✦ Segal Consulting

Ventura County Employees' Retirement Association

ACTUARIAL EXPERIENCE STUDY

Analysis of Actuarial Experience
During the Period
July 1, 2014 through June 30, 2017

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May 24, 2018

Board of Retirement
Ventura County Employees' Retirement
1190 South Victoria Avenue, Suite 200
Ventura, CA 93003-6572

Re: Review of Actuarial Assumptions for the June 30, 2018 Actuarial Valuation

Dear Members of the Board:

We are pleased to submit this report of our review of the actuarial experience for the Ventura County Employees' Retirement Association. This study utilizes the census data for the period July 1, 2014 to June 30, 2017 and provides the proposed actuarial assumptions, both economic and demographic, to be used in the June 30, 2018 valuation.

We are members of the American Academy of Actuaries and we meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion herein.

We look forward to reviewing this report with you and answering any questions you may have.

Sincerely,

Paul Angelo, FSA, MAAA, FCA, EA
Senior Vice President and Actuary

John W. Monroe, ASA, MAAA, EA
Vice President and Actuary

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I. Introduction, Summary, and Recommendations

To project the cost and liabilities of the pension plan, assumptions are made about all future events that could affect the amount and timing of the benefits to be paid and the assets to be accumulated. Each year actual experience is compared against the projected experience, and to the extent there are differences, the future contribution requirement is adjusted.

If assumptions are modified, contribution requirements are adjusted to take into account a change in the projected experience in all future years. There is a great difference in both philosophy and cost impact between recognizing the actuarial deviations as they occur annually and changing the actuarial assumptions. Taking into account one year's gains or losses without making a change in the assumptions means that year's experience is treated as temporary and that, over the long run, experience will return to what was originally assumed. Changing assumptions reflects a basic change in thinking about the future, and it has a much greater effect on the current contribution requirements than recognizing gains or losses as they occur.

The use of realistic actuarial assumptions is important in maintaining adequate funding, while paying the promised benefit amounts to participants already retired and to those near retirement. The actuarial assumptions used do not determine the "actual cost" of the plan. The actual cost is determined solely by the benefits and administrative expenses paid out, offset by investment income received. However, it is desirable to estimate as closely as possible what the actual cost will be so as to permit an orderly method for setting aside contributions today to provide benefits in the future, and to maintain equity among generations of participants and taxpayers.

This study was undertaken in order to review the economic and demographic actuarial assumptions and to compare the actual experience with that expected under the current assumptions during the three-year experience period from July 1, 2014 through June 30, 2017. The study was performed in accordance with Actuarial Standard of Practice (ASOP) No. 27 "Selection of Economic Assumptions for Measuring Pension Obligations" and ASOP No. 35 "Selection of Demographic and Other Non-Economic Assumptions for Measuring Pension Obligations." These Standards of Practice put forth guidelines for the selection of the various actuarial assumptions utilized in a pension plan actuarial valuation. Based on the study's results and expected future experience, we are recommending various changes in the current actuarial assumptions.

We are recommending changes in the assumptions for inflation, investment return, promotional and merit salary increases, retirement from active employment, spouse age differences, retirement age for deferred vested members, percent of members assumed to go on to work for a reciprocal system, reciprocal salary increases, pre-retirement mortality, healthy life post-retirement mortality, disabled life post-retirement mortality, termination (refund and deferred vested retirement), disability (service and non-service connected) and in-service redemptions.

Our recommendations for the major actuarial assumption categories are as follows:

Pg #	Actuarial Assumption Categories	Recommendation
8	**Inflation:** Future increases in the Consumer Price Index (CPI) which drives investment returns and active member salary increases, as well as cost-of-living adjustments (COLAs) for retirees.	Reduce the inflation assumption from 3.00% to 2.75% per annum as discussed in Section (III)(A).
10	**Investment Return:** The estimated average net rate of return on current and future assets of the Association as of the valuation date. This rate is used to discount liabilities.	Reduce the investment return assumption from 7.50% to 7.25% per annum as discussed in Section (III)(B).
16	**Individual Salary Increases:** Increases in the salary of a member between the date of the valuation to the date of separation from active service. This assumption has three components: • Inflationary salary increases • Real "across the board" salary increases • Promotional and merit increases	Reduce the current inflationary salary increase assumption from 3.00% to 2.75% and maintain the current real "across the board" salary increase assumption at 0.50%. This means that the combined inflationary and real "across the board" salary increases will decrease from 3.50% to 3.25%. Change the promotional and merit increases to those developed in Section III(C). Future promotional and merit salary increases are higher under the proposed assumptions. The recommended salary increase assumptions anticipate slightly higher salary increases overall for General members and slightly lower salary increases overall for Safety members.
22	**Retirement Rates:** The probability of retirement at each age at which participants are eligible to retire. **Other Retirement Related Assumptions including:** • Percent married and spousal age differences for members not yet retired • Retirement age for inactive vested members • Future reciprocal members and reciprocal salary increases	For active members, adjust the current retirement rates to those developed in Section (IV)(A). For non-PEPRA members, we are proposing different sets of age based retirement assumptions for those with less than 30 years of service and to those with 30 or more years of service. For both non-PEPRA General and Safety members, reduce retirement assumptions for those with less than 30 years of service and increase retirement assumptions for those with 30 or more years of service. For active and inactive vested members, maintain the percent married at retirement assumption at 70% for males and 55% for females. Reduce the spouse age difference assumption from three years to two years for female members (female members are assumed to be two years younger than their male spouse beneficiaries). For inactive vested members, maintain the assumed retirement age at 59 for General members and reduce to age 53 for Safety members. Reduce the current proportion of future terminated members expected to be covered by a reciprocal system from 50% to 45% for General members and maintain the assumption at 60% for Safety members. In addition, reduce the reciprocal salary increase assumptions to 3.75% for General members and 3.95% for Safety members.

Pg #	Actuarial Assumption Categories	Recommendation
32 38	**Mortality Rates:** The probability of dying at each age. Mortality rates are used to project life expectancies.	For healthy General retirees and all beneficiaries, change from the current RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2035 set back one year for males and set forward one year for females to the Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table times 90% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017.

For healthy Safety retirees, change from the current RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2035 set back three years to the Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table times 75% for males and 85% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017.

For disabled General retirees, change from the current RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2035 set forward six years for males and eight years for females to the Headcount-Weighted RP-2014 Disabled Retiree Mortality Table times 85% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017.

For disabled Safety retirees, change from the current RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2035 set forward two years to the Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table times 100% for males and 115% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017.

For pre-retirement mortality, change from the current post-retirement mortality tables to the Headcount-Weighted RP-2014 Employee Mortality Table times 80%, projected generationally with the two-dimensional scale MP-2017.

For determining member contribution rates, reserves and optional forms, change the mortality rates to those developed in Section (IV)(B).

The recommended mortality assumptions will anticipate longer life expectancies for both pre-retirement and healthy post-retirement. For disableds, shorter life expectancies are anticipated. |
41	**Termination Rates:** The probability of leaving employment at each age and receiving either a refund of contributions or a deferred vested retirement benefit.	Adjust the current termination rates to those developed in Section (IV)(D). The recommended assumptions will anticipate slightly more terminations for General and Safety members.
46	**Disability Incidence Rates:** The probability of becoming disabled at each age.	Adjust the current disability rates to those developed in Section (IV)(E). The recommended assumptions will anticipate fewer disability retirements for General members and Safety members.
49	**In Service Redemptions:** Additional pay elements that are expected to be received during the member's final average earnings period.	Decrease the current in-service redemption assumptions for non-PEPRA Safety and maintain the current assumption for non-PEPRA General, as developed in Section IV(F).
50	**Average Entry Age (for member contributions):** Used for determining contribution rates for non-PEPRA members hired after November 1974 who are not contributing fifty percent of Normal Cost.	Maintain the current average entry age assumption for General and Safety members as developed in Section IV(G).

We are also proposing a change to the methodology for determining a member's entry age for use in applying the actuarial cost method. Currently, the entry age for allocating Normal Cost is the member's age at hire. We propose setting this entry age as the member's age on the valuation date minus years of service. We believe that this proposed change will better allocate costs over the years in which the member earned service credit. This proposed change does not impact the average entry ages used by VCERA to determine member contribution rates for non-PEPRA active members that are not contributing fifty percent of the Normal Cost.

We have estimated the impact of the proposed assumption changes as if they were applied to the June 30, 2017 actuarial valuation. These estimated impacts reflect the 50/50 sharing of Normal Cost for non-PEPRA tiers. In particular, if all of the proposed economic assumptions changes (as recommended in Section III of this report) were implemented, the average employer rate would have increased by 1.04% of payroll and the average member rate would have increased by 0.38% of payroll. Of the various economic assumption changes, the most significant cost impact is from the investment return assumption change.

Furthermore, if all of the proposed demographic assumption changes (as recommended in Section IV of this report) were implemented, the average employer rate would have increased by 0.50% of payroll. The average member rate would have decreased by 0.06% of payroll. Of the various demographic assumption changes, the most significant cost impact are from the mortality assumption change for General membership and retirement assumption change for Safety membership. The impact of the proposed change in methodology for setting entry age described above has been included with the impact of the demographic assumptions.

Therefore, the estimated cost impact of all proposed assumption changes (both economic and demographic) is 1.54% of payroll for the average employer rate, where the Normal Cost rate increased by 0.48% and the UAAL amortization rate increased by 1.06%. The average member rate would have increased by 0.32% of payroll.

Section II provides some background on the basic principles and methodology used for the experience study and for the review of the economic and demographic actuarial assumptions. A detailed discussion of each assumption and reasons for the proposed changes are found in Section III for the economic assumptions and Section IV for the demographic assumptions. The cost impact of the proposed changes is detailed in Section V.

II. Background and Methodology

In this report, we analyzed both economic and demographic ("non-economic") assumptions. The primary economic assumptions reviewed are inflation, investment return, and salary increases. Demographic assumptions include the probabilities of certain events occurring in the population of members, referred to as "decrements," e.g., termination from service, disability retirement, service retirement, and death before and after retirement. In addition to decrements, other demographic assumptions reviewed in this study include the percentage of members with an eligible spouse or domestic partner, spousal age difference, in-service redemptions, percent of members assumed to go on to work for a reciprocal system, reciprocal salary increases and average entry age for member contributions.

Economic Assumptions

Economic assumptions consist of:

> **Inflation:** Increases in the price of goods and services. The inflation assumption reflects the basic return that investors expect from securities markets. It also reflects the expected basic salary increase for active employees and drives increases in the allowances of retired members.

> **Investment Return:** Expected long-term rate of return on the Association's investments after administration and investment expenses. This assumption has a significant impact on contribution rates.

> **Salary Increases:** In addition to inflationary increases, it is assumed that salaries will also grow by "across the board" real pay increases in excess of price inflation. It is also assumed that employees will receive raises above these average increases as they advance in their careers. These are commonly referred to as promotional and merit increases. Payments to amortize any Unfunded Actuarial Accrued Liability (UAAL) are assumed to increase each year by the price inflation rate plus any "across the board" real pay increases that are assumed.

The setting of these economic assumptions is described in Section III.

Demographic Assumptions

In order to determine the probability of an event occurring, we examine the "decrements" and "exposures" of that event. For example, taking termination from service, we compare the number of employees who actually terminate in a certain age and/or service category (i.e., the number of "decrements") with those "who could have terminated" (i.e., the number of "exposures"). For example, if there were 500 active employees in the 20-24 age group at the beginning of the year and 50 of them terminate during the year, we would say the probability of termination in that age group is 50 ÷ 500 or 10%.

The reliability of the resulting probability is highly dependent on both the number of decrements and the number of exposures. For example, if there are only a few people in a high age category at the beginning of the year (number of exposures), we would not lend as much credibility to the probability of termination developed for that age category, especially if it is out of line with the pattern shown for the other age groups. Similarly, if we are considering the death decrement, there may be a large number of exposures in, say, the age 20-24 category, but very few decrements (actual deaths); therefore, we would not be able to rely heavily on the probability developed for that category.

One reason we use several years of experience for such a study is to have more exposures and decrements, and therefore more statistical reliability. Another reason for using several years of data is to smooth out fluctuations that may occur from one year to the next. However, we also calculate the rates on a year-to-year basis to check for any trend that may be developing in the later years.

III. Economic Assumptions

A. Inflation

Unless an investment grows at least as fast as prices increase, investors will experience a reduction in the inflation-adjusted value of their investment. There may be times when "riskless" investments return more or less than inflation, but over the long term, investment market forces will generally require an issuer of fixed income securities to maintain a minimum return which protects investors from inflation.

The inflation assumption is long term in nature, so it is set using primarily historical information. Following is an analysis of 15 and 30 year moving averages of historical inflation rates:

HISTORICAL CONSUMER PRICE INDEX – 1930 TO 2017[1]
(U.S. City Average - All Urban Consumers)

	25th Percentile	Median	75th Percentile
15-year moving averages	2.4%	3.4%	4.5%
30-year moving averages	3.0%	3.8%	4.8%

The average inflation rates have continued to decline gradually over the last several years due to the relatively low inflationary period over the past two decades. Also, the later of the 15-year averages during the period are lower as they do not include the high inflation years of the mid-1970s and early 1980s.

Based on information found in the Public Plans Data website, which is produced in partnership with the National Association of State Retirement Administrators (NASRA), the median inflation assumption used by 168 large public retirement funds[2] in their 2016 fiscal year valuations was 3.00%. In California, CalPERS, CalSTRS, Contra Costa County, Los Angeles County, Orange County and two other 1937 Act CERL systems use an inflation assumption of 2.75% while two other 1937 Act CERL systems use an inflation assumption of 2.50% and twelve other 1937 Act CERL systems use an inflation assumption of 3.00%.

VCERA's investment consultant, New England Pension Consultants (NEPC), anticipates an annual inflation rate of 2.75%, while the average inflation assumption provided by NEPC and six other investment advisory firms retained by Segal's California public sector clients was 2.40%. Note that, in general, investment consultants use a time horizon[3] for this assumption that is shorter than the time horizon of the actuarial valuation.

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[1] Source: Bureau of Labor Statistics – Based on CPI for All items in U.S. city average, all urban consumers, not seasonally adjusted (Series Id: CUUR0000SA0)

[2] Among 168 large public retirement funds, the inflation assumption was not available for 14 of the public retirement funds in the survey data.

[3] The time horizon used by the seven investment consultants included in our review generally ranges from 10 years to 30 years and NEPC uses 30 years.

To find a forecast of inflation based on a longer time horizon, we referred to the 2017 report on the financial status of the Social Security program.[4] The projected average increase in the Consumer Price Index (CPI) over the next 75 years under the intermediate cost assumptions used in that report was 2.60%. Besides projecting the results under the intermediate cost assumptions using an inflation assumption of 2.60%, alternative projections were also made using a lower and a higher inflation assumption of 2.00% and 3.20%, respectively.

We also compared the yields on the thirty-year inflation indexed U.S. Treasury bonds to comparable traditional U.S. Treasury bonds.[5] As of April 2018, the difference in yields is about 2.14%, which provides a measure of market expectations of inflation.

Based on all of the above information, we recommend that the current 3.00% annual inflation assumption be reduced to 2.75% for the June 30, 2018 actuarial valuation.

The setting of the inflation assumption using the information outlined above is a somewhat subjective process, and Segal does not apply a specific weight to each of the metrics in determining our recommended inflation assumption. Based on a consideration of all these metrics, we have recently been recommending the same 2.75% inflation assumption in our experience studies for our California based public retirement system clients. As discussed on the previous page of this report, several large California public retirement systems have recently adopted a 2.75% inflation assumption in their valuations, including two systems (Contra Costa County and Orange County) that are Segal clients.

Retiree Cost of Living Increases

Consistent with our recommended inflation assumption, we also recommend reducing the current assumptions to value the post-retirement COLA benefit from 3.00% to 2.75% per year for all General Tier 1 and Safety members.

Note that General Tier 2 members with COLA provision are entitled to receive a fixed 2% COLA, not limited to actual changes in the CPI, that applies to future service after March 2003. The current and proposed COLA assumptions are shown below:

Maximum COLA for all General Tier 1 and Safety Members	Current Assumption	Proposed Assumption
3.00%	3.00%	2.75%

In developing the COLA assumption, we also considered the results of a stochastic approach that would attempt to account for the possible impact of low inflation that could occur before COLA banks are able to be established for the member. Although the results of this type of analysis might justify the use of a lower COLA assumption, we are not recommending that at this time. The reasons for this conclusion include the following:

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4   Source: Social Security Administration – The 2017 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds

5   Source: Board of Governors of the Federal Reserve System

> The results of the stochastic modeling are significantly dependent on assuming that lower levels of inflation will persist in the early years of the projections. If this is not assumed, then the stochastic modeling will produce results similar to our proposed COLA assumptions.

> Using a lower long-term COLA assumption based on a stochastic analysis would mean that an actuarial loss would occur even when the inflation assumption of 3.00% is met in a year. We question the reasonableness of this result.

We do not see the stochastic possibility of COLAs averaging less than those predicted by the assumed rate of inflation as a reliable source of cost savings that should be anticipated in our COLA assumptions. Therefore, we continue to recommend setting the COLA assumptions based on the long-term annual inflation assumption, as we have in prior years.

B. Investment Return

The investment return assumption is comprised of two primary components, inflation and real rate of investment return, with adjustments for expenses and risk.

Real Rate of Investment Return

This component represents the portfolio's incremental investment market returns over inflation. Theory has it that as an investor takes a greater investment risk, the return on the investment is expected to also be greater, at least in the long run. This additional return is expected to vary by asset class and empirical data supports that expectation. For that reason, the real rate of return assumptions are developed by asset class. Therefore, the real rate of return assumption for a retirement association's portfolio will vary with the Board's asset allocation among asset classes.

The following is the VCERA's current target asset allocation and the assumed real rate of return assumptions by asset class. The first column of real rate of return assumptions are determined by reducing NEPC's total or "nominal" 2018 return assumptions by their assumed 2.75% inflation rate. The second column of returns (except for Master Limited Partnerships, Absolute Return Fixed Income, Private Debt/Credit Strategies, Absolute Return (Risk Parity) and Private Equity) represents the average of a sample of real rate of return assumptions. The sample includes the expected annual real rate of return provided to us by NEPC and six other investment advisory firms retained by Segal's public sector clients. We believe these averages are a reasonable consensus forecast of long-term future market returns in excess of inflation.[6]

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[6] Note that, just as for the inflation assumption, in general the time horizon used by the investment consultants in determining the real rate of return assumption is shorter than the time horizon encompassed by the actuarial valuation.

VCERA'S TARGET ASSET ALLOCATION AND ASSUMED ARITHMETIC REAL RATE OF RETURN ASSUMPTIONS BY ASSET CLASS AND FOR THE PORTFOLIO

Asset Class	Percentage of Portfolio	NEPC's Assumed Real Rate of Return[7]	Average Assumed Real Rate of Return from a Sample of Consultants to Segal's California Public Sector Clients[8]
Large Cap Equity	27.04%	6.08%	5.32%
Small Cap Equity	4.48%	6.89%	6.07%
Developed Int'l Equity	17.32%	6.98%	6.68%
Emerging Market Equity	4.16%	9.72%	8.87%
Core Bonds	9.00%	1.17%	1.04%
Real Estate	8.00%	4.88%	4.65%
Master Limited Partnerships[9]	4.00%	6.31%	6.31%[10]
Absolute Return Fixed Income	7.00%	1.71%	1.71%[10]
Private Debt/Credit Strategies	3.00%	5.50%	5.50%[10]
Absolute Return (Risk Parity)[9]	6.00%	4.63%	4.63%[10]
Private Equity	10.00%	8.97%	8.97%[10]
Total	**100.00%**	**5.77%**	**5.41%**

The above are representative of "indexed" returns and do not include any additional returns ("alpha") from active management. This is consistent with the Actuarial Standard of Practice No. 27, Section 3.6.3.d, which states:

> "Investment Manager Performance - Anticipating superior (or inferior) investment manager performance may be unduly optimistic (or pessimistic). The actuary should not assume that superior or inferior returns will be achieved, net of investment expenses, from an active investment management strategy compared to a passive investment management strategy unless the actuary believes, based on relevant supporting data, that such superior or inferior returns represent a reasonable expectation over the measurement period."

