Segal Consulting

City of Fresno Fire & Police Retirement System

ACTUARIAL EXPERIENCE STUDY

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

![Segal Consulting logo]

May 22, 2019

Board of Retirement
City of Fresno Fire & Police Retirement System
2828 Fresno Street, Suite 201
Fresno, CA 93721-1327

Re: Review of Actuarial Assumptions for the June 30, 2019 Actuarial Valuation

Dear Members of the Board:

We are pleased to submit this report of our review of the actuarial experience for the City of Fresno Fire & Police Retirement System. This study utilizes the census data for the period July 1, 2015 to June 30, 2018 and provides the proposed actuarial assumptions to be used in the June 30, 2019 valuation.

The review of the economic assumptions for use in the June 30, 2019 valuation is provided in a separate report.

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   Andy Yeung, ASA, MAAA, FCA, EA
Senior Vice President and Actuary   Vice President and Actuary

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

I. Introduction, Summary, and Recommendations

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

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

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

This study was undertaken in order to review the 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. 35 "Selection of Demographic and Other Non-Economic Assumptions for Measuring Pension Obligations" and ASOP No. 27 "Selection of 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 merit and promotion salary increases, retirement from active employment, DROP election, pre-retirement mortality, healthy life post-retirement mortality, disabled life post-retirement mortality, termination (refund and deferred vested retirement), duty disability, election of optional forms of benefit at retirement, percent married assumption for female members, and assumptions to anticipate cash-outs at retirement.

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

Pg #	Actuarial Assumption Categories	Recommendation
7	**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	Change the merit and promotion increases to those developed in Section (III)(B). Future merit and promotion salary increases are slightly higher at most years of service under the proposed assumption. The review of the inflationary and real "across-the-board" increase components of the salary increase assumption is provided as part of our review of economic actuarial assumptions for the June 30, 2019 actuarial valuation.
10	**Leave Conversions and Cash-outs:** Additional pay elements that are expected to be received on both an ongoing basis and during the member's final average earnings period.	Adjust the current assumptions for the cash-outs to those developed in Section (III)(C).
12	**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 • Future reciprocal members and reciprocal salary increases • Percent married and spousal age differences for members not yet retired • Election of optional forms of benefit at retirement	<u>For Tier 1 Members</u> Since all non-retired members have already elected to participate in the DROP as of June 30, 2018, we are not recommending any changes to those assumptions used in the June 30, 2018 valuation. <u>For Tier 2 Members</u> Adjust the current retirement rates to those developed in Section (III)(D). For deferred vested members, maintain the assumed retirement age at 52. Reduce the percentage of future deferred members expected to work at a reciprocal system from 50% to 45%. Maintain the salary increase assumption of 4.00% for those deferred vested reciprocal members who elect to leave their contributions on deposit (based on expected salary increase assumptions for active members with 10 or more years of service). For active and deferred vested members, maintain the percent married at retirement assumption at 85% for male members and reduce the assumption from 85% to 80% for female members. Maintain the spouse age difference assumption that male retirees are two years older than their spouses and female retirees are two years younger than their spouses. Change the percentages of married male and female members and unmarried members assumed to elect the Unmodified Option and Option 2 (A/B) while maintaining the percentage assumed to elect Option 3 (A/B) at retirement or DROP entry.

Pg #	Actuarial Assumption Categories	Recommendation
18	**Mortality Rates:** The probability of dying at each age. Mortality rates are used to project life expectancies.	For pre-retirement mortality: Current: Headcount-Weighted RP-2014 Employee Mortality Table projected 20 years with the two-dimensional scale MP-2015 times 75%. Recommended base table: Pub-2010 Safety Employee Amount-Weighted Mortality Table.
20		For Healthy retirees and all beneficiaries: Current: Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table projected 20 years with the two-dimensional scale MP-2015, set forward one year for females. Recommended base table: Retirees - Pub-2010 Safety Healthy Retiree Amount-Weighted Mortality Table. Beneficiaries – Pub-2010 General Healthy Retiree Amount-Weighted Mortality Table times 105%.
25		For disabled retirees: Current: Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table projected 20 years with the two-dimensional scale MP-2015, set forward four years. Recommended base table: Pub-2010 Safety Disabled Retiree Amount-Weighted Mortality Table. All recommended tables are projected generationally with the two-dimensional mortality improvement scale MP-2018.
22		For member contribution rates and optional forms, change the mortality rates to those developed in Section (III)(E).
28	**Termination Rates:** The probability of leaving employment at each age and receiving either a refund of contributions or a deferred vested retirement benefit.	For Tier 1 Members Since all non-retired members have already elected to participate in the DROP as of June 30, 2018, we are not recommending any changes to those assumptions used in the June 30, 2018 valuation. For Tier 2 Members Adjust the current termination rates to those developed in Section (III)(G). Maintain the termination assumption structure previously based on service for those with less than five years of service and on age for those with five or more years of service. Decrease the proportion of terminated members expected to receive refund of contributions after five years of services.
32	**Disability Incidence Rates:** The probability of becoming disabled at each age due to duty or ordinary disability.	For Tier 1 Members Since all non-retired members have already elected to participate in the DROP as of June 30, 2018, we are not recommending any changes to those assumptions used in the June 30, 2018 valuation. For Tier 2 Members Adjust the current duty disability rates to those developed in Section (III)(H) and maintain the ordinary disability rates. The recommended assumptions will anticipate more duty disability retirements for older members.

Pg #	Actuarial Assumption Categories	Recommendation
37	**DROP Assumptions:** The probability of electing to enter DROP at each age at which participants are eligible and the duration of DROP participation.	For Tier 1 Members Since all non-retired members have already elected to participate in the DROP as of June 30, 2018, we are not recommending any changes to those assumptions used in the June 30, 2018 valuation. For Tier 2 Members Adjust the current DROP election rates to those developed in Section (III)(I). Change the DROP election assumption structure previously based on years since first eligible to one based on age and service. Maintain the current assumption that members remain in DROP of 7 years.

We have estimated the impact of all the recommended demographic and economic assumptions and the alternative investment return assumption as if they were applied to the June 30, 2018 actuarial valuation. The tables below show the changes in the employer and member contribution rates due to the proposed assumption changes separately for the recommended demographic assumption changes (as recommended in Section III of this report) and the recommended and alternative economic assumption changes (as recommended in the separate report).

Cost Impact (Without Considering Any Impact on Surplus Distribution)		
	Recommended (7.00% Return and Other Recommended Assumptions)	Alternative (7.25% Return and Other Recommended Assumptions)
Impact on Employer (Tier 1)		
Change due to demographic assumptions	1.26%	1.26%
Change due to economic assumptions	0.07%	-1.71%
Total change in average employer rate	1.33%	-0.45%
Total estimated change in annual dollar amount ($000s)	$80	-$27
Impact on Employer (Tier 2)		
Change due to demographic assumptions	2.32%	2.32%
Change due to economic assumptions	0.05%	-1.80%
Total change in average member rate	2.37%	0.52%
Total estimated change in annual dollar amount ($000s)	$2,517	$573
Impact on UAAL and Funded Percentage		
Change in UAAL	$28.2 million	-$9.4 million
Change in funded percentage	From 120.3% to 117.5%	From 120.3% to 121.2%

Of the various demographic assumption changes, the most significant cost impacts are from the mortality assumption change followed by the change in the DROP election assumption. Of the various economic assumption changes, the most significant cost impact is from the investment return assumption change under Recommended (cost increase) and the inflation assumption change under Alternative (cost decrease).

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 the separate report for the economic assumptions and Section III for the demographic assumptions. The cost impact of the proposed changes is detailed in Section IV.

II. Background and Methodology

In this report, we analyzed the demographic ("non-economic") assumptions. Our analysis of the "economic" assumptions for the June 30, 2019 valuation is provided in a separate report. Demographic assumptions include the probabilities of certain events occurring in the population of members, referred to as "decrements," e.g., termination from service, disability retirement, service retirement, DROP election, and death before and after retirement. In addition to decrements, other demographic assumptions reviewed in this study include the percentage of members with an eligible spouse or domestic partner, spousal age difference, merit and promotion salary increases, election of optional forms of benefit at retirement, and assumptions to anticipate leave conversions and cash-outs.

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. Actuarial Assumptions

A. Economic Assumptions

The economic assumptions are reviewed in a separate reported titled "Review of Economic Actuarial Assumptions for the June 30, 2019 Actuarial Valuation."

B. Merit and Promotion Salary Increases

The System's retirement benefits are determined in large part by a member's compensation just prior to retirement or election to participate in the DROP. For that reason, it is important to anticipate salary increases that employees will receive over their careers. These salary increases are made up of three components:

1. Inflationary increases;

2. Real "across the board" Pay Increases; and

3. Merit and Promotion Increases.

The inflationary increases are assumed to follow the recommended general annual inflation assumption of 2.75% discussed in our separate economic assumptions report. We also discussed in that report our recommended assumption of an annual 0.50% "across the board" pay increase. Therefore, the total annual inflation and real "across the board" increase of 3.25% is used as the assumed annual rate of payroll growth at which payments to the UAAL or Prefunded Actuarial Accrued Liability are assumed to increase.

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. Increases are measured in combination for all Tier 1 and Tier 2 current active non-DROP and DROP members. 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 50% 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 during the last three years, we have analyzed this assumption using the data for the past nine years. 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 six-year period from the prior two experience studies (recalculated for all active non-DROP and DROP members on a salary-weighted basis). The current and proposed assumptions are also shown. The actual increases for the most recent nine-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 during the nine-year experience period.

MERIT AND PROMOTION INCREASES

Years of Service	Rate (%)				
	Current Assumptions	2015-2018 Actual Average Increase (Last 3 Years)	2009-2015 Actual Average Increase (Prior Two Studies)[1]	2009-2018 Actual Average Increase (Last 9 Years)	Proposed Assumption
Less than 1	8.50	10.90	10.72	10.87	9.50
1	8.00	11.84	9.27	11.04	9.50
2	5.00	5.15	4.55	4.74	5.00
3	4.00	2.80	3.93	3.81	4.00
4	3.75	7.65	3.94	3.97	4.00
5	3.00	9.15	3.44	3.61	3.50
6	1.25	6.46	0.83	1.24	1.25
7	0.75	3.49	-0.29	0.24	1.00
8	0.75	3.20	-0.25	0.78	1.00
9	0.50	3.32	0.34	1.46	1.00
10 & Over	0.50	2.58	-0.05	0.96	0.75

Chart 1 provides a graphical comparison of the actual merit and promotion increases, compared to the proposed and current assumptions. The chart also shows the actual merit and promotion increases based on averages over the current three-year period as well as over a nine-year period, including the previous two three-year experience periods. This is discussed below.

The System has had salary gains during eight of the past nine valuations meaning salaries increased less than assumed. That was the case even though we have been reducing the inflation

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[1] The average rates have been recalculated for all Tier 1 and Tier 2 active non-DROP and DROP members on a salary-weighted basis. We have also revised the actual average inflation plus "across the board" increase used previously for the 2012-2015 period.

component of the salary increase assumption. With that experience in mind, we examined the merit and promotion increases from the most recent three-year experience period together with the experience from the prior two experience studies for a combined total of nine-year experience. We believe that the combined experience provides a more reasonable representation of potential future merit and promotion salary increases over the long term. In light of the predominately favorable salary experience (i.e., increases less than assumed) over the last nine valuations, we made relatively modest adjustments to the assumptions recommended even though the data from the most three-year period might appear to support higher assumptions. We will continue to monitor the salary experience to determine if higher assumptions might be warranted in our next study.

Based on this experience, we are proposing increases in the merit and promotion salary increases. Overall, salary increases are assumed to be slightly higher when the above somewhat higher merit and promotion increases are taken into consideration with our other recommendation to lower the price inflation assumption by 0.25%.

