✱ Segal Consulting

The Water and Power Employees' Retirement Plan of the City of Los Angeles

ACTUARIAL EXPERIENCE STUDY

Analysis of Actuarial Experience
During the Period
July 1, 2015 through June 30, 2018

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June 12, 2019

Board of Administration
The Water and Power Employees' Retirement Plan of the City of Los Angeles
111 North Hope St., Room 357
Los Angeles, California 90012

Re: Review of Actuarial Assumptions for the July 1, 2019 Actuarial Valuation

Dear Members of the Board:

We are pleased to submit this report of our review of the actuarial experience for the Water and Power Employees' Retirement Plan of the City of Los Angeles (WPERP). This study utilizes the census data for the experience period from July 1, 2015 to June 30, 2018 and provides the proposed actuarial assumptions, both economic and demographic, to be used in the July 1, 2019 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   John Monroe, ASA, MAAA, EA
Senior Vice President and Actuary   Vice President and Actuary

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I. Introduction, Summary, and Recommendations

To project the cost and liabilities of the Retirement 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, 2015 through June 30, 2018. 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, merit and promotion salary increases, retirement from active employment, spousal age difference, pre-retirement mortality, healthy life post-retirement mortality, disabled life mortality, beneficiary mortality, termination (vested and ordinary), and future service accruals.

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

Pg #	Actuarial Assumption Categories	Recommendation
7	**Inflation:** Future increases in the Consumer Price Index (CPI) which drives investment returns and active member salary increases, as well as COLA increases to retired members.	Reduce the inflation assumption from 3.00% to 2.75% per annum as discussed in Section (III)(A).
9	**Investment Return:** The estimated average net rate of return on current and future assets of the Plan as of the valuation date. This rate is used to discount liabilities.	Reduce the investment return assumption from 7.25% to 7.00% 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 • Merit and promotion increases	Reduce the current inflationary salary increase assumption from 3.00% to 2.75% per annum 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 be reduced from 3.50% to 3.25%. Change the merit and promotion increases to those developed in Section (III)(C). Future merit and promotion increases are higher at all years of service categories under the proposed assumptions. The recommended salary increase assumptions anticipate higher salary increases <u>overall</u> after taking into account the recommended change to lower the price inflation component by 0.25%.
20	**Retirement Rates:** The probability of retirement at each age at which participants are eligible to retire. **Other Retirement Related Assumptions including:** • Retirement age for deferred vested members • Percent married and spousal age differences for members not yet retired	For active members, adjust the current retirement rates to those developed in Section (IV)(A). The retirement rate assumptions anticipate earlier retirements for Tier 1 members and slightly later retirements for Tier 2 members. For deferred vested Tier 1 and 2 members, maintain the assumed retirement age at 60 and 63, respectively. For deferred vested Tier 1 and Tier 2 members receiving Permanent Total Disability benefit, maintain the assumed retirement age at the earlier of 65 or 55 with 30 years of service. For active and deferred vested members, maintain the percent married at retirement assumption at 85% for males and 60% for females. Maintain the spouse age difference assumption that male retirees are three years older than their spouses and reduce the age difference for female retirees from three years to two years younger than their spouses.

Pg #	Actuarial Assumption Categories	Recommendation
27	**Mortality Rates:** The probability of dying at each age. Mortality rates are used to project life expectancies.	For pre-retirement mortality: Current base table: Headcount Weighted RP-2014 Employee Mortality Table, multiplied by 80%. Recommended base table for Members: Pub-2010 General Employee Amount-Weighted Above-Median Mortality Table. For healthy and disabled retirees: Current base table: Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table with no age adjustment for males and set back one year for females. Recommended base table: Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table, multiplied by 105% for males and 100% for females. For beneficiaries: Current base table: Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table with no age adjustment for males and set back one year for females. Recommended base table: Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table. All current tables are projected generationally with the two-dimensional mortality improvement scale MP-2015. All recommended tables are projected generationally with the two-dimensional mortality improvement scale MP-2018. For optional form of payment amounts at retirement and conversion of contribution balances at retirement, change the mortality rates to those developed in Section (IV)(B).
34	**Termination Rates:** The probability of leaving employment at each age and receiving either a refund of member contributions or a deferred vested retirement benefit.	Adjust the current termination rates to those developed in Section (IV)(C). The recommended assumption will anticipate fewer terminations. Additionally, adjust the assumptions for future Tier 1 ordinary withdrawals (i.e., refund of member contributions) and deferred vested terminations.
38	**Disability Incidence Rates:** The probability of becoming disabled at each age.	Maintain the current disability rates as shown in Section (IV)(D).
40	**Future Service Accruals:** The amount of service projected to be earned by active members in years after the valuation date.	Maintain the assumed annual future service increase of 1.0 year as developed in Section IV(E). For Tier 1 active members, reduce the assumed purchase of additional service from 0.10 years to 0.07 years for each future year of employment. For Tier 2 active members, reduce the assumed purchase of additional service from 0.03 years to 0.02 years for each future year of employment.

We have estimated the impact of all the recommended demographic and economic assumptions as if they were applied to the July 1, 2018 actuarial valuation. The table below shows the changes in the funding elements due to the proposed assumption changes (as recommended in Sections III and IV of this report).

Cost Impact		
	Based on July 1, 2018 Actuarial Valuation	
	Current Assumptions	Recommended Assumptions
All Tiers Combined (Aggregate)		
Actuarial accrued liability	$13,187,542,730	$13,192,451,473
Actuarial value of assets	12,009,999,030	12,009,999,030
Unfunded actuarial accrued liability (UAAL)	$1,177,543,700	$1,182,452,443
1. Total normal cost	22.66%	23.54%
2. Expected member contributions	-7.09%	-6.94%
3. Employer normal cost: (1)+(2)	15.57%	16.60%
4. Amortization of UAAL	23.17%	23.07%
5. Total required employer contribution: (3)+(4), with mid-year interest adjustment	40.15%	41.05%
6. Projected compensation	$1,073,554,607	$1,075,100,864

If all of the proposed demographic assumption changes were implemented, the required employer contribution would have changed by -0.04% of payroll.

In addition, if all of the proposed economic assumptions changes were implemented the required employer contribution would have increased by an additional 0.94% of payroll.

Accordingly, if all of the proposed assumption changes (both economic and demographic) were implemented, the required employer contribution would have increased by 0.90% of payroll. Of the various assumption changes, the most significant cost impact is from the merit and promotion salary increase assumption change.

If the Board adopts the assumption changes, then based on Plan language, the assumptions for interest crediting, optional form of payment amounts at retirement, and conversion of contribution balances to annuities at retirement will also change. The impact of those changes has been reflected in the results shown above.

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 incidence, service retirement, and death 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, the spousal age difference, and the assumption used to anticipate future service accruals including the purchase of service by active members.

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 members and drives increases in the allowances of retired members.

> **Investment Return:** Expected long-term rate of return on the Plan's investments after 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 members will receive raises above these average increases as they advance in their careers. These are commonly referred to as merit and promotion increases.

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 of death 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 both historical information and long-term forecasts. Following is an analysis of 15 and 30 year moving averages of historical inflation rates:

HISTORICAL CONSUMER PRICE INDEX – 1930 TO 2018[1]
(U.S. City Average - All Urban Consumers)

	25th Percentile	Median	75th Percentile
15-year moving averages	2.4%	3.3%	4.5%
30-year moving averages	2.9%	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 178 large public retirement funds[2] in their 2017 fiscal year valuations was 2.75%. In California, CalSTRS and ten 1937 Act CERL systems use an inflation assumption of 2.75%, one 1937 Act CERL system uses an inflation assumption of 2.90% and two 1937 Act CERL systems use an inflation assumption of 2.50%. CalPERS recently lowered their inflation assumption from 2.75% to 2.50% over a 3-year period. Seven other 1937 Act CERL systems use an inflation assumption of 3.00%, as do LACERS and LA Fire and Police.

LADWP's investment consultant, RVK, anticipates an annual inflation rate of 2.50%, while the average inflation assumption provided by RVK and six other investment advisory firms retained by Segal's California public sector clients was 2.35%. 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 178 large public retirement funds, the inflation assumption was not available for 32 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. RVK has stated that they use a long-term assumption.

To find a forecast of inflation based on a longer time horizon, we referred to the 2018 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 2019, the difference in yields is about 1.97%, 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 July 1, 2019 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, since 2018 we have been recommending the same 2.75% inflation assumption in our experience studies for our California based public retirement system 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 for Tier 1 members from 3.00% to 2.75% per year. The current and proposed COLA assumptions are shown below:

Tier	Maximum COLA	Current Assumption	Proposed Assumption
Tier 1	3.00%	3.00%	2.75%
Tier 2	2.00%	2.00%	2.00%

Note that for members in Tier 2, we recommend maintaining the 2.00% assumption currently used to project the maximum 2% post-retirement COLA benefit for the July 1, 2019 actuarial valuation.

In developing the COLA assumption, we also considered the use 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:

➤ 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.

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[4] Source: Social Security Administration – The 2018 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

> Using lower long-term COLA assumptions based on a stochastic analysis would mean that an actuarial loss would occur even when the inflation assumption of 2.75% 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 plan's portfolio will vary with the Board's asset allocation among asset classes.

The following is WPERP's current target asset allocation along with two sets of real rate of return assumptions by asset class. The first column of real rate of return assumptions are determined by reducing RVK's total or "nominal" 2019 return assumptions by their assumed 2.50% inflation rate. The second column of returns (except for Custom Fixed Income and Custom Real Return) 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 RVK 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.

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

Asset Class	Percentage of Portfolio	RVK's Assumed Real Rate of Return[6]	Average Assumed Real Rate of Return from a Sample of Consultants to Segal's California Public Sector Clients[7]
Large Cap US Equity	22.95%	4.25%	5.44%
Small Cap US Equity	1.75%	4.75%	6.18%
Developed International Large Cap Equity	13.06%	5.75%	6.54%
Developed International Small Cap Equity	2.18%	6.00%	6.64%
Global Equity	2.90%	5.30%	6.45%
Emerging Market Equity	5.16%	8.25%	8.73%
Real Estate	8.00%	4.10%	4.60%
Cash and Equivalents	1.00%	0.50%	0.25%
Private Equity	8.00%	7.00%	9.27%
Hedge Funds	5.00%	2.50%	3.53%
Custom Fixed Income	25.00%	1.65%	1.65%[8]
Custom Real Return	5.00%	2.07%	2.07%[8]
Total	**100.00%**	**4.05%**	**4.80%**

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 has reason to believe, based on relevant supporting data, that such superior or inferior returns represent a reasonable expectation over the long term."

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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[6] Derived by reducing RVK's nominal return assumptions by their 2.50% inflation assumption.

[7] These are based on the projected arithmetic returns provided by RVK and six other investment advisory firms serving WPERP and 16 other city and county retirement systems in California. These return assumptions are gross of any applicable investment expenses.

[8] For these asset classes, RVK's assumptions are applied in lieu of the average because there is a larger disparity in returns for these assets classes among the firms surveyed and using RVK's assumptions should more closely reflect the underlying investments made specifically for WPERP.

2. Using a sample average of expected real rate of returns allows the WPERP'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 4.80% portfolio real rate of return be used to determine WPERP's investment return assumption. This is 0.06% higher than the return that was used three years ago in the review of the recommended investment return assumption for the July 1, 2016 valuation. The difference is due to changes in WPERP's target asset allocation (0.06%), changes in the real rate of return assumptions provided to us by the investment advisory firms (-0.01%) and the interaction effect between these two changes (0.01%).

Investment Expenses

For funding purposes, the real rate of return assumption for the portfolio needs to be adjusted for investment expenses expected to be paid from investment income. The following table provides the investment expenses in relation to the average Market Value of Assets for the five-year period ending June 30, 2018.

INVESTMENT EXPENSES AS A PERCENTAGE OF MARKET VALUE OF ASSETS ($ in '000s)

Year Ending June 30	Average Market Value of Assets[9]	Investment Expenses	Investment %
2014	$8,300,495	$28,007	0.34%
2015	9,683,420	30,858	0.32%
2016	10,038,163	28,699	0.29%
2017	10,065,468	35,268	0.35%
2018	11,296,104	42,957	0.38%
Five-Year Average			0.34%
Current Assumption			0.30%
Proposed Assumption			0.35%

As shown above, we have increased the future expense assumption from 0.30% to 0.35%. This assumption will be re-examined in subsequent assumption reviews as new data becomes available.