The following are some observations about the returns provided above:

1. The investment consultants to our California public sector clients have each provided us with their expected real rates of return for each asset class, over various future periods of time. However, in general, the returns available from investment consultants are projected over time periods shorter than the durations of a retirement plan's liabilities.

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[7] Derived by reducing NEPC's nominal rate of return assumptions by their assumed 2.75% inflation rate. These returns are net of active management fees.

[8] These are based on the projected arithmetic returns provided by NEPC and six other investment advisory firms serving the county retirement system of Ventura and 16 other city and county retirement systems in California. These return assumptions are gross of any applicable investment expenses, except for NEPC's returns as noted in the footnote above.

[9] These are categorized as "Real Assets" when reported to VCERA by NEPC.

[10] For these asset classes, NEPC's assumption is applied in lieu of the average because there is a larger disparity in returns for these asset classes among the firms surveyed and using NEPC's assumption should more closely reflect the underlying investments made specifically for VCERA.

2. Using a sample average of expected real rate of returns allows the VCERA's investment return assumption to reflect a broader range of capital market information and should help reduce year to year volatility in the investment return assumption.

3. Therefore, we recommend that the 5.41% portfolio real rate of return be used to determine VCERA's investment return assumption. This is 0.15% higher than the return that was used three years ago in the review of the recommended investment return assumption for the June 30, 2015 valuation. The difference is due to changes in the System's target asset allocation (+0.36%), changes in the real rate of return assumptions provided to us by the investment advisory firms (-0.17%) and the interaction effect between these changes (-0.04%).

Association Expenses

For funding purposes, the real rate of return assumption for the portfolio needs to be adjusted for investment and administrative expenses expected to be paid from investment income. The following table provides these expenses in relation to the actuarial value of assets for the five years ending June 30, 2017.

ADMINISTRATIVE AND INVESTMENT EXPENSES AS A PERCENTAGE OF ACTUARIAL VALUE OF ASSETS (Dollars in 000's)

Year Ending June 30	Actuarial Value of Assets[11]	Administrative Expenses	Investment Expenses[12,13]	Administrative %	Investment %	Total %
2013	$3,633,626	$3,944	$8,725	0.11	0.24	0.35
2014	3,964,814	4,045	9,237	0.10	0.23	0.33
2015	4,311,131	3,854	10,055	0.09	0.23	0.32
2016	4,592,439	4,474	9,788	0.10	0.21	0.31
2017	4,963,653	5,524	9,405	0.11	0.19	0.30
Five-Year Average				0.10	0.22	0.32
Recommendation						0.30

Note that we have excluded the investment expenses associated with private equity and real assets because the capital market assumptions provided by NEPC for those categories are already net of active management fees.

The average expense percentage over this five-year period is 0.32%. Based on this experience, we have reduced the future expense assumption component from 0.40% to 0.30%. This assumption will be re-examined in subsequent assumption reviews as new data becomes available.

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[11] As of end of plan year.

[12] Net of securities lending expenses. Because we do not assume any additional net return for this program, we effectively assume that any securities lending expenses will be offset by related income.

[13] Net of expenses associated with private equity and alternative investments.

Note related to investment expenses paid to active managers – As cited above, under Section 3.6.3.d of ASOP No. 27, the effect of an active investment management strategy should be considered "net of investment expenses…unless the actuary believes, based on relevant data, that such superior or inferior returns represent a reasonable expectation over the measurement period." For VCERA, a significant portion of the investment expenses were paid for expenses associated with active managers.

We have not performed a detailed analysis to measure how much of the investment expenses paid to active managers might have been offset by additional returns ("alpha") earned by that active management.

As noted above, we have excluded investment expenses associated with private equity and real assets. If necessary, we will work with the VCERA's staff to determine whether future studies might potentially further exclude additional investment expenses for active managers that are expected to be offset by investment returns. For now, we will continue to use the current approach that any "alpha" that may be identified would be treated as an increase in the risk adjustment and corresponding confidence level. For example, 0.25% of alpha would increase the confidence level by 3% (see discussions that follow on definitions of risk adjustment and confidence level).

Risk Adjustment

The real rate of return assumption for the portfolio is adjusted to reflect the potential risk of shortfalls in the return assumptions. VCERA's asset allocation determines this portfolio risk, since risk levels are driven by the variability of returns for the various asset classes and the correlation of returns among those asset classes. This portfolio risk is incorporated into the real rate of return assumption through a risk adjustment.

The purpose of the risk adjustment (as measured by the corresponding confidence level) is to increase the likelihood of achieving the actuarial investment return assumption in the long term.[14] The 5.41% expected real rate of return developed earlier in this report was based on expected mean or average arithmetic returns. This means there is a 50% chance of the actual return in each year being at least as great as the average (assuming a symmetrical distribution of future returns). The risk adjustment is intended to increase that probability somewhat above the 50% level. This is consistent with our experience that retirement plan fiduciaries would generally prefer that returns exceed the assumed rate more often than not. Note that, based on the investment return assumptions recently adopted by systems that have been analyzed under this model, we observe a confidence level generally in the range of 50% to 60%.

Three years ago, the Board adopted an investment return assumption of 7.50%. That return implied a risk adjustment of 0.36%, reflecting a confidence level of 54% that the actual average return over 15 years would not fall below the assumed return, assuming that the distribution of returns over that period follows the normal statistical distribution.[15]

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[14] This type of risk adjustment is sometimes referred to as a "margin for adverse deviation."

[15] Based on an annual portfolio return standard deviation of 12.69% provided by NEPC in 2015. Strictly speaking, future compounded long-term investment returns will tend to follow a log-normal distribution. However, we believe the Normal distribution assumption is reasonable for purposes of setting this type of risk adjustment.

In our model, the confidence level associated with a particular risk adjustment represents the likelihood that the actual average return would equal or exceed the assumed value over a 15-year period. For example, if we set our real rate of return assumption using a risk adjustment that produces a confidence level of 60%, then there would be a 60% chance (6 out of 10) that the average return over 15 years will be equal to or greater than the assumed value. The 15-year time horizon represents an approximation of the "duration" of the fund's liabilities, where the duration of a liability represents the sensitivity of that liability to interest rate variations.

If we use the same 54% confidence level from our last study to set this year's risk adjustment, based on the current long-term portfolio standard deviation of 13.61% provided by NEPC, the corresponding risk adjustment would be 0.38%. Together with the other investment return components, this would result in an investment return assumption of 7.48%, which is slightly lower than the current assumption of 7.50%.

Based on the general practice of using one-quarter percentage point increments for economic assumptions, we evaluated the effect on the confidence level of other alternative investment return assumptions. In particular, due to the higher risk profile of the current target asset allocation compared to VCERA's prior asset allocation and compared to the other California retirement systems that we evaluate using this risk model, we believe that a higher confidence level could be justified. Therefore, we recommend a 7.25% investment return assumption to reflect the additional risk taken on by VCERA. Together with the other investment return components, the 7.25% investment return assumption would produce a risk adjustment of 0.61%, which corresponds to a confidence level of 57%.

The table below shows VCERA's investment return assumptions and for the years when this analysis was performed, the risk adjustments and corresponding confidence levels compared to the values for prior studies. Note that the recommended confidence level of 57% is the same as the confidence level adopted by the Board for the 2009-2011 valuations.

HISTORICAL INVESTMENT RETURN ASSUMPTIONS, RISK ADJUSTMENTS AND CONFIDENCE LEVELS BASED ON ASSUMPTIONS ADOPTED BY THE BOARD

Year Ending June 30	Investment Return	Risk Adjustment	Corresponding Confidence Level
2009 - 2011	8.00%	0.57%	57%
2012 - 2014	7.75%	0.41%	54%
2015 - 2017	7.50%	0.36%	54%
2018 (Recommended)	7.25%	0.61%	57%

As we have discussed in prior experience studies, the risk adjustment model and associated confidence level is most useful as a means for comparing how VCERA has positioned itself relative to risk over periods of time[16]. The use of a 57% confidence level should be considered in context with other factors, including:

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[16] In particular, it would not be appropriate to use this type of risk adjustment as a measure of determining an investment return rate that is "risk-free."

> As noted above, the confidence level is more of a relative measure than an absolute measure, and so can be reevaluated and reset for future comparisons.

> The confidence level is based on the standard deviation of the portfolio that is determined and provided to us by NEPC. The standard deviation is a statistical measure of the future volatility of the portfolio and so is itself based on assumptions about future portfolio volatility and can be considered somewhat of a "soft" number.

> A confidence level of 57% is within the range of about 50% to 60% that corresponds to the risk adjustments used by most of Segal's other California public retirement system clients. Again, taking into account the higher risk profile of the current target asset allocation compared to other California retirement systems, we believe that a higher confidence level could be justified.

> As with any model, the results of the risk adjustment model should be evaluated for reasonableness and consistency. This is discussed in the later section on "Comparison with Other Public Retirement Systems".

Taking into account the factors above, our recommendation is to reduce the net investment return assumption from 7.50% to 7.25%. As noted above, this return implies a 0.61% risk adjustment, reflecting a confidence level of 57% that the actual average return over 15 years would not fall below the assumed return.

Recommended Investment Return Assumption

The following table summarizes the components of the investment return assumption developed in the previous discussion. For comparison purposes, we have also included similar values from the last study.

Assumption Component	Recommended Value June 30, 2018	Adopted Value June 30, 2015
Inflation	2.75%	3.00%
Plus Average Real Rate of Return	5.41%	5.26%
Minus Expense Adjustment	(0.30%)	(0.40%)
Minus Risk Adjustment	(0.61%)	(0.36%)
Total	**7.25%**	**7.50%**
Confidence Level	**57%**	**54%**

Based on this analysis, we recommend that the investment return assumption be decreased from 7.50% to 7.25% per annum.

Comparing with Other Public Retirement Systems

One final test of the recommended investment return assumption is to compare it against those used by other public retirement systems, both in California and nationwide.

We note that a 7.25% investment return assumption is the most common among California public sector retirement systems with many other systems reducing it to 7.00% or lower. In particular, seven County employees' retirement systems use a 7.00% earnings assumption. Furthermore, the CalPERS Board has approved a reduction in the earnings assumption to 7.00% and CalSTRS adopted a 7.00% earnings assumption for the 2017 valuation.

The following table compares VCERA's recommended net investment return assumption against those of the nationwide public retirement systems that participated in the National Association of State Retirement Administrators (NASRA) 2017 Public Fund Survey for 168 large public retirement funds[17] in their 2016 fiscal year valuations:

Assumption	VCERA	NASRA 2016 Public Fund Survey[18]		
		Low	Median	High
Net Investment Return	7.25%	6.50%	7.50%	8.50%

The detailed survey results show that more than one-half of the systems have an investment return assumption in the range of 6.75% to 7.50%, and over half of those systems have used an assumption of 7.50%. The survey also notes that several plans have reduced their investment return assumption during the last year. State systems outside of California tend to change their economic assumptions less frequently and so may lag behind emerging practices in this area.

In summary, we believe that both the risk adjustment model and the higher risk associated with the asset allocation indicate a lower earnings assumption. The recommended assumption of 7.25% provides for a risk margin within the risk adjustment model consistent with VCERA practice, and it is consistent with VCERA's current practice relative to other public systems.

C. Salary Increase

Salary increases impact plan costs in two ways: (i) by increasing members' benefits (since benefits are a function of the members' highest average pay) and future normal cost collections; and (ii) by increasing total active member payroll which in turn generates lower UAAL contribution rates. These two impacts are discussed separately below.

As an employee progresses through his or her career, increases in pay are expected to come from three sources:

1. **Inflation:** Unless pay grows at least as fast as consumer prices grow, employees will experience a reduction in their standard of living. There may be times when pay increases lag or exceed inflation, but over the long term, labor market forces may require an employer to maintain its employees' standards of living.

   As discussed earlier in this report, we are recommending that the assumed rate of inflation be reduced from 3.00% to 2.75% per annum. This inflation component is used as part of the salary increase assumption.

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[17] Among 168 large public retirement funds, the investment return assumption was not available for 12 of the public retirement funds in the survey data.

[18] Public Plans Data website – Produced in partnership with the National Association of State Retirement Administrators (NASRA)

2. **Real "Across the Board" Pay Increases:** These increases are typically termed productivity increases since they are considered to be derived from the ability of an organization or an economy to produce goods and services in a more efficient manner. As that occurs, at least some portion of the value of these improvements can provide a source for pay increases. These increases are typically assumed to extend to all employees "across the board". The State and Local Government Workers Employment Cost Index produced by the Department of Labor provides evidence that real "across the board" pay increases have averaged about 0.6% - 0.8% annually during the last ten to twenty years.

   We also referred to the annual report on the financial status of the Social Security program published in July 2017. In that report, real "across the board" pay increases are forecast to be 1.2% per year under the intermediate assumptions.

   The real pay increase assumption is generally considered a more "macroeconomic" assumption, which is not necessarily based on individual plan experience. However, recent salary experience with public systems in California as well as anecdotal discussions with plans and plan sponsors indicate lower future real wage growth expectations for public sector employees. We note that for VCERA's active members, the actual average inflation plus "across the board" increase (i.e., wage inflation) over three year period ending June 30, 2017 was 3.08%.

   Considering these factors, we recommend maintaining the real "across the board" salary increase assumption at 0.50%. This means that the combined inflation and "across the board" salary increase assumption will decrease from 3.50% to 3.25%.

3. **Promotional and Merit Increases:** As the name implies, these increases come from an employee's career advances. This form of pay increase differs from the previous two, since it is specific to the individual. For VCERA, there are service-specific promotional and merit increases.

   The annual promotional and merit increases are determined by measuring the actual increases received by members over the experience period, net of the inflationary and real "across the board" pay increases. Increases are measured separately for General and Safety members. This is accomplished by:

   a. Measuring each continuing member's actual salary increase over each year of the experience period;

   b. Excluding any members with increases of more than 50% or decreases of more than 10% during any particular year;

   c. Categorizing these increases according to member demographics;

   d. Removing the wage inflation component from these increases (assumed to be equal to the increase in the members' average salary during the year);

   e. Averaging these annual increases over the three-year experience period; and

   f. Modifying current assumptions to reflect some portion of these measured increases reflective of their "credibility."

To be consistent with the other economic assumptions, these promotional and merit assumptions should be used in combination with the 3.25% assumed inflation and real "across the board" increases.

The following table shows the General members' actual average promotional and merit increases by years of service over the three-year period from July 1, 2014 through June 30, 2017 along with the actual average increases based on combining the current three-year period with the three years from the prior experience study. The current and proposed assumptions are also shown. The actual increases for the most recent three-year period were reduced by the actual average inflation plus "across the board" increase (i.e., wage inflation, estimated as the increase in average salaries) for each year over the current three-year experience period (3.3% on average).

GENERAL MEMBERS
PROMOTIONAL AND MERIT INCREASES

Years of Service	Rate (%)			
	Current Assumptions	Actual Average Increase (Last 3 Years)	Actual Average Increase from Current and Prior Study	Proposed Assumption
Less than 1	6.00	9.17	8.41	7.00
1	4.25	6.81	6.08	5.25
2	3.25	5.51	4.64	4.00
3	2.75	5.07	4.02	3.50
4	2.25	4.07	3.30	2.75
5	1.75	3.56	2.80	2.25
6	1.25	3.54	3.00	2.00
7	1.00	3.13	2.42	1.75
8	0.75	2.80	1.99	1.50
9	0.50	2.89	1.75	1.25
10	0.50	3.05	1.95	1.00
11	0.50	2.58	1.74	0.95
12	0.50	2.64	1.78	0.90
13	0.50	2.26	1.73	0.85
14	0.50	2.65	2.05	0.80
15	0.50	2.35	1.80	0.75
16	0.50	1.56	1.21	0.70
17	0.50	2.18	1.43	0.65
18	0.50	1.58	1.39	0.60
19	0.50	1.55	0.94	0.55
20 & over	0.50	1.90	1.11	0.50

The following table provides the same information for Safety members. The actual average promotional and merit increases were determined by reducing the actual average total salary increases by the actual average inflation plus real "across the board" increase (i.e.,

wage inflation, estimated as the increase in average salaries) for each year over the three-year period (3.2% on average).

<p style="text-align:center; color:red;">**SAFETY MEMBERS
PROMOTIONAL AND MERIT INCREASES**</p>

Years of Service	Rate (%)			
	Current Assumptions	Actual Average Increase (Last 3 Years)	Actual Average Increase from Current and Prior Study	Proposed Assumption
Less than 1	8.00	11.95	9.62	8.50
1	6.25	7.33	6.82	6.50
2	4.75	5.75	5.33	5.00
3	4.00	4.84	4.33	4.25
4	3.25	6.21	5.63	3.75
5	3.00	4.33	4.16	3.50
6	2.25	3.41	3.05	2.50
7	1.50	1.51	1.45	1.50
8	1.25	0.31	1.09	1.25
9	1.00	0.84	1.25	1.00
10	0.75	2.23	1.01	0.95
11	0.75	1.39	1.13	0.90
12	0.75	0.33	0.29	0.85
13	0.75	1.19	1.11	0.80
14	0.75	0.76	0.84	0.70
15	0.75	0.72	1.02	0.70
16	0.50	0.88	0.76	0.70
17	0.50	1.46	1.19	0.70
18	0.50	1.17	1.31	0.70
19	0.50	1.27	1.31	0.70
20 & over	0.50	1.18	0.94	0.70

Charts 1 and 2 provide a graphical comparison of the actual promotional and merit increases, compared to the proposed and current assumptions. The charts also show the actual promotional and merit increases based on an average of both the current and previous three-year experience periods. This is discussed below. Chart 1 shows this information for General members and Chart 2 for Safety members.

We realize that the most recent three-year experience period may not be typically indicative of future long-term promotional and merit salary increases. Therefore, we also examined the promotional and merit salary experience from the prior experience study. We believe that when the experience from the last two studies are combined into an average result, it provides a more reasonable representation of potential future promotional and merit salary increases over the long term. Nevertheless, in our proposed changes to promotional and merit salary increases, we have still given relatively less weight to the actual average increases during the last two studies.

Based on this experience, we are proposing increases overall in the promotional and merit salary increases for both General and Safety members. Overall, salary increases are assumed to be slightly higher for General members and slightly lower for Safety members since we are recommending a change to lower the price inflation assumption.

Active Member Payroll

Projected active member payrolls are used to develop the UAAL contribution rate. Future values are determined as a product of the number of employees in the workforce and the average pay for all employees. The average pay for all employees increases only by inflation and real "across the board" pay increases. The promotional and merit increases are not an influence, because this average pay is not specific to an individual.

We recommend that the active member payroll increase assumption be decreased from 3.50% to 3.25% annually, consistent with the combined inflation plus real "across the board" salary increase assumptions.