CHART 1: MERIT AND PROMOTION SALARY INCREASE RATES
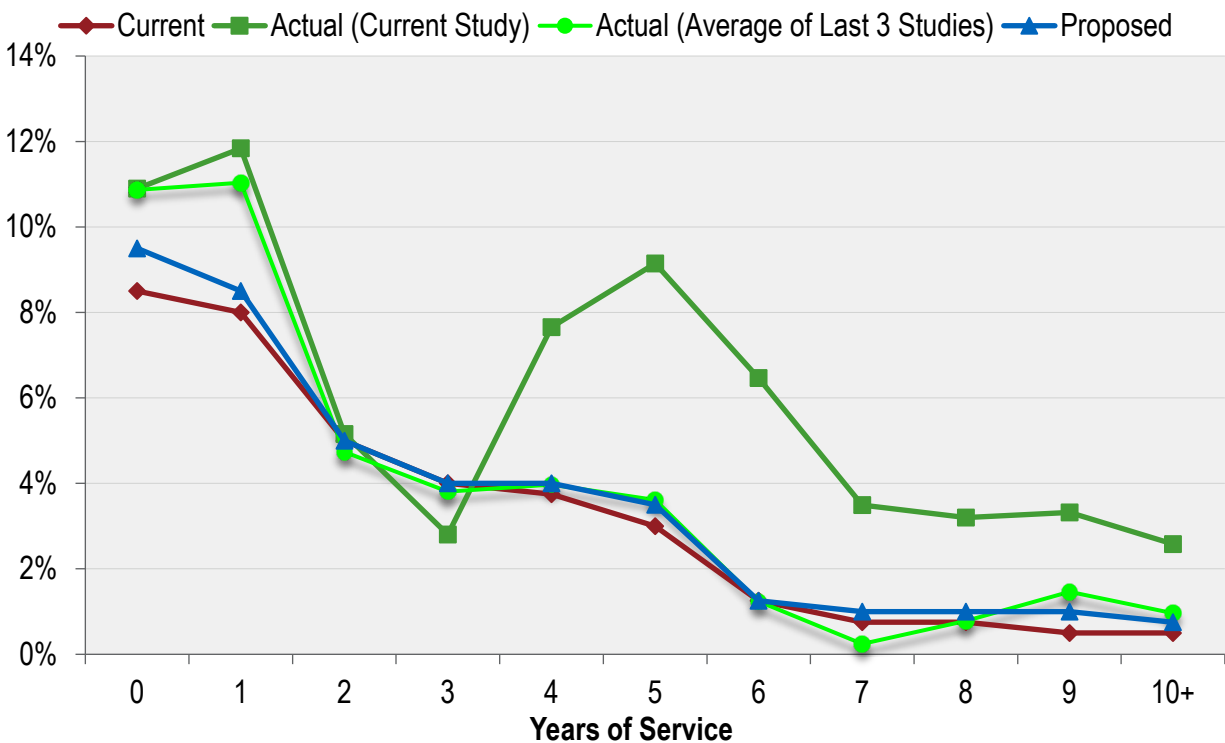
C. Leave Conversions and Cash-Outs

Besides the salaries that are routinely reported by the Retirement System for the annual actuarial valuation, there are several additional pay elements that are included as compensation earnable for pension purposes. These additional pay elements fall into two categories:

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

➢ Cash-out Elements – Those that are expected to be received only during the member's final average earnings pay period.

Ongoing Pay Elements

For Police members, Ongoing Holiday Leave Cash-out is recognized in the actuarial calculations by virtue of all accruals being included in the salary that is reported for active Police members for the annual valuation. However, for all Fire members, an assumption is currently applied to approximate the Ongoing Holiday Leave Cash-out as that salary is only included in the salary that is reported for active Fire members for the annual valuation at the time of the cash-out. Since not all accruals are cashed-out on an annual basis, we continue to recommend that an assumption be applied to anticipate the maximum cash-out that is allowed. As the maximum Ongoing Holiday Leave that can be cashed-out on an annual basis is 312 hours for Tier 1 management, Tier 1 non-management and Tier 2 management, **we recommend maintaining the current assumption of 3.6%**[2]. As the maximum for Tier 2 non-management is 156 hours, **we recommend maintaining the current assumption of 1.8%**.

Cash-out Elements

In order to anticipate these cash-outs, in this study we have collected data for members who retired or enrolled in the DROP during the last three years. The cash-outs for these members, expressed as a percentage of final average pay, are summarized in the following table:

Cash-out Type	Current Rate	Observed Rate	Proposed Rate
A. Average Leave Time Cash-out*			
Tier 1			
1) Management employees	1.00%	N/A	1.00%
2) Non-Management employees**	0.25%	N/A	0.25%
Tier 2			
1) Management employees	1.00%	N/A	0.00%
2) Non-Management employees	0.25%	N/A	0.00%
B. Sick Leave	7.00%	5.3%	6.00%

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[2] 3.6% is equal to $312/(56*52*3)$ where 56 is the number of hours worked per week based on a full-time schedule, 52 is the number of weeks in a year and 3 is the number of years included in the final averaging period.

Cash-out Type	Current Rate	Observed Rate	Proposed Rate
C. Additional Holiday Leave			
1) Tier 2 Police management	Actual bank or 1.50%***	5.4%	Actual bank or 1.50%***
2) Tier 2 Police non-management	Actual bank or 1.50%***	6.0%	Actual bank or 1.50%***

* *Based on recent discussions with the System, it is our understanding that the Leave Time Cash-out is not available for Tier 2 members. Accordingly, we are revising this assumption for Tier 2 members.*

** *Since non-management employees may become management employees in the future, we recommend a 0.25% assumption based on the fact that in the last three years, 15% of all employees retired as management employees and those management employees had an average salary that was about 1.5 times greater than non-management employees (i.e., 1.00%*15%*1.5=0.225% which we have rounded to 0.25%).*

***For employees that have over 96 hours as reported in the data for the annual actuarial valuation, we will use the actual hours in the employee's holiday balance. For employees that have less than 96 hours, we will assume that they will accrue 96 hours by the time they enter DROP or retire. Therefore we recommend a 1.50% assumption which is approximately equal to 96/(40*52*3) where 40 is the number of hours worked per week based on a full-time schedule, 52 is the number of weeks in a year and 3 is the number of years included in the final averaging period.*

We recommend maintaining the Leave Time Cash-out assumption for Tier 1 members, eliminating the Leave time Cash-out assumption for Tier 2 members, decreasing the Sick Leave assumption from 7.00% to 6.00%, and maintaining the Additional Holiday Leave assumption.

As recommended in the prior study, we have reviewed the impact on final average salary of the Absence with Substitution (AWS) program for Tier 2 Police members, which allows a member to work additional hours for another member in the years immediately preceding retirement, thereby increasing their final salary. As part of that review, we were provided with the highest three years of earnings for all Tier 2 Police members who retired or elected DROP in the one-year period ending June 30, 2018. About 30% of members had some additional hours reported from the AWS program during the highest three years of earnings. However, after discussions with the System, it is our understanding that any additional hours resulting from the AWS program will be treated the same as holiday leave, i.e. accrue to the holiday leave balance (and therefore is included directly in our assumption for additional holiday leave) or be cashed out and included in pensionable compensation reported to us in the annual valuation (and therefore is included indirectly in our analysis of annual salary increases). Accordingly, we are not recommending an explicit assumption for the AWS program at this time. We will continue to monitor this experience and may recommend an explicit assumption in a future study.

D. Retirement Rates

For Tier 1 Members

Since all non-retired members have already elected to participate in the DROP as of June 30, 2018, we are not recommending any changes to those assumptions used in the June 30, 2018 valuation.

For Tier 2 Members

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

Currently, the assumed retirement rates are a function of only member's age. Our experience review analyzed recent years' retirement experience both as a function of age and years of service in relation to the probability of retirement. Our review concludes that the retirement rates correlate with age but less so with years of service. Therefore, we recommend that retirement rates continue to be structured as a function age only.

The table on the following page shows the observed service retirement rates based on the actual experience over the past three years. The observed service retirement rates were determined by comparing those members who actually retired from service to those eligible to retire from service, with "N/A" denoting no eligible active members. 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.

Please note that the actual retirement experience was only a reflection of those members who never elected to participate in the DROP. Based on the data collected, only eleven Tier 2 members have retired during the past three years who never elected the DROP. We are recommending some decreases in the Tier 2 rates.

As most Tier 2 members are expected to elect DROP, the application of the service retirement rates are not expected to have a material impact in projecting the cost for the plan.

	Tier 2 – Rate of Retirement (%)		
Age	Current Rate (%)	Actual Rate (%)	Proposed Rate (%)
50	5.31	3.00	4.00
51	4.12	1.28	2.00
52	4.64	0.00	2.00
53	5.09	2.50	3.00
54	5.09	3.13	3.00
55	19.46	0.00	10.00
56	11.72	11.11	10.00
57	7.82	0.00	5.00
58	9.69	0.00	5.00
59	9.17	0.00	5.00
60	60.00	50.00	30.00
61	60.00	0.00	30.00
62	60.00	0.00	30.00
63	75.00	0.00	50.00
64	75.00	N/A	50.00
65 and over	100.00	N/A	100.00

As shown above, we are recommending decreases in most of the retirement rates.

Chart 2 on the following page compares actual experience with the current and proposed rates of retirement for Tier 2.

CHART 2: RETIREMENT RATES – TIER 2
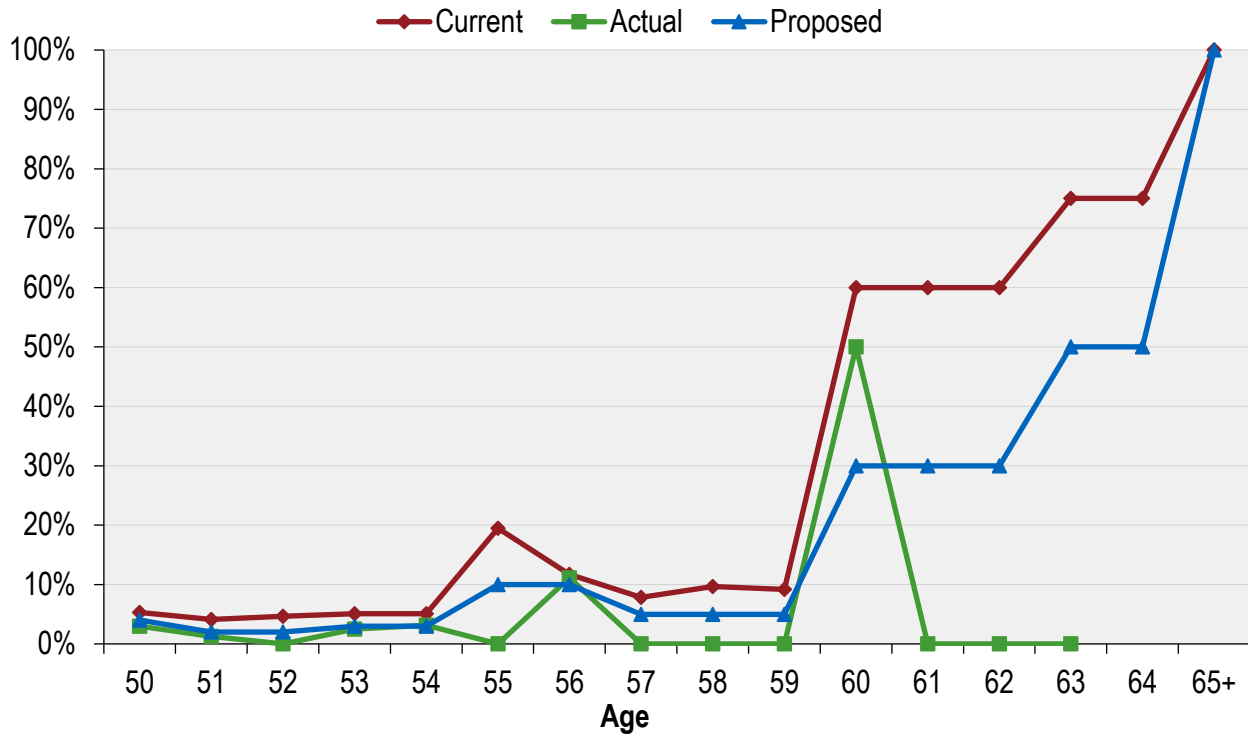
Deferred Vested Members

In prior valuations, deferred vested Tier 2 members were assumed to retire at age 52. Over the last three years, four Tier 2 member retired from deferred vested status at age 51.7. In the last study, there was one Tier 2 retirements from deferred vested status with an average age of 59.5.

We recommend maintaining the assumed retirement at age 52 for deferred vested Tier 2 members.

Reciprocity

In prior valuations, 50% of all future deferred vested members were assumed to continue to work for a reciprocal employer. The actual experience was that only 42% of all deferred vested members went on to be covered by a reciprocal retirement system.

We recommend an assumption of 45% of all future deferred vested members will continue to work for a reciprocal employer be used instead of the current assumption of 50%.