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 can be considered "net of investment expenses" when determining whether "the actuary has reason to believe, based on relevant supporting data, that such superior or inferior returns represent a reasonable expectation over the long term."

For WPERP, approximately 75% of the investment expenses are associated with active portfolio management. We have not performed a detailed analysis to measure how much of the investment

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[9] Average for plan year.

expenses paid to active managers might have been offset by additional returns ("alpha") earned by that active management.

For this study, we have continued 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. WPERP'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.[10] This is consistent with our experience that retirement plan fiduciaries would generally prefer that returns exceed the assumed rate more often than not.

The 4.80% expected real rate of return developed earlier in this report was based on expected mean or average arithmetic returns. In our model, the confidence level associated with a particular risk adjustment represents the relative likelihood that future investment earnings would equal or exceed the assumed earnings over a 15-year period on an expected value basis.[11] 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. 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 55%.

Three years ago, the Board adopted an investment return assumption of 7.25%. That return implied a risk adjustment of 0.19%, reflecting a confidence level of 52% 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.[12]

If we use the same 52% confidence level from our last study to set this year's risk adjustment, based on the current long-term portfolio standard deviation of 12.44% provided by RVK, the corresponding risk adjustment would be 0.19%. Together with the other investment return components, this would result in an investment return assumption of 7.01%, which is 0.24% lower than the current assumption of 7.25%.

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

[11] If a retirement system uses the expected arithmetic average return as the discount rate in the funding valuation, that retirement system is expected to have no surplus or asset shortfall relative to its expected obligations assuming all actuarial assumptions are met in the future.

[12] Based on an annual portfolio return standard deviation of 12.20% provided by RVK. 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.

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, a net investment return assumption of 7.00%, together with the other investment return components, would produce a risk adjustment of 0.20% which corresponds to a confidence level of 52% and is the same as the 52% confidence level from our last study. For comparison, a net investment return assumption of 6.75% would have a risk adjustment of 0.45% which corresponds to a confidence level of 55% which is higher than the 52% confidence level from our last study.

The table below shows WPERP's recommended investment return assumption, the risk adjustment and confidence level compared to the historical values for prior studies.

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

Years Ending June 30	Investment Return[13]	Risk Adjustment	Corresponding Confidence Level
2007 – 2009	8.00%	0.89%	62%
2010 – 2013	7.75%	0.89%	61%
2014 – 2015	7.50%	0.29%	53%
2016 – 2018	7.25%	0.19%	52%
2019 (Recommended)	**7.00%**	**0.20%**	**52%**

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 WPERP has positioned itself relative to risk over periods of time.[14] The use of an expected return with a 52% confidence level under Segal's model should be considered in context with other factors, including:

➤ 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 RVK. 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 52% is within the range of about 50% to 55% confidence levels that correspond to the risk adjustments currently used by most of Segal's other California public retirement system clients.

➤ We have not taken into account any additional returns ("alpha") that might be earned on active management. This means that if active management generates enough alpha to cover

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[13] The investment return assumptions are gross of administrative expenses.

[14] 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."

its related expenses, this would increase returns. This aspect of Segal's model is further evaluated in the next section.

➤ 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 "Comparisons with Other Public Retirement Systems".

Taking into account the factors above, we recommend the Board reduce the net investment return assumption from 7.25% to 7.00%. As noted above, this return implies a 0.20% risk adjustment and reflecting a confidence level of 52%.

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	July 1, 2019 Recommended	July 1, 2016 Adopted
Inflation	2.75%	3.00%
Plus Average Real Rate of Return	4.80%	4.74%
Minus Expense Adjustment	(0.35%)	(0.30%)
Minus Risk Adjustment	(0.20%)	(0.19%)
Total	**7.00%**	**7.25%**
Confidence Level	**52%**	**52%**

Based on this analysis, we recommend that the investment return assumption be decreased from 7.25% to 7.00% per annum.

Comparison with Alternative Model used to Review Investment Return Assumption

Since our appointment as actuary for WPERP, we have consistently reviewed investment return assumptions based on our model that incorporates expected arithmetic real returns for the different asset classes and for the entire portfolio as one component of that model.[15] The use of "forward looking expected arithmetic returns" is one of the approaches discussed for use in the Selection of Economic Assumptions for Measuring Pension Obligations under Actuarial Standards of Practice (ASOP) No. 27.

Besides using forward looking expected arithmetic returns, ASOP No. 27 also discussed setting investment return assumptions using an alternative "forward looking expected geometric returns" approach.[16] Even though expected geometric returns are lower than expected arithmetic returns,

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[15] Again, as discussed in footnote 11, if a retirement system uses the expected arithmetic average return as the discount rate in the funding valuation, that retirement system is expected to have no surplus or asset shortfall relative to its expected obligations assuming all actuarial assumptions are met in the future.

[16] If a retirement system uses the expected geometric average return as the discount rate in the funding valuation, that retirement system is expected to have asset value that generally converges to the median accumulated value as the time horizon lengthens assuming all actuarial assumptions are met in the future.

those California public retirement systems that have set investment return assumptions using this alternative approach have in practice adopted investment return assumptions that are comparable to those adopted by the Board for WPERP. This is because under the model used by those retirement systems, their investment return assumptions are <u>not</u> reduced to anticipate future investment expenses.[17]

For comparison, we evaluated the 7.00% recommended assumptions based on the expected geometric return for the entire portfolio, gross of the investment expenses. Under that model, over a 20-year period, there is a 55% likelihood that future average geometric returns will meet or exceed 7.00%.[18]

Comparisons 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 an investment return assumption of 7.00% or lower is becoming more common among California public sector retirement systems. In particular, ten of the 1937 Act CERL systems use a 7.00% investment return assumption with one 1937 Act CERL system at 6.75%. The San Jose and San Diego City retirement systems use investment return assumptions of 6.75% and 6.50%, respectively. Furthermore, the CalPERS Board approved a reduction in the earnings assumption to 7.00% and CalSTRS adopted a 7.00% earnings assumption for the 2017 valuation. Most other public sector retirement systems in California are currently using a 7.25% earnings assumption.

The following table compares WPERP's recommended net investment return assumption against those of the 178 large public retirement funds[19] in their 2017 fiscal year valuations based on information found in the Public Plans Data website, which is produced in partnership with the NASRA:

Assumption	WPERP	Public Plans Data[20]		
		Low	Median	High
Net Investment Return	7.00%	5.75%	7.50%	8.50%

The detailed data shows that more than two-thirds of the systems have an investment return assumption in the range of 6.75% to 7.50%, and a little less than one-half of those systems (or about one-third overall) have used an assumption of 7.50%. Also, about one-third of the systems

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[17] This means that if that model were to be applied to WPERP, the expected geometric return would not be adjusted for the approximately 0.35% investment expenses paid by WPERP.

[18] We performed this stochastic simulation using the capital market assumptions included in the 2018 survey prepared by Horizon Actuarial Services. That simulation was performed using 10,000 trial outcomes of future market returns, using assumptions from 20-year arithmetic returns, standard deviations and correlation matrix that were found in the 2018 survey that included responses from 34 investment advisors.

[19] Among 178 large public retirement funds, the investment return assumption was not available for 25 of the public retirement funds in the survey data.

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

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 other considerations indicate lower earnings assumption. The recommended assumption of 7.00% provides for a risk margin within the risk adjustment model that is consistent with WPERP's current practice under that model.

C. Salary Increase

Salary increases impact plan costs by increasing members' benefits (since benefits are a function of the members' highest average pay) and future Normal Cost collections. The components of the assumption are discussed 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.

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 0.3% - 0.7% 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 2018. 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 also note that for WPERP's active members, the actual average inflation plus "across the board" increase (i.e., wage inflation) over the three-year period ending June 30, 2018 was 1.99%, which is lower than the change in CPI of 2.66% during that same period:

Year Ending	Actual Average Increase[21]	Actual Change in CPI[22]
June 30, 2016	-0.60%	1.76%
June 30, 2017	1.59%	2.20%
June 30, 2018	4.97%	4.01%
Three-Year Average	**1.99%**	**2.66%**

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. **Merit and Promotion 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 WPERP, there are service-specific merit and promotion increases.

    The annual merit and promotion 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. This is accomplished by:

    a. Measuring each continuing member's actual salary increase over each year of the experience period on a salary weighted basis, with higher weights assigned to experience from members with larger salaries;

    b. Excluding any members with increases of more than 30% or decrease 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 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 merit and promotion assumptions should be used in combination with the recommended 3.25% assumed inflation and real "across the board" increases.

    Due to the high variability of the actual salary increases, we have analyzed this assumption using the data for the past six years. We believe that when the experience from the current and prior studies is combined into an average result, it provides a more reasonable representation of potential future merit and promotion salary increases over the long-term.

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[21] Reflects the increase in average salary for members at the beginning of the year versus those at the end of the year. It does not reflect the average salary increases received by members who worked the full year.

[22] Based on the change in June CPI for the Los Angeles-Long Beach-Anaheim Area.

The following table shows the actual average merit and promotion increases by years of service over the three-year period from July 1, 2015 through June 30, 2018 along with the actual average increases based on combining the current three-year period with the three-year period from the prior experience study. The current and proposed assumptions are also shown. The actual increases for the current three-year period and the prior 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 each of the three-year experience periods (2.0% and 0.6% respectively, on average).

Merit and Promotion Increases

Years of Service	Rate (%)			
	Current Assumptions	Actual Average Increase (Last 3 Years)	Actual Average Increases from Current and Prior Study	Proposed Assumption
Less than 1	6.50	7.62	7.50	7.00
1 – 2	6.00	8.01	8.20	7.00
2 – 3	5.50	7.43	7.24	6.50
3 – 4	4.50	6.77	5.93	5.25
4 – 5	3.00	6.28	4.62	3.75
5 – 6	2.00	4.08	3.28	2.75
6 – 7	1.50	3.17	2.72	2.25
7 – 8	1.40	2.84	2.48	2.00
8 – 9	1.30	2.01	2.01	1.70
9 – 10	1.20	2.38	2.13	1.60
10 – 11	1.00	2.26	2.00	1.50
11 – 12	1.00	2.01	1.71	1.45
12 – 13	1.00	1.92	1.73	1.40
13 – 14	1.00	2.23	1.85	1.35
14 – 15	1.00	1.98	1.88	1.30
15 – 16	1.00	1.67	1.70	1.25
16 – 17	1.00	1.84	1.68	1.25
17 – 18	1.00	1.69	1.61	1.25
18 – 19	1.00	1.64	1.47	1.25
19 – 20	1.00	1.78	1.53	1.25
20 & Over	1.00	1.64	1.35	1.25

Chart 1 compares actual experience with the current and proposed rates of actual merit and promotion increases. Also shown is the actual merit and promotion increases based on an average of both the current and previous three-year experience periods.

Based on this experience, we are recommending increases in the merit and promotion salary increase assumption for all years of service categories.