CHART 1: PROMOTIONAL AND MERIT SALARY INCREASE RATES
GENERAL MEMBERS
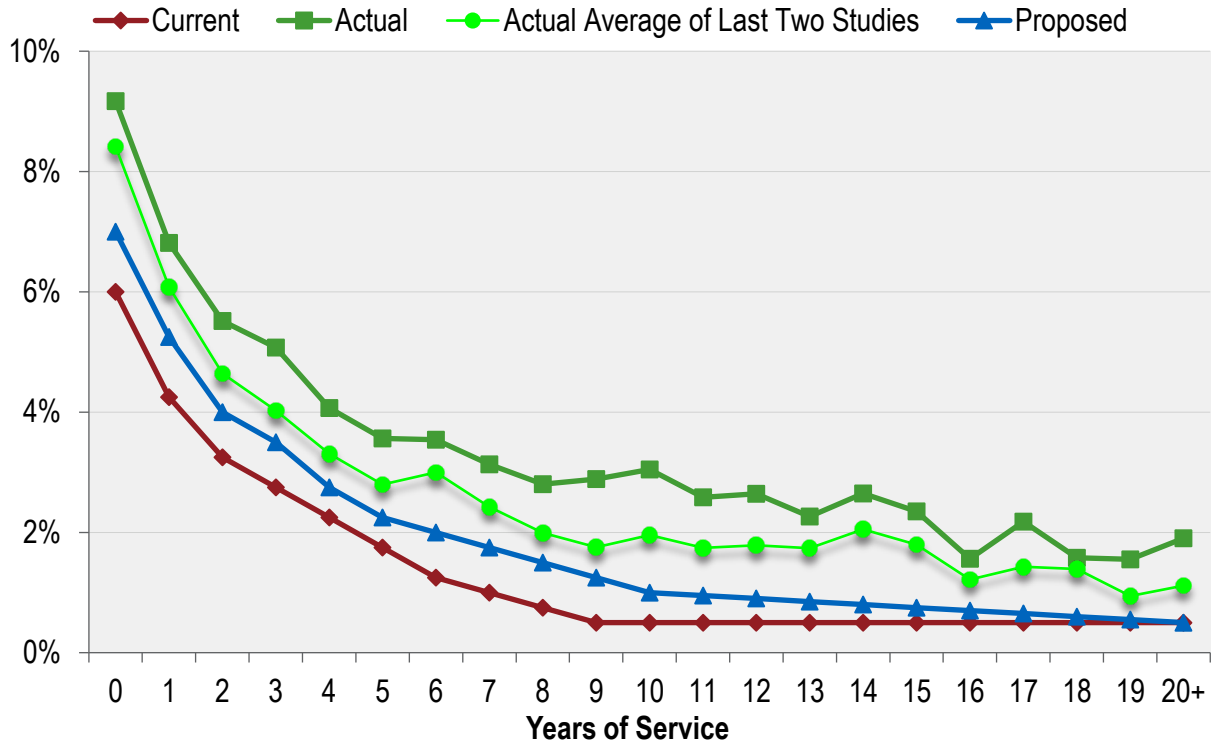
CHART 2: PROMOTIONAL AND MERIT SALARY INCREASE RATES
SAFETY MEMBERS
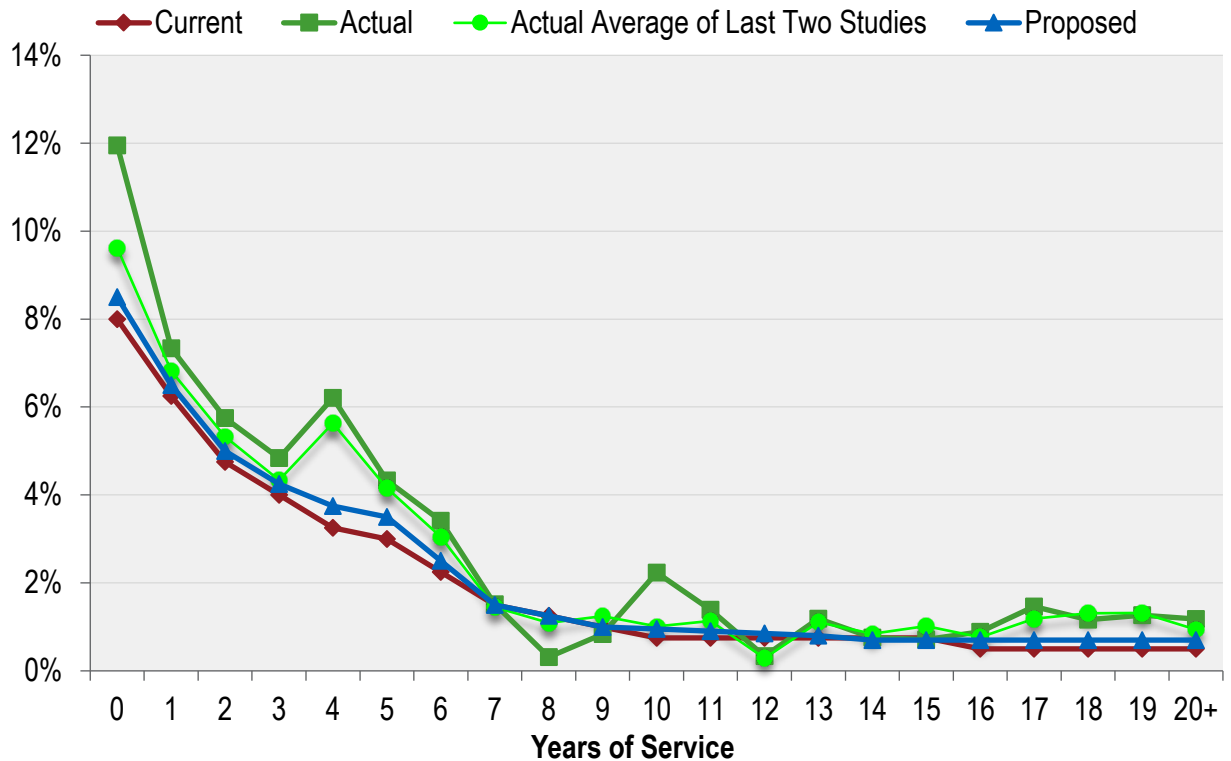
IV. Demographic Assumptions

A. Retirement Rates

The age at which a member retires from service (i.e., who did not retire on a disability pension) will affect both the amount of the benefits that will be paid to that member as well as the period over which funding must take place.

Currently, the assumed retirement rates are a function of only member's age. Our experience review analyzed recent years' retirement experience both as a function of age and years of service in relation to the probability of retirement. Our review concludes that the retirement rates correlate both with age and with years of service especially for those with high years of service.

As a result of this observation, we recommend that retirement rates be structured as a function of both age and years of service. The new structure of retirement assumptions will apply different sets of age based retirement assumptions for those with less than 30 years of service and to those with more than 30 years of service.

The table on the following page shows the observed service retirement rates for non-PEPRA General members based on the actual experience over the past three years. Due to the change in structure described above, we also used the experience from the prior study along with the current period in developing our proposed assumptions. The observed service retirement rates were determined by comparing those members who actually retired from service to those eligible to retire from service. This same methodology is followed throughout this report and was described in Section II. Also shown are the current rates assumed and the rates we propose:

Non-PEPRA General Tiers

Age	Current Rate	Rate of Retirement (%)			
		Less than 30 Years of Service		30 or More Years of Service	
		Actual Rate	Proposed Rate	Actual Rate	Proposed Rate
Under 50	0.00	100.00	0.00	0.00	50.00
50	2.50	1.94	2.00	0.00	2.00
51	2.50	1.79	2.00	0.00	2.00
52	3.00	2.26	2.50	0.00	2.50
53	3.50	1.97	3.00	0.00	3.00
54	4.00	1.67	3.25	2.63	3.25
55	4.50	4.72	4.75	9.09	4.75
56	5.00	4.94	5.00	1.82	5.00
57	6.00	5.14	5.50	6.90	5.50
58	8.00	6.04	7.00	8.77	7.00
59	8.00	6.54	7.50	10.91	7.50
60	12.00	9.72	10.50	13.73	15.75
61	15.00	11.83	14.00	26.32	21.00
62	22.00	27.50	25.00	48.94	37.50
63	20.00	17.99	20.00	30.43	30.00
64	22.00	18.75	20.00	14.29	30.00
65	30.00	26.12	28.00	71.43	42.00
66	35.00	32.10	35.00	66.67	52.50
67	35.00	30.16	30.00	16.67	45.00
68	35.00	18.87	30.00	20.00	45.00
69	20.00	27.27	22.50	0.00	22.50
70	20.00	30.30	22.50	0.00	22.50
71	20.00	16.67	20.00	0.00	20.00
72	20.00	6.67	20.00	0.00	20.00
73	20.00	29.41	20.00	25.00	20.00
74	30.00	27.78	20.00	0.00	20.00
75 & Over	100.00	17.65	100.00	14.29	100.00

As shown above, we are recommending decreases in most of the retirement rates for non-PEPRA General members with less than 30 years of service and recommending increases in most of the retirement rates for non-PEPRA General members with 30 or more years of service.

The same retirement rates are proposed for both General Tier 1 and Tier 2 members. This is because retirement experience is largely driven by Tier 2 members as there are very few Tier 1 non-retired members.

In some age categories, limited experience is available such as under age 50 (for those with 30 or more years of service) or over age 65. For the under age 50 category, we are proposing the

introduction of a 50% retirement rate. For ages over 65, there is some smoothing of the proposed rates for those age categories.

Chart 3 that follows later in this section compares actual experience with the current and proposed rates of retirement for non-PEPRA General members with less than 30 years of service.

Chart 4 compares actual experience with the current and proposed rates for non-PEPRA General members with 30 or more years of service.

The following table shows the observed retirement rates for non-PEPRA Safety members over the past three years. Also shown are the current rates assumed and the rates we propose:

Non-PEPRA Safety Tiers

		Rate of Retirement (%)			
		Less than 30 Years of Service		30 or More Years of Service	
Age	Current Rate	Actual Rate	Proposed Rate	Actual Rate	Proposed Rate
40	1.00	0.00	1.00	0.00	1.00
41	1.00	0.00	1.00	0.00	1.00
42	1.00	0.00	1.00	0.00	1.00
43	1.00	2.70	1.00	0.00	1.00
44	1.00	2.08	1.00	0.00	1.00
45	1.00	0.00	1.00	0.00	1.00
46	1.00	0.00	1.00	0.00	1.00
47	1.00	1.39	1.00	0.00	1.00
48	1.00	1.39	1.00	0.00	1.00
49	1.50	0.00	1.00	0.00	1.00
50	2.50	1.60	2.00	0.00	2.00
51	2.00	2.56	2.25	0.00	2.25
52	3.00	1.98	2.50	0.00	2.50
53	4.00	2.30	3.50	3.57	3.50
54	17.00	11.69	13.00	7.32	13.00
55	22.00	16.67	20.00	47.06	30.00
56	22.00	22.22	20.00	25.93	30.00
57	20.00	18.75	18.00	18.18	27.00
58	19.00	26.67	22.00	42.86	33.00
59	22.00	20.00	22.00	33.33	33.00
60	22.00	18.75	25.00	37.50	37.50
61	25.00	28.57	28.00	50.00	42.00
62	35.00	44.44	35.00	0.00	45.00
63	40.00	14.29	35.00	0.00	45.00
64	40.00	50.00	35.00	100.00	45.00
65 & Over	100.00	40.00	100.00	50.00	100.00

Overall, we are recommending decreases in most of the retirement rates for non-PEPRA Safety members with less than 30 years of service and recommending increases in most of the retirement rates for non-PEPRA Safety members with 30 or more years of service.

Chart 5 compares actual experience with the current and proposed rates for non-PEPRA Safety members with less than 30 years of service.

Chart 6 compares actual experience with the current and proposed rates for non-PEPRA Safety members with 30 or more years of service.

Note that effective January 1, 2013, new PEPRA formulas were implemented for new General and Safety tiers. For these new tiers we do not have any experience from the past three years to propose new rates based on actual retirements from members of those tiers nor change the current assumption structure based on both age and years of service. However, we have recommended changes to the retirement assumptions at some ages for PEPRA members based on our recommended assumptions for non-PEPRA members. This assumption will continue to be monitored in future experience studies, including whether service based retirement rates should also be implemented for PEPRA tiers.

The following are the current and proposed rates of retirement for PEPRA General and Safety members:

General and Safety PEPRA Tiers

Age	Rate of Retirement (%)			
	Current General PEPRA Tiers	Proposed General PEPRA Tiers	Current Safety PEPRA Tiers	Proposed Safety PEPRA Tiers
50	0.00	0.00	5.00	4.00
51	0.00	0.00	2.00	2.25
52	2.00	1.50	4.00	3.50
53	2.00	1.50	6.00	5.50
54	2.50	2.00	16.00	13.00
55	4.00	4.00	20.00	20.00
56	4.50	4.50	20.00	20.00
57	5.00	5.00	18.00	18.00
58	6.00	5.50	18.00	18.00
59	7.00	6.00	25.00	25.00
60	9.00	9.00	25.00	25.00
61	11.00	11.00	25.00	25.00
62	20.00	22.50	40.00	40.00
63	20.00	20.00	40.00	40.00
64	18.00	18.00	40.00	40.00
65	20.00	20.00	100.00	100.00
66	30.00	30.00	100.00	100.00
67	30.00	30.00	100.00	100.00
68	30.00	25.00	100.00	100.00
69	30.00	35.00	100.00	100.00
70	50.00	50.00	100.00	100.00
71	50.00	50.00	100.00	100.00
72	50.00	50.00	100.00	100.00
73	50.00	50.00	100.00	100.00
74	50.00	50.00	100.00	100.00
75 & Over	100.00	100.00	100.00	100.00

Chart 7 compares the current rates with the proposed rates of retirement for PEPRA General members.

Chart 8 compares the current rates with the proposed rates of retirement for PEPRA Safety members.

Deferred Vested Members

In prior valuations, deferred vested General and Safety members were assumed to retire at age 59 and 54, respectively. The average age at retirement over the prior three years was 60 for General and 52 for Safety. We recommend maintaining the General assumption at age 59 since we

recently increased this assumption for General members from age 58 to 59 in the last experience study. We also recommend decreasing the Safety assumption to age 53.

Reciprocity

It was also assumed that 50% of inactive General and 60% of inactive Safety deferred vested participants would be covered under a reciprocal retirement system and receive 4.00% annual salary increases from termination until their date of retirement. As of June 30, 2017, about 41% of the total General deferred vested members and 61% of the total Safety deferred vested members have gone on to be covered by a reciprocal retirement system. As a result, we recommend decreasing the reciprocal assumption to 45% for General members and maintaining the assumption at 60% for Safety members. This recommendation takes into account the experience of all deferred vested members as of June 30, 2017 instead of just new deferred vested members during the three-year period. This is because there is a lag between a member's date of termination and the time that it is known if they have reciprocity with a reciprocal retirement system.

In addition, based on our recommended salary increase assumptions, we propose that the current 4.00% annual salary increase assumption for reciprocal members be decreased to 3.75% (i.e., 2.75% inflation plus 0.50% "across the board" plus 0.50% promotional and merit) for General deferred vested participants and 3.95% (i.e., 2.75% inflation plus 0.50% "across the board" plus 0.70% promotional and merit) for Safety deferred vested participants. This assumption is used to anticipate salary increases (under the reciprocal system) from termination from VCERA to the expected date of retirement. This assumption is based on the ultimate promotional and merit salary increase assumptions for General and Safety members together with the 2.75% inflation and 0.50% real "across the board" salary increase assumptions that are recommended earlier in Section III of this report.

Form of Payment and Survivor Continuance under Unmodified Option

In prior valuations, it was assumed that all members would select the unmodified option at retirement. Actual experience for recent new retirees shows that more than 90% select the unmodified option. Therefore, we recommend maintaining the assumption that all members will elect the unmodified option at retirement.

It was also assumed that 70% of all active male members and 55% of all active female members would be married or have an eligible domestic partner and selected the unmodified option when they retired. We reviewed experience for new retirees during the three-year period and determined the actual percentage of these new retirees that had an eligible spouse or eligible domestic partner at the time of retirement. The results of that analysis are shown below.

|	New Retirees – Actual Percent with Eligible Spouse or Domestic Partner and Selected Unmodified Option	
Year Ending June 30	**Male**	**Female**
2015	61%	58%
2016	N/A	N/A
2017	69%	56%
Total	**66%**	**57%**

Note that we have excluded the actual experience for the year ending June 30, 2016 because the beneficiary data was incomplete in that the year due to the change in the pension administrative system. This issue has subsequently been resolved in the June 30, 2017 valuation. According to experience of members who retired for the years ending June 30, 2015 and June 30, 2017, about 66% of all male members and 57% of all female members were married or had a domestic partner at retirement and selected the unmodified option. We recommend maintaining the assumption for both males and females members at 70% and 55%, respectively.

Since the value of the survivor's benefit is dependent on the survivor's age and sex, we must also have assumptions for the age and sex of the survivor. Based on the experience for members who retired during the years ending June 30, 2015 and June 30, 2017 and studies done for other retirement systems, we recommend the following:

1. Since most the survivors are actually the opposite sex, even with the inclusion of domestic partners, we will continue to assume that the survivor's sex is the opposite of the member.

2. The current and proposed assumption for the age of the survivor are shown below. These assumptions will continue to be monitored in future experience studies.