The annual reciprocal salary increase assumption is based on the ultimate merit and promotion salary increase assumptions together with the 2.75% inflation and 0.50% real "across the board" salary increase assumptions that are recommended in a separate report. This assumption is utilized to anticipate salary increases from termination from the System to the expected date of retirement.

We propose no changes to this annual salary increase assumption, consistent with the salary increase assumption for active members. This includes general salary increases of 3.25% plus 0.75% merit and promotion increases.

We recommend maintaining the annual reciprocal salary increase assumption for current and future deferred vested members of 4.00% (i.e., 2.75% inflation plus 0.50% "across the board" plus 0.75% merit and promotion for members with ten or more years of service).

Survivor Continuance and Optional Forms of Benefit

In prior valuations, it was assumed that 85% of all active and inactive members would be married or have an eligible domestic partner or beneficiary when they retired. We reviewed experience for members who retired or entered DROP during the three-year period and determined the actual percentage of these new retirees that had an eligible spouse or eligible domestic partner or beneficiary at the time of retirement. The results of that analysis are shown below.

Year Ending June 30	New Retirees – Actual Percent with Eligible Spouse or Domestic Partner or Beneficiary and Selected Option with Continuance		
	Male	Female	All Retirees
2016	100%	80%	94%
2017	85%	40%	77%
2018	87%	50%	79%
Total	**89%**	**56%**	**82%**

We recommend maintaining the eligible survivor assumption for male members at 85% and reducing the assumption for female members to 80%.

Pursuant to Sections 3-341 and 3-417 of the Municipal Code, a member may elect to receive an optional form of benefit at retirement that is the actuarial equivalent of his or her unmodified retirement allowance in the form of a lesser retirement allowance payable throughout life, with one of the six options stipulated in the Code. It has been the System's longstanding practice to use only the current investment return and mortality assumptions, and without considering the value of the future COLA benefits as stipulated in the Code, in determining the actuarially equivalent optional forms of benefit.

The code section requirement of excluding the COLA assumption in calculating benefit amounts under optional forms of payment results in higher benefit amounts payable under Options 2A, 2B, 3A and 3B[3] as compared to the benefit amount that would result if the COLA assumption were included. This is because the value of the future COLAs expected to be paid over both the lives of the member and the beneficiary are proportionately greater than the value of the future COLAs expected to be paid over just the member's life. Since members (and their survivors)

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[3] Option 2A and Option 3A provide 100% and 66 2/3% continuance, respectively, of the member's modified allowance, payable to the designated beneficiary upon the member's death. Option 2B and Option 3B provide 100% and 83 1/3% continuance, respectively, of the member's modified allowance, payable to the spouse/domestic partner upon the member's death.

actually do receive COLAs, this Code requirement results in a slight subsidy to members whenever they elect those options.

As we pointed out in setting the contribution rates starting in the June 30, 2018 valuation, the Code requirement of excluding the COLA assumption in the optional forms of benefit calculations means that there would be a small actuarial loss when a member retires and elects one of the options mentioned and starts collecting COLA benefits. Since it would be preferable to avoid known actuarial losses by anticipating such elections, in the June 30, 2018 valuation we introduced an assumption to anticipate election of the different optional forms of benefit at retirement.

The following tables show the observed percentages of election of optional forms of benefit for male and female members with survivors over the last three years. Also shown are the current percentages assumed and the percentages we propose.

Male Members with Survivor Election of Optional Forms of Benefit At Retirement			
Optional Form:	Current Assumption	Actual System Experience	Proposed Assumption
Unmodified	40%	36.4%	35%
Option 2 (A/B)	45%	52.7%	50%
Option 3 (A/B)	15%	10.9%	15%

Female Members with Survivor Election of Optional Forms of Benefit At Retirement			
Optional Form	Current Assumption	Actual System Experience	Proposed Assumption
Unmodified	40%	44.4%	45%
Option 2 (A/B)	45%	33.3%	40%
Option 3 (A/B)	15%	22.2%	15%

We recommend changing the percentages of married male and female members and unmarried members assumed to elect the Unmodified Option and Option 2 (A/B) while maintaining the percentage assumed to elect Option 3 (A/B) at retirement or DROP entry.

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 more than 95% of the survivors are actually the opposite sex, even with the inclusion of domestic partners, and other eligible beneficiaries, 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 over the last six years 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 System Experience	Proposed Assumption
Male	2 years older	2.3 years older	2 years older
Female	2 years younger	0.8 years younger	2 years younger

We recommend maintaining the spouse age difference assumptions and that the spouse is the opposite sex of the member.

E. Mortality Rates - Healthy

The "healthy" mortality rates project the life expectancy of a member who retires from service (i.e., who did not retire on a disability pension). Also, the "healthy" pre-retirement mortality rates project what proportion of members will die before retirement. The table currently being used for post-service retirement mortality rates is the Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table projected 20 years using a "static" approach with the two-dimensional scale MP-2015, with no setback for males and set forward one year for females. Beneficiaries are assumed to have the same mortality as members who have taken a service (non-disability) retirement.

When we conducted the last experience study, we notified the Board that we would recommend a switch from a Headcount-Weighted to a Benefit-Weighted table and from a "static" to "generational" approach to anticipate mortality improvement, 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 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 Safety members are as follows:

	Amounts ($) by Gender, Job Category, and Status			
	Males		**Females**	
Job Category	**Employees**	**Retirees**	**Employees**	**Retirees**
Safety - Median	72,200	36,900	61,800	29,200

Note: Values shown as of 2010.

After adjusting the above amounts by a measure of U.S. price inflation from 2010 to 2018 for a total increase of about 20%, about 80% of the benefit amounts (or salaries) paid to the System's members were above those adjusted median amounts and 20% were below. In other words, the benefit amounts (or salaries) paid to the System's members were both above and below the median, though most were above the median. We recommend that the total population version of

the mortality tables for each job category be used. We will continue to monitor the System's mortality experience and advise the Board whether a switch to the above median table, which anticipates even longer life expectancies, would be warranted at the next experience study.

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

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

We understand that RPEC intends to publish annual updates to their mortality improvement scales. Improvement scale MP-2018 is the latest improvement scale available. We recommend that given the trend in the retirement industry to move towards generational mortality, it would be reasonable for the Board to adopt the Benefit-Weighted Safety Pub-2010 mortality table (adjusted for the System's experience), and project the mortality improvement generationally using the MP-2018 mortality improvement scale.

In order to use more actual System experience in our analysis, we have used experience for a nine-year period by using data from the current (from July 1, 2015 to June 30, 2018) and the last two (from July 1, 2012 to June 30, 2015 and from July 1, 2009 to June 30, 2012) experience study periods to analyze this assumption.

Even with the use of nine 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. Because the System had substantially fewer than 1,000 deaths during the study period, in our recommended assumptions we have only partially adjusted the Pub-2010 mortality tables to fit the System's experience. In future experience studies, more data will be available which may further increase the credibility of the System's 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) projected 20 years with the two-dimensional scale MP-2015 times 75%.

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

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 nine years is shown in the table below. We also show the deaths weighted by benefit amount under the proposed assumptions. In the prior study we set the mortality assumption using a static mortality projection so that actual deaths would be about 120% of those assumed. As noted above, we are recommending the use of a generational mortality table rather than a static mortality table. A generational mortality table incorporates a more direct assumption for future mortality improvement by reducing the mortality rates from the base table in future years. Accordingly, the goal is to adjust the base table so that actual deaths would be about 100% of those assumed (i.e. without a margin for future mortality improvement), because future mortality improvement is already reflected in the generational projection.

If we use the benchmark Pub-2010 Safety total table without any adjustment, the proposed actual to expected ratio would be 93%. If we used the Pub-2010 Safety above-median table without any adjustment, the proposed actual to expected ratio would be 108%. If we used the Pub-2010 Safety below-median table without any adjustment, the proposed actual to expected ratio would be 82%. As we point out earlier in this report, we are recommending the total table in this study and may propose the above-median table as more information becomes available in the next study.

Also, the proposed mortality table reflects current experience to the extent that the experience is credible based on standard statistical theory. For the System, the volume of member data makes it only partially credible. That is why, as shown in the table below, the proposed mortality table has an actual to expected ratio of 93% rather than 100%. In future years, we would expect the actual to expected ratio to be around 100% as long as actual mortality improves at the same rates as anticipated by the generational mortality tables.

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

	Healthy Retirees ($ in thousands)		
Gender	**Current Expected Weighted Deaths**	**Actual Weighted Deaths**	**Proposed Expected Weighted Deaths**
Male	$424.3	$469.1	$499.9
Female	$5.3	$1.6	5.0
Total	**$429.6**	**$470.7**	**$504.9**
Actual / Expected	110%		93%

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.

We recommend updating the current table to the Pub-2010 Safety Healthy Retiree Amount-Weighted Mortality Table (separate tables for males and females) projected generationally with the two-dimensional mortality improvement scale MP-2018. The recommended mortality tables will have an actual to expected ratio of 93%.

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.

Gender	Healthy Retirees		
	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	94.8	110	111.0
Female	1.8	1	1.7
Total	**96.6**	**111**	**112.7**
Actual / Expected	115%		98%

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

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

Chart 3 compares actual to expected deaths on a benefit-weighted basis under the current and proposed assumptions over the past nine years.

Chart 4 compares actual to expected deaths on a headcount-weighted basis under the current and proposed assumptions over the past nine years provided for informational purposes only.

Chart 5 shows the life expectancies (i.e., expected future lifetime) under the current and the proposed tables on a benefit-weighted basis. Life expectancies under the 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.

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 retires and beneficiaries.

Pub-2010 has separate mortality tables for healthy General, Safety and Teachers retirees and all contingent annuitants. However, the Pub-2010 Contingent Survivors Table is developed only based on contingent survivor data after the death of the retiree. Considering the small size of the System's beneficiary population and the fact that those contingent survivor mortality rates are somewhat comparable (about 1% higher) to those of the healthy General retiree mortality rates proposed for the Employees System's healthy retirees and beneficiaries, we recommend using the same mortality table for the Fire & Police System's beneficiaries as for the Employees System's healthy retirees and beneficiaries.

We recommend updating the current table to the Pub-2010 General Healthy Retiree Amount-Weighted Mortality Table (separate tables for males and females) times 105%, projected generationally with the two-dimensional mortality improvement scale MP-2018.

## Mortality Table for Member Contributions (Tier 1 only) and Optional Forms of Payment

There are administrative reasons why a generational mortality table is more difficult to implement for determining member contributions, optional forms of payment and reserves. For determining member contributions, one emerging practice is to approximate the use of a generational mortality table by the use of a static table with projection of the mortality improvement from the measurement year over a period that is close to the duration of the benefit payments for active members. Similarly, for optional forms of payment, a generational mortality table could be approximated by static projection over a period that is close to the duration of the benefit payments for new retirees. We would recommend the use of these approximations for determining member contributions (Tier 1 only) and optional forms of payment.

We recommend that the mortality tables used for determining contributions be updated to a blended table based on the Pub-2010 Safety Healthy Retiree Amount-Weighted Mortality Table (separate tables for males and females) projected 30 years (from 2010) with the two-dimensional mortality improvement scale MP-2018, weighted 90% male and 10% female for the member, and to a blended table based on the Pub-2010 General Healthy Retiree Amount-Weighted Mortality Table (separate tables for males and females) times 105%, projected 30 years (from 2010) with the two-dimensional mortality improvement scale MP-2018, weighted 10% male and 90% female for the beneficiary.

We recommend that the mortality tables used for determining optional forms of payment be updated to a blended table based on the Pub-2010 Safety Healthy Retiree Amount-Weighted Mortality Table (separate tables for males and females) projected 20 years (from 2010) with the two-dimensional mortality improvement scale MP-2018, weighted 90% male and 10% female for the member, and to a blended table based on the Pub-2010 General Healthy Retiree Amount-Weighted Mortality Table (separate tables for males and females) times 105%, projected 20 years (from 2010) with the two-dimensional mortality improvement scale MP-2018, weighted 10% male and 90% female for the beneficiary.