CHART 1: MERIT AND PROMOTION SALARY INCREASE RATES
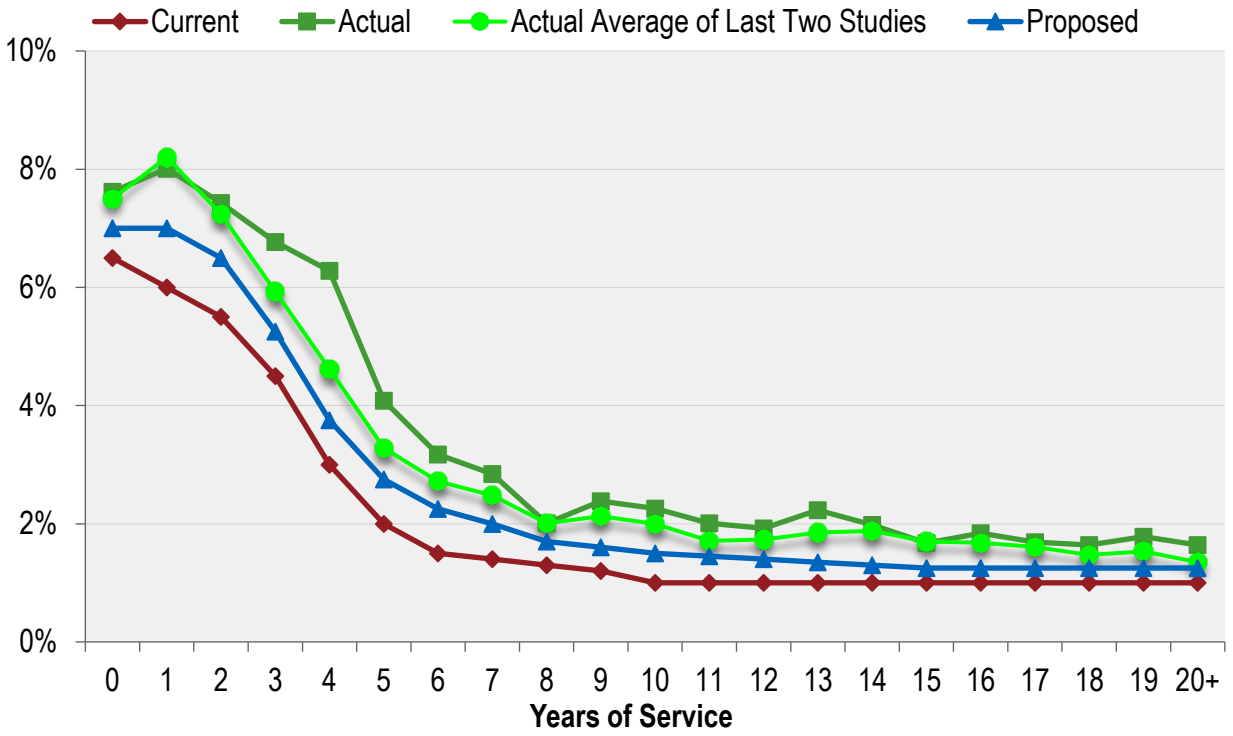
IV. Demographic Assumptions

A. Retirement Rates

The age at which a member retires 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.

Based on the distinct retirement patterns for Tier 1 members with 30 or more years of service at retirement compared to those with under 30 years, we continue to recommend separate retirement rates for these groups of members. Due to the one-time large number of retirements in early 2016, we have analyzed this assumption using the data for the past six years to capture more experience.

The table below shows the observed service (non-disability) retirement rates for Tier 1 members with under 30 years of service at retirement over the last six years, and for Tier 1 members with 30 or more years. 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.

Effective January 1, 2014, a new Tier 2 was implemented. For this new tier, we do not have credible experience from the past three years to propose new rates based on actual retirements from Tier 2 members. We are nonetheless recommending changes at some ages commensurate with the changes we are recommending for Tier 1.

The second table shows the current and proposed rates of retirement for Tier 2 members.

Tier 1 Members

	Rate of Retirement (%)					
	Less than 30 Years of Service			30 or More Years of Service		
Age	Current Rate	Actual Rate*	Proposed Rate	Current Rate	Actual Rate*	Proposed Rate
50	0.00	0.00	0.00	0.00	1.50	1.00
51	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.34	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00
55	4.50	4.04	4.25	25.00	29.42	27.00
56	2.00	2.10	2.00	20.00	20.68	20.00
57	2.50	2.63	2.50	17.00	17.45	17.50
58	3.00	3.96	3.50	17.00	18.84	17.50
59	3.00	4.07	3.50	17.00	17.20	17.50
60	5.00	5.72	5.50	20.00	23.02	22.00
61	6.00	7.21	6.50	20.00	25.74	22.00
62	6.00	7.92	7.00	20.00	24.19	22.00
63	6.00	10.52	8.00	25.00	25.23	25.00
64	7.00	9.35	8.50	25.00	28.79	27.00
65	11.00	12.57	11.50	28.00	32.12	30.00
66	11.00	13.00	12.00	28.00	32.86	30.00
67	11.00	14.01	12.50	28.00	24.11	30.00
68	11.00	11.11	13.00	28.00	27.43	30.00
69	13.00	20.61	17.00	28.00	32.47	30.00
70	25.00	17.89	22.00	25.00	20.63	25.00
71	25.00	23.19	22.00	25.00	22.92	25.00
72	25.00	13.73	22.00	25.00	36.59	25.00
73	25.00	20.51	22.00	25.00	29.63	25.00
74	25.00	16.13	22.00	25.00	12.50	25.00
75 & Over	100.00	20.31	100.00	100.00	21.65	100.00

*Actual rates shown are based on six years of data.

As shown above, we are recommending overall increases in the retirement rates at ages 58 to 69 for Tier 1 members with less than 30 years of service and recommending increases in the retirement rates at most ages for Tier 1 members with 30 or more years of service. The result of these recommendations is to anticipate earlier retirements.

Chart 2 that follows later in this section compares actual experience with the current and proposed rates of retirement for Tier 1 members with less than 30 years of service.

Chart 3 compares actual experience with the current and proposed rates of retirement for Tier 1 members with 30 or more years of service.

Tier 2 Members

Age	Less than 30 Years of Service		30 or More Years of Service	
	Current Rate	**Proposed Rate**	**Current Rate**	**Proposed Rate**
55	0.00	0.00	25.00	25.00
56	0.00	0.00	14.00	14.00
57	0.00	0.00	12.00	13.00
58	0.00	0.00	12.00	13.00
59	0.00	0.00	12.00	13.00
60	5.00	5.50	17.50	17.50
61	2.50	3.50	5.00	10.00
62	0.00	2.50	5.00	10.00
63	20.00	20.00	25.00	25.00
64	15.00	12.00	25.00	25.00
65	14.00	11.00	28.00	28.00
66	14.00	11.00	28.00	28.00
67	14.00	12.00	28.00	28.00
68	14.00	12.50	28.00	28.00
69	13.00	15.00	28.00	28.00
70	100.00	50.00	100.00	50.00
71	100.00	50.00	100.00	50.00
72	100.00	50.00	100.00	50.00
73	100.00	50.00	100.00	50.00
74	100.00	50.00	100.00	50.00
75 & Over	100.00	100.00	100.00	100.00

Rate of Retirement (%)

There was very little retirement experience during this period for Tier 2 members. We have based our recommended rates on a combination of the current assumptions used for this tier and some of the proposed changes in rates for Tier 1.

As shown above, we are recommending mostly decreases in the retirement rates for ages over 63 for Tier 2 members with less than 30 years of service and recommending increases in the retirement rates at most of the earlier ages for Tier 2 members with 30 or more years of service. The net result of these recommendations is to anticipate slightly later retirements.

Chart 4 compares the current and proposed rates of retirement for Tier 2 members with less than 30 years of service.

Chart 5 compares the current and proposed rates of retirement for Tier 2 members with 30 or more years of service.

Deferred Vested Members

In prior valuations, deferred vested Tier 1 and Tier 2 members were assumed to retire at ages 60 and 63, respectively. Also, Tier 1 and Tier 2 members receiving Permanent Total Disability (PTD) benefits were assumed to retire at the earlier of age 65 or age 55 with 30 years of service and receive the Formula pension. The average age at retirement over the prior three years is shown in the table below. Also shown are the current ages assumed and the ages we propose.

Retirement Age for Deferred Vested Members			
	Tier 1 Members	Tier 2 Members	Tier 1 and Tier 2 Members Receiving PTD
Average Age	61.6	N/A	63.7
Current Assumption	60.0	63.0	65 or 55 with 30 years of service
Proposed Assumption	**60.0**	**63.0**	**65 or 55 with 30 years of service**

As shown above, we recommend maintaining the deferred vested retirement assumption of age 60 for Tier 1 members (who are also assumed to receive a Money Purchase Annuity) and age 63 for Tier 2 members. We also recommend maintaining the retirement age for Tier 1 and Tier 2 members receiving a PTD at the earlier of age 65 or age 55 with 30 years of service and receive the Formula pension upon retirement.

Survivor Continuance

In prior valuations, it was assumed that 85% of all active and inactive male members and 60% of all active and inactive female members would be married or have an eligible domestic partner at pre-retirement death or when they retire.

The following table shows the observed percentage of new retirees with an eligible spouse or domestic partner at the time of retirement based on the actual experience over the past three years. Also shown are the current rates assumed and the rates we propose:

| Year Ending June 30	New Retirees – Actual Percent with Eligible Spouse or Domestic Partner	
	Male	**Female**
2015-2018	78%	53%
Current Assumption	85%	60%
Proposed Assumption	**85%**	**60%**

As shown above, we recommend maintaining the percent married assumption for male and female members at 85% and 60%, respectively. Also, we recommend that this assumption continue to be applied to current retirees retired before April 1, 2012 with Options Full, A, B or C since they are missing data regarding their survivor.

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 current three-year period and studies done for other retirement systems, we recommend the following:

1. Since the majority of survivors are of the opposite sex, even with the inclusion of domestic partners, we will continue to assume that for all active and inactive members, the survivor's sex is the opposite of the member.

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

| Beneficiary Sex	Survivor's Age as Compared to Member's Age		
	Current Assumption	**Actual WPERP Experience**	**Proposed Assumption**
Male	3 years older	3.0 years older	3 years older
Female	3 years younger	1.7 years younger	2 years younger