Survivor Ages – Current Assumptions			
	Survivor's Age as Compared to Member's Age		
Beneficiary Sex	**Current Assumption**	**Actual Experience**	**Recommended Assumption**
Male	3 years older	2.1 years older	2 years older
Female	3 years younger	2.5 years younger	3 years younger

CHART 3: RETIREMENT RATES
NON-PEPRA GENERAL MEMBERS WITH LESS THAN 30 YEARS OF SERVICE
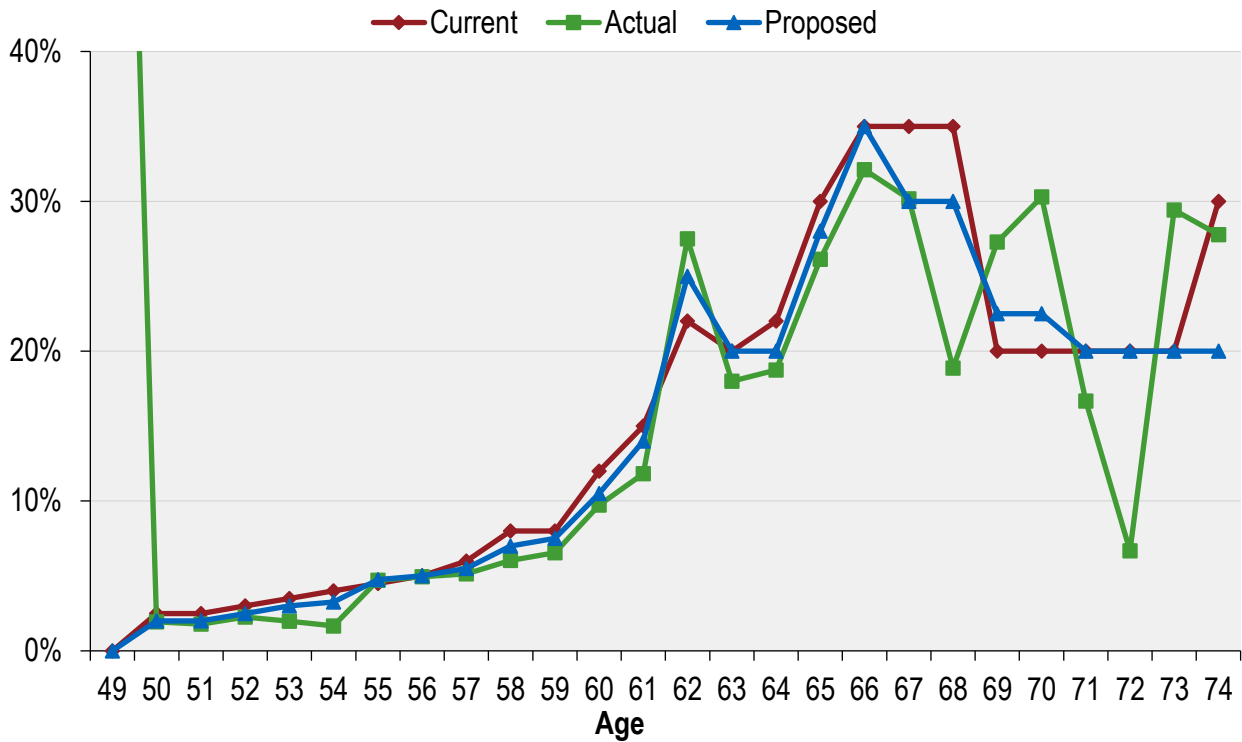
CHART 4: RETIREMENT RATES
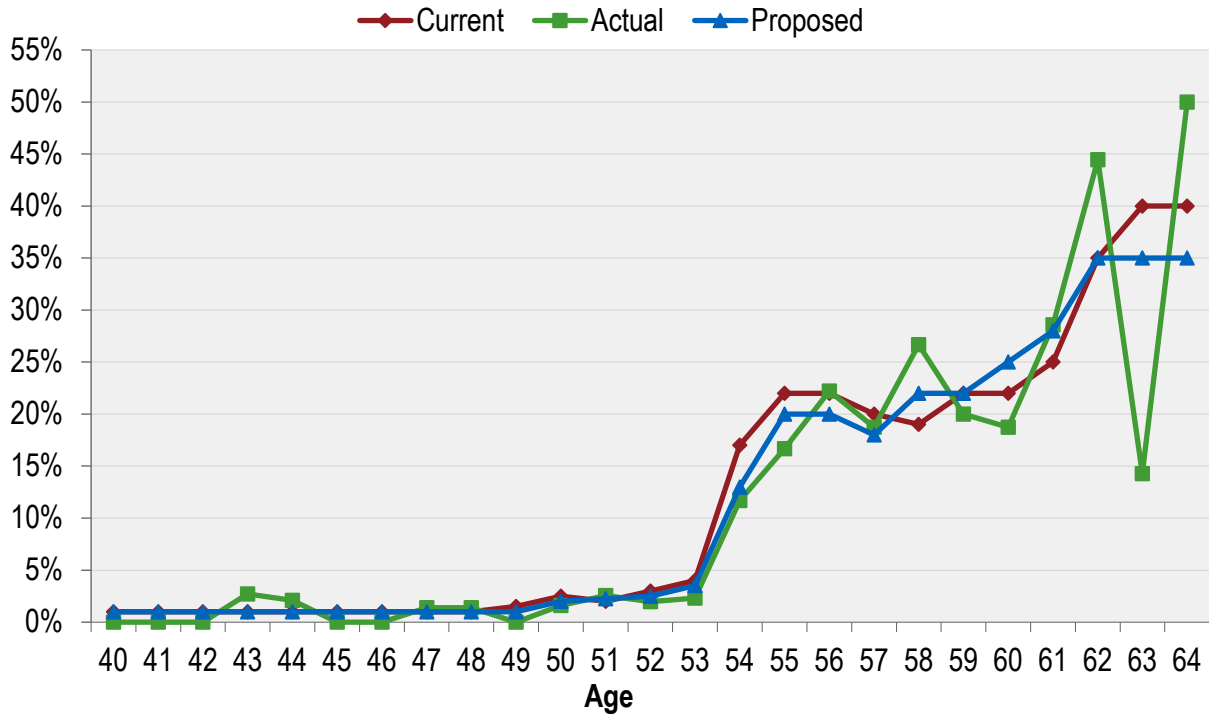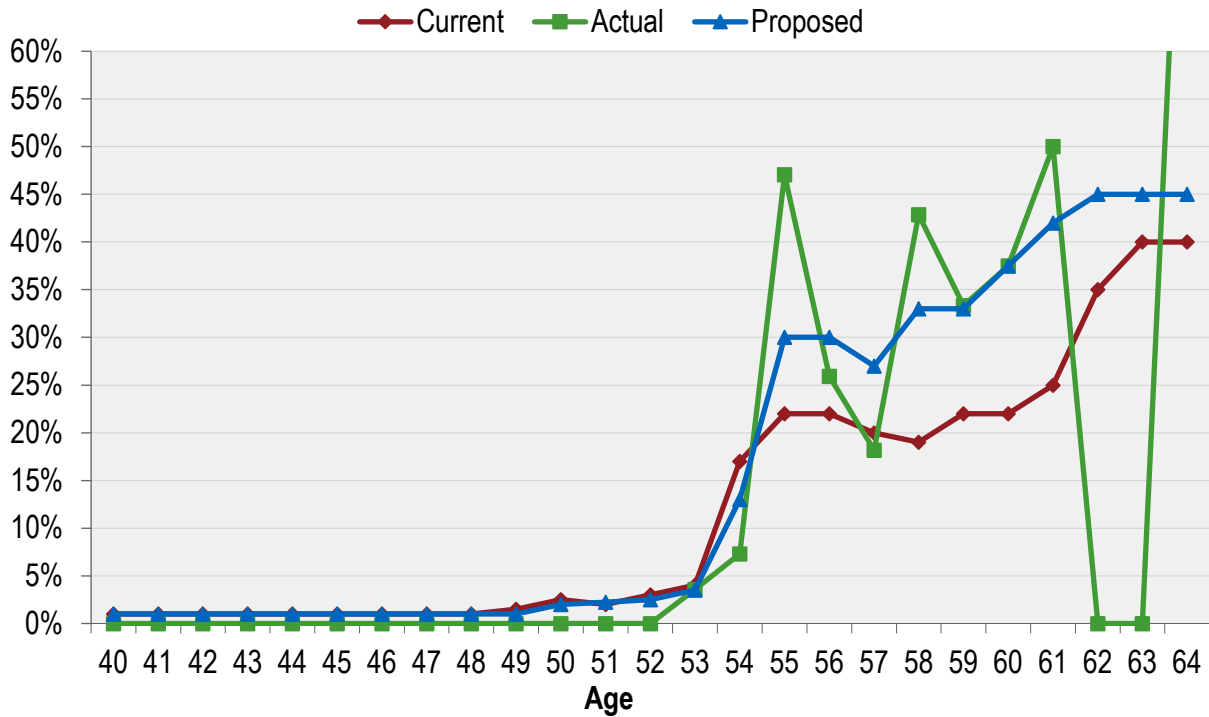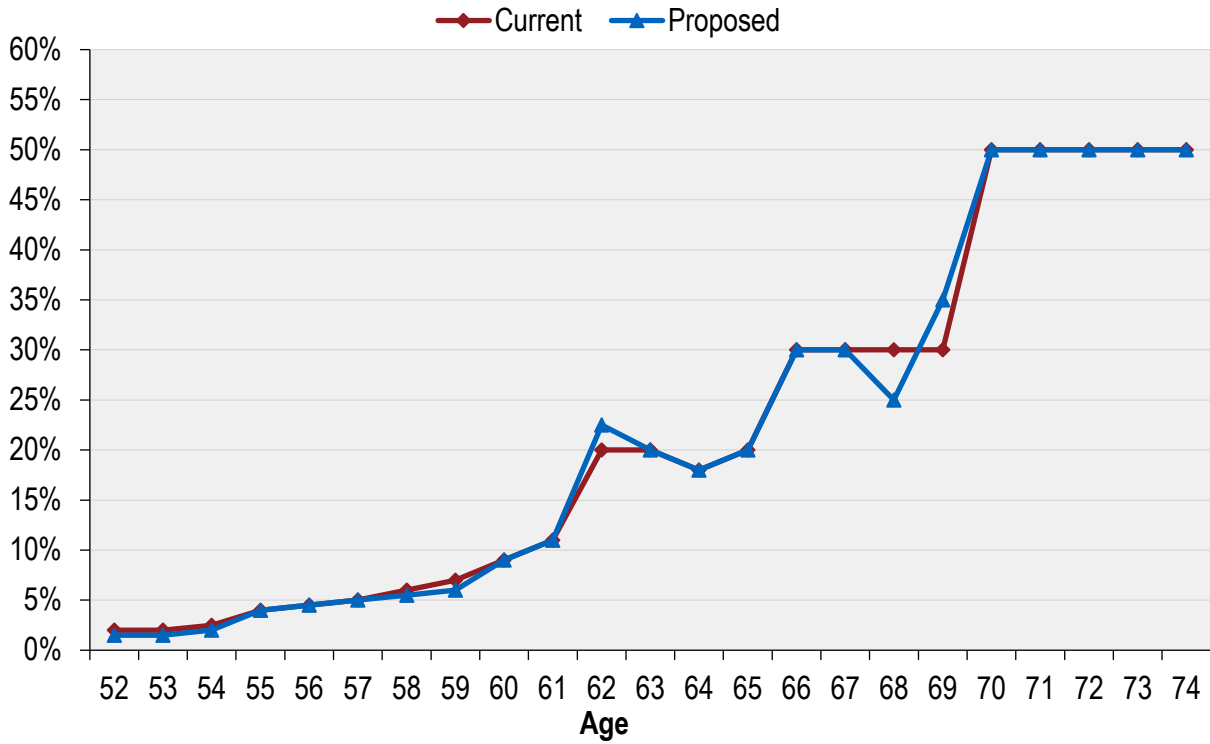NON-PEPRA GENERAL MEMBERS WITH 30 OR MORE YEARS OF SERVICE
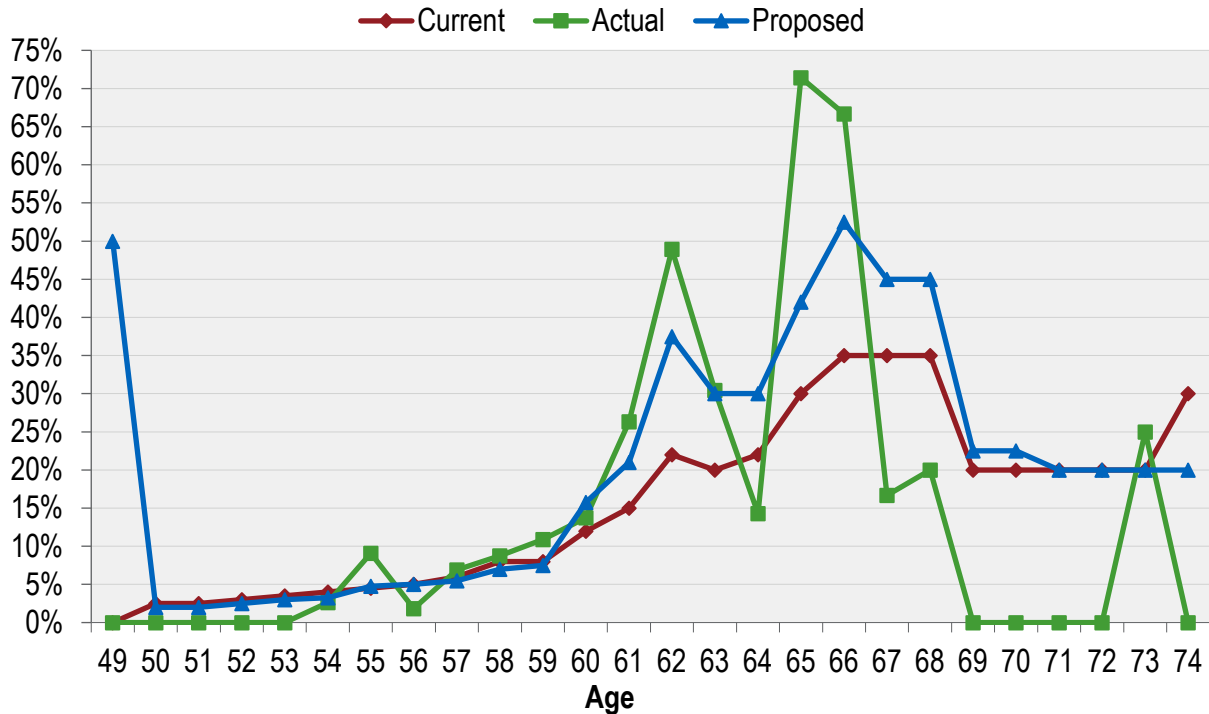
**CHART 5: RETIREMENT RATES
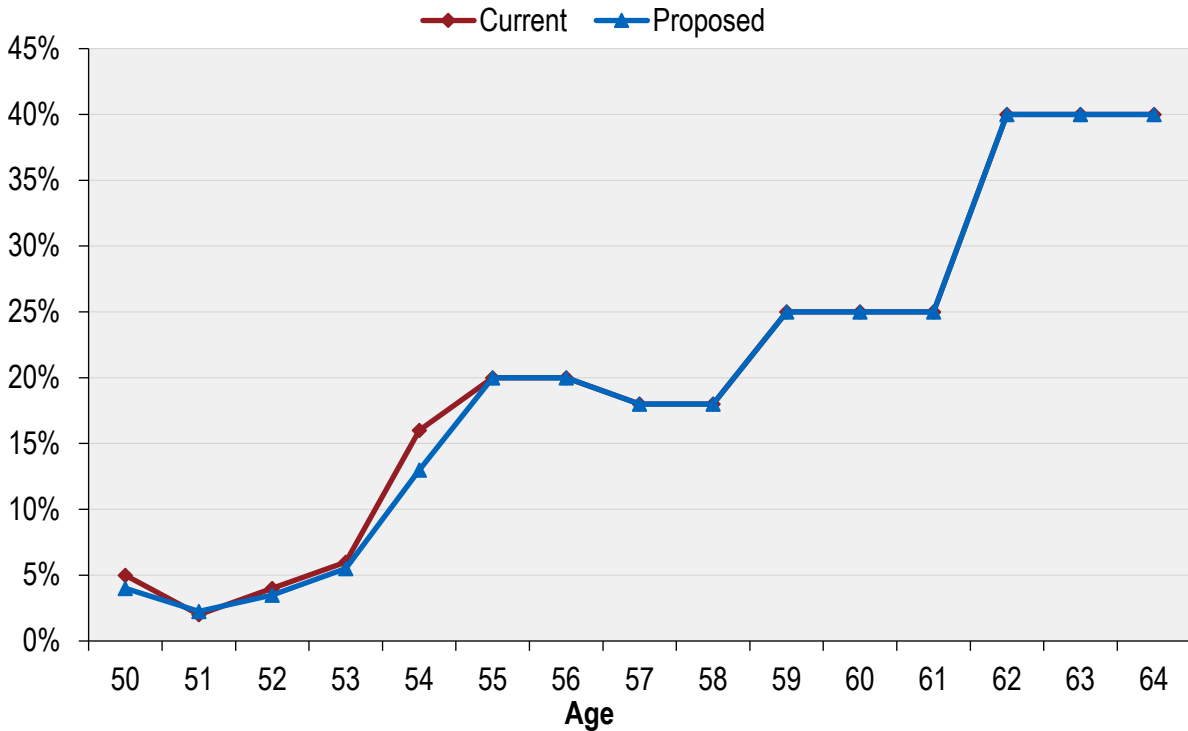NON-PEPRA SAFETY MEMBERS WITH LESS THAN 30 YEARS OF SERVICE**

**CHART 6: RETIREMENT RATES
NON-PEPRA SAFETY MEMBERS WITH 30 OR MORE YEARS OF SERVICE**

CHART 7: RETIREMENT RATES
PEPRA GENERAL MEMBERS

CHART 8: RETIREMENT RATES
PEPRA SAFETY MEMBERS

B. Mortality Rates - Healthy

The "healthy" mortality rates project the life expectancy of a member who retires from service (i.e., who did not retire on a disability pension). Also, the "healthy" pre-retirement mortality rates project what proportion of members will die before retirement. For General members, the table currently being used for post-service retirement mortality rates is the RP-2000 Combined Healthy Mortality Table (separate tables for males and females) projected with Scale BB to 2035 with ages set back one year for males and set forward one year for females. For Safety members, the table currently being used for post-service retirement mortality rates is the RP-2000 Combined Healthy Mortality Table (separate tables for males and females) projected with Scale BB to 2035 with ages set back three years. Beneficiaries are assumed to have the same mortality of a General member of the opposite sex who has taken a service (non-disabled) retirement.

The Society of Actuaries (SOA) has published the RP-2014 family of mortality tables and associated mortality improvement scales. Within that family of mortality tables, there are mortality rates developed for annuitants on a "headcount" weighted basis that weight all retirees at the same age the same way without regard to the level of benefits those annuitants are receiving from a retirement plan. Mortality rates are also developed for annuitants on a "benefit" weighted basis, with higher credibility assigned to experience from annuitants receiving larger benefits. However, we note that the RP-2014 benefit-weighted mortality table was prepared without any data from public and multi-employer pension plans. As a result, the headcount-weighted basis is the approach currently used by Segal for its California public system clients (including VCERA).

The SOA is in the process of collecting data from public sector plans so that they can develop mortality tables based on public sector experience comparable to the RP-2014 mortality tables developed using data collected from private and multi-employer plans. It is our understanding that those mortality tables will be available in 2018/2019. We will include a discussion with the Board on whether to consider the benefit-weighted mortality rates in the next experience study after those public sector experience mortality tables become available.

As for the mortality improvement scales, they can be applied in one of two ways. Historically, the more common application has been to use a "static" approach to anticipate a fixed level of mortality improvement for all annuitants receiving benefits from a retirement plan. This is in contrast to a "generational" approach where each future year has its own mortality table that reflects the forecasted improvements, using the published improvement scales. While the static approach is still used by some of Segal's California public system clients, as well as CalPERS, the "generational" approach is the emerging practice within the actuarial profession.

A generational mortality table provides dynamic projections of mortality experience for each cohort of retirees. For example, the mortality rate for someone who is 65 next year will be slightly less than for someone who is 65 this year. In general, using generational mortality anticipates increases in the cost of the Plan over time as participants' life expectancies are projected to increase. This is in contrast to updating a static mortality assumption with each experience study as we have proposed in prior experience studies.

We understand that the Retirement Plans Experience Committee of the Society of Actuaries (RPEC) intends to publish annual updates to their mortality improvement scales. Improvement scale MP-2017 is the latest improvement scale available. We recommend that given the trend in

the retirement industry to move towards generational mortality, it would be reasonable for the Board to adopt the Headcount-Weighted RP-2014 mortality table (adjusted for VCERA experience), and project the mortality improvement generationally using the MP-2017 mortality improvement scale.

As an illustration of the relative impact of these approaches, we have provided in the table below the approximate change in the total employer and member contribution rates based on the different approaches to build in margin for future mortality improvements.

	Employer and Member Contribution Rate Impact Combined
Headcount Weighted RP-2014 Family of Tables – Static Approach	0.0% of payroll
Benefit Weighted RP-2014 Family of Tables – Static Approach	1.0% of payroll
Headcount Weighted RP-2014 Family of Tables – Generational Approach	**0.4% of payroll**
Benefit Weighted RP-2014 Family of Tables – Generational Approach	1.4% of payroll

In order to use more actual VCERA experience in our analysis, we have used experience for a nine-year period by using data from the current (from July 1, 2014 to June 30, 2017) and the last two (from July 1, 2011 to June 30, 2014 and from July 1, 2008 to June 30, 2011) experience study periods to analyze this assumption.

Pre-Retirement Mortality

In prior experience studies, the pre-retirement mortality rates for active members were set equal to the post-retirement mortality rates for retirees since the actual number of deaths among active members was not large enough to provide a statistically creditable analysis. However, this approach is not compatible with our current proposal because the post-retirement RP-2014 Healthy Annuitant tables do not include rates for ages below 50.