These are based on the proposed valuation mortality table for healthy retirees and the actual gender distribution of active members.
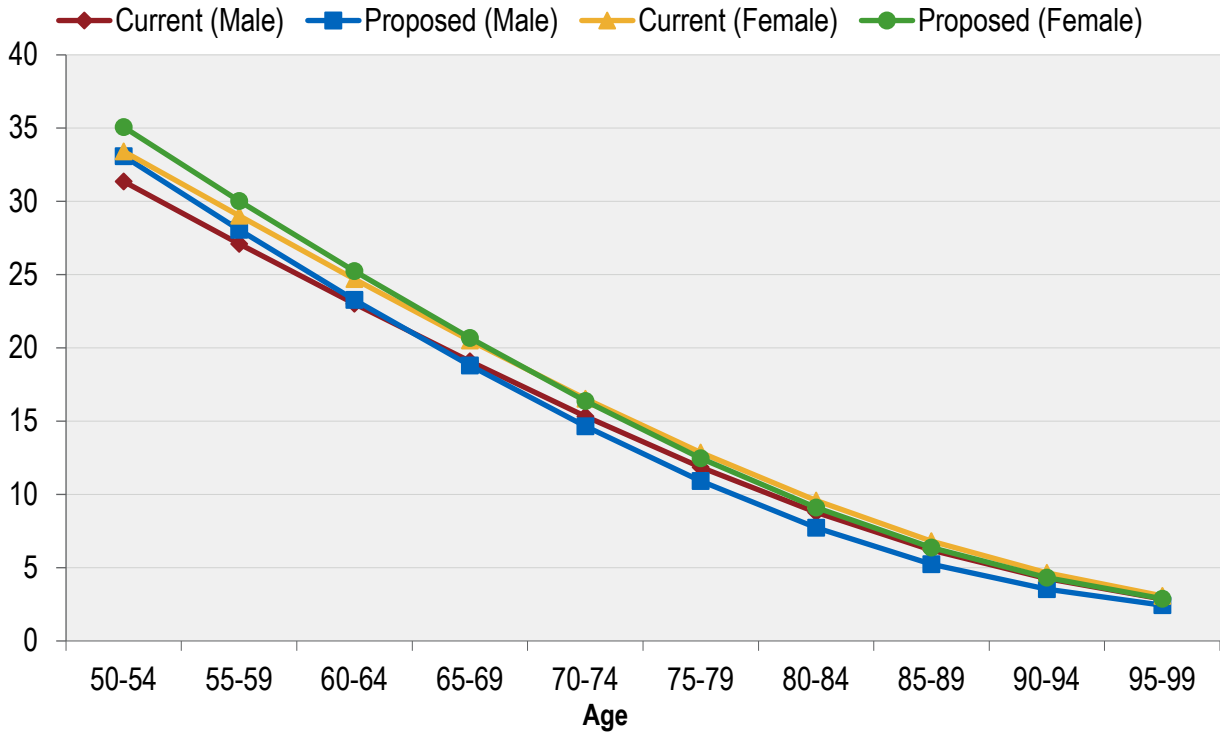
**CHART 3: POST-RETIREMENT BENEFIT-WEIGHTED DEATHS
NON-DISABLED MEMBERS (IN THOUSANDS)
(JULY 1, 2009 THROUGH JUNE 30, 2018)**
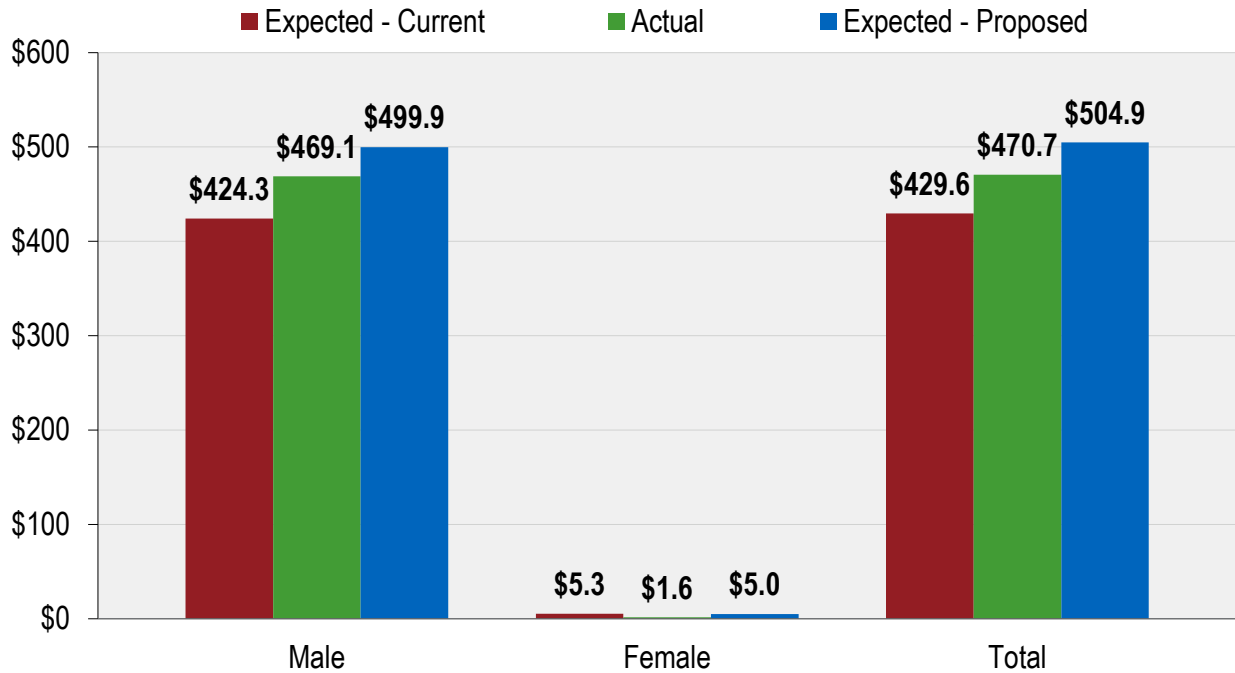
**CHART 4: POST-RETIREMENT HEADCOUNT-WEIGHTED DEATHS
NON-DISABLED MEMBERS
PROVIDED FOR INFORMATIONAL PURPOSES ONLY**

(JULY 1, 2009 THROUGH JUNE 30, 2018)
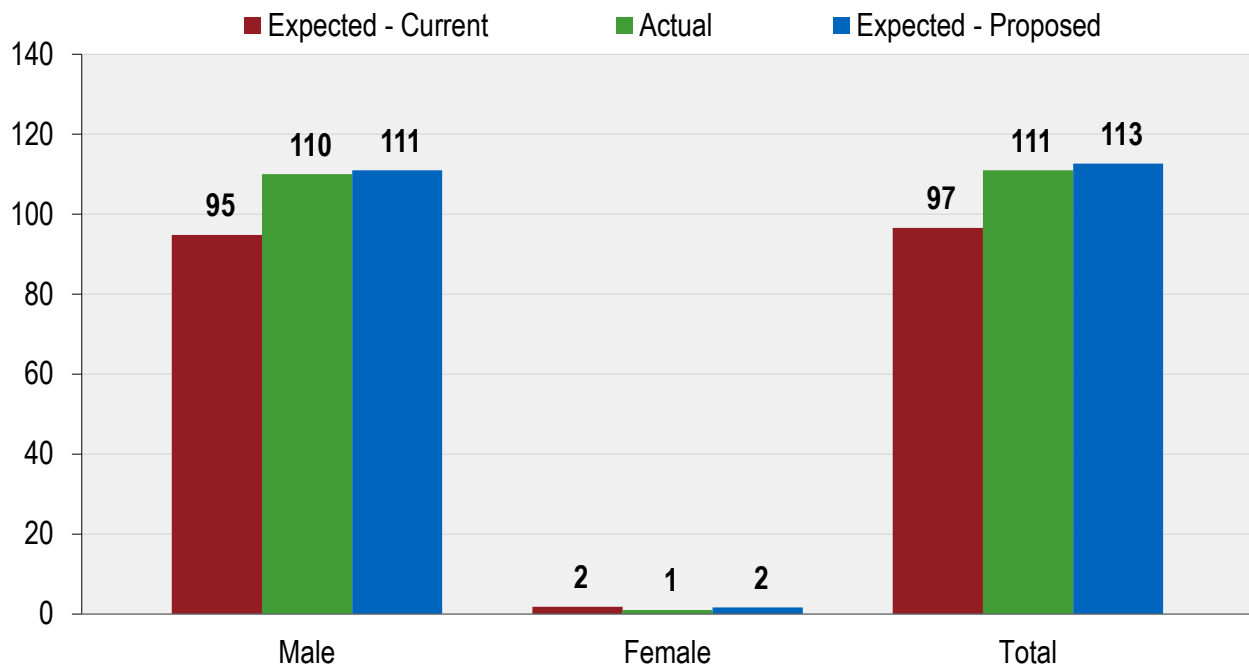
CHART 5: BENEFIT-WEIGHTED LIFE EXPECTANCIES
NON-DISABLED MEMBERS

F. Mortality Rates - Disabled

Since mortality rates for disabled members can vary from those of healthy members, a different mortality assumption is often used. The table currently being used is the Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table projected 20 years using a "static" approach with the two-dimensional scale MP-2015 set forward four years.

Post-Retirement Mortality (Disability Retirements)

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

Gender	Disabled Retirees ($ in thousands)		
	Current Expected Weighted Deaths	Actual Weighted Deaths	Proposed Expected Weighted Deaths
Male	$223.2	$214.2	$189.9
Female	$6.4	$0.0	$5.6
Total	**$229.6**	**$214.2**	**$195.5**
Actual / Expected	93%		110%

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.

The Pub-2010 family of mortality tables provide separate disabled retiree mortality tables for Safety disabled retirees. **We recommend updating the current table for disabled members to the Pub-2010 Safety Disabled Retiree Amount-Weighted Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.** The recommended mortality tables has an actual to expected ratio of 110%.

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.

Gender	Disabled Retirees		
	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	52.3	54	44.2
Female	1.6	0	1.4
Total	**53.9**	**54**	**45.6**
Actual / Expected	100%		119%

Notes: (1) Experience shown above is weighted by headcounts instead of by annual benefit amounts.
 (2) Expected deaths under the proposed generational mortality table are based on mortality rates from the base year projected with mortality improvements to the experience study period.

