head of householder rates, staff derived new set of head of household estimates, which were controlled to published data from the California Department of Finance. Note that for each head of household there is, by definition, one household. Thus, by adding up all of the head of householders, staff was able to generate estimates of the total number of households within each county.¹⁰

Finally, vacant units were added to the total number of households in order to obtain an estimate of housing units. Vacancy data was obtained from the Census for 1990, 2000 and 2010 and from the Department of Finance for in between years.¹¹ To better understand what a normal housing vacancy rate might be, staff reviewed historical data on residential vacancy for the last two decades. Once a vacancy rate was established, this was used to calculate the total number of vacant housing units, using the number of households as a proxy for the number of occupied housing units. By adding together estimates of the total number of vacant and occupied housing units, staff derived estimates of the total housing stock within each county.

Forecasting Sub-County Population, Households and Housing Units

To derive a city-level forecast of population, household population, households, and housing units, staff used a simplified version of the methodology described above. The MPO is not required to develop detailed demographic characteristics for city-level estimates. As such the household and

⁸ U.S. Census Bureau, 2010 Decennial Census, Summary File 2, Table PCT-12.

⁹ The householders data for the "Some other race alone, not Hispanic or Latino" and "Native Hawaiian and Other Pacific Islander alone, not Hispanic or Latino" categories of population in San Benito County was suppressed because there was not a population of greater than 100. For these ethnic categories the regional rate was used instead given the lack of data on this population.

¹⁰ The Census does include "second dwelling units" or accessory units within their counts of households if the unit has its own bathroom and kitchen facilities. However, there are likely illegal "granny units" that are not counted through this process.

¹¹ Department of Finance, E-8 Historical Population and Housing Estimates for Cities, Counties and the State, 1990-2000, August 2008; and Department of Finance, E-5 Population and Housing Estimates for Places, 2001-2010, with 2000 Benchmark, September 2011.

housing unit conversion was done using aggregate group quarters and household formation rates for each city, as reported in the 2010 Census.¹² Vacancy rates were derived from a 25-year average as reported from the Department of Finance.¹³ The Department of Finance does benchmark their estimates to the decennial Census.

Some of the jurisdictions within the region show a declining population over the last 10 to 20 years. Because the Implicit Shift-Share method was used for estimating 2020 population and the method reflects the change in population over time, for those jurisdictions that have experienced population decline there will be a continuation of that decline reflected for the year 2020. After 2020 the share of the regional population calculated for each jurisdiction was held constant. This has the effect of showing an increase in population after 2020 even if the 2020 estimate is lower than the 2010 estimate. In other words, while the 2020 estimate will reflect historical constraints to population growth by showing a decline, there is too little information to know whether those same constraints will exist after 2020, so instead of assuming continual decline, growth was held at a constant. There will be forecast revisions before 2020 that will take into account changes of these trends through an analysis of historical years.

Section 4: Demographic History of the AMBAG Region

The AMBAG region grew at a faster rate than California in the 1960s and 1970s, and grew at approximately the same rate as the state in the 1980s (24% in AMBAG region, 26% statewide). Both the state and the AMBAG region grew at the same rate in the 1990s (14%). The AMBAG region's growth fell far below the statewide average between 2000 and 2010, increasing by only three percent while the state grew by 10 percent.

AMBAG Region: 1970 to 1990

Between 1970 and 1990 the AMBAG region population grew by more than 110,000 each decade, increasing by 29 percent from 1970 to 1980 and by 24 percent from 1980 to 1990. Growth slowed in the 1990s. The slowdown can be attributed, in part, to the closure of Fort Ord in 1994,

¹² U.S. Census Bureau, 2010 Decennial Census, Summary File 1, Tables QTP-12 and PCT-12.

¹³ Department of Finance, E-8 Historical Population and Housing Estimates for Cities, Counties and the State, 1990-2000, August 2008; Department of Finance, E-4 Population Estimates for Cities, Counties and the State, 2001-2010, September 2011 and Department of Finance, E-5 Population Estimates for Cities, Counties and the State, 2010-2016, July 2016.

which is described in more detail in the “Adjustments” section, below. These population losses greatly affected the growth rates of the communities of Marina and Seaside prior to 2000. Concurrent civilian job losses affected population growth in the AMBAG region more broadly. The AMBAG region population grew by 88,500 (14%) between 1990 and 2000.

AMBAG Region: 2000 to 2010

In the following decade, population growth slowed considerably. The AMBAG region population grew by only 22,100 (3%) during the decade between 2000 and 2010. This pattern of slowing population growth reflects an aging population and lower net migration into the AMBAG region. Lowered net migration could be due to several factors including but not limited to water resource constraints, the after-effects of the closure of Fort Ord, as well as increasing housing costs followed by a major recession.