From the RP-2014 family of tables, we recommend that pre-retirement mortality follow the Headcount-Weighted RP-2014 Employee Mortality Table (separate tables for males and females) times 80%, projected generationally with the two-dimensional scale MP-2017. The 80% scaling factor is to account for the lower incidences of observed pre-retirement death on the combined General and Safety workforce relative to the standard table. In addition, based on experience from the last three years of 35 total deaths, only one was due to service-connected (duty) causes. Therefore, we recommend maintaining the current assumption that all pre-retirement deaths are assumed to be non-service connected (ordinary).

Post-Retirement Mortality (Service Retirements)

Among all retired members, the actual deaths compared to the expected deaths under the current assumptions for the last nine years is shown in the table below. We also show the deaths under the proposed assumptions. In prior years we have generally set the mortality assumption using a static mortality projection so that actual deaths will be at least 10% greater than those assumed.

As noted above, we are recommending the use of a generational mortality table rather than static mortality. A generational mortality table incorporates a more explicit assumption for future mortality improvement. Accordingly, the goal is to start with a mortality table that closely matches the current experience (without a margin for future mortality improvement), and then reflect mortality improvement by projecting lower mortality rates in future years. That is why the proposed actual to expected ratios shown in the table below for General and Safety are 99% and 94%, respectively. In future years these ratios should remain around 100%, as long as actual mortality improves at the same rates as anticipated in the generational mortality tables. The number of actual deaths compared to the number expected under the current and proposed assumptions for the last nine years are as follows:

Gender	General Members – Healthy			Safety Members - Healthy		
	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	259	319	337	45	58	65
Female	381	439	428	3	8	5
Total	640	758	765	48	66	70
Actual / Expected	118%		99%	138%		94%

Even with the use of nine years of experience, the data is only partially credible, based on standard statistical theory. The number of deaths needed for full credibility is 1,082 (90% confident that the results are within 5% of the expected value). Therefore, in our recommended assumptions we did not fully adjust the RP-2014 mortality tables to fit VCERA's experience. In future experience studies, more data will be available which may increase the credibility further.

For General members, the combined ratio of actual to expected deaths was 118%. We recommend updating the current table to the Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females) times 90% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017. This will bring the actual to expected ratio to 99%.

For Safety members, the combined ratio of actual to expected deaths was 138%. We recommend updating the current table to the Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females) times 75% for males and 85% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017. This will bring the actual to expected ratio to 94%.

All of this is consistent with ASOP 35 as we anticipate expected future improvement in life expectancy using the generational approach.

Chart 9 compares actual to expected deaths for General members under the current and proposed assumptions over the past nine years. Experience shows that there were more deaths than predicted by the current table.

Chart 10 has the same comparison for Safety members. Experience shows that there were more deaths than predicted by the current table.

Chart 11 shows the life expectancies (i.e., expected future lifetime) under the current and the proposed tables for General members.

Chart 12 shows the same information for Safety members.

The expected deaths (Charts 9 and 10) and life expectancies (Charts 11 and 12) under the proposed generational mortality table are based on mortality rates from 2014 which is the base year of the table. In practice, life expectancies will be assumed to increase based on applying the mortality improvement scale.

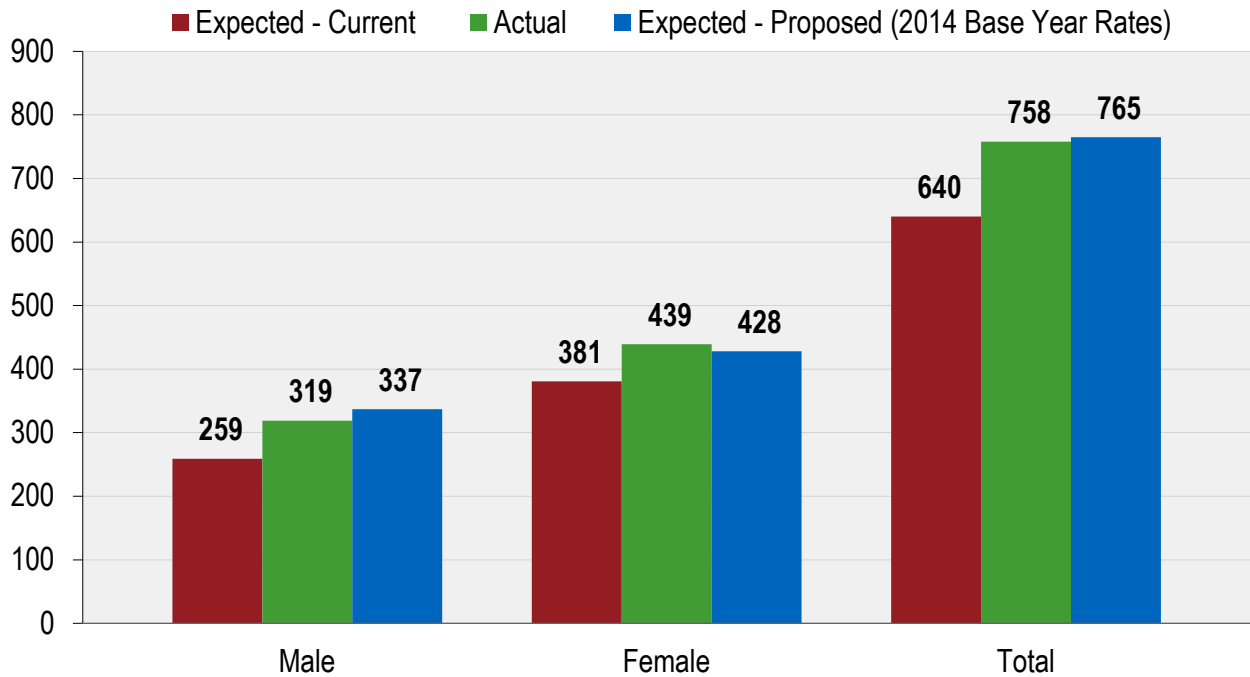## Mortality Table for Member Contributions, Optional Forms of Payment and Reserves

There are administrative reasons why a generational mortality table is more difficult to implement for determining member contributions for legacy tiers (i.e., non-PEPRA), optional forms of payment and reserves. For determining member contributions, one emerging practice is to approximate the use of a generational mortality table by the use of a static table with projection of the mortality improvement over a period that is close to the duration of the benefit payments for active members. We would recommend the use of this approximation for determining member contributions for legacy tiers.

We recommend that the mortality table used for determining contributions for General members be updated to a blended table based on the Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females) times 90% for males and 100% for females, projected 20 years with the two-dimensional mortality improvement scale MP-2017, weighted one-third male and two-thirds female. This is based on the proposed valuation mortality table for General members and the actual gender distribution of General members.

We also recommend an update to the mortality table for Safety members to be the Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females) times 75% for males and 85% for females, projected 20 years with the two-dimensional mortality improvement scale MP-2017, weighted 80% male and 20% female. This is based on the proposed mortality table for Safety members and the actual gender distribution for the current Safety members.

We recommend that the mortality tables used for determining optional forms of payment and reserves be updated to the same mortality tables above, except they will still be generationally projected with the two-dimensional MP-2017 projection scale associated with a retirement year of 2021. This will still allow for a generational projection, but results in an administratively feasible amount of factors.

CHART 9: POST-RETIREMENT DEATHS
NON-DISABLED GENERAL MEMBERS
(JULY 1, 2008 THROUGH JUNE 30, 2017)

Legend: ■ Expected - Current ■ Actual ■ Expected - Proposed (2014 Base Year Rates)

	Expected - Current	Actual	Expected - Proposed
Male	259	319	337
Female	381	439	428
Total	640	758	765

CHART 10: POST-RETIREMENT DEATHS
NON-DISABLED SAFETY MEMBERS
(JULY 1, 2008 THROUGH JUNE 30, 2017)

Legend: ■ Expected - Current ■ Actual ■ Expected - Proposed (2014 Base Year Rates)

	Expected - Current	Actual	Expected - Proposed
Male	45	58	65
Female	3	8	5
Total	48	66	70

CHART 11: LIFE EXPECTANCIES
NON-DISABLED GENERAL MEMBERS
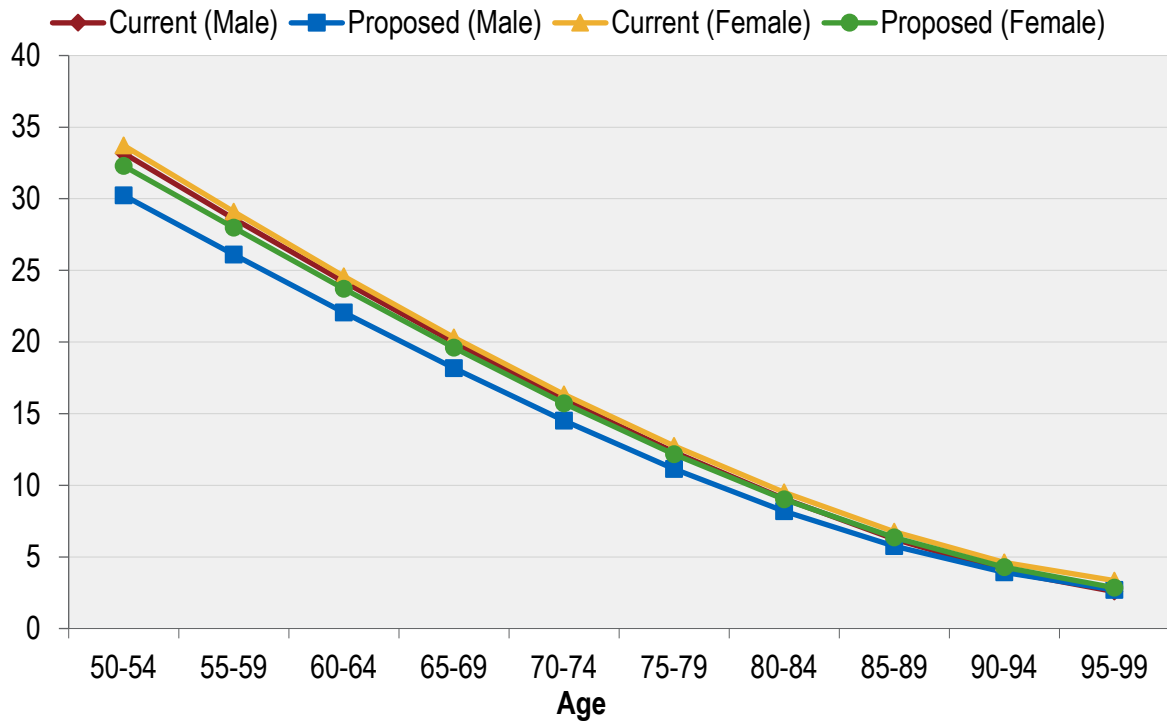
CHART 12: LIFE EXPECTANCIES
NON-DISABLED SAFETY MEMBERS
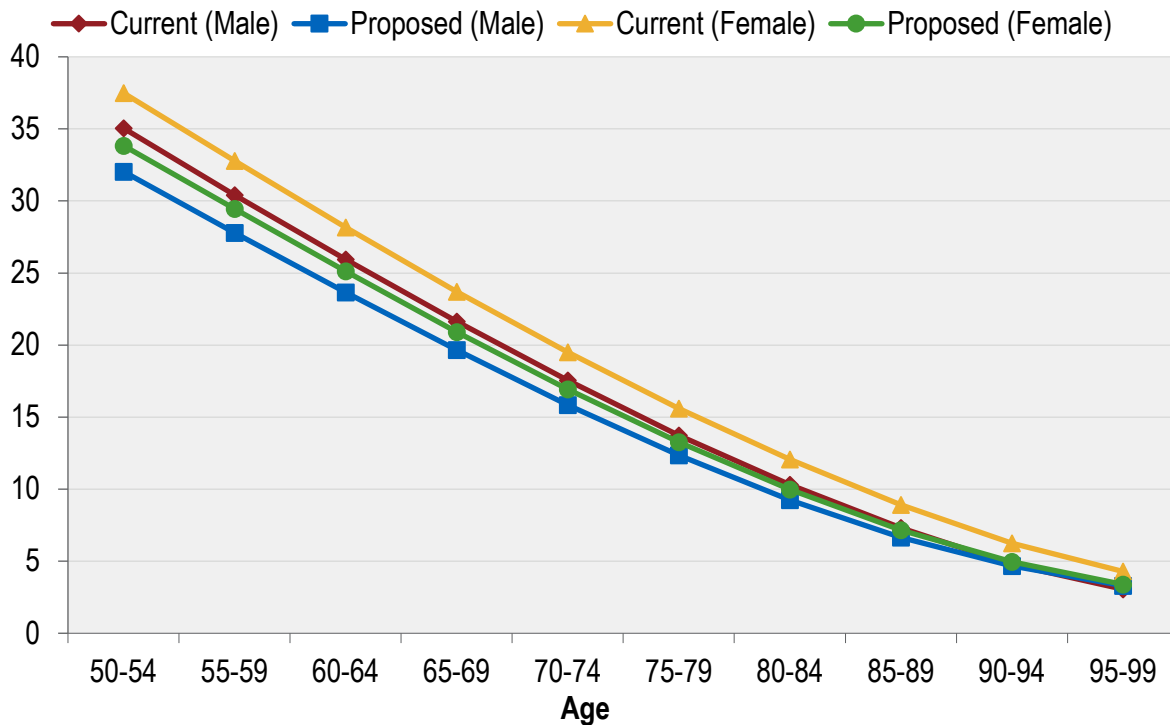
C. Mortality Rates - Disabled

Since mortality rates for disabled members can vary from those of healthy members, a different mortality assumption is often used. For General members, the table currently being used is the RP-2000 Combined Healthy Mortality Table (separate tables for males and females) projected with Scale BB to 2035 with ages set forward six years for males and set forward eight years for females. For Safety members, the table currently being used is the RP-2000 Combined Healthy Mortality Table (separate tables for males and females) projected with Scale BB to 2035 with ages set forward two years.

The number of actual deaths compared to the number expected under the current and proposed assumptions for the last nine years are as follows:

Gender	General - Disabled			Safety - Disabled		
	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	47	53	58	44	56	52
Female	69	82	73	2	3	4
Total	**116**	**135**	**131**	**46**	**59**	**56**
Actual / Expected	116%		103%	128%		105%

Based on the actual experience, we recommend updating the current table for General disabled members to the Headcount-Weighted RP-2014 Disabled Retiree Mortality Table (separate tables for males and females) times 85% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017. This will bring the actual to expected ratio to 103%.

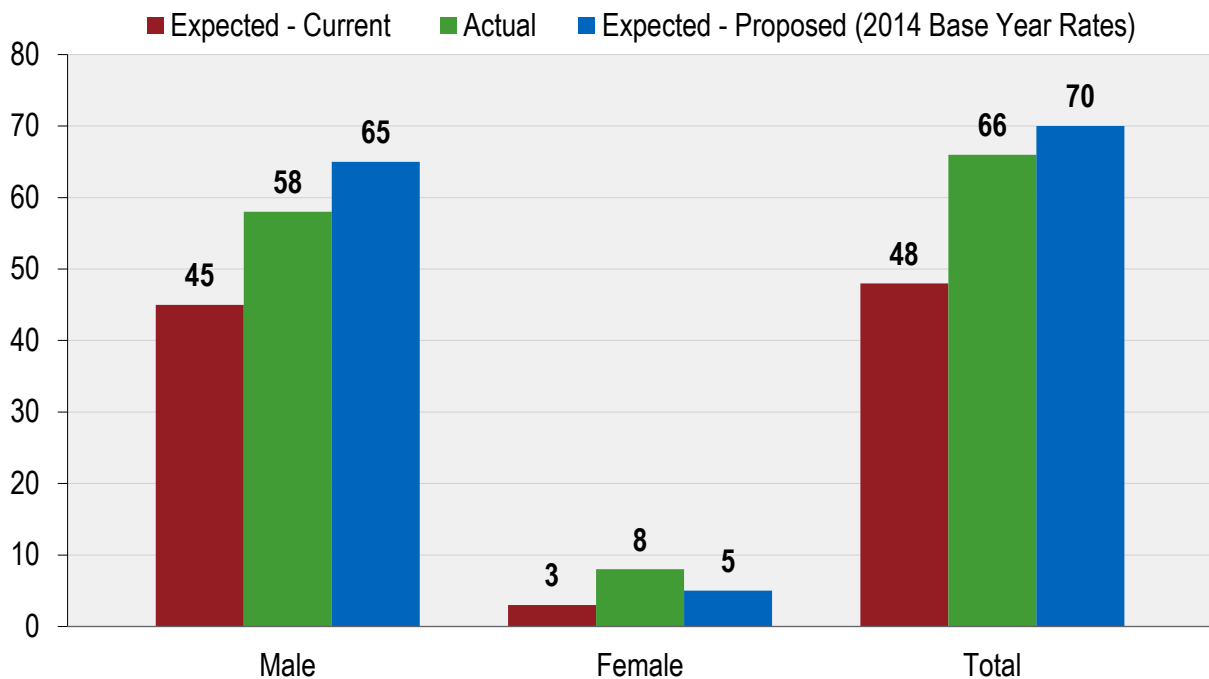However, based on the actual experience, we recommend updating the current table for Safety disabled members to the Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females) times 100% for males and 115% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017. This will bring the actual to expected ratio to 105%.

Chart 13 compares actual to expected deaths for disabled General members under both the current and proposed assumptions over the past nine years. Experience shows that there were more deaths than predicted by the current table.

Chart 14 has the same comparison for Safety members. Experience shows that there were more deaths than predicted by the current table.

Chart 15 shows the life expectancies under the current and the proposed tables for General members.

Chart 16 shows the same information for Safety members.