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

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

Chart 8 shows the life expectancies (i.e., expected future lifetime) under the current and the proposed tables for disabled members on a benefit-weighted basis. Life expectancies under the 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.
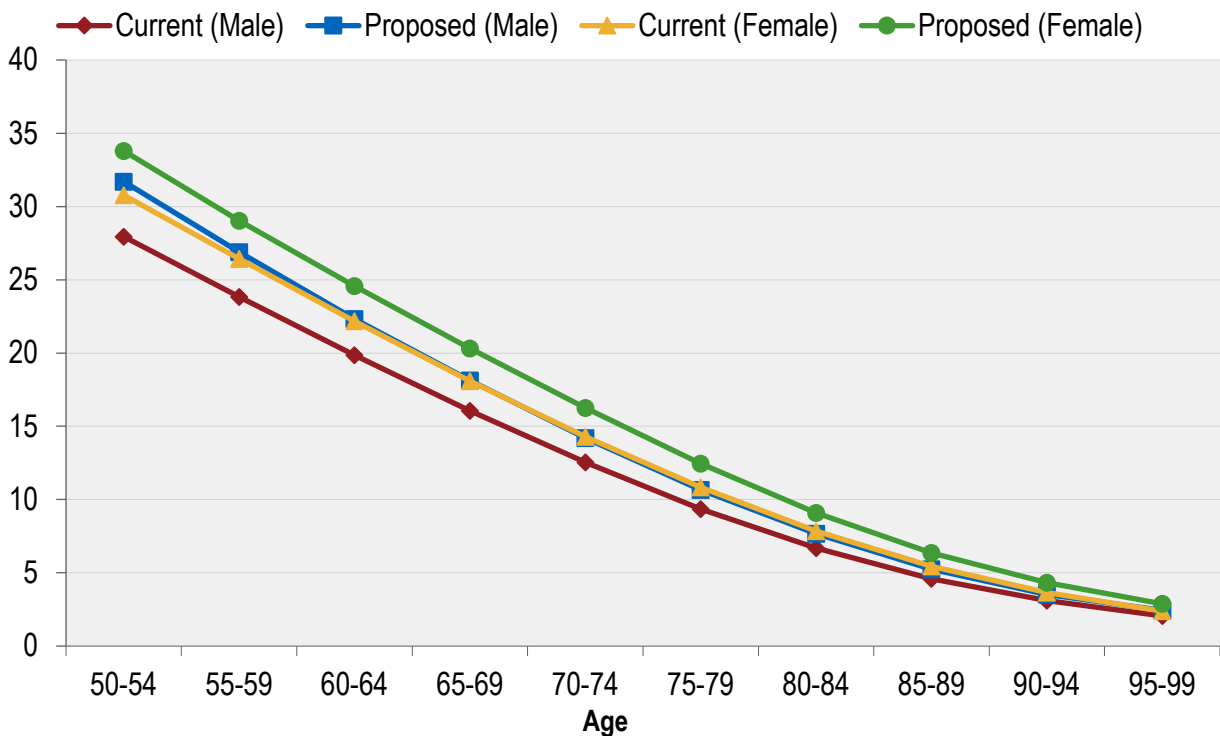
CHART 6: POST-RETIREMENT BENEFIT-WEIGHTED DEATHS DISABLED MEMBERS (IN THOUSANDS) (JULY 1, 2009 THROUGH JUNE 30, 2018)
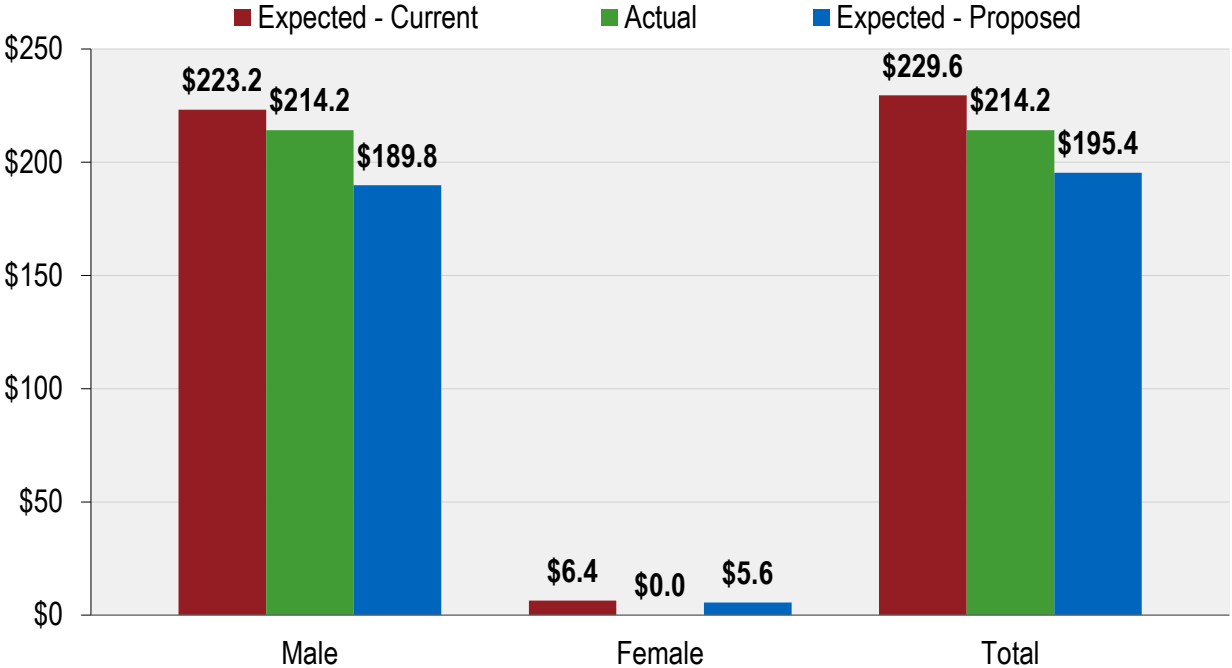
CHART 7: POST-RETIREMENT HEADCOUNT-WEIGHTED DEATHS
DISABLED MEMBERS
PROVIDED FOR INFORMATIONAL PURPOSES ONLY
(JULY 1, 2009 THROUGH JUNE 30, 2018)
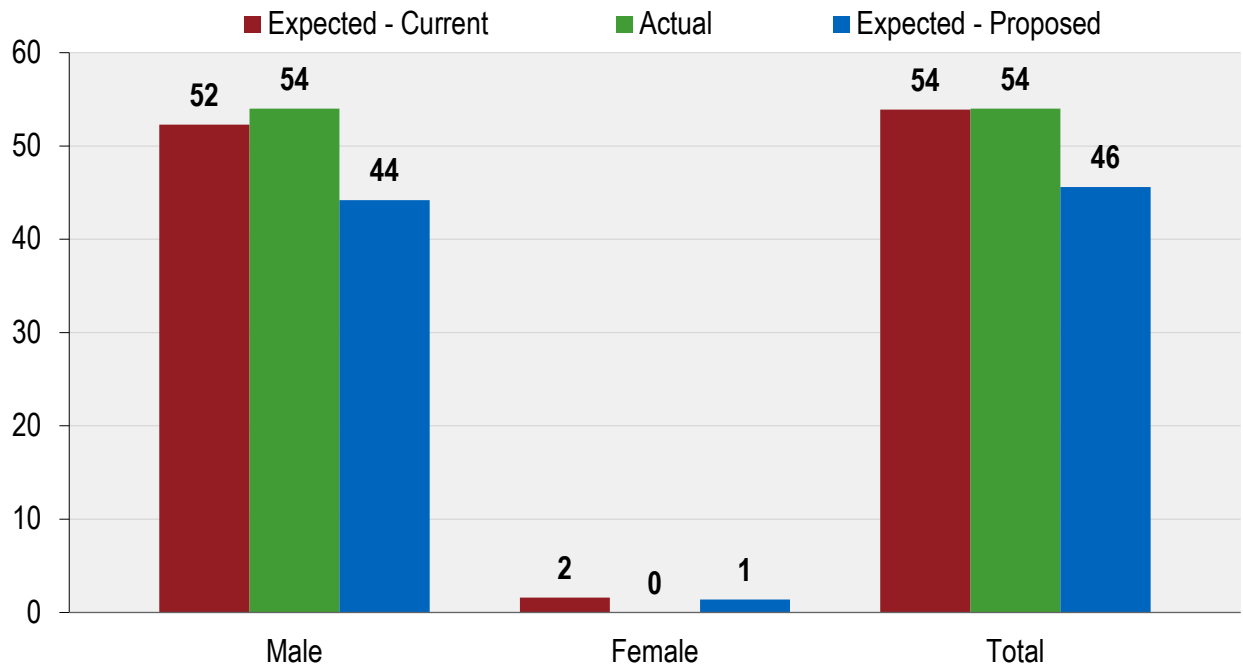
CHART 8: BENEFIT-WEIGHTED LIFE EXPECTANCIES
DISABLED MEMBERS

G. Termination Rates

For Tier 1 Members

Since all non-retired members have already elected to participate in the DROP as of June 30, 2018, we are not recommending any changes to those assumptions used in the June 30, 2018 valuation.

For Tier 2 Members

Termination rates include all terminations for reasons other than death, disability, or retirement. Under the current assumptions, there is an overall assumed incidence of total termination combined with a separate assumption for the percent of members who would elect to withdrawal their contributions (ordinary withdrawal) versus a deferred retirement benefit (vested termination). In addition, the assumed termination rates are a function of a member's years of service for members with fewer than five years of service, and a function of a member's age for members with five or more years of service. Starting with this year's experience review, we analyzed all terminations based on age and years of service and we recommend maintaining the termination assumption structure previously based on service for those with less than five years of service and on age for those with five or more years of service.

The current termination rates, termination experience (total) over the last three years, and proposed termination rates are shown in the following tables. Please note that we have excluded any members that were eligible for retirement.

Rates of Termination for Tier 2

Years of Service	Less than Five Years of Service (%)		
	Current Rates	Actual Rates	Proposed Rates
0-1	12.00	9.62	10.00
1-2	8.00	4.62	6.00
2-3	2.00	1.30	3.00
3-4	1.50	0.00	3.00
4-5	1.00	0.00	3.00

Age	Five or More Years of Service (%)		
	Current Rates	Actual Rates	Proposed Rates
20	3.00	N/A	3.00
25	2.75	0.00	3.00
30	2.10	3.67	3.00
35	1.50	2.42	2.00
40	1.20	1.42	1.20
45	0.80	0.97	0.80
50	Not calculated*	Not calculated	Not calculated

* *"Not calculated" since these members are assumed to either retire or continue working.*

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.

We will also continue to assume that termination rates are zero at any age where members are eligible to retire. In other words, at those ages, members will either retire in accordance with the retirement rate assumptions or continue working, rather than terminate and defer their benefit. This is mainly the case at the highest service categories since most members in those categories are eligible to retire and so have been excluded from our review of this experience.

Chart 9 compares actual to expected terminations (both withdrawals and vested terminations) over the past three years for both the current and proposed assumptions for Tier 2 members.

Chart 10 shows the current and proposed termination rates for Tier 2 members with less than five years of service.

Chart 11 shows the current and proposed termination rates for Tier 2 members with five or more years of service.

Based upon the recent experience, we have adjusted the termination rates accordingly.

In addition, we recommend the following assumptions for the percent of Tier 2 members who would elect a refund of contributions versus those who would leave their contributions on deposit and receive a deferred vested benefit.

Years of Service	Proportion of Total Termination Assumed to Receive Refunds for Tier 2 (%)		
	Current Rate	Actual Rate	Proposed Rate
0 – 4	100.0	100.0	100.0
5 or more	50.0	28.6	40.0

CHART 9: ACTUAL NUMBER OF TERMINATIONS COMPARED TO EXPECTED (TIER 2)

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

Category	Expected - Current	Actual	Expected - Proposed
Less than Five Years of Service	41	29	34
Five or More Years of Service	25	35	30
Total	66	64	64
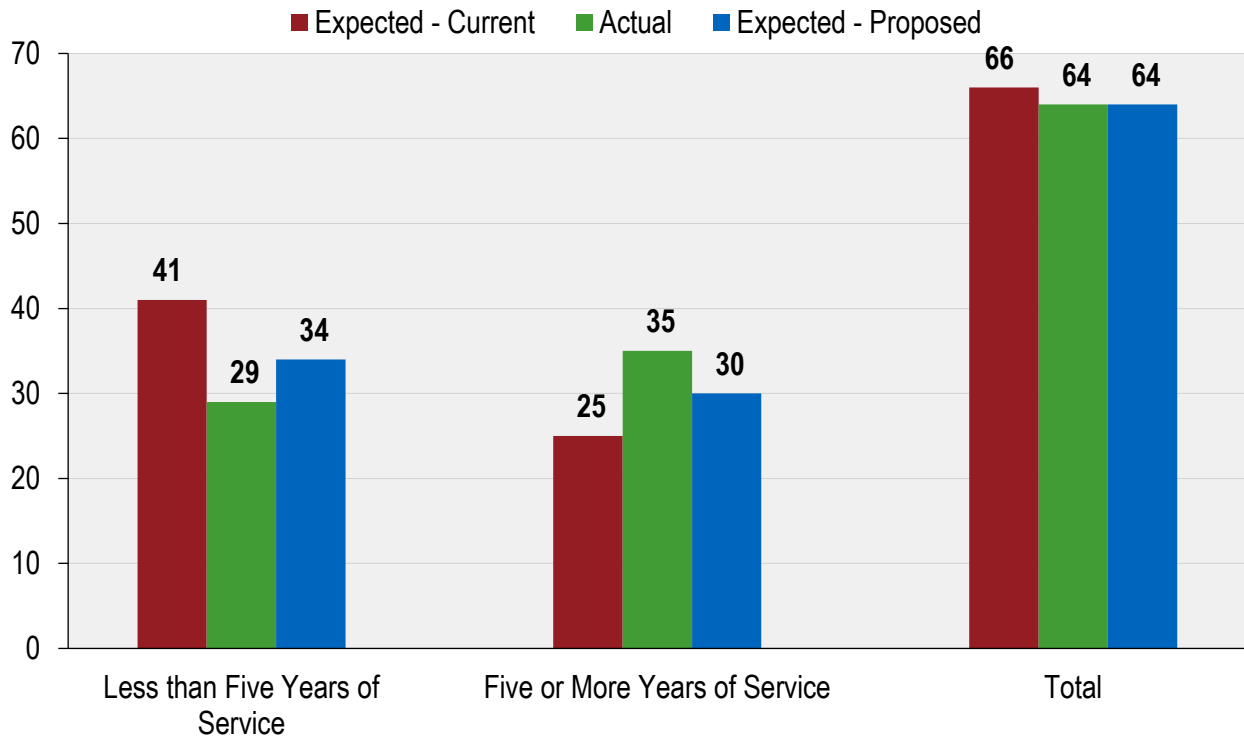
CHART 10: TERMINATION RATES – TIER 2 MEMBERS (LESS THAN FIVE YEARS OF SERVICE)