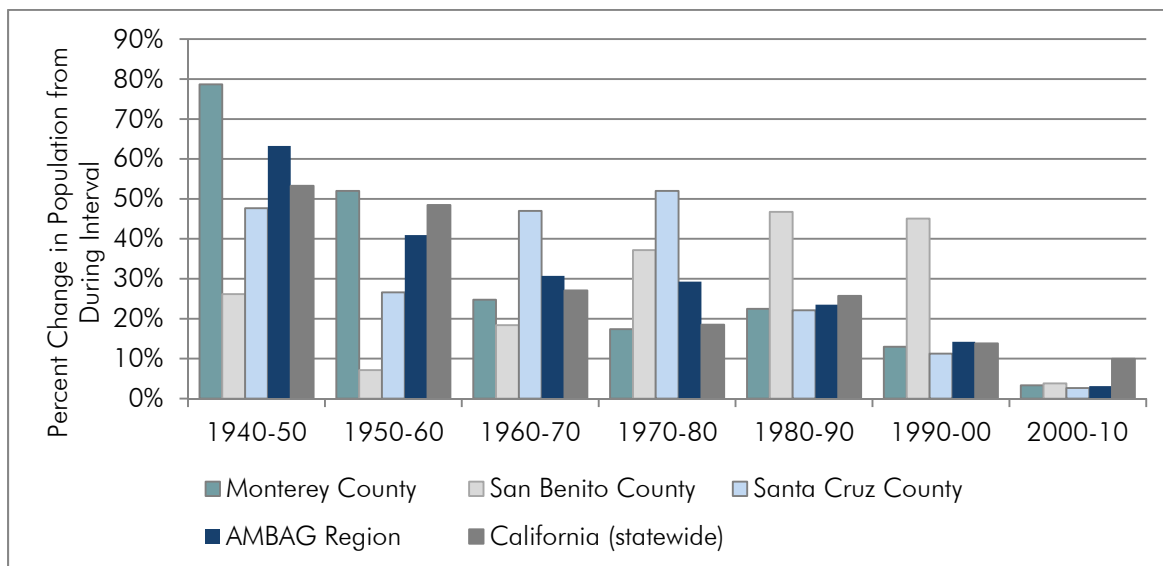
AMBAG Region: 2010 to 2015

In the five years since the decennial census, population growth began to return to historical levels. The AMBAG region population grew by nearly 30,000 (4%) during the period between 2010 and 2015. This recovery in population growth reflects post-recession recovery.

Demographic History of AMBAG Counties

Population growth details for all three counties are shown below. County-specific summaries follow the charts.

Figure 19: Population Growth Rates in Monterey County, San Benito County, Santa Cruz County, AMBAG Region and California (statewide) 1940-2010

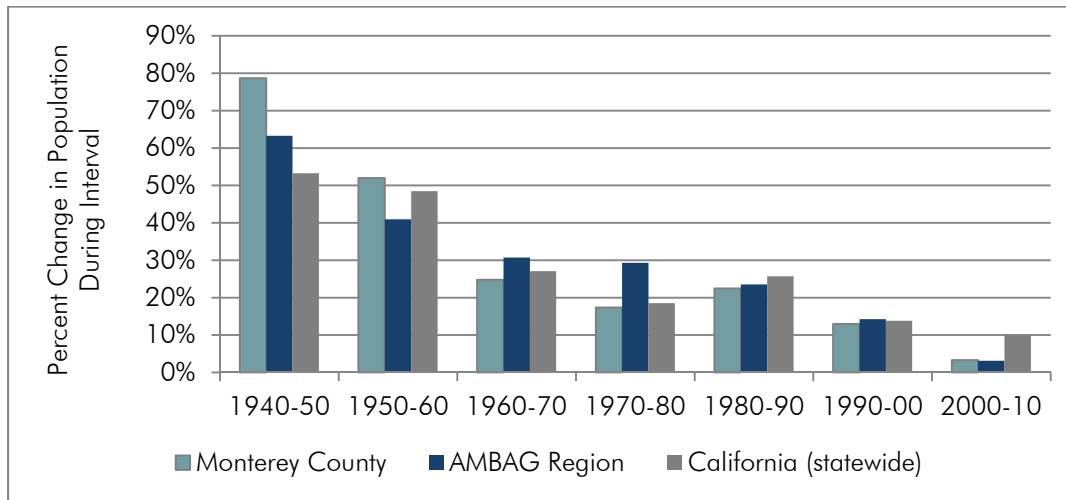


Source: California Department of Finance

Monterey County

Between 1960 and 2000, Monterey County has grown at a rate slower than the AMBAG region as a whole. Between 2000 and 2010 Monterey County grew at the same rate as the region. (See Figure 20)

Figure 20: Population Growth Rate in Monterey County, AMBAG Region and California (statewide) 1940-2010



Source: California Department of Finance

As a result of the closure of Fort Ord, Monterey County experienced a population decline in the middle of the 1990s, yet population growth rebounded later in the decade. The county registered 13 percent growth (an increase of 46,100) between 1990 and 2000. (See Figures 2 and 3)

The 1990s also saw the opening of two large institutions: California State University, Monterey Bay and Salinas Valley State Prison. Both are described in more detail in the Special Populations section below.

While the County as a whole grew, six of the county’s thirteen jurisdictions experienced population loss during the 1990s (Carmel-By-The-Sea, -4%; Del Rey Oaks, -1%, Marina, -29%, Monterey, -7%, Pacific Grove, -4%, Seaside, -15%). Conversely, the population of Salinas grew by nearly 34,000 during the decade. Soledad also grew at a rapid clip (16,000 population) largely as the result of Salinas Valley State Prison opening in 1996.

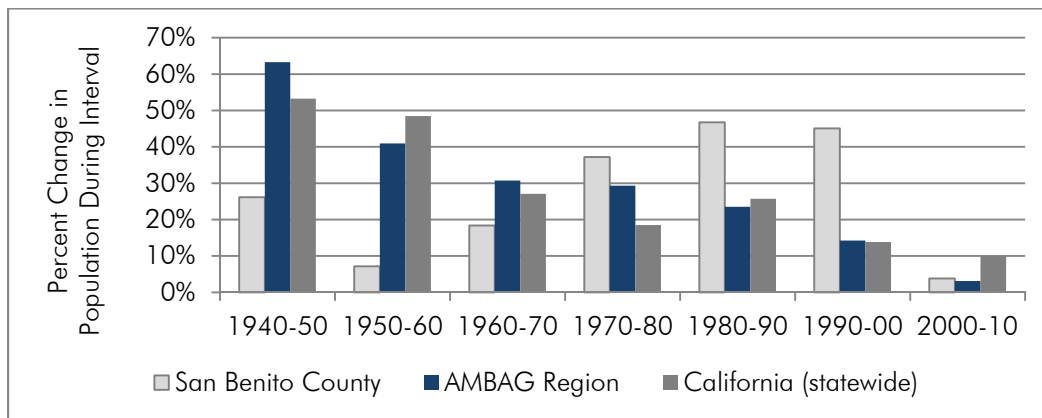
The following decade saw much slower growth, with an increase of less than 13,300 (3%) between 2000 and 2010. Five jurisdictions lost population (Carmel-By-The-Sea, -9%; Del Rey Oaks, -2%, Monterey, -6%, Pacific Grove, -3%, unincorporated Monterey County, -1%). The city of Seaside remained virtually unchanged.