CHART 13: POST-RETIREMENT DEATHS
DISABLED GENERAL MEMBERS
(JULY 1, 2008 THROUGH JUNE 30, 2017)

Legend: Expected - Current | Actual | Expected - Proposed (2014 Base Year Rates)

	Male	Female	Total
Expected - Current	47	69	116
Actual	53	82	135
Expected - Proposed (2014 Base Year Rates)	58	73	131
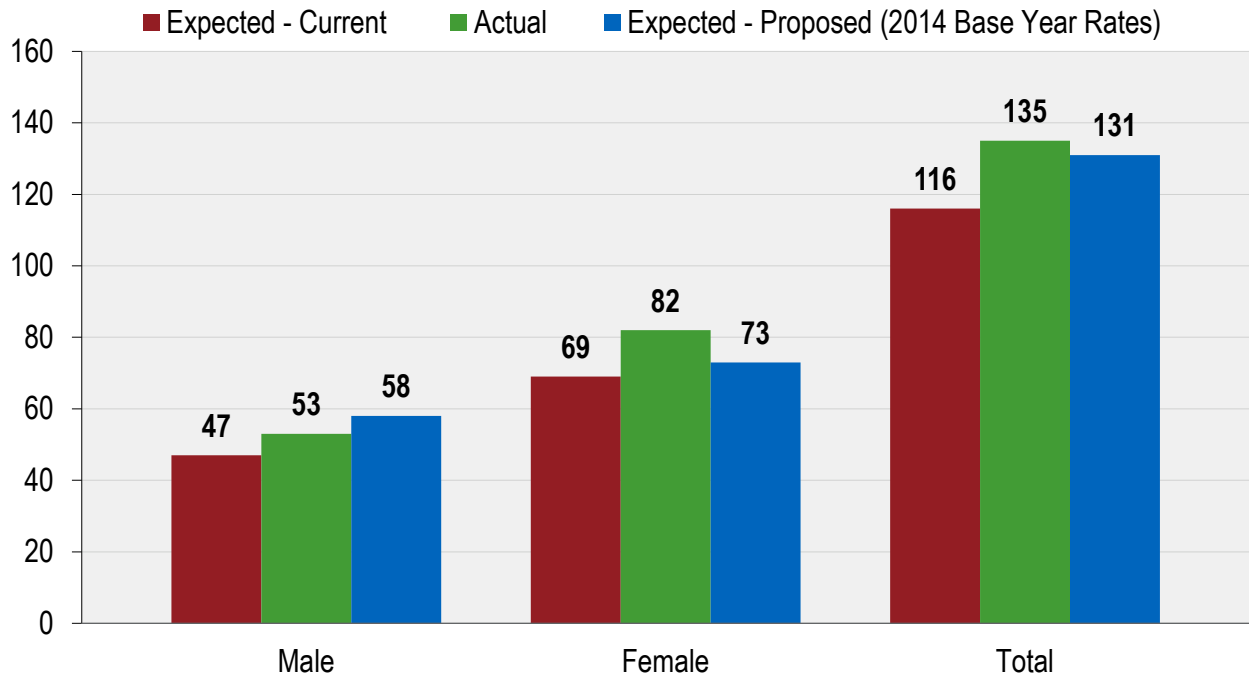
CHART 14: POST-RETIREMENT DEATHS
DISABLED SAFETY MEMBERS
(JULY 1, 2008 THROUGH JUNE 30, 2017)

Legend: Expected - Current | Actual | Expected - Proposed (2014 Base Year Rates)

	Male	Female	Total
Expected - Current	44	2	46
Actual	56	3	59
Expected - Proposed (2014 Base Year Rates)	52	4	56
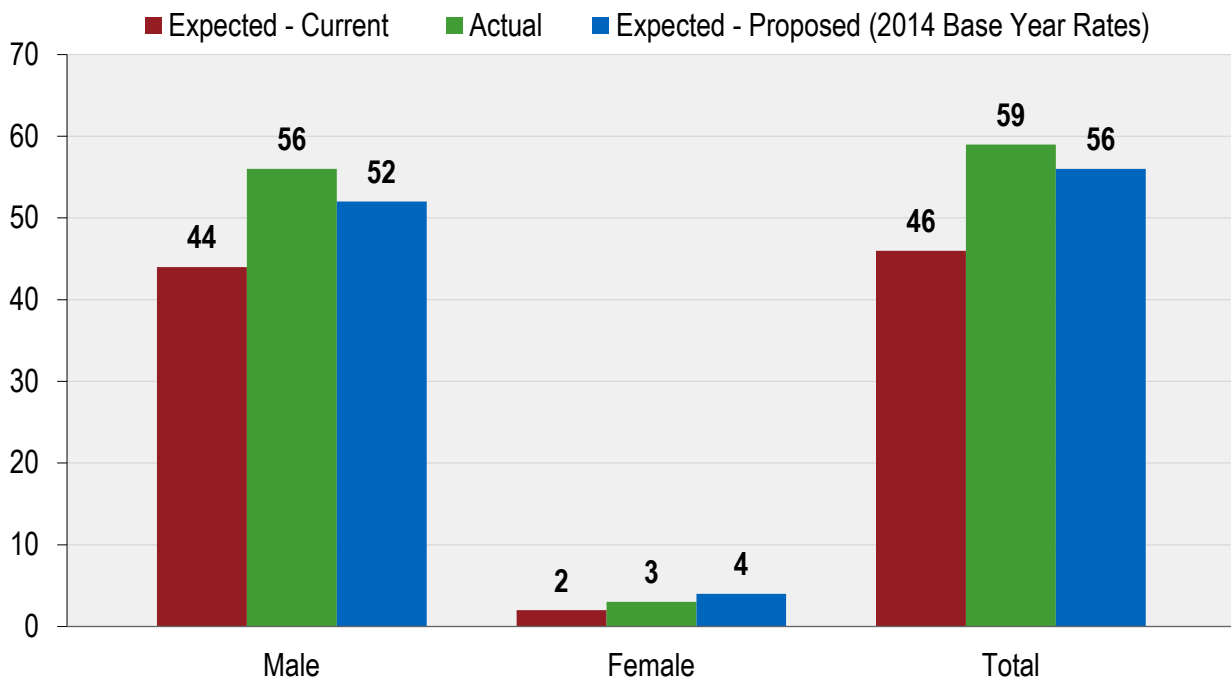
CHART 15: LIFE EXPECTANCIES
DISABLED GENERAL MEMBERS
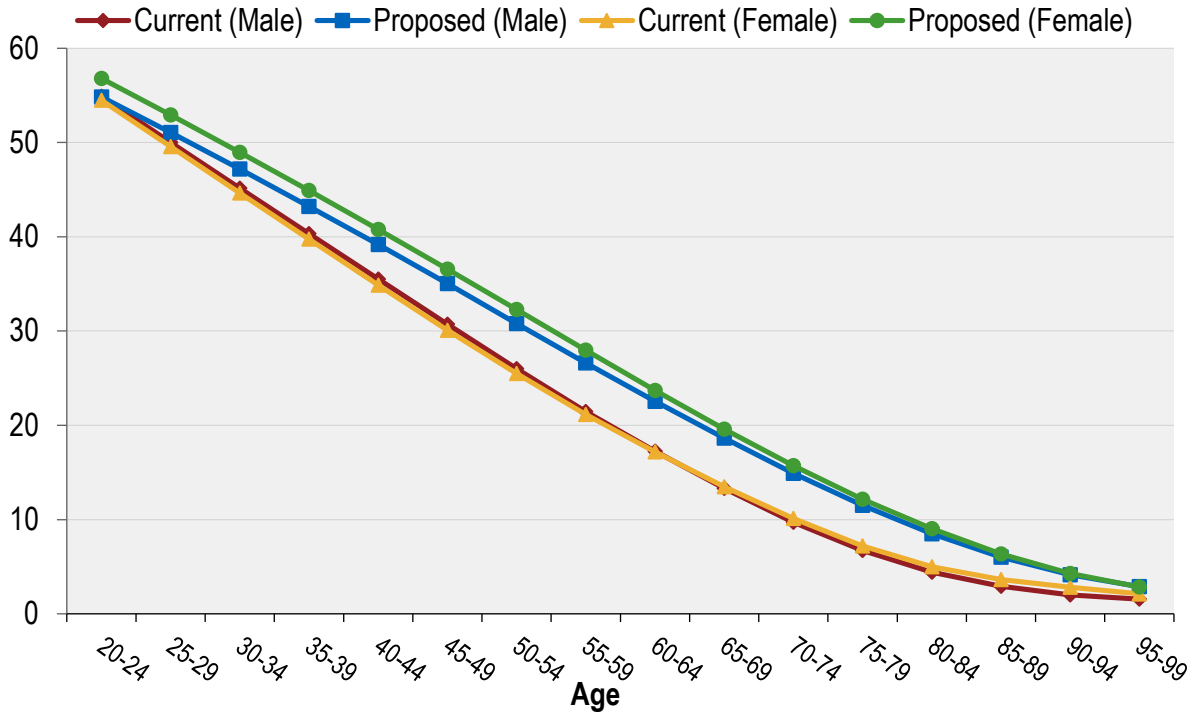
CHART 16: LIFE EXPECTANCIES
DISABLED SAFETY MEMBERS
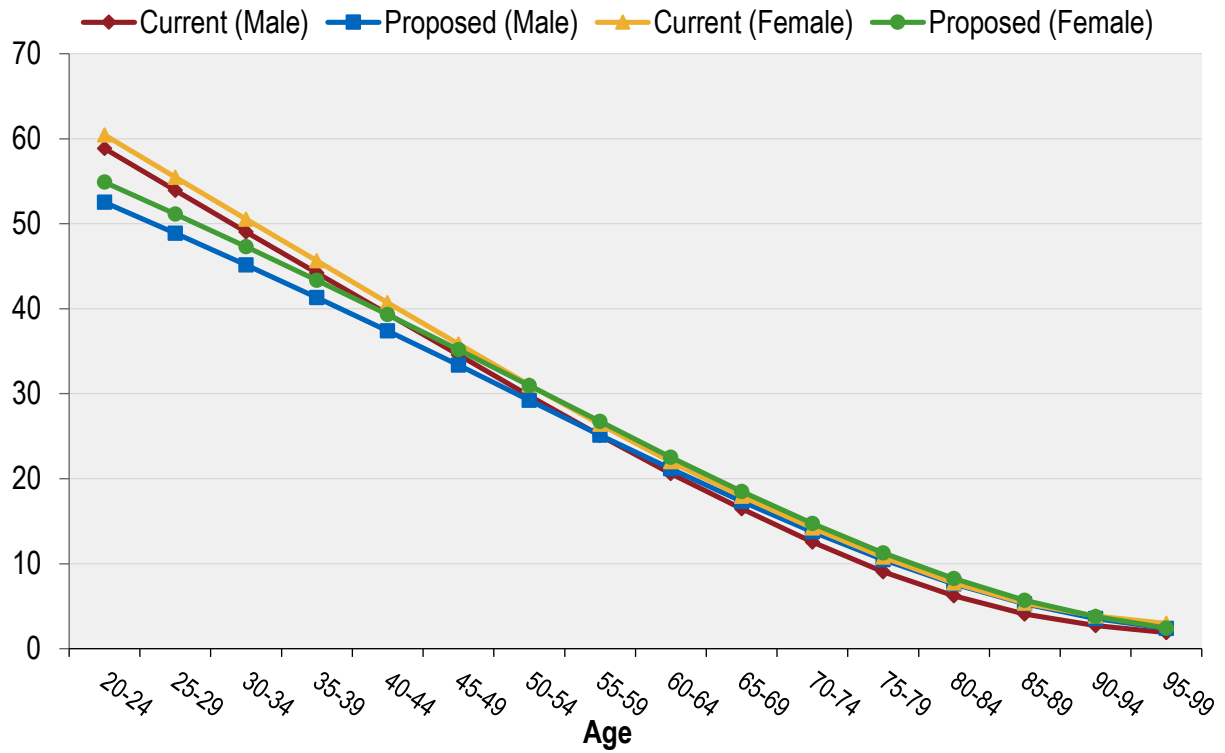
D. Termination Rates

Termination rates include all terminations for reasons other than death, disability, or retirement. Under the current assumptions there is an overall incidence of termination assumed, combined with an assumption that a member will choose between a refund of contributions and a deferred vested benefit based on which option is more valuable. With this study, we continue to recommend that this same assumption structure be used.

Currently, assumed termination rates are a function of years of service. We continue to believe that termination rates are strongly correlated with years of service. Therefore, we have maintained the current termination assumption structure as a function of years of service.

The termination experience over the last three years for General and Safety members is shown by years of service in the following tables. Please note that we have excluded any members that were eligible for retirement. We also show the current and proposed assumptions.

Rates of Termination – General

Years of Service	Termination Rate (%)		
	Current Rate	Observed Rate	Proposed Rate
Less than 1	14.00	14.31	14.00
1	10.00	10.15	10.00
2	8.00	9.01	8.25
3	7.00	8.45	7.25
4	6.00	5.43	6.00
5	4.00	7.23	5.00
6	3.75	5.10	4.00
7	3.50	3.43	3.50
8	3.50	2.80	3.50
9	3.25	4.47	3.25
10	3.25	3.61	3.25
11	3.00	1.42	3.00
12	3.00	4.33	3.00
13	2.75	2.34	2.75
14	2.75	4.08	2.75
15	2.50	1.97	2.50
16	2.50	3.24	2.50
17	2.25	3.49	2.25
18	2.00	1.57	2.00
19	2.00	1.74	2.00
20 or more	2.00	2.84	2.00

Rates of Termination – Safety

Years of Service	Termination Rate (%)		
	Current Rate	Observed Rate	Proposed Rate
Less than 1	10.00	13.73	11.00
1	6.00	5.70	6.00
2	5.50	6.86	5.75
3	5.00	3.23	4.50
4	4.00	4.80	4.25
5	2.75	3.79	3.00
6	2.50	2.42	2.50
7	2.00	2.76	2.25
8	1.80	1.75	1.80
9	1.60	1.76	1.60
10	1.40	3.52	1.40
11	1.20	0.00	1.20
12	1.00	3.39	1.00
13	0.95	0.67	0.95
14	0.90	0.66	0.90
15	0.85	0.00	0.85
16	0.80	1.22	0.80
17	0.75	0.70	0.75
18	0.70	0.00	0.70
19	0.65	0.00	0.65
20 or more	0.60	0.00	0.60

It is important to note that not every service category has enough exposures and/or decrements such that the results in that category are statistically credible even if we look at six years' worth of experience. This is mainly the case at the highest service categories since most members in those categories are eligible to retire and so have been excluded from our review of this experience.

Chart 17 compares actual to expected terminations over the past three years for both the current and proposed assumptions for General members.

Chart 18 graphs the same information as Chart 17, but for Safety members.

Chart 19 shows the actual termination rates over the past three years compared to the current and proposed assumptions for General members.

Chart 20 shows the same information as Chart 19, but for Safety members.

Based upon the recent experience, the termination rates for both General and Safety members have been increased during the early years of employment at most service categories. Overall, for both General and Safety members, the proposed termination rates are higher than those under the current assumptions.

It is our understanding that General Tier 2 COLA members can elect a refund of all or a portion of their Tier 2 COLA member contributions and forgo the Tier 2 COLA upon retirement. Based on the data for the year ending June 30, 2017, about 39% of total General Tier 2 COLA member contributions were refunded for retiring members. However, since we only received the actual experience regarding the refunded General Tier 2 COLA contributions for one year, we will continue to conservatively assume that all members retiring with the Tier 2 COLA will elect to have the COLA applied to their benefit in lieu of a refund. We will continue to monitor this as we obtain more data in the future.

We will also continue to assume that termination rates are zero at any age where members are assumed to retire. In other words, at those ages, members will either retire in accordance with the retirement rate assumptions or continue working, rather than terminate and defer their benefit.

CHART 17: ACTUAL NUMBER OF TERMINATIONS COMPARED TO EXPECTED – GENERAL MEMBERS

Legend: Expected - Current | Actual | Expected - Proposed

Year ended June 30,	Expected - Current	Actual	Expected - Proposed
2015	288	286	293
2016	299	382	304
2017	325	325	331
Total	912	993	928
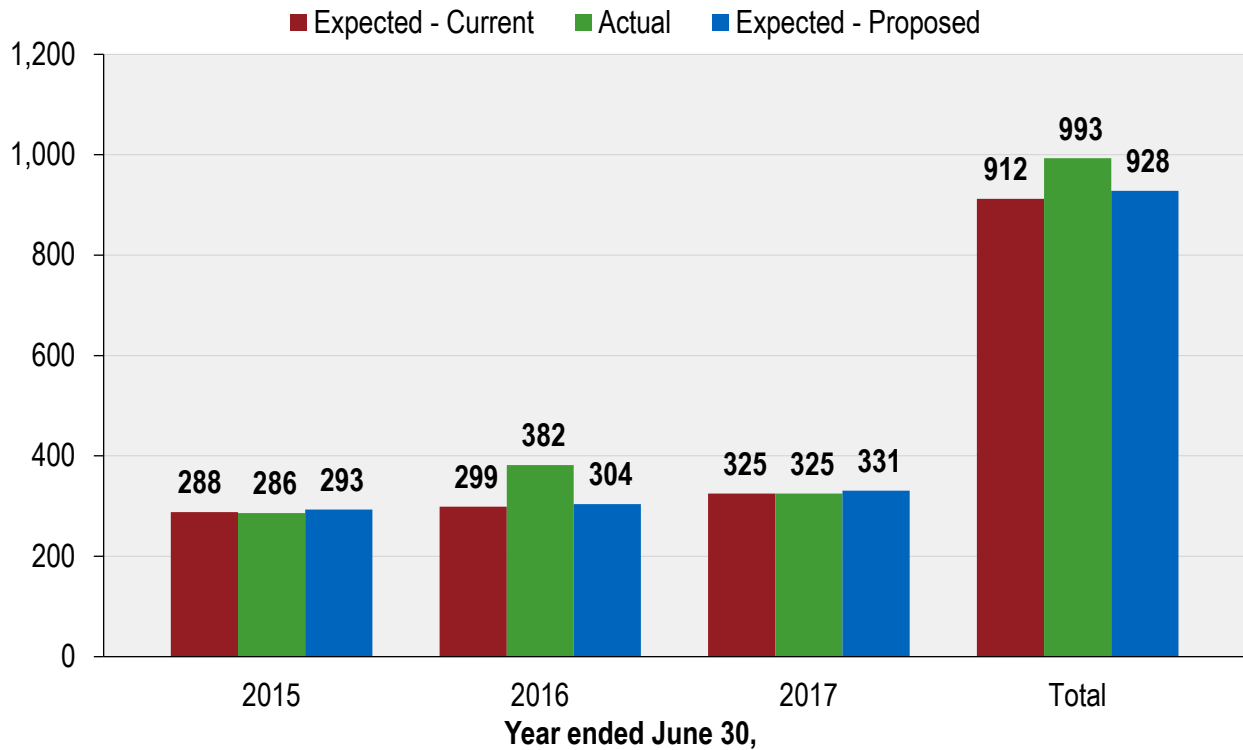
CHART 18: ACTUAL NUMBER OF TERMINATIONS COMPARED TO EXPECTED – SAFETY MEMBERS

Legend: Expected - Current | Actual | Expected - Proposed

Year ended June 30,	Expected - Current	Actual	Expected - Proposed
2015	28	31	29
2016	27	31	28
2017	26	29	27
Total	81	91	84