CHART 2: RETIREMENT RATES –TIER 1 MEMBERS
LESS THAN 30 YEARS OF SERVICE
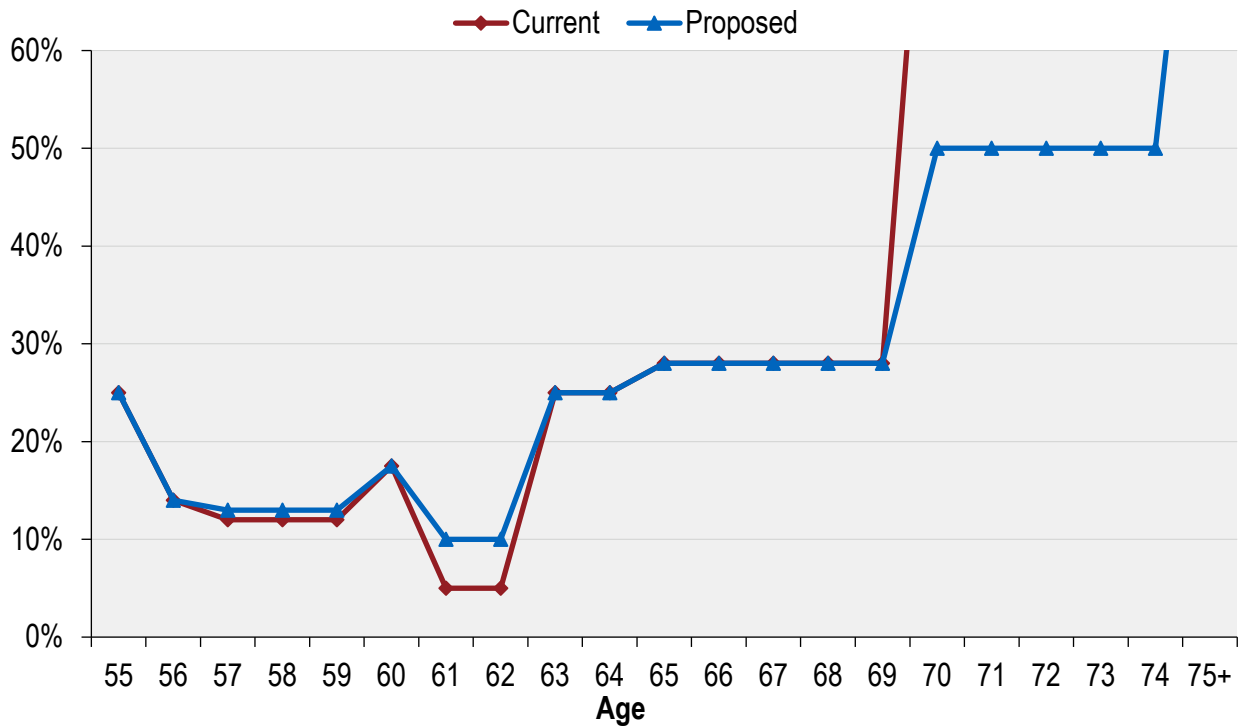## (JULY 1, 2012 THROUGH JUNE 30, 2018)
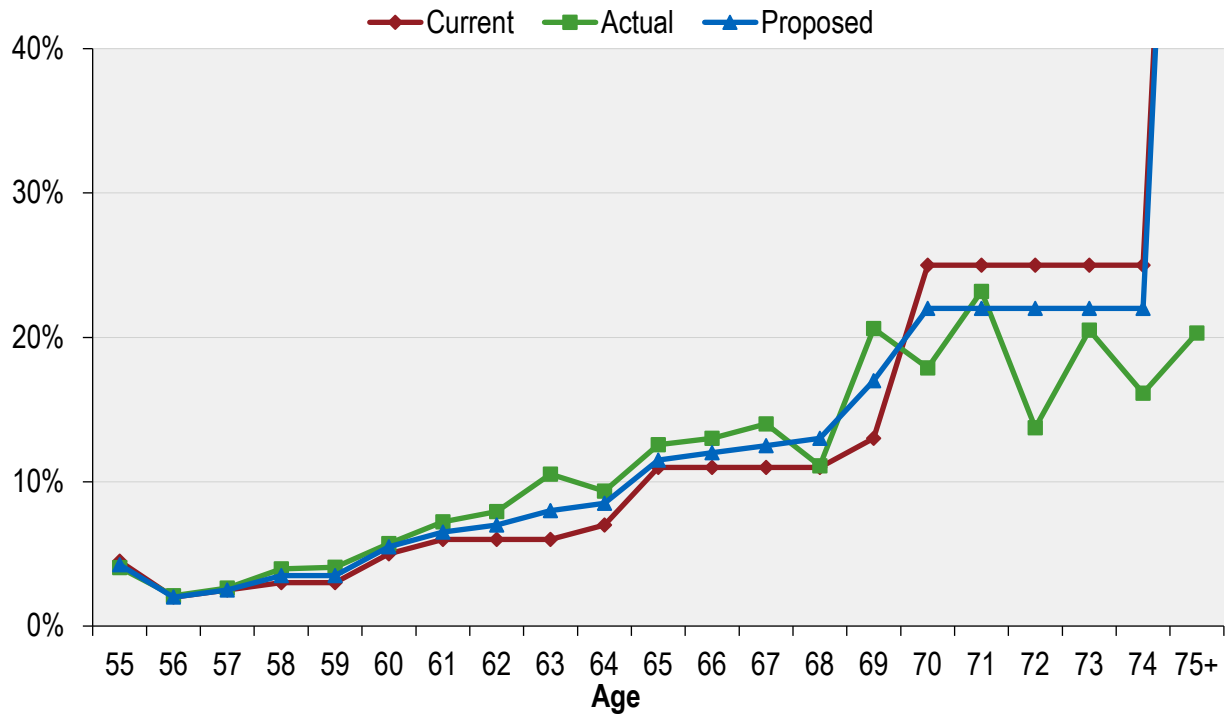
CHART 3: RETIREMENT RATES –TIER 1 MEMBERS
30 OR MORE YEARS OF SERVICE
(JULY 1, 2012 THROUGH JUNE 30, 2018)
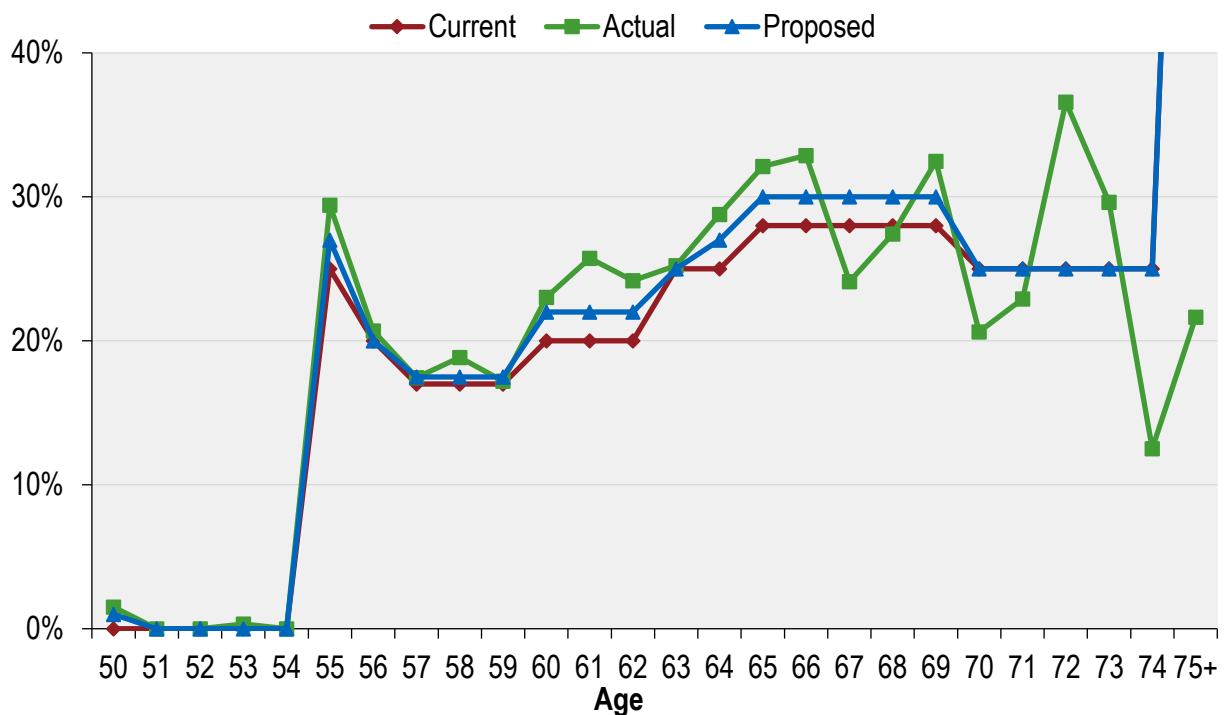
CHART 4: RETIREMENT RATES –TIER 2 MEMBERS
LESS THAN 30 YEARS OF SERVICE
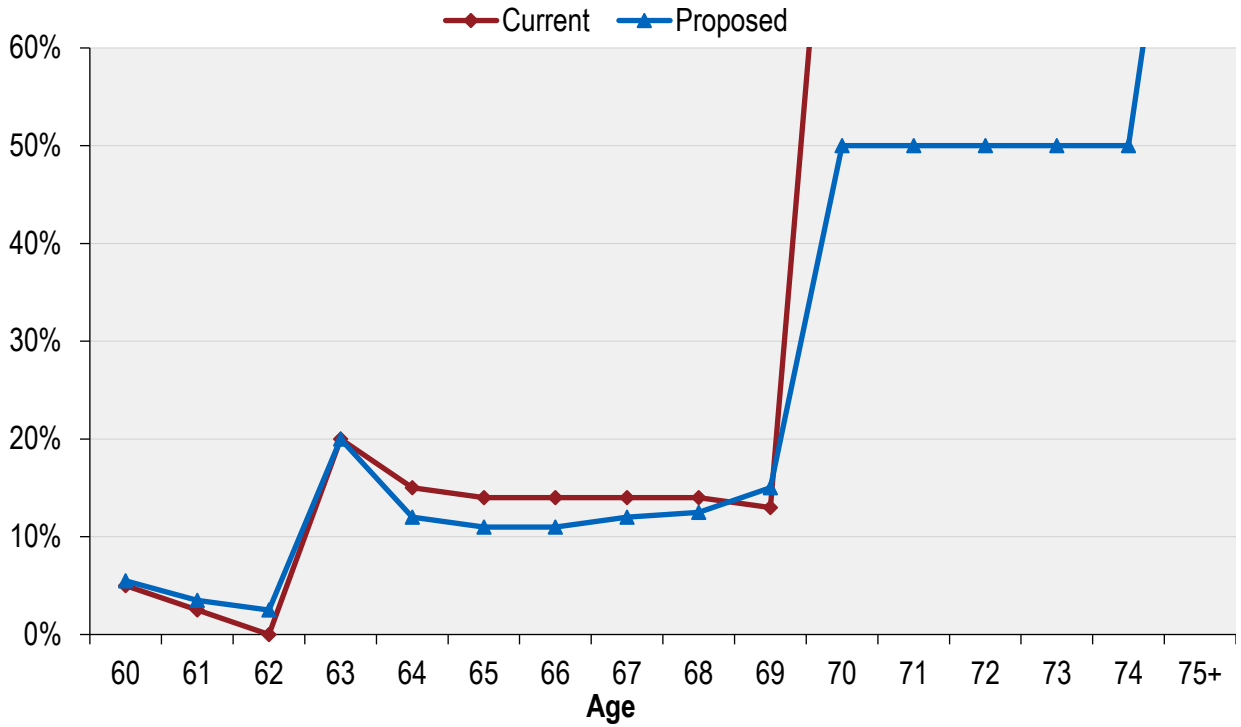
CHART 5: RETIREMENT RATES –TIER 2 MEMBERS
30 OR MORE YEARS OF SERVICE

B. Mortality Rates

The "healthy" mortality rates project the life expectancy of a member who retires from service (i.e., who does not receive a Permanent Total Disability benefit). Also, the "healthy" pre-retirement mortality rates project what proportion of members will die before retirement. The table currently being used for post-service retirement mortality rates is the Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table with no age adjustment for males and set back one year for females, projected generationally with the two-dimensional scale MP-2015. Beneficiaries are assumed to have the same mortality as members who have taken a service retirement.

When we conducted the last experience study, we discussed with the Board that we would recommend changing from a Headcount-Weighted to a Benefit-Weighted table, but only after the Society of Actuaries (SOA) provides mortality tables based on public sector experience comparable to the RP-2014 mortality tables developed using data collected from private and multi-employer pension plans.

The Retirement Plans Experience Committee (RPEC) of the SOA has recently published the Pub-2010 Public Retirement Plans Mortality tables (Pub-2010). For the first time, the Pub-2010 mortality tables are based exclusively on public sector pension plan experience in the United States. Within the Pub-2010 family of mortality tables, there are separate tables by job categories of General, Safety and Teachers. Included with the mortality tables is the analysis prepared by RPEC that continues to observe that, after age and sex, benefit amount for healthy retirees and salary for employees are the most significant predictors of mortality differences within the job categories. Therefore, Pub-2010 includes mortality rates developed for annuitants on a "benefit" weighted basis, with greater weight assigned to experience from annuitants receiving larger benefits to reflect that retirees with larger benefits generally live longer than those with lower benefits.

As the Pub-2010 study shows that benefit (or salary for employees) is a significant predictor of mortality difference, the Pub-2010 family of mortality tables also include mortality rates based on population with above-median benefit amount (or salary for employees), below-median benefit amount (or salary for employees) and total population within each job category. The median benefit amounts used to determine the above-median and below-median mortality rates as shown in the Pub-2010 report for General members are as follows:

	Median Amounts ($) by Sex, Job Category, and Status			
	Males		Females	
Job Category	Employees	Retirees	Employees	Retirees
General	45,800	21,200	34,700	11,900

Note: Values shown as of 2010.

Even after we adjust the above amounts by a reasonable measure of U.S. price inflation from 2010 to 2018 for a total increase of about 20%, the benefit amounts (or salaries) paid to WPERP's members were generally greater than the adjusted median amounts shown above.

Therefore, we recommend that the above-median version of the mortality tables for General members be used.

We continue to recommend that the mortality improvement scale be projected generationally where each future year has its own mortality table that reflects the forecasted improvements, using the published improvement scales. 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.

We understand that RPEC intends to publish annual updates to their mortality improvement scales. Improvement scale MP-2018 is the latest improvement scale available. We recommend that the Board adopt the Pub-2010 General Benefit-Weighted Above-Median mortality table (adjusted for WPERP experience), and project the mortality improvement generationally using the MP-2018 mortality improvement scale. The MP-2018 scale projects lower future mortality improvement as compared to the currently used MP-2015 scale.