The cities of Salinas and Soledad continued growing (5% and 12%, respectively). Gonzales, Greenfield, King City and Marina also grew. Sand City recorded a rapid rate of population growth due to its small size, but added only 73 people.

San Benito County

While San Benito County grew at a rate much slower than the AMBAG region prior to the 1970s, the county saw rapid population growth in the 1970s, 1980s, and 1990s. (See Figure 21)

Figure 21: Population Growth Rate in San Benito, AMBAG Region and California (statewide) 1940-2010



Source: California Department of Finance

San Benito County registered rapid population growth, adding more than 16,500 population (45%) between 1990 and 2000. During this decade the city of Hollister nearly doubled in population (78%) while the population of San Juan Bautista declined (-1%).

San Benito’s population growth slowed to four percent (2,000 population) between 2000 and 2010. The trend of the 1990s was reversed. Hollister grew by only one percent while San Juan Bautista increased by 20 percent.

Santa Cruz County

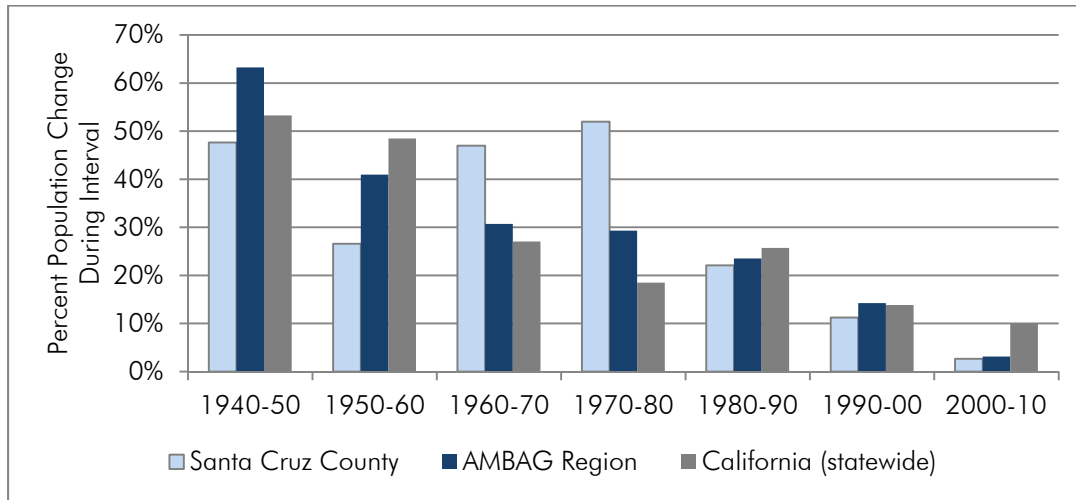
Santa Cruz County grew at a rate faster than the AMBAG region in the 1970s and 1980s, but grew more slowly in every other decade from 1940-2010. (See Figure 22)

Santa Cruz County grew by more than 25,800 (11%) between 1990 and 2000. The fastest-growing jurisdiction in Santa Cruz County between 1990 and 2000 was Watsonville (42%) followed by Scotts Valley (31%). Capitola’s population fell during the decade (-1%).

The County’s growth slowed considerably, adding just under 6,800 population (3%) between 2000 and 2010. The fastest-growing jurisdiction in Santa Cruz County between 2000 and 2010 was Watsonville (16%, including the annexation area, 11% without) followed by Santa Cruz (10%). Scotts

Valley, which grew rapidly during the 1990s, showed only two percent population growth during the decade. Capitola’s population fell during the decade (-1%).

Figure 22: Population Growth Rate in Santa Cruz County, AMBAG Region and California (statewide) 1940-2010



Source: California Department of Finance

Adjustments for Special Populations

In small area demographic analysis, some populations grow or decline as a result of exogenous factors, rather than in response to demographic or economic conditions. For example, uniformed military populations, college populations, and prison populations may grow or decline as new facilities are added or older facilities are phased out of use. These population changes involve facilities that are outside the authority of local land use agencies and that change based on policy, rather than demographic, factors.

Changes in these facilities can result in population “shocks” that affect the rate of population change within an area, independent of larger demographic and economic trends.

As a result of their unique characteristics, these populations are referred to as “special populations” and are often treated separately in forecasting.

Special populations include people associated with military bases, tourists, prisons, and colleges and universities. The size of a special population may have no connection to the general trends affecting the area. A special population can be stable for long periods of time, balloon quickly, and deflate, or, in the case of military bases, disappear rapidly through a closure program. It is best to develop a detailed understanding of the nature of the special population and set out the projection for it separately.¹⁴

Over the past two decades, the AMBAG region has been home to several “special populations” including the military resident population at Fort Ord, the Defense Language Institute and Naval Postgraduate School, students at UCSC and CSUMB, and inmates at SVSP.

In the preliminary forecast, AMBAG staff began the shift-share analysis at 1996 to address the population “shocks” resulting from the closure of Fort Ord and the opening of both California State University Monterey Bay and the Salinas Valley State Prison. While this adjustment was effective at addressing some of the special population concerns, it has a key weakness: it does not allow for independent forecasting of special populations.

The following discussion provides a method for addressing that issue.

History of Special Populations in the AMBAG Region

Fort Ord

Established in 1917, Fort Ord was eliminated during the Base Realignment and Closure Act of 1990, closing in 1994. This resulted in the loss of more than 30,000 residents in Monterey County, primarily in the jurisdictions of Marina and Seaside, as described in the Fort Ord Reuse Plan:

Fort Ord has been a significant presence in Monterey County since 1917... maintained a large military population numbering approximately 14,500 military personnel and 17,000

¹⁴ Merc, Stuart. “Projections and Demand Analysis.” Planning and Urban Design Standards. published by the American Planning Association. Sept 2012.

<http://books.google.com/books?id=NXpncFYj73QC&pg=PA299&lpg=PA299&dq=%22special+population%22+forecasting&source=bl&ots=L2fSbUMT8R&sig=uV05NN3-rNYcpCr97xU2hTpYt6s&hl=en&sa=X&ei=eEC5UMT8O42tqAGAvIDQCQ&ved=0CG0Q6AEwCQ#v=onepage&q=%22special%20population%22%20forecasting&f=false>

*family members of active-duty personnel... the resident population of Fort Ord totaled 31,270 in 1991.*¹⁵

In addition...