Legend: ◆ Current ■ Actual ▲ Proposed
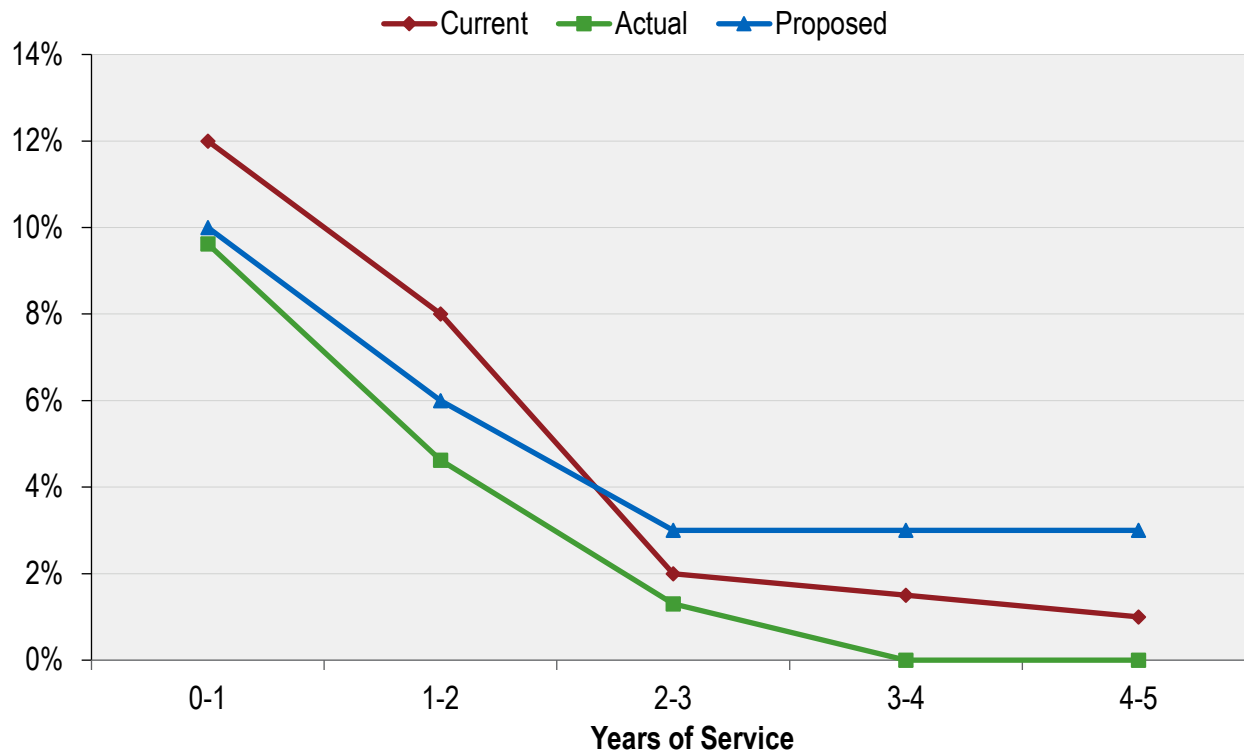
Years of Service

CHART 11: TERMINATION RATES – TIER 2 MEMBERS
(FIVE OR MORE YEARS OF SERVICE)
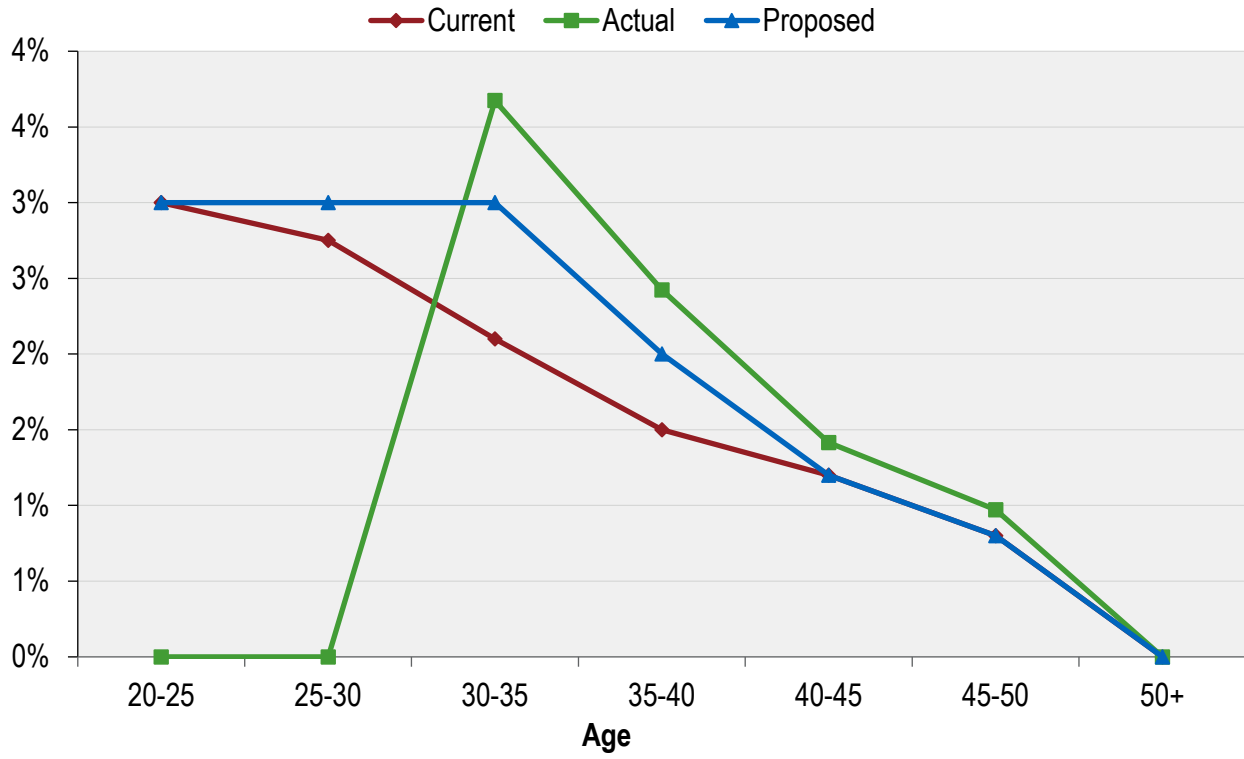
H. Disability Incidence Rates

For Tier 1 Members

Since all non-retired members have already elected to participate in the DROP as of June 30, 2018, we are not recommending any changes to those assumptions used in the June 30, 2018 valuation.

For Tier 2 Members

When a member becomes disabled, he or she may be entitled to a pension that may not depend on the member's years of service. Historically, we have determined the rates of disability incidence by comparing by age the actual disability incidence to the total number of actives who could have become disabled, regardless of benefit eligibility even in the case of ordinary disability. For the first time in this study for the ordinary disability assumption we are excluding from our analysis actives who have not yet met the eligibility requirement of ten years of service, since these members would either receive a refund of contributions or a deferred service retirement benefit. (We have continued to include all members in studying the duty disability assumption since there is no minimum years of service requirement.)

The following summarizes the actual incidence of disabilities over the past three years compared to the current and proposed assumptions for disability incidence:

Rates of Duty Disability Incidence –Tier 2

Age	Duty Disability Incidence Rate (%)		
	Current Rate*	Actual Rate	Proposed Rate
20 – 24	0.20	0.00	0.10
25 – 29	0.35	0.00	0.20
30 – 34	0.60	0.77	0.70
35 – 39	0.80	1.24	1.00
40 – 44	1.10	1.36	1.20
45 – 49	1.30	0.80	1.20
50 – 54	1.60	1.94	1.80
55 – 59	1.90	8.70	5.30
60 – 64	0.00	25.00	12.50

The above observed rates do not include 3 Tier 2 DROP members who were granted a duty disability retirement after entering the DROP. This is because, based on past discussions with the Retirement System, it is our understanding that there are no changes in the benefits payable for these members as a result of their reclassifications. However, members that are granted a disability retirement after entering the DROP would be expected to have shorter life expectancies similar to those of other disabled retirees. Based on the actual percentage of members who left DROP during the past three years and were subsequently granted a disability retirement during that period, we recommend continuing the practice of using a blended mortality table for current

and future DROP members before their retirement from the City equal to 80% of the proposed mortality tables for service retirement and 20% of the proposed mortality table for disabled retirement.

Rates of Ordinary Disability Incidence –Tier 2

Age	Ordinary Disability Incidence Rate (%)		
	Current Rate	Actual Rate	Proposed Rate
20 – 24	0.00	N/A	0.00
25 – 29	0.01	N/A	0.01
30 – 34	0.01	0.00	0.01
35 – 39	0.05	0.00	0.05
40 – 44	0.20	0.20	0.20
45 – 49	0.25	0.00	0.25
50 – 54	0.10	0.00	0.10
55 – 59	0.00	0.00	0.00
60 – 64	0.00	0.00	0.00

In preparing our prior experience studies, we included in the actual rates those members who changed status from vested terminated or service retirement to disability retirement regardless of whether their actual dates of disabilities would have fallen during the three-year period within those prior experience studies. That was done in order to capture the lag in processing the disability application.

However, we understand from our discussions with the System that the higher rates of observed disability incidence are due in part to the processing of a backlog of disability applications corresponding to the hiring of two additional counselors in fiscal year 2016.

We believe with the new staffing, we should consider excluding some of the disabilities reported from vested terminated or service retirement to disability retirement if the disability was granted before a certain date. Below is a table which summarizes the number of such disabilities that we consider excluding based on one-year, two-ear and a three-year lag:

Number of Members to be Excluded		
One-Year Lag (With Date of Retirement prior to July 1, 2014)	Two-Year Lag (With Date of Retirement prior to July 1, 2013)	Three-Year Lag (With Date of Retirement prior to July 1, 2012)
3	1	1

We believe despite the additional staffing it would be prudent to assume that there would still be a two-year lag in the disability application process until more data is available at the next experience study. As a result, we have only reduced the actual incidence of disability reported to us by 1.

Chart 12 compares actual number of duty and ordinary disabilities over the past three years for Tier 2 to that expected under both the current and proposed assumptions.

Chart 13 shows the actual duty disability incidence rates over the past three years compared to the current and proposed assumptions for Tier 2 members.

Chart 14 shows the actual ordinary disability incidence rates over the past three years compared to the current and proposed assumptions for Tier 2 members.

CHART 12: ACTUAL NUMBER OF DISABILITIES COMPARED TO EXPECTED (TIER 2)

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

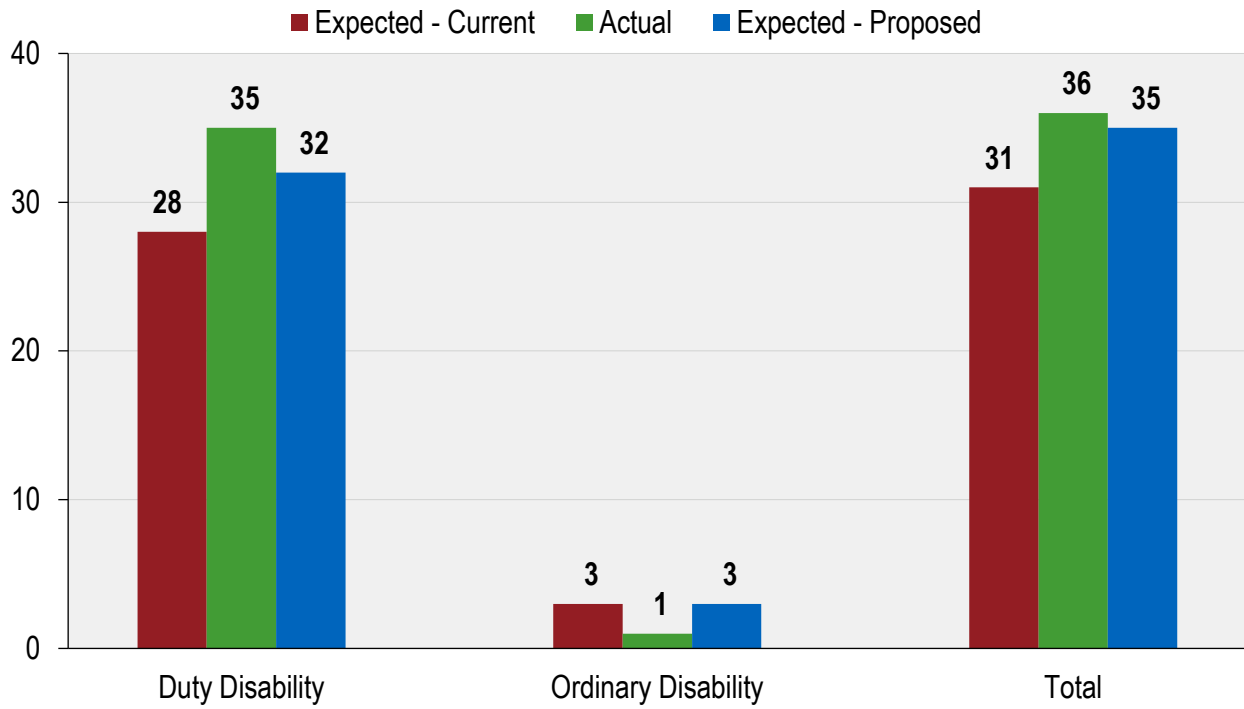|	Expected - Current	Actual	Expected - Proposed
Duty Disability	28	35	32
Ordinary Disability	3	1	3
Total	31	36	35