In order to use more actual WPERP experience in our analysis, we have used experience for a six-year period by using data from the current (from July 1, 2015 to June 30, 2018) and the last (from July 1, 2012 to June 30, 2015) experience study period to analyze this assumption.

Even with the use of six years of experience, based on standard statistical theory the data is only partially credible especially under the recommended benefit-weighted basis when dispersion of retirees' benefit amounts is taken into account. In 2008 the SOA published an article recommending that mortality assumptions include an adjustment for credibility. Under this approach, the number of deaths needed for full credibility for a headcount-weighted mortality table is just over 1,000, where full credibility means a 90% confidence that the actual experience will be within 5% of the expected value. Therefore, in our recommended assumptions, we have only partially adjusted the Pub-2010 mortality tables to fit WPERP's experience. In future experience studies, more data will be available which may further increase the credibility of the WPERP experience.

Pre-Retirement Mortality

The table currently being used for pre-retirement mortality rates is the Headcount-Weighted RP-2014 Employee Mortality Table (separate tables for males and females) multiplied by 80%, projected generationally with the two-dimensional scale MP-2015.

We recommend changing the pre-retirement mortality to follow the Pub-2010 General Employee Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

We also recommend maintaining the current assumption that 5% of pre-retirement deaths are duty related.

Post-Retirement Mortality (Service Retirements)

Among all retired members, the actual deaths compared to the expected deaths weighted by benefit amounts under the current assumptions for the last six years are shown in the table below. We also show the deaths weighted by benefit amount under the proposed assumptions. As noted above, we are recommending the continued use of a generational mortality table. A generational mortality table incorporates an 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.

Also, the proposed mortality table reflects current experience to the extent that the experience is credible based on standard statistical theory. For WPERP, the volume of member data makes it relatively credible. That is why the proposed table (as shown in the table below) after adjustments for partial credibility have actual to expected ratio of 102%. In future years the ratio should remain around 102%, as long as actual mortality improves at the same rate as anticipated by the generational mortality tables.

The number of actual deaths weighted by benefit amount compared to the number expected under the current and proposed assumptions both weighted by benefit amounts for the last six years are as follows:

Sex	Healthy Retirees ($ in millions)		
	Current Expected Weighted Deaths	Actual Weighted Deaths	Proposed Expected Weighted Deaths
Male	$72.3	$66.8	$65.2
Female	$8.6	$8.1	$8.3
Total	**$81.0**	**$74.9**	**$73.6**
Actual / Expected	93%		102%

Notes: (1) Experience shown above is weighted by annual benefit amounts instead of by headcounts.

(2) Expected amounts under the proposed generational mortality table are based on mortality rates from the base year projected with mortality improvements to the experience study period.

* If we use the benchmark Pub-2010 table without any adjustments, the proposed actual to expected ratio would be 106%.

We recommend changing the post-retirement table to the Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females) times 105% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2018. The recommended mortality tables will have an actual to expected ratio of 102% for males and 97% for females.

For this transitional year for informational purposes only, we have also provided in the table below the actual and expected deaths computed without weighting these by benefit amounts.

This is similar to how actual and expected deaths ratios were developed based on the prior headcount approach.

	Healthy Retirees		
Sex	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	1,292	1,304	1,184
Female	247	252	249
Total	**1,539**	**1,556**	**1,433**
Actual / Expected	101%		109%

Notes: (1) Experience shown above is weighted by headcounts instead of by annual benefit amounts.
(2) The proposed expected deaths are based on the recommended Pub-2010 General Amount-Weighted Above-Median Mortality Tables.

Chart 6 compares the actual to expected deaths on a benefit-weighted basis under the current and proposed assumptions over the past six years.

Chart 7 compares the actual to expected number of deaths on a headcount-weighted basis under the current and proposed assumptions over the past six years, provided for informational purposes only.

Chart 8 shows the life expectancies (i.e., expected future lifetime) under the current and proposed tables on a benefit-weighted basis. Life expectancies under the current and proposed generational mortality rates are based on age as of 2019. In practice, life expectancies will be assumed to increase based on applying the mortality improvement scale.

Disabled Mortality

Disabled mortality was included in the development of assumed healthy mortality rates. This was done because the number of disabled pensioners who were receiving benefits from both the Permanent Total Disability Fund and the Retirement Plan is minimal compared to the total number of pensioners receiving only Retirement Plan benefits. We continue to recommend using the same mortality table for disabled members who received a Permanent Total Disability benefit as is used for healthy service retired members.

Beneficiaries Mortality

In studying the mortality for beneficiaries in our prior experience study, we reviewed the actual deaths compared to the expected deaths and recommended the same mortality tables for healthy retirees and all beneficiaries. However, Pub-2010 has separate mortality tables for healthy retirees and beneficiaries.

The Pub-2010 Contingent Survivors Table is developed only based on Contingent Survivor data after the death of the retirees. Considering the size of WPERP's beneficiary population and that the Contingent Survivor mortality rates are somewhat comparable (about 2% higher) to those of the General Healthy retiree mortality rates, we recommend using the General Healthy retiree mortality table for the beneficiaries based on the sex of the beneficiaries.

For beneficiaries, we recommend changing the mortality assumption to follow the Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.
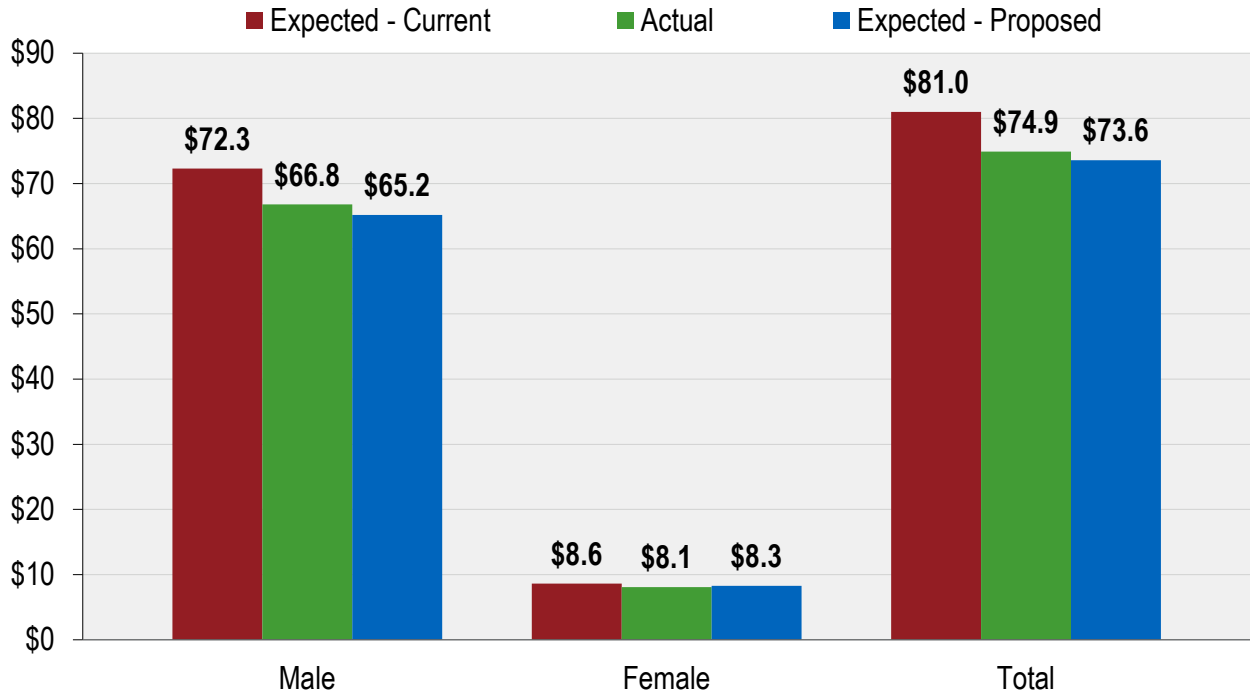
Mortality Table for Optional Form of Payment Amounts and Conversion of Contribution Balances to Annuities at Retirement

If these mortality assumptions are adopted by the Board, then based on Plan language, the actuarial factors used for optional form of payment amounts and conversion of contribution balances to annuities at retirement will be adjusted to be consistent with the mortality assumptions proposed in this report. This would ensure that the optional forms of payment, etc. are actuarially equivalent to the Full Retirement Allowance form of payment used in the determination of employer contribution rates.

Similar to the approach used in the prior experience study that was adopted by the Board, we recommend the following unisex mortality table be used in determining optional form of payments amounts and converting contribution balances to annuities at retirement:

Member: Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table times 105% for males and 100% for females, projected generationally with the two-dimensional improvement scale MP-2018 associated with a retirement year of 2022, weighted 75% male and 25% female.

Beneficiary: Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table, projected generationally with the two-dimensional improvement scale MP-2018 associated with a retirement year of 2022, weighted 25% male and 75% female.

**CHART 6: POST-RETIREMENT BENEFIT-WEIGHTED DEATHS
(IN MILLIONS)
(JULY 1, 2012 THROUGH JUNE 30, 2018)**

Legend: ■ Expected - Current ■ Actual ■ Expected - Proposed

Male: $72.3, $66.8, $65.2
Female: $8.6, $8.1, $8.3
Total: $81.0, $74.9, $73.6

**CHART 7: POST-RETIREMENT HEADCOUNT-WEIGHTED DEATHS
PROVIDED FOR INFORMATIONAL PURPOSES ONLY
(JULY 1, 2012 THROUGH JUNE 30, 2018)**