*The on-post resident population was divided between the two municipalities of Marina and Seaside. Through 1990, 17,139 people (56%) were within the Seaside city limits and 13,321 people (44%) were within the Marina city limits (Harding Lawson Associates, 1991, Workplan remedial investigation/feasibility study, Fort Ord, CA).*¹⁶

These population losses greatly affected the communities of Marina and Seaside. However, the forecast was developed using the 2000 to 2015 time period as historical reference. By 2000 abnormalities in growth rates caused by the closure of Fort Ord had self-corrected. As the development plans for the remainder of the Fort Ord redevelopment area are implemented and the jurisdictions within the bounds of Fort Ord start to grow, population data will begin to reflect a growth rate that accounts for this growth.

Defense Language Institute and Naval Postgraduate School

The Army Language School, later renamed the Defense Language Institute, has been a presence in Monterey County since the end of World War II. The number of people living in group quarters at the Institute and Postgraduate School has been stable, at approximately 4,000, in recent years. Because of this stability, the 2018 RGF presumes no change to the population of these two institutions in future years.

University of California, Santa Cruz

Founded in 1965, the University of California, Santa Cruz grew to 9,800 students by the 1991-92 academic year, 10,885 students by the 1999-2000 academic year, and 16,300 full-time equivalent students in the 2009-2010 academic year.¹⁷ The most recent master plan projects full-time equivalent enrollment of 19,500 by 2020.¹⁸ In meetings with AMBAG staff, UCSC staff indicated that they expect growth of 300-500 students per year, resulting in a 2040 student forecast of 27,000-28,000.

¹⁵ Fort Ord Reuse Plan, Volume 1: Context and Framework. June 1997.

¹⁶ Fort Ord Reuse Plan, Volume 2: Reuse Plan Elements. June 1997.

¹⁷ University of California, Santa Cruz Department of Planning and Budget. <http://planning.ucsc.edu/irps/thirdWeek.asp> accessed December 2012. Figures based on 3-quarter average measured in the spring quarter of the academic year.

¹⁸ UC Santa Cruz Long-Range Development Plan 2005–2020. September 2006.

California State University, Monterey Bay

Founded in 1995, California State University Monterey, Bay grew to 2,265 students during the 1999-2000 school year and 4,000 students by 2010.¹⁹ Although not created by the Fort Ord Reuse Plan, the University is a significant component of the Base Reuse Plan and as it continues to grow will help to stimulate the economic development of the Fort Ord Area. The most recent master plan projects full-time equivalent student enrollment of 12,000 by 2025.²⁰ In meetings with AMBAG staff, CSUMB staff indicated that they expect growth to continue after 2025. AMBAG and PRB extrapolated student growth rates to forecast 13,700 students at CSUMB in 2040.

Salinas Valley State Prison and Soledad Correctional Training Facility

Opened in 1996, Salinas Valley State Prison has a design capacity of 3,888.²¹ According to annual reporting by the California Department of Finance, the facility had a resident population of 4,100 at the beginning of the 2000s decade and a population of 3,630 on January 1, 2010.²² The facility has a maximum capacity of 4,400, according to the 2010 Master Plan Annual Report.²³

Opened in 1946, Soledad Correctional Training Facility has a design capacity of 3,301. According to annual reporting by the California Department of Corrections and Rehabilitation and counts from the 2000 and 2010 decennial census, the facility had a resident population of between 6,000 and 7,200 during the decade.²⁴

Because both facilities currently house group quarters populations in excess of their design capacity, no future population growth is shown at these facilities in the 2018 RGF. Population totals are held constant at their 2015 levels.

¹⁹ California State University Monterey Bay historical timeline <http://about.csumb.edu/node/4287> accessed November 2012.

²⁰ Recirculated Draft Environmental Impact Report for the California State University Monterey Bay 2007 Master Plan. July 2008.

²¹ California Department of Corrections and Rehabilitation website for Salinas Valley State Prison. Figure reported for fiscal year 2009-2010. http://www.cdcr.ca.gov/Facilities_Locator/SVSP-Institution_Stats.html accessed December 9, 2012.

²² California Department of Finance. Exclusion and Dorm Report. November 2012.

²³ Master Plan Annual Report: Calendar Year 2010. California Department of Corrections and Rehabilitation. January 2011.

²⁴ California Department of Corrections and Rehabilitation website for Soledad Correctional Training Facility. Figure reported for fiscal year 2007 http://www.cdcr.ca.gov/Facilities_Locator/CTF-Institution_Stats.html accessed December 9, 2012. Population counts derived from institutionalized group quarters counts from Census 2000 and Census 2010, U.S. Census Bureau.

Table 10: Historical Special Population Counts

	1990	2000	2010	2015
Fort Ord Military Population	31,270*	0	0	0
Defense Language Institute and Naval Postgraduate School	**	**	4,227	4,004
University of California, Santa Cruz	9,800***	10,885	16,332	17,276
California State University, Monterey Bay	0	2,265	4,000	6,368
Salinas Valley State Prison	0	4,100	3,630	3,592
Soledad Correctional Training Facility	0	7,120	6,148	4,707

*This figure is a known estimate for 1990.

** Data for 1990 and 2000 are not available.

***1990 figure for University of California, Santa Cruz reflects data from the 1991-92 academic year, the earliest year reported.

Adjustments to the Population Projections

Developing Special and Non-Special Population Estimates

Special populations provide a challenge to the population projections, because their growth and decline is often not determined by factors that impact the rates of change of the general population. This is particularly true of college students, prison inmates, and military personnel and their dependents. Residents of nursing homes, while also a special population, share many of the characteristics of the general population, and their growth and decline often mirrors the demographic changes of the larger community. To deal with the special population issue, a common procedure applied in population projections is to exclude the special populations by using group quarters data and to project the adjusted population separately, i.e., the total population minus the special population. At the end of the projection module, the special population is added back to the projected adjusted population to produce the projected total population. The special population is either held constant or projected separately.²⁵

Thus, projections for AMBAG jurisdictions (Marina, Santa Cruz, Seaside, Soledad and unincorporated Monterey County) should be adjusted to account for special populations independent of the non-special population trends.