CHART 19: TERMINATION RATES –
GENERAL MEMBERS
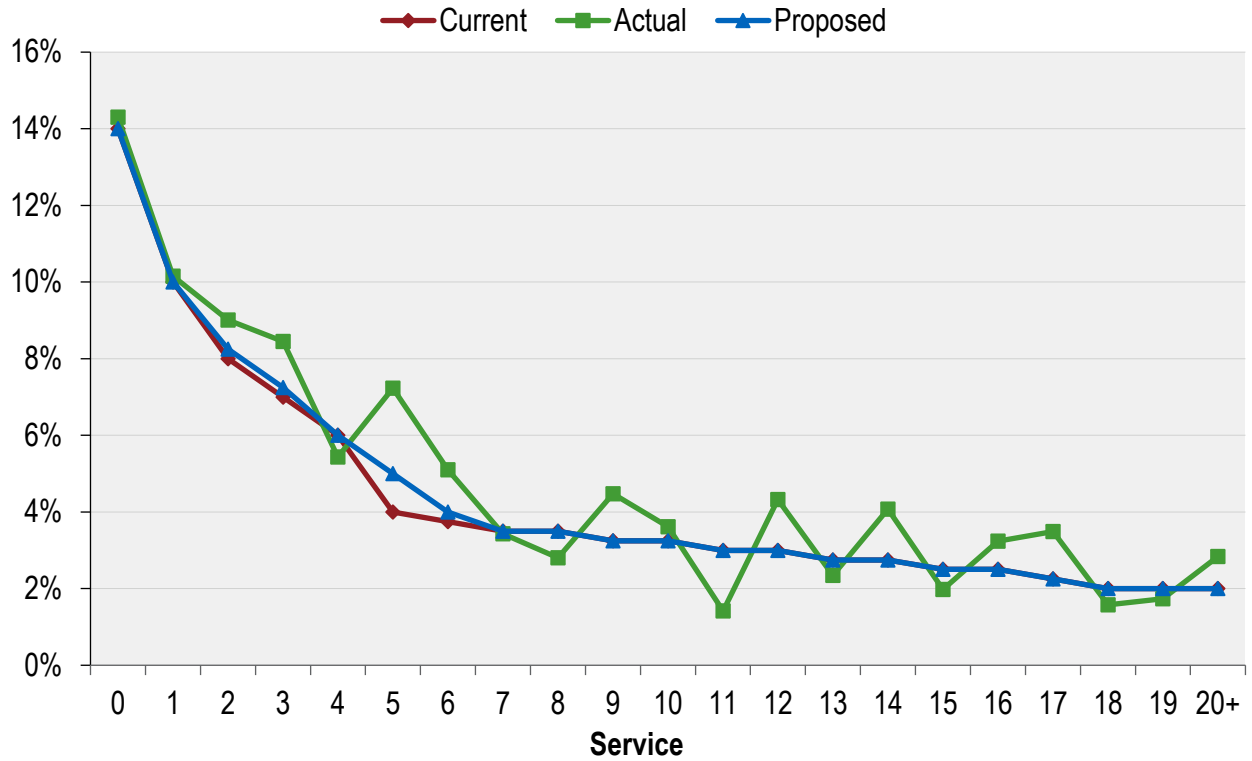
CHART 20: TERMINATION RATES –
SAFETY MEMBERS
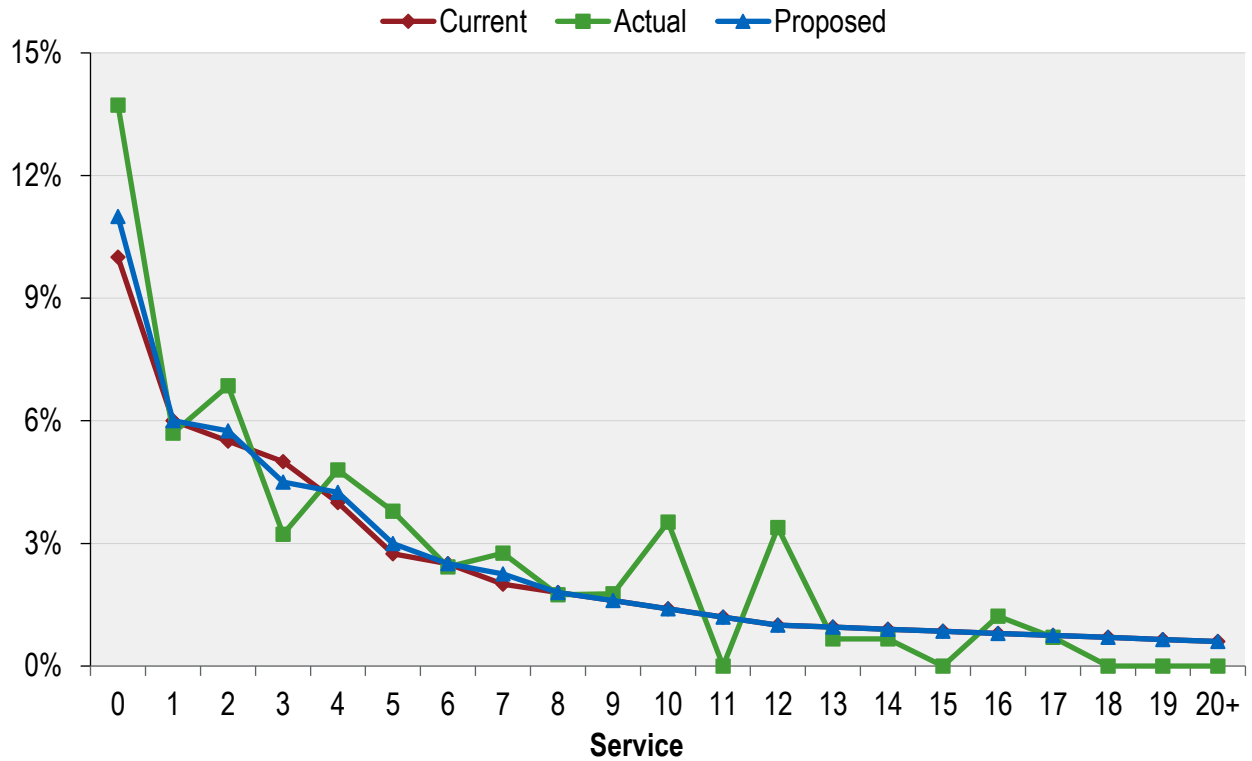
E. Disability Incidence Rates

When a member becomes disabled, he or she may be entitled to at least a 50% of pay pension (service connected disability), or a pension that depends upon the member's years of service (non-service connected disability). The following summarizes the actual incidence of combined service and non-service connected disabilities over the past three years compared to the current and proposed assumptions for both service connected and non-service connected disability incidence:

Rates of Disability Incidence - General

Age	Disability Incidence Rate* (%)		
	Current Rate	Observed Rate	Proposed Rate
20 – 24	0.01	0.00	0.01
25 – 29	0.02	0.00	0.02
30 – 34	0.05	0.00	0.04
35 – 39	0.10	0.00	0.08
40 – 44	0.15	0.08	0.13
45 – 49	0.25	0.14	0.20
50 – 54	0.35	0.17	0.25
55 – 59	0.45	0.24	0.35
60 – 64	0.60	0.31	0.45
65 – 69	0.75	0.32	0.60
70 – 74	1.00	0.00	0.75

*   Total rate for service connected and non-service connected disabilities.

Rates of Disability Incidence - Safety

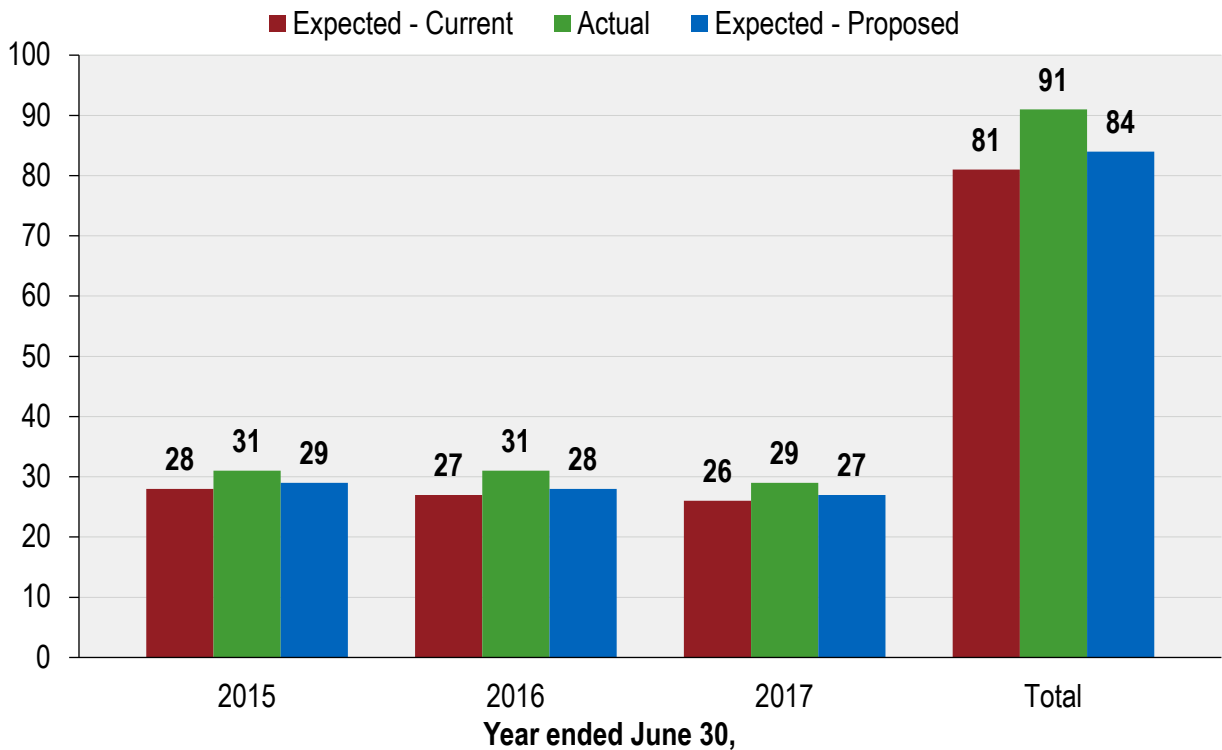| Age	Disability Incidence Rate* (%)		
	Current Rate	Observed Rate	Proposed Rate
20 – 24	0.05	0.00	0.05
25 – 29	0.15	0.00	0.15
30 – 34	0.30	0.29	0.30
35 – 39	0.40	0.56	0.40
40 – 44	0.70	0.38	0.60
45 – 49	1.00	0.90	1.00
50 – 54	1.80	1.12	1.50
55 – 59	3.60	3.55	3.60
60 – 64	6.00	8.24	7.00

*   Total rate for service connected and non-service connected disabilities.

Chart 21 compares the actual number of service connected and non-service connected disabilities over the past three years to that expected under both the current and proposed assumptions. The proposed disability rates were adjusted to reflect the past three years' experience. Overall, there are decreases in the rates proposed for both General and Safety members.

Chart 22 shows actual disability incidence rates, compared to the assumed and proposed rates for General members. Since 15% of disabled General members received a service connected disability, we recommend reducing the current assumption from 35% to 25% of disabilities being entitled to a service connected disability retirement. The remaining 75% of disabled General members are assumed to receive a non-service connected disability retirement.

Chart 23 shows the same information as Chart 21, but for Safety members. Since 90% of disabled Safety members received a service connected disability, we recommend maintaining the current assumption that 90% of disabilities will receive a service connected disability retirement. The remaining 10% of disabled Safety members are assumed to receive a non-service connected disability retirement.

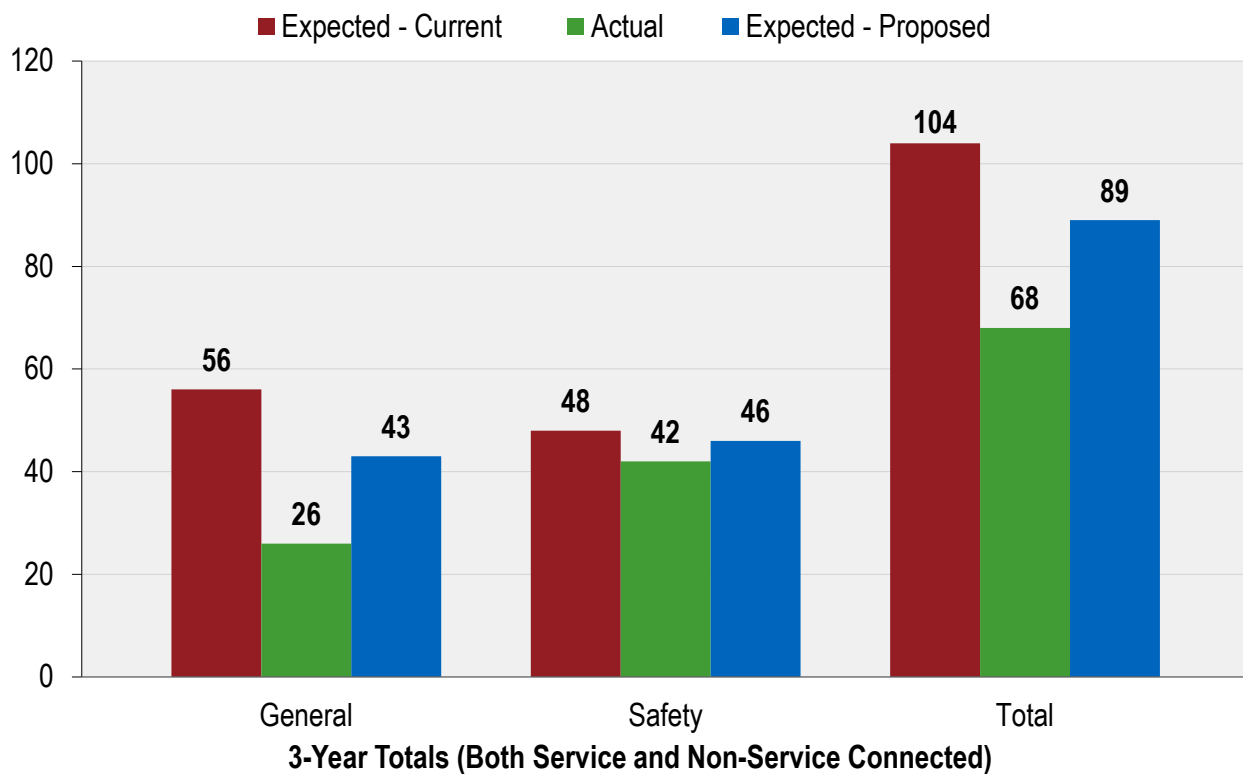**CHART 21: ACTUAL NUMBER OF DISABILITIES COMPARED TO EXPECTED**

3-Year Totals (Both Service and Non-Service Connected)

CHART 22: DISABILITY INCIDENCE RATES – GENERAL MEMBERS
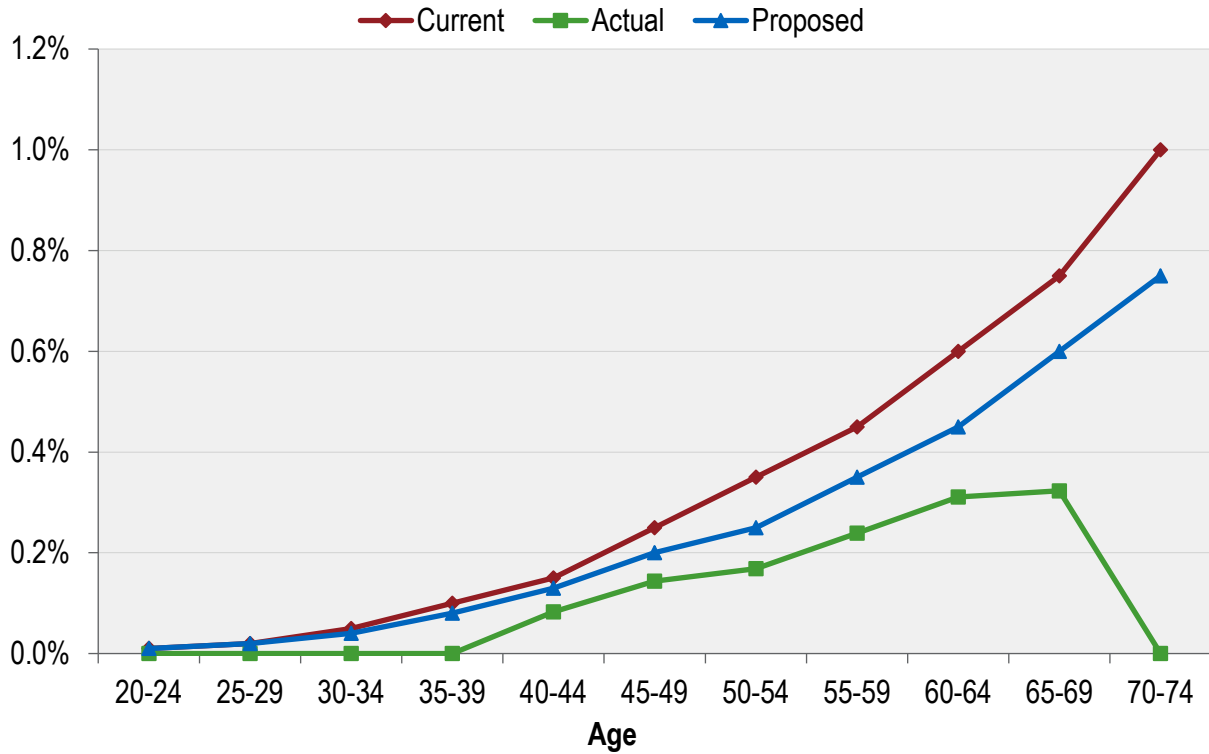
CHART 23: DISABILITY INCIDENCE RATES – SAFETY MEMBERS
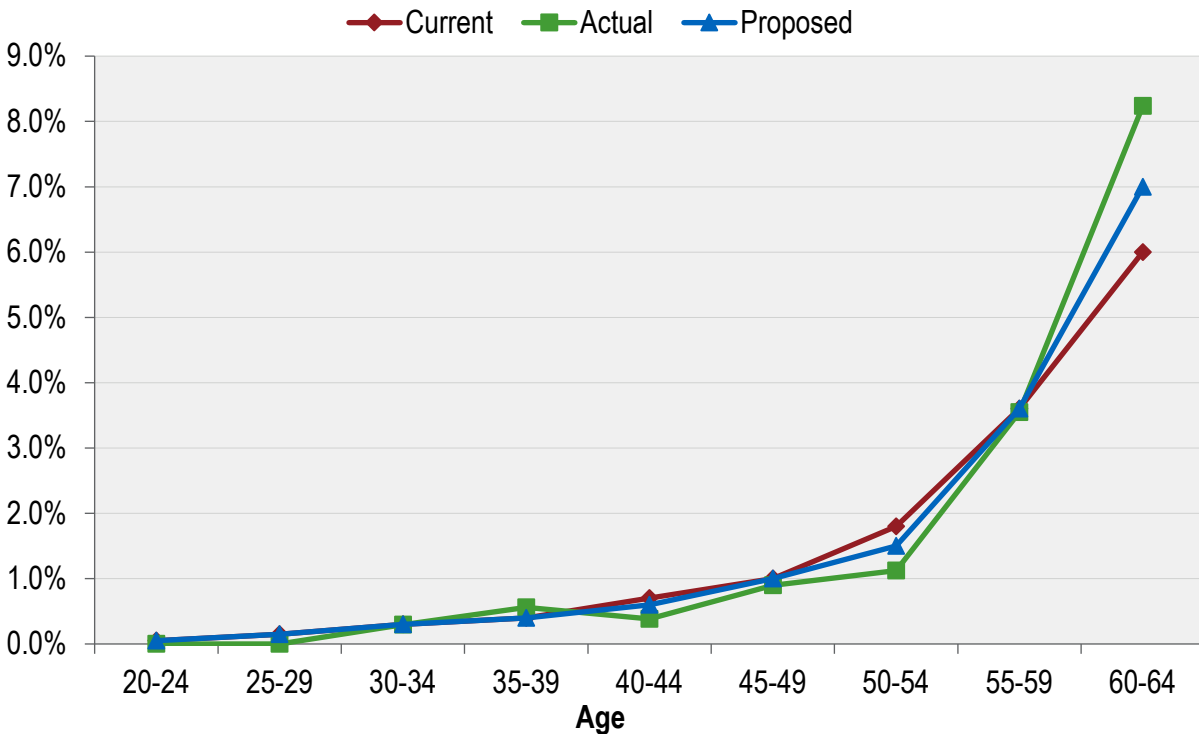
F. In-Service Redemptions

In 1998, the Board of Retirement, in the course of actions related to the Ventura Settlement, determined that several additional pay elements should be included as Earnable Compensation. These additional pay elements fall into two categories:

> Ongoing Pay Elements – Those that are expected to be received relatively uniformly over a member's employment years; and

> In-Service Redemption Elements – Those that are expected to be received only during the member's final average earnings pay period.

The first category is recognized in the actuarial calculations by virtue of being included in the current pay of active members. The second category requires a separate actuarial assumption to anticipate its impact on a member's retirement benefit.

In this study, we have collected data for the last three years to estimate in-service redemptions for non-PEPRA active members as a percentage of final average pay. The results are summarized in the following table:

Year Ending June 30	Actual Average In-Service Redemptions for Non-PEPRA Members		
	General Tier 1	General Tier 2	Safety
2015	9.16%	3.89%	7.29%
2016	5.61%	3.76%	5.12%
2017	7.27%	3.69%	7.59%
Average	7.42%	3.77%	6.53%
Current Assumption	7.50%	3.50%	7.25%
Proposed Assumption	7.50%	3.50%	7.00%

For determining the cost of the basic benefit (i.e., non-COLA component), the cost of this pay element is currently recognized in the valuation as an employer only cost and does not affect member contribution rates.

Based on the data in the above table, the in-service redemption assumption has been maintained for General Tier 1 and General Tier 2 members and decreased for Safety members. For General Tier 2, we maintained the assumption based on a combination of the experience during the current and prior three-year periods.