Legend: ■ Expected - Current ■ Actual ■ Expected - Proposed

Male: 1,292, 1,304, 1,184
Female: 247, 252, 249
Total: 1,539, 1,556, 1,433

✶ Segal Consulting 32
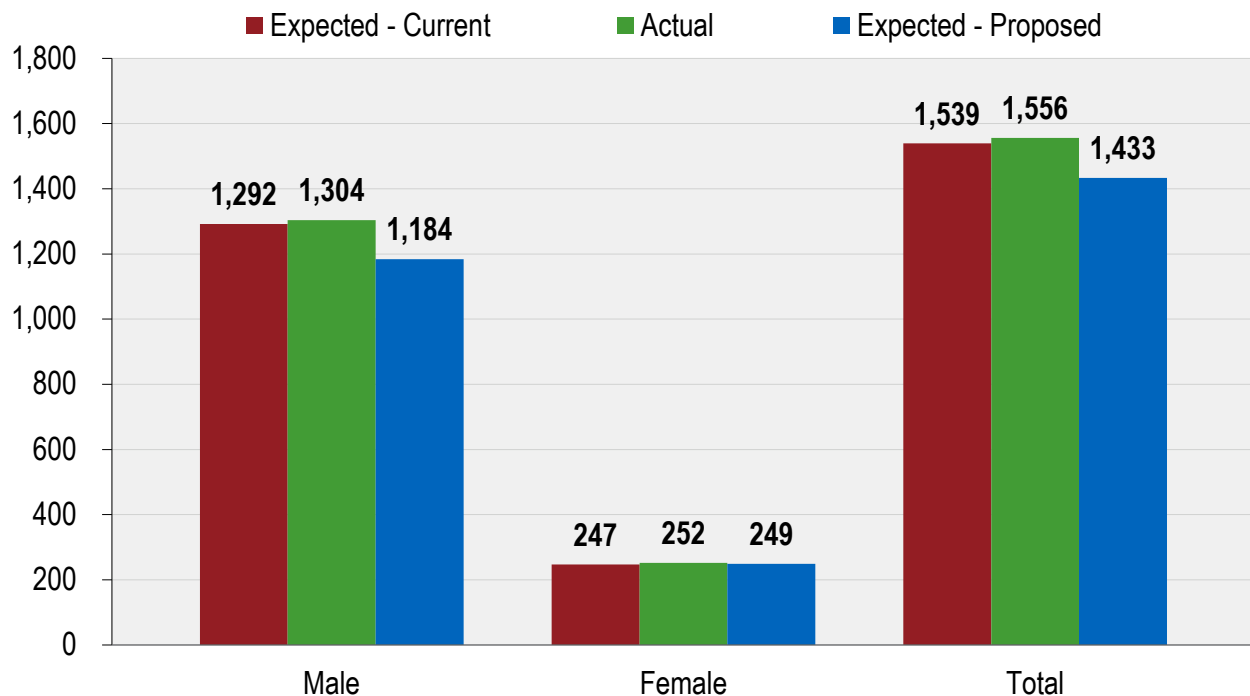
CHART 8: BENEFIT-WEIGHTED LIFE EXPECTANCIES
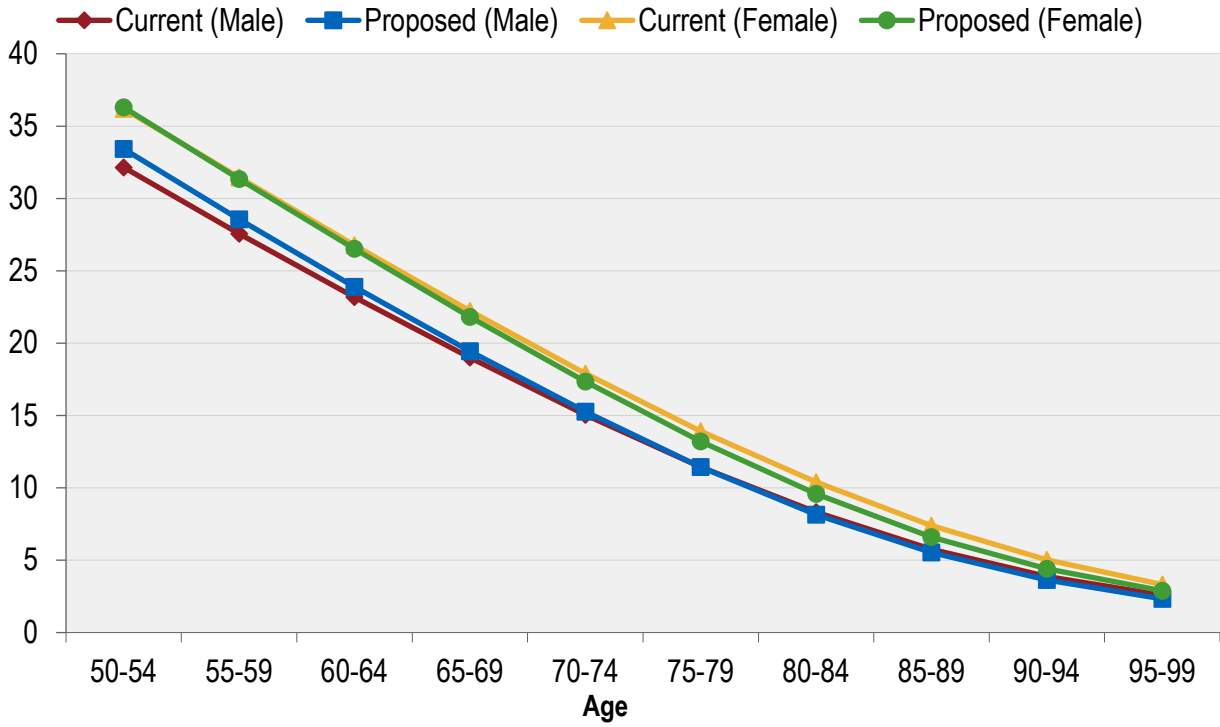
C. Termination Rates

Termination rates include all terminations for reasons other than death, disability or retirement. Under the current assumptions, there is an overall incidence of terminations assumed, combined with an assumption that a member will choose between a refund of member contributions (ordinary withdrawal) or a deferred retirement benefit (vested termination). With this experience study we are continuing to recommend that a combined set of withdrawal and termination assumptions be used with a separate assumption regarding the proportion of members who choose a refund of member contributions or a deferred benefit.

Currently, the termination assumptions are a function of years of service. We recommend maintaining this assumption structure. The termination experience over the last three years is shown by years of service in the following table. Also shown is the average of the current three-year period with the prior three-year period from the previous experience study. Please note that we have excluded any members that were eligible for retirement. We also show the current and proposed assumptions.

Rates of Termination

	Rates of Termination (%)			
Years of Service	Current Rate	Actual Rate	Actual Average from Current and Prior Study	Proposed Rate
Less than 1	12.00	7.70	10.04	10.00
1 – 2	6.00	4.43	4.86	5.25
2 – 3	4.00	2.68	2.89	3.75
3 – 4	2.50	6.38	4.07	3.50
4 – 5	2.00	5.07	2.56	2.50
5 – 6	2.00	2.24	1.67	2.00
6 – 7	1.75	1.13	1.06	1.50
7 – 8	1.50	2.16	1.48	1.50
8 – 9	1.25	1.75	1.50	1.50
9 – 10	1.00	1.14	1.06	1.00
10 – 11	0.75	1.05	0.76	0.75
11 – 12	0.75	1.82	1.01	0.75
12 – 13	0.75	1.07	1.11	0.75
13 – 14	0.75	1.11	0.79	0.75
14 – 15	0.75	0.49	0.55	0.75
15 – 16	0.75	1.57	1.32	0.75
16 – 17	0.75	1.06	0.97	0.75
17 – 18	0.75	0.17	0.10	0.75
18 – 19	0.75	0.69	0.68	0.75
19 – 20	0.75	0.00	0.44	0.75
20 & Over	0.75	0.36	0.34	0.50

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.

As shown above, we are recommending overall decreases in the termination rates.

The actual number of terminations over the three-year period was lower than what was assumed. We also examined the prior three-year experience period and we believe that the combined average result of the two three-year experience periods provides a reasonable representation of expected future terminations over the long-term.

Chart 12 compares the actual to expected number of terminations over the past three years for the current and proposed assumptions.

Chart 13 compares the actual experience over the past three years with the current and proposed rates of termination by years of service. The chart also shows the actual experience based on an average of both the current and previous three-year experience periods.

Currently, termination rates are not applied for members eligible to retire, that is, we assume that members eligible to retire at termination will retire in accordance with the retirement rate assumptions rather than terminate and defer their benefit. While the actual termination experience over the three-year period shows that there are some terminations occurring for members eligible to retire, we did not find this experience sufficient to change the current assumption.

We recommend maintaining the assumption that members who are eligible to retire will elect to receive their retirement benefit in lieu of a deferred vested benefit.

We are recommending a minor change in the assumption regarding the service range for which the ultimate total termination rates for Tier 1 are allocated between ordinary withdrawals (those who terminate and take a refund of employee contributions) and vested terminations (those who leave contributions in Plan and retire later).

Tier 1 Ordinary Withdrawals			
Years of Service[23]	Current Rate	Actual Rate	Proposed Rate
Less than 1	100%	100%	100%
1 – 9	30%	25%	30%
10 & Over	15%	13%	15%
Tier 1 Vested Terminations			
Years of Service[23]	Current Rate	Actual Rate	Proposed Rate
Less than 1	0%	0%	0%
1 – 9	70%	75%	70%
10 & Over	85%	87%	85%

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[23] The service ranges shown describes the proposed assumptions. It is 1 to 10 and 11 & over under the current assumptions.

For Tier 2 members, very limited termination experience was available over the three-year period. Therefore, we recommend maintaining the current assumption of 100% ordinary withdrawals for Tier 2 members with less than 5 years of service and 15% ordinary withdrawals for Tier 2 members with 5 or more years of service.

CHART 12: ACTUAL NUMBER OF TERMINATIONS COMPARED TO EXPECTED
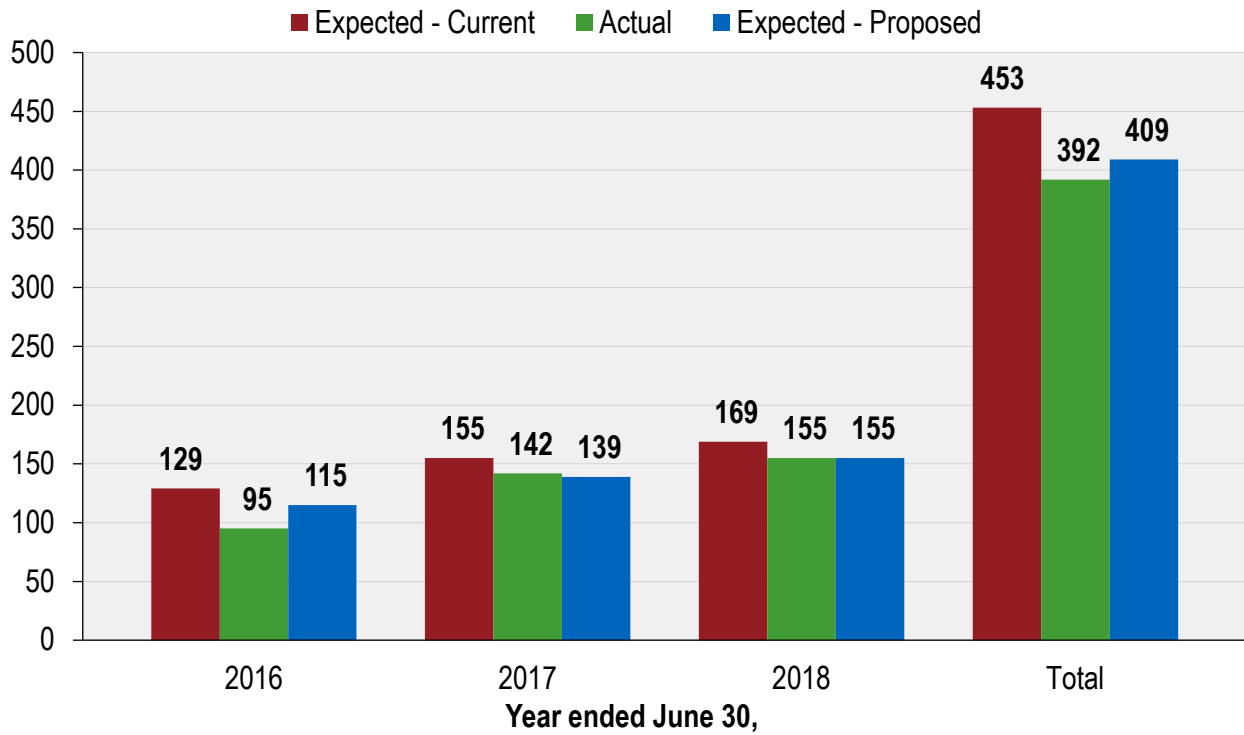
CHART 13: TERMINATION RATES
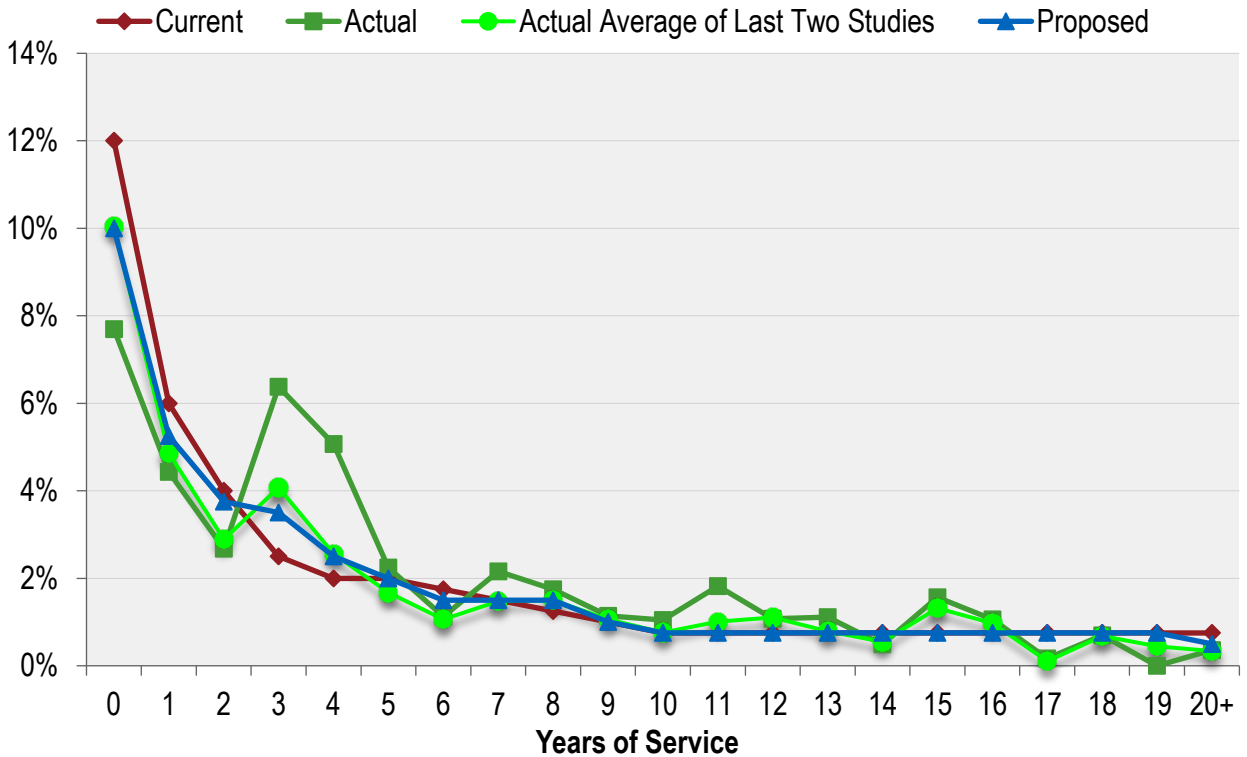
D. Disability Incidence Rates