²⁵ Rayer, Stephan. MISER Population Projections for Massachusetts, 2000–2020. July 2003. <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&cad=rja&ved=0CEUQFjAD&url=http%3A%2F%2Fwww.uconn.edu%2Fmiser%2Fpopulation%2FDocuments%2FMAPProjMethodology.doc&ei=-ke5UNPKDMmdqgH0h4GgDQ&usq=AFQjCNF6tP0wQ9CqtSb8X7-EUtMm9rmMrw&sig2=8pz3atGy03rNWjtvjbdjeg>

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To accomplish this, special populations should be subtracted from the census year population estimates used in developing the shift-share model population shares. Independent projections of the special populations (e.g., from master plan documents) should then be addressed separately in the population forecast.

Incorporating Special Populations into the Final Projections

As noted above, Fort Ord has closed, and thus major military populations can be assumed to be constant throughout the remainder of the forecast.

For the universities and the prison, master plan documents provide useful information about expected future populations. These population plans can be used to fill in horizon-year projections, which are then kept constant for any remaining years of the AMBAG forecast. Additionally, staff worked closely with UCSC to develop conservative estimates for growth after the horizon year of their long range development plan.

Translating Population Growth into Housing

Special population adjustments for Fort Ord require no special processing, as the military population on Fort Ord is not expected to change in future years.

However, university populations for UCSC and CSUMB pose a special case. While housing will be provided by the universities, it is likely that many students will live in group quarters (described in more detail in Attachment 4), but at least some students will reside in housing “in town” as part of the resident population of surrounding jurisdictions. For this reason, university population projections and housing projections were completed separately from the jurisdiction population projections.

Population projection adjustments for SVSP and SCTF require no special processing for housing unit projections. These populations will be classified as group quarters, and thus are not considered in housing calculations.

Adjustments for Annexations

The shift-share approach outlined above presumes that most population change is a result of demographic and economic forces that can be represented by the rate of change over time. The shift-share approach is intended for use with jurisdictions that retain consistent geographic boundaries over time. Because the shift-share method presumes constant geographic boundaries, annexations, which by definition change jurisdiction boundaries, pose a unique problem. Adjustment techniques are needed to address these cases. Between 1990 and 2010 there was one populated annexation in the AMBAG region. This case, the Watsonville annexation, is described in more detail below.

History of Annexations in the AMBAG Region

In 2000 the city of Watsonville annexed a portion of unincorporated Santa Cruz County. Known as the Freedom-Carey annexation, the change was recorded in July 2000, after the 2000 decennial Census.

Historical population estimates for the City of Watsonville, unincorporated Santa Cruz County and Freedom-Carey annexation area are shown in Table 11 below.

The data for 2000 reflect reports published by the Local Agency Formation Commission with respect to the annexation area. Data for 1990 were derived using trend extrapolations based on the rate of growth in associated census tracts (1106 and 1107). Similarly, data for 2010 were derived using trend extrapolations based on the rate of growth in associated census tracts (1105.02, 1106 and 1107).

If the annexation of 2,022 residents were simply attributed to the population growth of Watsonville between 2000 and 2010, it would account for forty percent of the growth in the city’s population during that period of time. Conversely, the loss of annexed population would account for more than half of the decline in unincorporated population between 2000 and 2010.

Since the shift reflects an administrative boundary change, not a demographic one, the shift-share model was adjusted accordingly.

Table 11: Historical Population Estimates for the Watsonville Annexation Area

	1990	2000	2010
City of Watsonville	31,099	44,246	51,199
Excluding Annexation Area	31,099	44,246	49,229
Unincorporated County of Santa Cruz	130,086	135,345	129,739
Excluding Annexation Area	128,426	133,323	129,739
Annexation Area	1,660	2,022	1,970

Adjusting the Watsonville and Unincorporated Santa Cruz County Projections

In order to ensure that the population shift resulting from annexation does not skew the shift-share results for Watsonville or unincorporated Santa Cruz County, population projections for Watsonville, unincorporated Santa Cruz County, and the annexation area were estimated separately.

To complete this adjustment, the estimated annexation area population was subtracted from the unincorporated Santa Cruz County population totals in 1990 and 2000. Similarly, the projected population from the annexation area population was added to Watsonville in 2010.

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Independent shift-share projections were developed for each of the three sub-areas: Watsonville excluding the annexation area, unincorporated Santa Cruz County excluding the annexation area and the annexation area.

To complete the projections, the annexation area projected population growth was added to Watsonville. Unlike the special population projections described above, there are no further adjustments needed to translate the resulting population projections into housing projections.

Attachment 1: List of Meetings & Attendees

Forecast Meetings Round 1 - Pre-Forecast

Agency	Meeting Date	Meeting Time	Meeting Location	Meeting Attendees (AMBAG)*	Meeting Attendees (not AMBAG)*
City of Gonzales	11/20/2015	9:00am	AMBAG	Paul Hierling	Thomas Truskowski
City of Hollister	11/30/2015	2:00pm	Conference Call	Paul Hierling and Heather Adamson	Bill Avera
City of Marina	11/3/2015	1:00pm	AMBAG	Heather Adamson and Paul Hierling	Justin Meek
City of Santa Cruz	11/12/2015	10:00am	AMBAG	Bhupendra Patel, Heather Adamson, Erich Friedrich and Sang Ko	Katherine Donovan, Claire Fliesler, Michelle King and Ron Powers
City of Watsonville	9/2/2015	1:30pm	Watsonville	Heather Adamson, Paul Hierling and Maura Twomey	Keith Boyle
County of San Benito	8/25/2015	1:00pm	County of San Benito	Heather Adamson, Paul Hierling and Maura Twomey (phone)	Byron Turner

*All attendees were at the meeting in person unless otherwise noted.