G. Average Entry Age (For Non-PEPRA Member Contributions)

The assumption for average entry age of non-PEPRA active members is used in determining the rate at which members who were hired after November 1974 contribute. In addition, this only applies to non-PEPRA active members that are not contributing fifty percent of the Normal Cost. The current assumption is age 35 for General members and age 27 for Safety members. The actual average entry ages for all active members as of June 30, 2017 is age 34.6 for General members and age 27.0 for Safety members.

Based on this experience we recommend that the average entry age for General members used for determining member contribution rates be maintained at age 35. For Safety members we recommend that the average entry age used for determining member contribution rates be maintained at age 27.

V. Cost Impact

The tables below show the changes in the employer and member contribution rates due to the proposed assumption changes as if they were applied in the June 30, 2017 actuarial valuation. These estimated impacts reflect the 50/50 sharing of Normal Cost for non-PEPRA tiers. If all of the proposed assumption changes (both economic and demographic) were implemented, the Plan's average employer rate would have increased by 1.54% of payroll. The average member rate would have increased by 0.32% of payroll. The Plan's UAAL would have increased by $109 million.

Employer Contribution Rate Impact (% of Payroll)								
Contributions	General Tier 1	General Tier 2	PEPRA General Tier 2	General Tier 2C	PEPRA General Tier 2C	Safety	PEPRA Safety	Overall
Normal Cost	-0.60%	0.39%	0.39%	0.77%	0.76%	0.12%	0.33%	0.48%
UAAL	1.13%	1.04%	1.04%	1.13%	1.13%	0.96%	0.96%	1.06%
Total	**0.53%**	**1.43%**	**1.43%**	**1.90%**	**1.89%**	**1.08%**	**1.29%**	**1.54%**

Total Employer Contribution Rate Impact (Estimated Annual Dollar Amounts in Thousands)								
Contributions	General Tier 1	General Tier 2	PEPRA General Tier 2	General Tier 2C	PEPRA General Tier 2C	Safety	PEPRA Safety	Overall
Total	$36	$3,033	$698	$4,031	$1,522	$1,578	$244	$11,142

Member Contribution Rate Impact (% of Payroll)								
Contributions	General Tier 1	General Tier 2	PEPRA General Tier 2	General Tier 2C	PEPRA General Tier 2C	Safety	PEPRA Safety	Overall
Total	-0.54%	0.39%	0.39%	0.39%	0.39%	0.10%	0.33%	0.32%

Member Contribution Rate Impact (Estimated Annual Dollar Amounts in Thousands)								
Contributions	General Tier 1	General Tier 2	PEPRA General Tier 2	General Tier 2C	PEPRA General Tier 2C	Safety	PEPRA Safety	Overall
Total	-$39	$820	$189	$814	$309	$129	$62	$2,284

Considered separately, the changes in the economic assumptions accounted for about three-quarters of the overall cost impact to the plan.

In particular, if all of the proposed economic assumptions changes were implemented, the average employer rate would have increased by 1.04% of payroll and the average member rate would have increased by 0.38% of payroll. Of the various economic assumption changes, the most significant cost impact is from the investment return assumption change.

Furthermore, if all of the proposed demographic assumption changes were implemented, the average employer rate would have increased by 0.50% of payroll. The average member rate would have decreased by 0.06% of payroll. Of the various demographic assumption changes, the most significant cost impact are from the mortality assumption change for General membership and retirement assumption change for Safety membership.

Therefore, as noted above, the estimated cost impact of all proposed assumption changes (both economic and demographic) is 1.54% of payroll for the average employer rate, where the Normal Cost rate increased by 0.48% and the UAAL amortization rate increased by 1.06%. The average member rate would have increased by 0.32% of payroll.

Appendix A: Current Actuarial Assumptions

Economic Assumptions

Net Investment Return:	7.50%, net of investment and administrative expenses.
Member Contribution Crediting Rate:	3.00% (actual increase is based on projected long term ten-year Treasury rate).
Consumer Price Index:	Increase of 3.00% per year; retiree COLA increases due to CPI are subject to a 3.00% maximum change per year for both PEPRA and Non-PEPRA General Tier 1 and both PEPRA and Non-PEPRA Safety. For both PEPRA and non-PEPRA General Tier 2, SEIU members receive a fixed 2% cost-of-living adjustment, not subject to changes in the CPI, that applies to future service after March 2003.
Payroll Growth:	Inflation of 3.00% per year plus "across the board" real salary increases of 0.50% per year.
Increases in Internal Revenue Code Section 401(a)(17) Compensation Limit:	Increase of 3.00% per year from the valuation date.
Increase in Section 7522.10 Compensation Limit:	Increase of 3.00% per year from the valuation date.

Individual Salary Increases

Annual Rate of Compensation Increase (%)		
Inflation: 3.00% per year; plus "across the board" real salary increases of 0.50% per year; plus the following promotional and merit increases:		
Years of Service	**General**	**Safety**
Less than 1	6.00	8.00
1	4.25	6.25
2	3.25	4.75
3	2.75	4.00
4	2.25	3.25
5	1.75	3.00
6	1.25	2.25
7	1.00	1.50
8	0.75	1.25
9	0.50	1.00
10	0.50	0.75
11	0.50	0.75
12	0.50	0.75
13	0.50	0.75
14	0.50	0.75
15	0.50	0.75
16	0.50	0.50
17	0.50	0.50
18	0.50	0.50
19	0.50	0.50
20 and Over	0.50	0.50

Demographic Assumptions

Mortality Rates – Healthy

> **General Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2035 set back one year for males and set forward one year for females

> **Safety Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2035 set back three years

Mortality Rates – Disabled

> **General Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2035 set forward six years for males and eight years for females

> **Safety Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2035 set forward two years

Mortality Rates – Beneficiaries

> **Beneficiaries:** Beneficiaries are assumed to have the same mortality as a General Member of the opposite sex who has taken a service (non-disability) retirement

The above mortality tables contain about a 10% margin, based on actual to expected deaths, as a provision appropriate to reasonably anticipate future mortality improvement, based on a review of mortality experience as of the measurement date.

Member Contribution Rates

> **General Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2035 set back one year for males and set forward one year for females weighted one-third male and two-thirds female

> **Safety Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2035 set back three years weighted 80% male and 20% female

Mortality Rates Before Retirement

	Rate (%)			
	General		Safety	
Age	Male	Female	Male	Female
25	0.03	0.02	0.03	0.02
30	0.04	0.03	0.03	0.02
35	0.06	0.05	0.05	0.03
40	0.09	0.07	0.08	0.05
45	0.13	0.11	0.11	0.08
50	0.18	0.17	0.16	0.12
55	0.29	0.25	0.24	0.18
60	0.48	0.39	0.41	0.27
65	0.77	0.72	0.64	0.44

All pre-retirement deaths are assumed to be non-service connected related.

Disability Incidence Rates

Age	Rate (%)	
	General[1]	Safety[2]
20	0.02	0.01
25	0.02	0.11
30	0.04	0.24
35	0.08	0.36
40	0.13	0.58
45	0.21	0.88
50	0.31	1.48
55	0.41	2.88
60	0.54	5.04
65	0.69	0.00
70	0.90	0.00

[1] *35% of General disabilities are assumed to be service connected disabilities and the other 65% are assumed to be non-service connected disabilities.*

[2] *90% of Safety disabilities are assumed to be service connected disabilities and the other 10% are assumed to be non-service connected disabilities.*

Withdrawal Rates[1]

Years of Service	Rate (%)	
	General	Safety
Less than 1	14.00	10.00
1	10.00	6.00
2	8.00	5.50
3	7.00	5.00
4	6.00	4.00
5	4.00	2.75
6	3.75	2.50
7	3.50	2.00
8	3.50	1.80
9	3.25	1.60
10	3.25	1.40
11	3.00	1.20
12	3.00	1.00
13	2.75	0.95
14	2.75	0.90
15	2.50	0.85
16	2.50	0.80
17	2.25	0.75
18	2.00	0.70
19	2.00	0.65
20 or more	2.00	0.60

[1] *The greater of a refund of member contributions and a deferred annuity is valued when a member withdraws.*

No withdrawal is assumed after a member is first assumed to retire.

Retirement Rates

	Rate (%)			
	General		Safety	
Age	Tier 1 and 2	PEPRA Tier 1 and 2	Non-PEPRA	PEPRA
40	0.00	0.00	1.00	0.00
41	0.00	0.00	1.00	0.00
42	0.00	0.00	1.00	0.00
43	0.00	0.00	1.00	0.00
44	0.00	0.00	1.00	0.00
45	0.00	0.00	1.00	0.00
46	0.00	0.00	1.00	0.00
47	0.00	0.00	1.00	0.00
48	0.00	0.00	1.00	0.00
49	0.00	0.00	1.50	0.00
50	2.50	0.00	2.50	5.00
51	2.50	0.00	2.00	2.00
52	3.00	2.00	3.00	4.00
53	3.50	2.00	4.00	6.00
54	4.00	2.50	17.00	16.00
55	4.50	4.00	22.00	20.00
56	5.00	4.50	22.00	20.00
57	6.00	5.00	20.00	18.00
58	8.00	6.00	19.00	18.00
59	8.00	7.00	22.00	25.00
60	12.00	9.00	22.00	25.00
61	15.00	11.00	25.00	25.00
62	22.00	20.00	35.00	40.00
63	20.00	20.00	40.00	40.00
64	22.00	18.00	40.00	40.00
65	30.00	20.00	100.00	100.00
66	35.00	30.00	100.00	100.00
67	35.00	30.00	100.00	100.00
68	35.00	30.00	100.00	100.00
69	20.00	30.00	100.00	100.00
70	20.00	50.00	100.00	100.00
71	20.00	50.00	100.00	100.00
72	20.00	50.00	100.00	100.00
73	20.00	50.00	100.00	100.00
74	30.00	50.00	100.00	100.00
75	100.00	100.00	100.00	100.00

Retirement Age and Benefit for Deferred Vested Members:	For current and future deferred vested members, retirement age assumptions are as follows: General Age: 59 Safety Age: 54 We assume that 50% and 60% of future General and Safety deferred vested members, respectively, will continue to work for a reciprocal employer. For reciprocals, we assume 4.00% compensation increases per annum.
Future Benefit Accruals:	1.0 year of service per year.
Unknown Data for Members:	Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.
Definition of Active Members:	All active members of VCERA as of the valuation date.
Form of Payment:	All members are assumed to elect the unmodified option at retirement.
Percent Married:	70% of male members and 55% of female members are assumed to be married at pre-retirement death or retirement. There is no explicit assumption for children's benefits.
Age of Spouse:	Female (or male) spouses are 3 years younger (or older) than their spouses.
In-Service Redemptions:	*Non-PEPRA Formulas:* The following assumptions for in-service redemptions pay as a percentage of final average compensation are used: General Tier 1 7.50% General Tier 2 3.50% Safety 7.25% For determining the cost of the basic benefit (i.e., non-COLA component), the cost of this pay element is currently recognized in the valuation as an employer only cost and does not affect member contribution rates. *PEPRA Formulas:* None.
Average Entry Age for Member Contribution Rates:	For non-PEPRA members hired after November 1974 who are not contributing fifty percent of Normal Cost, they will pay a contribution corresponding to a General and Safety member hired at entry age 35 and 27, respectively.
Methodology for use in Setting Entry Age for use in Actuarial Cost Method:	Age at member's hire date.

Appendix B: Proposed Actuarial Assumptions

Economic Assumptions

Net Investment Return:	7.25%, net of investment and administrative expenses.
Member Contribution Crediting Rate:	2.75% (actual increase is based on projected long term ten-year Treasury rate).
Consumer Price Index:	Increase of 2.75% per year; retiree COLA increases due to CPI are subject to a 3.00% maximum change per year for both PEPRA and Non-PEPRA General Tier 1 and both PEPRA and Non-PEPRA Safety. For both PEPRA and non-PEPRA General Tier 2, SEIU members receive a fixed 2% cost-of-living adjustment, not subject to changes in the CPI, that applies to future service after March 2003.
Payroll Growth:	Inflation of 2.75% per year plus "across the board" real salary increases of 0.50% per year.
Increases in Internal Revenue Code Section 401(a)(17) Compensation Limit:	Increase of 2.75% per year from the valuation date.
Increase in Section 7522.10 Compensation Limit:	Increase of 2.75% per year from the valuation date.

Individual Salary Increases

Annual Rate of Compensation Increase (%) Inflation: 2.75% per year; plus "across the board" real salary increases of 0.50% per year; plus the following promotional and merit increases:		
Years of Service	**General**	**Safety**
Less than 1	7.00	8.50
1	5.25	6.50
2	4.00	5.00
3	3.50	4.25
4	2.75	3.75
5	2.25	3.50
6	2.00	2.50
7	1.75	1.50
8	1.50	1.25
9	1.25	1.00
10	1.00	0.95
11	0.95	0.90
12	0.90	0.85
13	0.85	0.80
14	0.80	0.70
15	0.75	0.70
16	0.70	0.70
17	0.65	0.70
18	0.60	0.70
19	0.55	0.70
20 and Over	0.50	0.70

Demographic Assumptions

Mortality Rates – Healthy

➢ **General Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females) times 90% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017

➢ **Safety Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females) times 75% for males and 85% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017

Mortality Rates – Disabled

> **General Members:** Headcount-Weighted RP-2014 Disabled Retiree Mortality Table (separate tables for males and females) times 85% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017

> **Safety Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females) times 100% for males and 115% for females, projected generationally with the two-dimensional mortality improvement scale MP-2017

Mortality Rates – Beneficiaries

> **Beneficiaries:** Beneficiaries are assumed to have the same mortality as a General Member of the opposite sex who has taken a service (non-disability) retirement

Pre-Retirement Mortality Rates

> **General and Safety Members:** Headcount-Weighted RP-2014 Employee Mortality Table (separate tables for males and females) times 80%, projected generationally with the two-dimensional scale MP-2017

The RP-2014 mortality tables and adjustments as shown above reflect the mortality experience as of the measurement date. The generational projection is a provision for future mortality improvement.

Member Contribution Rates

> **General Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females) times 90% for males and 100% for females, projected 20 years with the two-dimensional mortality improvement scale MP-2017, weighted one-third male and two-thirds female

> **Safety Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females) times 75% for males and 85% for females, projected 20 years with the two-dimensional mortality improvement scale MP-2017, weighted 80% male and 20% female

Mortality Rates Before Retirement

Age	Rate (%) Male	Rate (%) Female
25	0.05	0.02
30	0.05	0.02
35	0.05	0.03
40	0.06	0.04
45	0.10	0.07
50	0.17	0.11
55	0.27	0.17
60	0.45	0.24
65	0.78	0.36
70	1.27	0.59

Note that generational projections beyond the base year (2014) are not reflected in the above mortality rates. All pre-retirement deaths are assumed to be non-service connected related.

Disability Incidence Rates

Age	Rate (%) General[1]	Rate (%) Safety[2]
20	0.01	0.05
25	0.02	0.11
30	0.03	0.24
35	0.06	0.36
40	0.11	0.52
45	0.17	0.84
50	0.23	1.30
55	0.31	2.76
60	0.41	5.64
65	0.54	2.80
70	0.69	0.00

[1] *25% of General disabilities are assumed to be service connected disabilities and the other 75% are assumed to be non-service connected disabilities.*

[2] *90% of Safety disabilities are assumed to be service connected disabilities and the other 10% are assumed to be non-service connected disabilities.*

Withdrawal Rates[1]

Years of Service	Rate (%)	
	General	Safety
Less than 1	14.00	11.00
1	10.00	6.00
2	8.25	5.75
3	7.25	4.50
4	6.00	4.25
5	5.00	3.00
6	4.00	2.50
7	3.50	2.25
8	3.50	1.80
9	3.25	1.60
10	3.25	1.40
11	3.00	1.20
12	3.00	1.00
13	2.75	0.95
14	2.75	0.90
15	2.50	0.85
16	2.50	0.80
17	2.25	0.75
18	2.00	0.70
19	2.00	0.65
20 or more	2.00	0.60

[1] *The greater of a refund of member contributions and a deferred annuity is valued when a member withdraws.*

No withdrawal is assumed after a member is first assumed to retire.

Retirement Rates

Age	Rate (%)			
	General Tier 1 and 2		Safety Non-PEPRA	
	Less than 30 Years of Service	30 or More Years of Service	Less than 30 Years of Service	30 or More Years of Service
Under 50	0.00	50.00	1.00	1.00
50	2.00	2.00	2.00	2.00
51	2.00	2.00	2.25	2.25
52	2.50	2.50	2.50	2.50
53	3.00	3.00	3.50	3.50
54	3.25	3.25	13.00	13.00
55	4.75	4.75	20.00	30.00
56	5.00	5.00	20.00	30.00
57	5.50	5.50	18.00	27.00
58	7.00	7.00	22.00	33.00
59	7.50	7.50	22.00	33.00
60	10.50	15.75	25.00	37.50
61	14.00	21.00	28.00	42.00
62	25.00	37.50	35.00	45.00
63	20.00	30.00	35.00	45.00
64	20.00	30.00	35.00	45.00
65	28.00	42.00	100.00	100.00
66	35.00	52.50	100.00	100.00
67	30.00	45.00	100.00	100.00
68	30.00	45.00	100.00	100.00
69	22.50	22.50	100.00	100.00
70	22.50	22.50	100.00	100.00
71	20.00	20.00	100.00	100.00
72	20.00	20.00	100.00	100.00
73	20.00	20.00	100.00	100.00
74	20.00	20.00	100.00	100.00
75	100.00	100.00	100.00	100.00

Retirement Rates (continued)

Age	Rate (%)	
	General PEPRA Tier 1 and 2	Safety PEPRA
50	0.00	4.00
51	0.00	2.25
52	1.50	3.50
53	1.50	5.50
54	2.00	13.00
55	4.00	20.00
56	4.50	20.00
57	5.00	18.00
58	5.50	18.00
59	6.00	25.00
60	9.00	25.00
61	11.00	25.00
62	22.50	40.00
63	20.00	40.00
64	18.00	40.00
65	20.00	100.00
66	30.00	100.00
67	30.00	100.00
68	25.00	100.00
69	35.00	100.00
70	50.00	100.00
71	50.00	100.00
72	50.00	100.00
73	50.00	100.00
74	50.00	100.00
75	100.00	100.00

Retirement Age and Benefit for Deferred Vested Members:	For current and future deferred vested members, retirement age assumptions are as follows: General Age: 59 Safety Age: 53 We assume that 45% and 60% of future General and Safety deferred vested members, respectively, will continue to work for a reciprocal employer. For reciprocals, we assume 3.75% and 3.95% compensation increases per annum for General and Safety deferred vested members, respectively.
Future Benefit Accruals:	1.0 year of service per year.
Unknown Data for Members:	Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.
Definition of Active Members:	All active members of VCERA as of the valuation date.
Form of Payment:	All members are assumed to elect the unmodified option at retirement.
Percent Married:	70% of male members and 55% of female members are assumed to be married at pre-retirement death or retirement. There is no explicit assumption for children's benefits.
Age of Spouse:	Male retirees are 3 years older than their spouses, and female retirees are 2 years younger than their spouses.
In-Service Redemptions:	*Non-PEPRA Formulas:* The following assumptions for in-service redemptions pay as a percentage of final average compensation are used: General Tier 1 7.50% General Tier 2 3.50% Safety 7.00% For determining the cost of the basic benefit (i.e., non-COLA component), the cost of this pay element is currently recognized in the valuation as an employer only cost and does not affect member contribution rates. *PEPRA Formulas:* None.
Average Entry Age for Member Contribution Rates:	For non-PEPRA members hired after November 1974 who are not contributing fifty percent of Normal Cost, they will pay a contribution corresponding to a General and Safety member hired at entry age 35 and 27, respectively.
Methodology for use in Setting Entry Age for use in Actuarial Cost Method:	Member's age at valuation date minus years of service.