When a member becomes disabled, he or she may be entitled to a Permanent Total Disability benefit from the Disability Fund. In order to capture more experience, we looked at the actual incidence of permanent total disabilities over the last two three-year experience periods compared to the number expected. The following tables summarize that data:

Disability Incidence

	Disability Incidence Rates (%)	
	Male	Female
	Current & Proposed Rate	Current & Proposed Rate
20 – 24	0.000	0.000
25 – 29	0.006	0.000
30 – 34	0.012	0.018
35 – 39	0.012	0.048
40 – 44	0.024	0.084
45 – 49	0.036	0.114
50 – 54	0.084	0.150
55 – 59	0.162	0.180

	Actual Disabilities	Total Expected Disabilities
Six Years	49	48
Ratio to Expected	102%	

As shown above, we are recommending maintaining the disability incidence rates.

Chart 14 compares the actual to expected number of disabilities over the past six years for the current and proposed assumptions.

Chart 15 shows the current and proposed rates of disability incidence.

CHART 14: ACTUAL NUMBER OF DISABILITIES COMPARED TO EXPECTED (JULY 1, 2012 THROUGH JUNE 30, 2018)
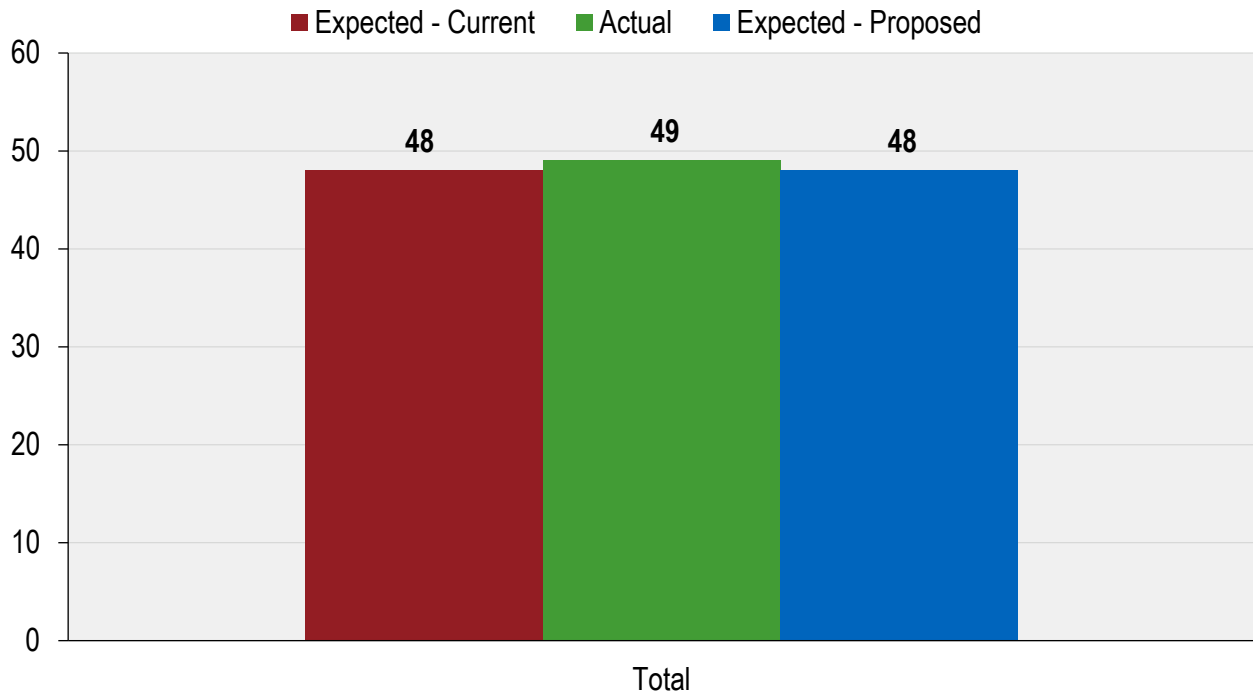
CHART 15: DISABILITY INCIDENCE RATES
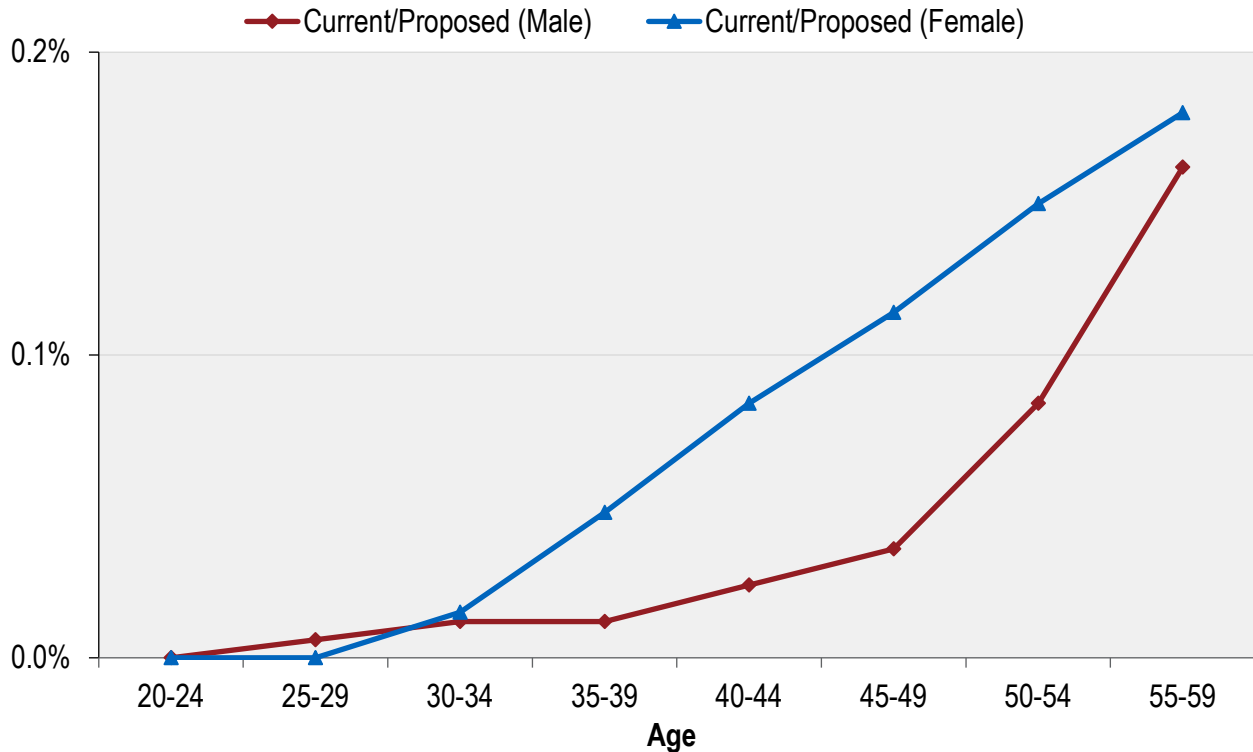
E. Future Service Accruals

Benefits under the Retirement Plan are based on a member's total service, including any purchased service. In order to project benefits and determine the liabilities, an assumption about the amount of service earned and purchased by members each year is necessary. The current assumption is that each Tier 1 and Tier 2 active member will earn 1.00 year of service and purchase an additional 0.10 and 0.03 years of service, respectively, for each future year of employment.

The actual average annual service increase for continuing Tier 1 active members was 1.027 years over the past three years. Based on this experience, we recommend reducing the Tier 1 active member purchase of additional service from 0.10 years to 0.07 years for each future year of employment.

The actual average annual service increase for continuing Tier 2 active members was 1.014 years over the past three years. Based on this experience, we recommend reducing the Tier 2 active member purchase of additional service from 0.03 years to 0.02 years for each future year of employment.

V. Cost Impact

We have estimated the impact of all the recommended demographic and economic assumptions as if they were applied to the July 1, 2018 actuarial valuation. The table below shows the changes in the funding elements due to the proposed assumption changes (as recommended in Sections III and IV of this report).

Cost Impact			
	Based on July 1, 2018 Actuarial Valuation		
	Current Assumptions	**Recommended Assumptions**	**Change**
All Tiers Combined (Aggregate)			
Actuarial accrued liability	$13,187,542,730	$13,192,451,473	
Actuarial value of assets	12,009,999,030	12,009,999,030	
Unfunded actuarial accrued liability (UAAL)	$1,177,543,700	$1,182,452,443	Increase of $4.9 Million
1. Total normal cost	22.66%	23.54%	
2. Expected member contributions	-7.09%	-6.94%	
3. Employer normal cost: (1)+(2)	15.57%	16.60%	
4. Amortization of UAAL	23.17%	23.07%	
5. Total required employer contribution: (3)+(4), with mid-year interest adjustment	40.15%	41.05%	+0.90% of pay
6. Projected compensation	$1,073,554,607	$1,075,100,864	
Tier 1			
1. Total normal cost	24.25%	25.07%	
2. Expected member contributions	-6.18%	-6.02%	
3. Employer normal cost: (1)+(2)	18.07%	19.05%	
4. Amortization of UAAL	23.17%	23.07%	
5. Total required employer contribution: (3)+(4), with mid-year interest adjustment	42.73%	43.59%	+0.86% of pay
6. Projected compensation	$815,357,490	$815,907,916	
Tier 2			
1. Total normal cost	17.64%	18.71%	
2. Expected member contributions	-9.94%	-9.86%	
3. Employer normal cost: (1)+(2)	7.70%	8.85%	
4. Amortization of UAAL	23.17%	23.07%	
5. Total required employer contribution: (3)+(4), with mid-year interest adjustment	31.99%	33.04%	+1.05% of pay
6. Projected compensation	$258,197,117	$259,192,948	

If all of the proposed <u>demographic</u> assumption changes were implemented, the required employer contribution would have changed by -0.04% of payroll.

In addition, if all of the proposed <u>economic</u> assumptions changes were implemented the required employer contribution would have increased by an additional 0.94% of payroll.

Accordingly, <u>if all of the proposed assumption changes</u> (both economic and demographic) were implemented, the required employer contribution would have increased by 0.90% of payroll. Of the various assumption changes, the most significant costs impact is from the merit and promotion salary increase assumption change.

If the Board adopts the assumption changes, then based on Plan language, the assumptions for interest crediting, optional form of payment amounts at retirement, and conversion of contribution balances to annuities at retirement will also change. The impact of those changes has been reflected in the results shown above.