Forecast Meetings Round 2 - Draft Regional Numbers

Agency	Meeting Date	Meeting Time	Meeting Location	Meeting Attendees (AMBAG)*	Meeting Attendees (not AMBAG)*
City of Capitola	12/16/2015	10:00am	Capitola	Heather Adamson and Paul Hierling	Richard Grunow and Katie Cattan
City of Carmel-By-The-Sea	1/25/2016	2:00pm	Carmel	Paul Hierling	Marc Weiner
City of Del Rey Oaks	N/A	N/A	N/A	N/A	N/A
City of Gonzales	2/12/2016	3:30pm	Gonzales	Paul Hierling and Bhupendra Patel	Tom Truzkowski
City of Greenfield	1/5/2016	1:00pm	Greenfield	Heather Adamson and Paul Hierling	Mic Steinmann and Susan Stanton
City of Hollister	2/3/2016	1:00pm	Hollister	Heather Adamson (phone) and Paul Hierling	Jill Morales, Byron Turner, Brent Barnes, Veronica Lezama
City of King City	2/23/2016	11:00am	King City	Paul Hierling, Maura Twomey	Doreen Liberto Blanck, Maricruz Aguilar
City of Marina	2/4/2015	1:15 PM	Marina	Paul Hierling	Justin Meek, Theresa Szymanis
City of Monterey	3/8/2016	11:00am	Monterey	Paul Hierling	Elizabeth Caraker
City of Pacific Grove	1/5/2016	11:00am	Pacific Grove	Heather Adamson and Paul Hierling	Mark Brodeur and Anatazia Aziz
City of Salinas	1/14/2016	11:00am	Salinas	Heather Adamson and Paul Hierling	Tara Hullinger and Megan Hunter
City of San Juan Bautista	2/2/2016	11:00am	SJB	Paul Hierling	Rodger Grimsley, Rudy Luquin
City of Sand City	2/29/2016	10:00am	Sand City	Paul Hierling	Chuck Pooler
City of Santa Cruz	1/7/2016	10:00am	Santa Cruz	Heather Adamson and Paul Hierling	Ron Powers, Michelle King and Katherine Donovan
City of Scotts Valley	1/27/2016	3:00pm	Scotts Valley	Heather Adamson, Paul Hierling, Maura Twomey and Bob Leiter	Taylor Bateman
City of Seaside	3/28/2016	9:00am	Conference Call	Heather Adamson	Rick Medina
City of Soledad	1/6/2016	10:00am	Soledad	Heather Adamson, Paul Hierling and Maura Twomey	Brent Slama
City of Watsonville	3/11/2016	10:00am	Watsonville	Heather Adamson	Suzi Merriman
County of Monterey	2/3/2016	10:00am	County of Monterey	Heather Adamson and Paul Hierling	Mike Novo, Jacqueline Onciano
County of San Benito	2/3/2016	1:00pm	County of San Benito	Heather Adamson (phone) and Paul Hierling	Jill Morales, Byron Turner, Brent Barnes, Veronica Lezama
County of Santa Cruz	1/27/2016	1:00pm	County of Santa Cruz	Heather Adamson, Paul Hierling, Maura Twomey and Bob Leiter	Paia Levine
CSU Monterey Bay	12/14/2015	9:30am	CSUMB	Paul Hierling	Kathleen Ventimiglia and Anya Spear
Fort Ord Reuse Authority	1/26/2016	1:30pm	FORA	Paul Hierling	Ted Lopez
Monterey County LAFCO	1/19/2016	1:00pm	Monterey LAFCO	Paul Hierling	Kate McKenna and Darren McBain
Santa Cruz County LAFCO	2/9/2016	2:00PM	Santa Cruz County LAFCO	Paul Hierling	Patrick McCormick
UC Santa Cruz	2/8/2016	10:00am	UCSC	Paul Hierling	Dean Fitch, Larry Pageler, Alisa Klaus

*All attendees were at the meeting in person unless otherwise noted.

Forecast Meetings Round 3 - Preliminary Draft Disaggregated Jurisdictional Numbers

Agency	Meeting Date	Meeting Time	Meeting Location	Meeting Attendees (AMBAG)*	Meeting Attendees (not AMBAG)*
City of Capitola	6/9/2016	4:30pm	Capitola	Heather Adamson	Rich Grunow and Katie Cattan
City of Carmel-By-The-Sea	7/14/2016	11am	Carmel	Bhupendra Patel and Sean Vienna	Marc Weiner
City of Del Rey Oaks	Reviewed via email and concurrence received on 7/11/16.	N/A	N/A	Heather Adamson, Maura Twomey and Sean Vienna	Daniel Dawson
City of Gonzales	7/7/2016	9:00am	AMBAG	Heather Adamson, Bhupendra Patel and Sean Vienna	Thomas Truszkowski
City of Greenfield	7/5/2016	2:30pm	Greenfield	Heather Adamson, Maura Twomey and Sean Vienna	Susan Stanton and Mic Steinman
City of Hollister	7/7/2016	11:30am	Hollister	Heather Adamson, Bhupendra Patel and Sean Vienna	Abraham Prado, Maria Mendez and Bill Avera
City of King City	7/19/2016	1pm	King City	Maura Twomey and Sean Vienna	Doreen Liberto-Blanck
City of Marina	7/5/2016	10am	Marina	Heather Adamson, Bhupendra Patel and Sean Vienna	Taven Kinison Brown and Layne Long
City of Monterey	6/14/2016	1pm	Monterey	Heather Adamson and Maura Twomey	Elizabeth Caraker and Kim Cole
City of Pacific Grove	7/13/2016	1pm	Pacific Grove	Heather Adamson and Sean Vienna	Mark Brodeur and Anatazia Aziz
City of Salinas	6/20/2016	10am	Salinas	Heather Adamson and Bhupendra Patel	Heather Adamson, Bhupendra Patel, Sean Vienna, Tara Hullinger, Megan Hunter, Lisa Brinton, Andy Merick, James Serano and Frederik Venter
City of San Juan Bautista	6/20/2016	1:30pm	SJB	Heather Adamson	Roger Grimsley and Rudy Luquin
City of Sand City	7/13/2016	9am	Sand City	Heather Adamson and Sean Vienna	Chuck Pooler
City of Santa Cruz	6/16/2016	1pm	Santa Cruz	Heather Adamson and Maura Twomey	Ron Powers, Michelle King and Stephanie Strelow
City of Scotts Valley	6/7/2016	11am	Scotts Valley	Heather Adamson and Maura Twomey	Taylor Bateman and Stephany Aguilar
City of Seaside	7/11/2016	10am	Seaside	Heather Adamson and Sean Vienna	Rick Medina
City of Soledad	7/6/2016	1pm	Soledad	Bhupendra Patel, Maura Twomey and Sean Vienna	Brent Salma
City of Watsonville	6/9/2016	3pm	Watsonville	Heather Adamson	Suzi Merriman and Justin Meek
County of Monterey	7/6/2016	10am	County of Monterey	Bhupendra Patel, Maura Twomey and Sean Vienna	Jacqueline Onciano
County of San Benito	6/15/2016	1:30pm	County of San Benito	Heather Adamson, Maura Twomey and Sean Vienna	Brent Barnes and Byron Turner
County of Santa Cruz	6/9/2016	10:30am	County of Santa Cruz	Heather Adamson and Maura Twomey	Paia Lavine, Barbara Mason and Steve Guiney
CSU Monterey Bay	7/19/2016	2:30pm	CSUMB	Bhupendra Patel and Sean Vienna	Anya Spear and Kathleen Ventimiglia
UC Santa Cruz	7/20/2016	10am	UCSC	Heather Adamson and Sean Vienna	Dean Fitch, Alisa Klaus, Larry Pageler and Julian Fernald (phone)