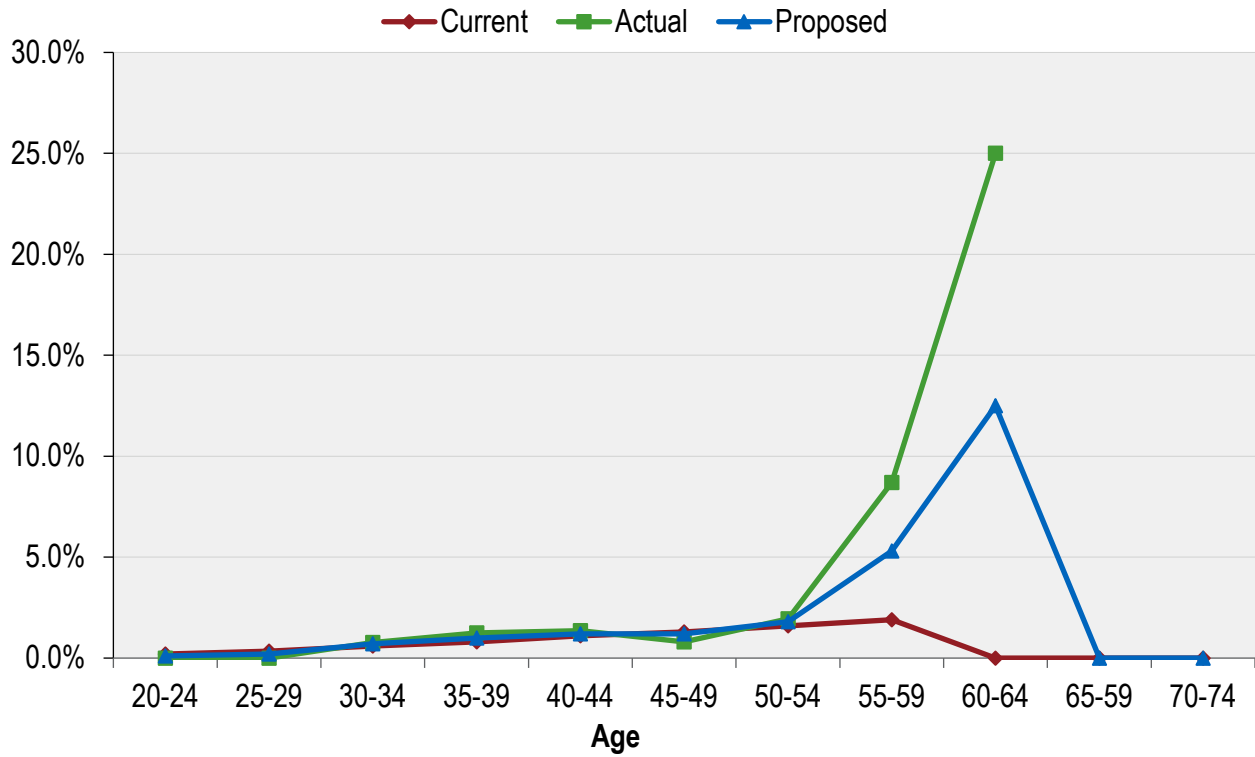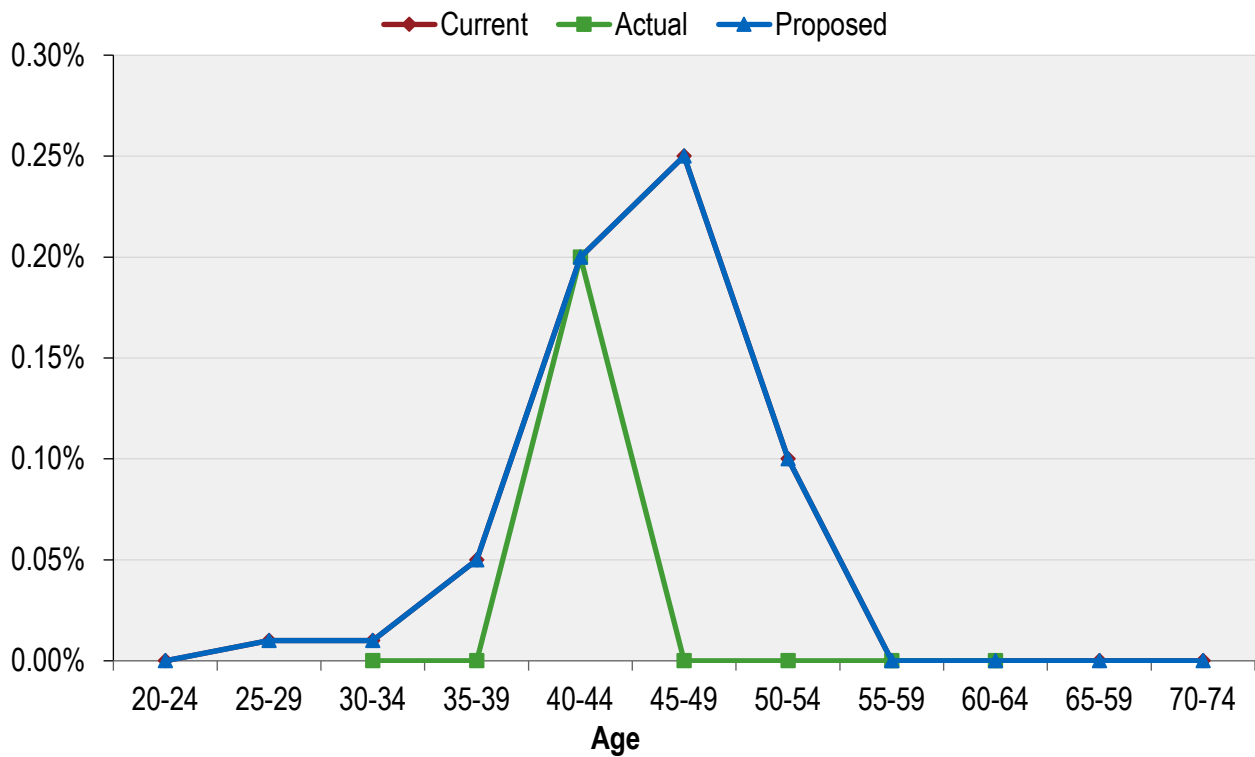## CHART 13: DUTY DISABILITY INCIDENCE RATES FOR TIER 2

CHART 14: ORDINARY DISABILITY INCIDENCE RATES FOR TIER 2

I. Drop Election Rates

For Tier 1 Members

Since all non-retired members have already elected to participate in the DROP as of June 30, 2018, we are not recommending any changes to those assumptions used in the June 30, 2018 valuation.

For Tier 2 Members

The DROP election rates are currently a function of years since first eligible for participation in the DROP. A member is considered first eligible for this purpose upon attaining age 50 with five years of service.

Consistent with our analysis of other assumptions, we have analyzed recent years' DROP election experience both as a function of age and years of service in relation to the probability of election. Our review concludes that the DROP election rates correlate better with age and years of service. Since the current rates are effectively age-based for most members, we recommend that the DROP election rate structure be updated as a function of both age and years of service.

The new structure will apply different sets of rates for those in different age and service bands. Because we are adopting this new structure for the first time, we have analyzed six years' worth of experience.

The DROP election experience over the last six years is shown below.

	DROP Elections		
	Current Expected	Actual	Proposed Expected
Total	66	48	45
Actual / Expected	73%		107%

As shown, the current expected number of DROP elections are higher than actual experience, and our proposed age and service structure is expected to more closely reflect the number of expected DROP elections for this group.

On the following pages are three charts illustrating the relationship between our current assumptions, actual experience, and our proposed assumptions.

Chart 15 compares actual to expected DROP elections over the past six years for both the current and proposed assumptions for Tier 2 members.

Chart 16 shows the average actual DROP election rates by age over the past six years compared to the current and proposed assumptions for Tier 2 members.

Chart 17 shows the average actual DROP election rates by years of service over the past six years compared to the current and proposed assumptions for Tier 2 members.

As illustrated in Chart 16, both the current and the proposed assumptions match somewhat the total number of actual DROP elections over the past six years and the trend in the DROP election

rates as a function of age. However, as illustrated in Chart 17, where the new structure improves upon the existing assumptions is to more closely match the increasing rates of DROP election as members accrue more years of service.

It is currently assumed that members remain in DROP for 7 years. Based on the experience of members who retired from the DROP during the past three years, the average number of years of participation in the DROP was 6.9. We recommend maintaining the current DROP participation period of 7 years.