Appendix A: Current Actuarial Assumptions

Economic Assumptions

Net Investment Return:	7.25%, net of investment expenses.
Administration Expenses:	Offset by additional employer contributions.
Employee Contribution, Additional Annuity and Matching Account Crediting Rate:	7.25%, based on Plan provisions
Consumer Price Index:	Increase of 3.00% per year; benefit increases due to CPI subject to 3.00% maximum for Tier 1 and 2.00% for Tier 2. The maximum COLA's are assumed to be paid for both Tier 1 and 2.
Increase in Internal Revenue Code Section 401(a)(17) Compensation Limit:	Increase of 3.00% per year from the valuation date.

Individual Salary Increases

Annual Rate of Compensation (%)	
Inflation: 3.00% per year; plus "across the board" real salary increases of 0.50% per year; plus the following merit and promotion increases:	
Years of Service	**Increase**
Less than 1	6.50
1 – 2	6.00
2 – 3	5.50
3 – 4	4.50
4 – 5	3.00
5 – 6	2.00
6 – 7	1.50
7 – 8	1.40
8 – 9	1.30
9 – 10	1.20
10 & Over	1.00

Demographic Assumptions

Post-Retirement Mortality Rates (Service Retirement, Disability Retirement, and Beneficiaries)

➤ Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table with no age adjustment for males and set back one year for females, projected generationally with the two-dimensional scale MP-2015.

Mortality Rates for Optional Form of Payment Amounts at Retirement and Conversion of Contribution Balance to Annuities at Retirement

➤ **Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table with no age adjustment for males and set back one year for females, projected generationally with the two-dimensional scale MP-2015 associated with a retirement year of 2019, weighted 75% male and 25% female.

➤ **Beneficiaries:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table with no age adjustment for males and set back one year for females, projected generationally with the two-dimensional scale MP-2015 associated with a retirement year of 2019, weighted 25% male and 75% female.

Pre-Retirement Mortality Rates

➤ Headcount-Weighted RP-2014 Employee Mortality Table multiplied by 80%, projected generationally with the two-dimensional scale MP-2015.

Age	Rate (%)*	
	Male	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

* *Generational projections beyond the base year (2014) are not reflected in the above mortality rates.*

5% of pre-retirement deaths are assumed to be duty related, with the remaining being non-duty related.

Disability Incidence Rates

Age	Rates (%)	
	Male	Female
25	0.006	0.000
30	0.012	0.006
35	0.012	0.036
40	0.018	0.072
45	0.030	0.102
50	0.054	0.138
55	0.126	0.168

Termination Rates

Rates (%)	
Years of Service	Total Termination
Less than 1	12.00
1 – 2	6.00
2 – 3	4.00
3 – 4	2.50
4 – 5	2.00
5 – 6	2.00
6 – 7	1.75
7 – 8	1.50
8 – 9	1.25
9 – 10	1.00
10 & Over	0.75

Tier 1 Allocation of Termination Rates (%) between Ordinary Withdrawals and Vested Terminations		
Years of Service	Ordinary Withdrawals	Vested Terminations
Less than 1	100	0
1 – 10	30	70
11 & Over	15	85
Tier 2 Allocation of Termination Rates (%) between Ordinary Withdrawals and Vested Terminations		
Years of Service	Ordinary Withdrawals	Vested Terminations
Less than 5	100	0
5 & Over	15	85

Ordinary withdrawals are assumed to receive their account balance at termination. Vested terminations are assumed to receive a deferred retirement benefit. No withdrawal is assumed after a member is first eligible to retire.

Retirement Rates

Age	Rate (%)			
	Tier 1		Tier 2	
	Under 30 Years of Service	30 or More Years of Service	Under 30 Years of Service	30 or More Years of Service
55	4.50	25.00	0.00	25.00
56	2.00	20.00	0.00	14.00
57	2.50	17.00	0.00	12.00
58	3.00	17.00	0.00	12.00
59	3.00	17.00	0.00	12.00
60	5.00	20.00	5.00	17.50
61	6.00	20.00	2.50	5.00
62	6.00	20.00	0.00	5.00
63	6.00	25.00	20.00	25.00
64	7.00	25.00	15.00	25.00
65	11.00	28.00	14.00	28.00
66	11.00	28.00	14.00	28.00
67	11.00	28.00	14.00	28.00
68	11.00	28.00	14.00	28.00
69	13.00	28.00	13.00	28.00
70	25.00	25.00	100.00	100.00
71	25.00	25.00	100.00	100.00
72	25.00	25.00	100.00	100.00
73	25.00	25.00	100.00	100.00
74	25.00	25.00	100.00	100.00
75 & Over	100.00	100.00	100.00	100.00

Retirement Age and Benefit for Inactive Vested Members:	For Tier 1, inactive vested members are assumed to retire at age 60 with a Money Purchase Annuity. For Tier 2, inactive vested members are assumed to retire at age 63. Tier 1 and Tier 2 members receiving Permanent Total Disability benefits are assumed to retire at the earlier of age 65 or age 55 with 30 years of service.
Future Benefit Accruals:	1.0 year of service per year.
Additional Service Accruals:	Tier 1 members are assumed to purchase an additional 0.10 years of service per year. Tier 2 members are assumed to purchase an additional 0.03 years of service per year. These service purchases exclude those priced at full actuarial cost. The valuation reflects expected future member contributions that are associated with these assumed service purchases.
Unknown Data for Members:	Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.

Percent Married:	85% of male members and 60% of female members are assumed to have an eligible spouse or domestic partner at pre-retirement death or retirement. The assumption is also applied for current retirees retired before April 1, 2012 with Options Full, A, B, or C since they are missing this data. Spousal gender is assumed to be opposite that of the member.
Age of Spouse:	Male retirees are 3 years older than their spouses, and Female retirees are 3 years younger than their spouses.
Definition of Active Members:	First day of biweekly payroll following employment.
Data Adjustments:	Data as of March 31 has been adjusted to June 30 by adding three months of age and, for active employees, three months of service. Contribution account balances were also increased by three months of interest. For members in pay status, we have increased their benefits by the assumed July 1 COLA.

Appendix B: Proposed Actuarial Assumptions

Economic Assumptions

Net Investment Return:	7.00%, net of investment expenses.
Administration Expenses:	Offset by additional employer contributions.
Employee Contribution, Additional Annuity and Matching Account Crediting Rate:	7.00%, based on Plan provisions
Consumer Price Index:	Increase of 2.75% per year; benefit increases due to CPI subject to 3.00% maximum for Tier 1 and 2.00% for Tier 2.
Increase in Internal Revenue Code Section 401(a)(17) Compensation Limit:	Increase of 2.75% per year from the valuation date.

Individual Salary Increases

Annual Rate of Compensation (%)	
Inflation: 2.75% per year; plus "across the board" real salary increases of 0.50% per year; plus the following merit and promotion increases:	
Years of Service	**Increase**
Less than 1	7.00
1 – 2	7.00
2 – 3	6.50
3 – 4	5.25
4 – 5	3.75
5 – 6	2.75
6 – 7	2.25
7 – 8	2.00
8 – 9	1.70
9 – 10	1.60
10 – 11	1.50
11 – 12	1.45
12 – 13	1.40
13 – 14	1.35
14 – 15	1.30
15 & Over	1.25

Demographic Assumptions

Post-Retirement Mortality Rates (Service Retirement and Disability Retirement)

➢ Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females) times 105% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2018.

Mortality Rates – Beneficiaries

➢ Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

Mortality Rates for Optional Form of Payment Amounts at Retirement and Conversion of Contribution Balance to Annuities at Retirement

➢ **Members:** Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table times 105% for males and 100% for females, projected generationally with the two-dimensional improvement scale MP-2018 associated with a retirement year of 2022, weighted 75% male and 25% female.

➢ **Beneficiaries:** Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table, projected generationally with the two-dimensional improvement scale MP-2018 associated with a retirement year of 2022, weighted 25% male and 75% female.

Pre-Retirement Mortality Rates

➢ Pub-2010 General Employee Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

	Rate (%)*	
Age	**Male**	**Female**
25	0.02	0.01
30	0.03	0.01
35	0.04	0.02
40	0.06	0.03
45	0.09	0.05
50	0.13	0.08
55	0.19	0.11
60	0.28	0.17
65	0.41	0.27
70	0.61	0.44

* *Generational projections beyond the base year (2010) are not reflected in the above mortality rates.*

5% of pre-retirement deaths are assumed to be duty related, with the remaining being non-duty related.

Disability Incidence Rates

Age	Rates (%)	
	Male	Female
25	0.006	0.000
30	0.012	0.006
35	0.012	0.036
40	0.018	0.072
45	0.030	0.102
50	0.054	0.138
55	0.126	0.168

Termination Rates

Rates (%)	
Years of Service	Total Termination
Less than 1	10.00
1 – 2	5.25
2 – 3	3.75
3 – 4	3.50
4 – 5	2.50
5 – 6	2.00
6 – 7	1.50
7 – 8	1.50
8 – 9	1.50
9 – 10	1.00
10 – 20	0.75
20 & Over	0.50

Tier 1 Allocation of Termination Rates (%) between Ordinary Withdrawals and Vested Terminations		
Years of Service	Ordinary Withdrawals	Vested Terminations
Less than 1	100	0
1 – 9	30	70
10 & Over	15	85
Tier 2 Allocation of Termination Rates (%) between Ordinary Withdrawals and Vested Terminations		
Years of Service	Ordinary Withdrawals	Vested Terminations
Less than 5	100	0
5 & Over	15	85

Ordinary withdrawals are assumed to receive their account balance at termination. Vested terminations are assumed to receive a deferred retirement benefit. No withdrawal is assumed after a member is first eligible to retire.

Retirement Rates

	Rate (%)			
	Tier 1		Tier 2	
Age	**Under 30 Years of Service**	**30 or More Years of Service**	**Under 30 Years of Service**	**30 or More Years of Service**
50	0.00	1.00	0.00	0.00
51	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00
55	4.25	27.00	0.00	25.00
56	2.00	20.00	0.00	14.00
57	2.50	17.50	0.00	13.00
58	3.50	17.50	0.00	13.00
59	3.50	17.50	0.00	13.00
60	5.50	22.00	5.50	17.50
61	6.50	22.00	3.50	10.00
62	7.00	22.00	2.50	10.00
63	8.00	25.00	20.00	25.00
64	8.50	27.00	12.00	25.00
65	11.50	30.00	11.00	28.00
66	12.00	30.00	11.00	28.00
67	12.50	30.00	12.00	28.00
68	13.00	30.00	12.50	28.00
69	17.00	30.00	15.00	28.00
70	22.00	25.00	50.00	50.00
71	22.00	25.00	50.00	50.00
72	22.00	25.00	50.00	50.00
73	22.00	25.00	50.00	50.00
74	22.00	25.00	50.00	50.00
75 & Over	100.00	100.00	100.00	100.00

Retirement Age and Benefit for Inactive Vested Members:	For Tier 1, inactive vested members are assumed to retire at age 60 with a Money Purchase Annuity. For Tier 2, inactive vested members are assumed to retire at age 63. Tier 1 and Tier 2 members receiving Permanent Total Disability benefits are assumed to retire at the earlier of age 65 or age 55 with 30 years of service.
Future Benefit Accruals:	1.0 year of service per year.
Additional Service Accruals:	Tier 1 members are assumed to purchase an additional 0.07 years of service per year. Tier 2 members are assumed to purchase an additional 0.02 years of service per year. These service purchases exclude those priced at full actuarial cost. The valuation reflects expected future member contributions that are associated with these assumed service purchases.
Unknown Data for Members:	Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.

Percent Married:	85% of male members and 60% of female members are assumed to have an eligible spouse or domestic partner at pre-retirement death or retirement. The assumption is also applied for current retirees retired before April 1, 2012 with Options Full, A, B, or C since they are missing this data. Spousal gender is assumed to be opposite that of the member.
Age of Spouse:	Male retirees are 3 years older than their spouses, and Female retirees are 2 years younger than their spouses.
Definition of Active Members:	First day of biweekly payroll following employment.
Data Adjustments:	Data as of March 31 has been adjusted to June 30 by adding three months of age and, for active employees, three months of service. Contribution account balances were also increased by three months of interest. For members in pay status, we have increased their benefits by the assumed July 1 COLA.