*All attendees were at the meeting in person unless otherwise noted.

Forecast Meetings Round 4 - Revised Draft Disaggregated Jurisdictional Numbers

Agency	Meeting Date	Meeting Time	Meeting Location	Meeting Attendees (AMBAG)*	Meeting Attendees (not AMBAG)*
Marina and Seaside	8/8/2016	10am	AMBAG	Heather Adamson, Sean Vienna and Beth Jarosz (AMBAG Consultant - phone)	Taven Kinison Brown (Marina) Rick Medina and Kurt Overmeyer (Seaside)
City of Santa Cruz and UCSC	8/11/2016	9:30am	City of Santa Cruz	Heather Adamson, Sean Vienna and Beth Jarosz (AMBAG Consultant - phone)	Ron Powers, Juliana Rebagliati, Michelle King and Katherine Donovan (City of Santa Cruz) Dean Fitch (UCSC)
City of Santa Cruz	8/24/2016	9:30am	City of Santa Cruz	Heather Adamson and Sean Vienna	Ron Powers, Michelle King, Juliana Rebagliati and Carol Berg
City of Gonzales	8/31/2016	3:00pm	AMBAG	Heather Adamson, Bhupendra Patel and Sean Vienna	Thomas Truskowski
City of Salinas	9/7/2016	10am	City of Salinas	Heather Adamson, Bhupendra Patel, Sean Vienna and Beth Jarosz (AMBAG Consultant - phone)	Megan Hunter and Lisa Brinton
City of Salinas	9/22/2016	10am	City of Salinas	Maura Twomey, Heather Adamson, Bhupendra Patel, Sean Vienna and Beth Jarosz (AMBAG Consultant - phone)	Megan Hunter, Tara Hullinger and Lisa Brinton

*All attendees were at the meeting in person unless otherwise noted.

Attachment 2: Employment Classification Explanations & Examples

AMBAG relies upon data from the California Employment Development Department and other statistical agencies (e.g. U.S. Bureau of Labor Statistics) for information about employment in the AMBAG region. Information is reported using the North American Industry Classification System (NAICS). NAICS is a production-orientated conceptual framework that groups establishments into industries based on their primary business activity. Establishments using similar material inputs, capital, and labor are classified in the same industry. In California, NAICS codes are assigned by the Labor Market Information Division (LMID) at the California Employment Development Department, and can be changed at the request of the employer.

AMBAG aggregates the detailed information into six major categories for planning purposes: Agriculture, Construction, Industrial, Retail, Service, and Public. Each category is described below.

Industry Sector Definitions

Agriculture (includes agriculture, forestry and fishing)

Establishments primarily engaged in growing crops, raising animals, harvesting timber, and harvesting animals from a farm, ranch, or their natural habitats.

Examples: Farms; ranches; dairies; greenhouses; nurseries; orchards; grape vineyards; cattle feedlots; logging; and support activities for agricultural or animal production (e.g. harvesting contractors, farm labor contractors).

Construction

Establishments that are primarily engaged in the construction of buildings or engineering projects, preparation of sites for new construction, and/or subdividing land for sale as building sites.

Examples: Primary activities include construction of highways and dams, production of a specific component for a project, and construction of buildings (e.g., new work, additions, alterations, etc.); flooring, roofing, and siding contractors.

Industrial (includes mining and manufacturing)

Establishments that extract naturally occurring mineral solids (e.g., coal or ores), liquid materials (e.g., crude petroleum), and gases (e.g., natural gas). Also includes manufacturing establishments engaged in the mechanical, physical, or chemical transformation of materials into new products. Typically these establishments use power-driven machines. However, this also includes

establishments that transform materials by hand and are engaged in selling products to the general public made on the same premises from which they are sold.

Examples: Fruit and vegetable preserving; animal slaughtering and processing; seafood product preparation and packaging; factories; mills; bakeries; candy stores (that make candy); custom tailors; breweries; wineries; bottled water manufacturing; book printing; iron foundries; paper manufacturing; chemical manufacturing; machine shops; and computer and electronic product manufacturing.

Retail (includes retail and wholesale)

Includes establishments engaged in wholesaling merchandise, typically without transformation, and rendering services related to the sale of merchandise. Wholesalers sell merchandise to other business, normally operate from a warehouse or office, and do not advertise to the general public. This category also includes establishments that engage primarily in retailing merchandise, generally without transformation, and rendering services related to the sale of the merchandise

Examples: Establishments engaged in wholesaling products, such as motor vehicles, furniture, construction materials, sporting goods, toys, electronic goods, paper and paper products, drugs, textiles, apparel, groceries, newspapers, and tobacco products. Also includes establishments engaged in retailing merchandise, such as motor vehicle and parts dealers, furniture and home furnishing stores, food and beverage stores, gasoline stations, clothing stores, sporting goods, hobby, book, florists and music stores.

Service (includes most service-producing sectors)

Service comprises a wide range of activities and includes establishments that provide transportation of passengers, cargo, warehousing and storage of goods, and support activities related to modes of transportation, as well as the utilities sector which is comprised of establishments engaged in the provision of utility services (e.g., electric power, natural gas, steam supply, water supply, and sewage removal). Also included are establishments engaged in information processes (i.e., producing and distributing information and processing data), establishments primarily engaged in financial transactions and/or facilitating financial transactions, establishments primarily engaged in renting, leasing, and managing real estate for others, establishments that specialize in performing professional, scientific, and technical activities for others, establishments that hold the securities of companies and enterprises for the purpose of owning a controlling interest or influencing management decisions, establishments that perform routine support activities for the day-to-day operations of other organizations (business services), leisure and hospitality establishments that operate facilities or provide services to meet varied cultural, entertainment, and recreational interests, establishments that provide customers with lodging and/or preparing meals, snacks, and beverages for immediate consumption, and establishments engaged in providing services not specifically

provided for elsewhere in the classification system. This includes establishments primarily engaged in activities such as equipment and machinery repairing, promoting religious activities, pet care services, etc.

Examples: Air, rail, water, truck, transit and ground passenger, and pipeline transportation; postal service; couriers and messengers; electric power generation; water and sewage systems; motion picture and sound recording industries; broadcasting; data processing and hosting; telecommunications; publishing industries; libraries and archives; commercial banking; credit card issuing; securities brokerage; portfolio management; direct life insurance carriers; passenger car rental; real estate agencies; commercial property managers; legal advice and representation; accounting, bookkeeping, and payroll services; architectural design services; computer services; research services; veterinary services; advertising; consulting; interior design services; public relations agencies; office administrative services; temporary help services; collection agencies; hazardous waste collection; dance companies; museums; zoos; nature parks; hotels and motels; campgrounds; caterers; restaurants; general automotive repair; car washes; computer and office machine repair and maintenance; barber shops; nail salons; parking lots and garages; civic and social organizations; political organizations; and labor unions.

Public (includes education, health care, and government)

The Public sector includes establishments that provide instruction and training in a wide variety of subjects. Also included are establishments that provide health care and social assistance for individuals. In addition, the sector includes of public administration establishments active at the federal, state, and local levels that administer, oversee, and manage public programs, and have authority over other institutions within a given area.

Examples: Elementary and secondary schools; colleges, universities, and professional schools; apprenticeship training; exam preparation and tutoring; dentists; chiropractors; family planning centers; ambulance services; community food services; temporary shelters; adoption agencies; child day care services; courts; police protection; executive offices; administrations of public health programs; and administration of economic programs.

Attachment 3: Comparison of Population Forecast Methods

In working with AMBAG to produce the 2018 Regional Growth Forecast, PRB conducted an evaluation of several population forecasting methods to ensure that the employment-driven population forecast technique was reasonable and reliable. While any forecast is a best guess given the most current information at the time it is produced, consistent results across several models lend credibility to the forecast results.

PRB compared population forecast results of the 2018 RGF (employment-driven method) with three other population forecasts: a cohort-change ratio (to 2025), a cohort-component forecast (to 2040), and the official, vintage 2014 forecast from the California Department of Finance. Results are presented in the table below.

The cohort-change ratio relied upon estimates of the population by age, race/ethnicity, and sex for the years 2000, 2005, 2010, and 2015. The method applied change ratios from 2000 to 2010 to predict the 2020 population and from 2005 to 2015 to predict the 2025 population.

The cohort-component forecast relied upon 2010 population by age, race/ethnicity, and sex, as well as data from the California Department of Public Health on mortality rates by age and sex, infant mortality rates by race/ethnicity and sex, and fertility rates by age and race/ethnicity. Modest adjustments were made to forecast fertility and mortality rates to reflect modest declines in teen birth rate and modest improvements in life expectancy. The model also assumed low levels of net domestic out-migration as well as steady, low levels of net international in-migration, for a total net migration of approximately 1,500 people per year.

The California Department of Finance vintage 2014 figures are presented without adjustment.

Summary of Alternative Forecast Results for the AMBAG Region

	2018 RGF	Cohort Change Ratio	Cohort Component	California Dept of Finance
2010	732,708	732,708	732,708	732,708
2015	762,676	762,676	762,676	762,318
2020	791,600	772,213	790,653	791,546
2025	816,900	822,007	816,862	821,594
2030	840,100	n.a.	840,625	845,871
2035	862,200	n.a.	862,452	871,231
2040	883,300	n.a.	882,334	886,675

Sources: PRB; California Department of Finance

Attachment 4: Group Quarters and Housing

The U.S. Census Bureau defines group quarters as follows:

Group Quarters (GQs) are places where people live or stay in a group living arrangement that is owned or managed by an entity or organization providing housing and/or services for the residents. These services may include custodial or medical care, as well as other types of assistance, and residency is commonly restricted to those receiving these services. People living in GQs usually are not related to each other. GQs include such places as college residence halls, residential treatment centers, skilled nursing facilities, group homes, military barracks, correctional facilities, workers' dormitories, and facilities for people experiencing homelessness.²⁶

With respect to the forecast, group quarters should be counted as population, not as units. For example, if a university builds additional student housing, the number of students housed within those university facilities will be counted as group quarters residents and removed from the calculation for household demand. This is true even if the university housing structures appear similar to a traditional apartment. In turn, those apartment-like university structures would not be counted as housing units in the forecast.

Complicating this issue is the fact that universities may also provide faculty and family housing units that may be restricted to university-affiliated staff or students and their families. In these cases, because families live together and rentals are year-round, not seasonal/temporary, we count those residents as belonging to households and we count the units as part of the housing stock.

²⁶ U.S. Census Bureau. "American Community Survey and Puerto Rico Community Survey 2015 Subject Definitions," (December 2016) accessed at https://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2015_ACSSubjectDefinitions.pdf on January 27, 2017.