CHART 15: ACTUAL NUMBER OF DROP ELECTION COMPARED TO EXPECTED – TIER 2
(JULY 1, 2012 THROUGH JUNE 30, 2018)
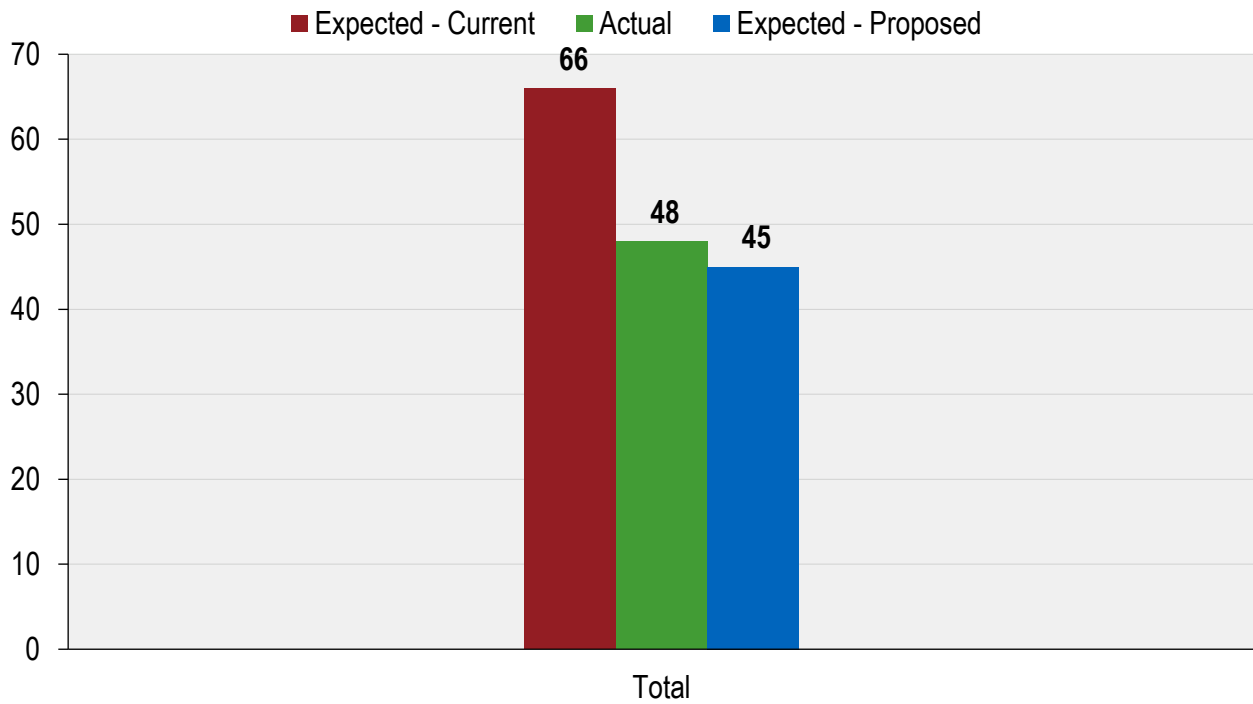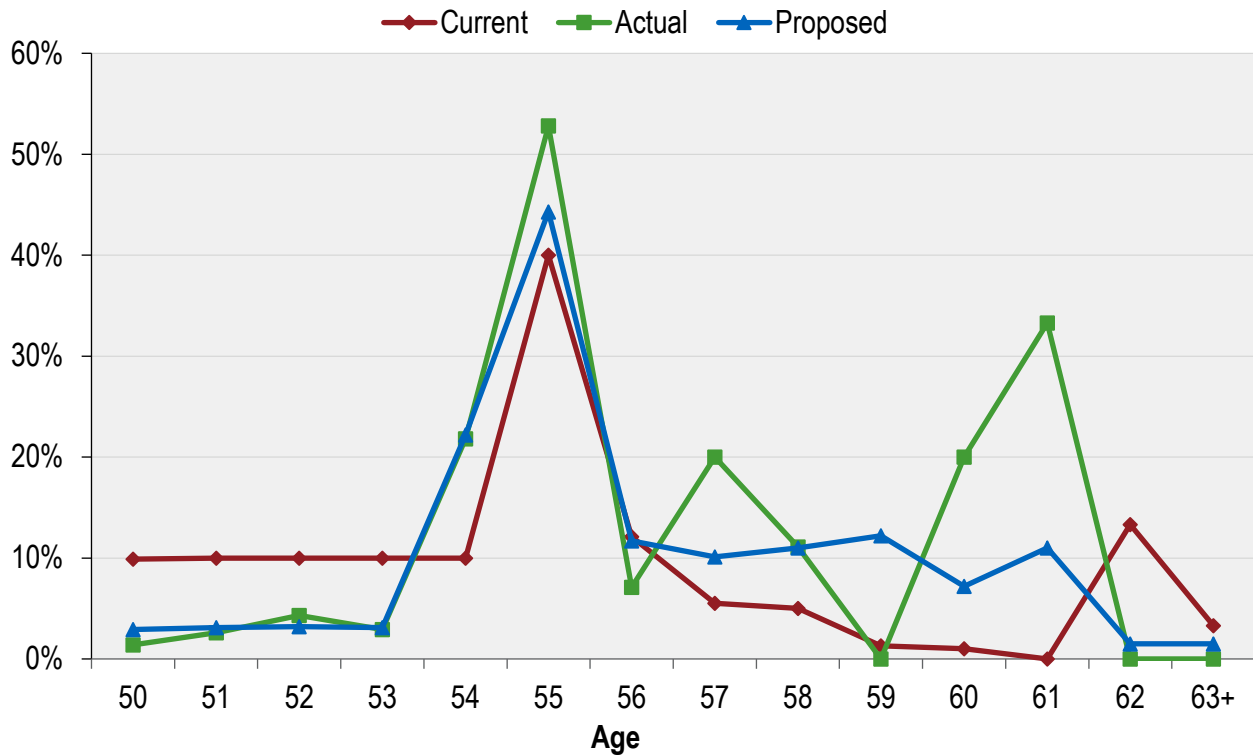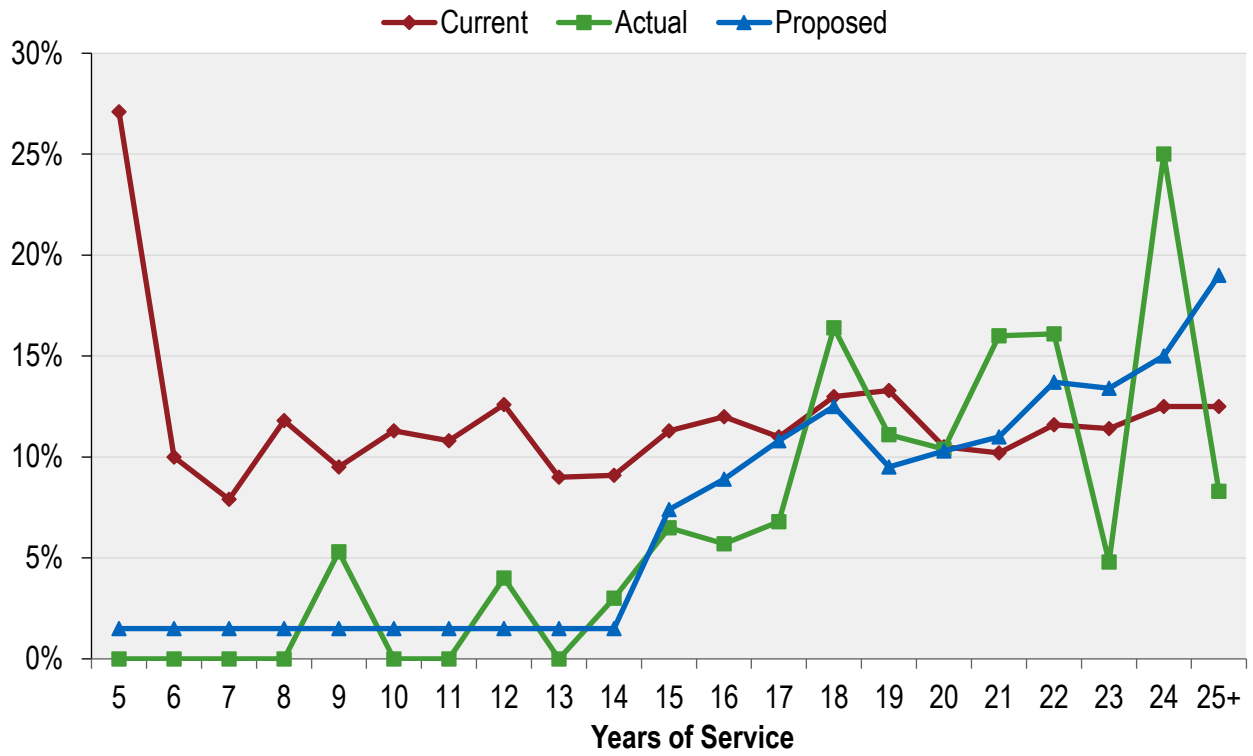

CHART 16: AVERAGE DROP ELECTION RATES BY AGE – TIER 2

CHART 17: AVERAGE DROP ELECTION RATES
BY YEARS OF SERVICE – TIER 2

Legend: Current, Actual, Proposed

X-axis: Years of Service (5 through 25+)
Y-axis: 0% to 30%

IV. Cost Impact

We have estimated the impact of all the recommended demographic and economic assumptions and the alternative investment return assumption as if they were applied to the June 30, 2018 actuarial valuation. The tables below show the changes in the employer and member contribution rates due to the proposed assumption changes separately for the recommended demographic assumption changes (as recommended in Section III of this report) and the recommended and alternative economic assumption changes (as recommended in the separate report).

Cost Impact (Without Considering Any Impact on Surplus Distribution)		
	Recommended (7.00% Return and Other Recommended Assumptions)	Alternative (7.25% Return and Other Recommended Assumptions)
Impact on Employer (Tier 1)		
Change due to demographic assumptions	1.26%	1.26%
Change due to economic assumptions	0.07%	-1.71%
Total change in average employer rate	1.33%	-0.45%
Total estimated change in annual dollar amount ($000s)	$80	-$27
Impact on Employer (Tier 2)		
Change due to demographic assumptions	2.32%	2.32%
Change due to economic assumptions	0.05%	-1.80%
Total change in average member rate	2.37%	0.52%
Total estimated change in annual dollar amount ($000s)	$2,517	$573
Impact on UAAL and Funded Percentage		
Change in UAAL	$28.2 million	-$9.4 million
Change in funded percentage	From 120.3% to 117.5%	From 120.3% to 121.2%

Of the various demographic assumption changes, the most significant cost impacts are from the mortality assumption change followed by the change in the DROP election assumption. Of the various economic assumption changes, the most significant cost impact is from the investment return assumption change under Recommended (cost increase) and the inflation assumption change under Alternative (cost decrease).

Appendix A: Current Actuarial Assumptions

Economic Assumptions

Merit and Promotion Salary Increases

Years of Service	Annual Increase (%)
Less than 1	8.50
1	8.00
2	5.00
3	4.00
4	3.75
5	3.00
6	1.25
7	0.75
8	0.75
9 and Above	0.50

Ongoing Pay Elements

➤ To reflect the cash-out of holiday leave to increase salary on an ongoing basis for Fire employees, we have increased the salary for all active Tier 1 employees and Tier 2 management employees by 3.6% and we have increased the salary for all active Tier 2 non-management employees by 1.8%.

➤ Since the salary data provided by the System already reflects the ongoing cash-out of holiday leave for Police employees, no assumption for Police employees is necessary.

Cash-out Elements

➤ There is an additional 1.00% increase for Fire and Police management employees and an additional 0.25% increase for Fire and Police non-management employees to reflect the average leave time cash-outs for management employees to increase final average salary at retirement.

➤ There is an additional 7.00% increase for all Fire and Police employees to reflect the conversion of sick leave to increase final average salary at retirement.

➤ To reflect the cash-out of additional holiday leave balance to increase final average salary at retirement for non-management Tier 2 Police employees, there is an additional increase equal to the actual hours reported in an employee's holiday balance if that balance is greater than 96 hours and for those with a balance less than 96 hours the additional increase is equal to 1.5%.

Demographic Assumptions

Post-Retirement Mortality Rates – Healthy

➤ **Healthy Members and Beneficiaries:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females), projected 20 years with the two-dimensional scale MP-2015, with no setback for males and set forward one year for females.

Post-Retirement Mortality Rates – Disabled

➤ Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females), projected 20 years with the two-dimensional scale MP-2015, set forward four years.

Employee Contribution Rates and Optional Benefits:

➤ **Healthy Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females), projected 20 years with the two-dimensional scale MP-2015, with no setback for males and set forward one year for females, weighted 80% male and 20% female.

➤ **Beneficiaries:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females), projected 20 years with the two-dimensional scale MP-2015, with no setback for males and set forward one year for females, weighted 20% male and 80% female.

➤ **Disabled Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table (separate tables for males and females), projected 20 years with the two-dimensional scale MP-2015, set forward four years, weighted 80% male and 20% female.

Pre-Retirement Mortality Rates

➤ Headcount-Weighted RP-2014 Employee Mortality Table (separate tables for males and females), projected 20 years with the two-dimensional scale MP-2015, times 75%.

	Rate (%)	
	Tier 1 & Tier 2	
Age	**Male**	**Female**
25	0.03	0.01
30	0.03	0.02
35	0.04	0.02
40	0.04	0.03
45	0.07	0.05
50	0.11	0.08
55	0.20	0.13
60	0.35	0.19
65	0.60	0.26

➤ All pre-retirement deaths are assumed to be duty.

Disability Incidence Rates

	Rate (%)			
	Tier 1		Tier 2	
Age	**Duty**	**Ordinary**	**Duty**	**Ordinary**
20	0.02	0.00	0.14	0.00
25	0.14	0.01	0.29	0.01
30	0.26	0.01	0.50	0.01
35	0.39	0.03	0.72	0.03
40	0.60	0.12	0.98	0.12
45	0.88	0.25	1.22	0.25
50	2.80	0.20	1.48	0.20
55	8.20	0.00	1.78	0.00
60	0.00	0.00	0.00	0.00

Termination Rates

Less than Five Years of Service (%)		
Years of Service	**Tier 1**	**Tier 2**
Less than 1	4.47	12.00
1	4.47	8.00
2	4.47	2.00
3	4.47	1.50
4	4.47	1.00

➤ 100% of members are assumed to elect a withdrawal of contributions. No termination is assumed after a member is assumed to retire.

Five or More Years of Service (%)			
Age	**Tier 1**		**Tier 2**
	5 - 10 Years	**10+ Years**	
20	2.87	3.57	3.10
25	2.87	3.57	2.85
30	1.88	2.63	2.36
35	0.87	1.44	1.74
40	0.44	0.92	1.32
45	0.19	0.63	0.96
50	0.00	0.00	0.00

➤ 100% of Tier 1 members with 5 - 10 years of service, 0% of Tier 1 members with 10+ years of service and 50% of Tier 2 members with 5+ years of service are assumed to elect a withdrawal of contributions. The remaining members are assumed to elect a deferred vested benefit. No termination is assumed after a member is assumed to retire.

Retirement Rates

	Rate (%)	
Age	**Tier 1**	**Tier 2**
50	12.72	5.31
51	7.63	4.12
52	7.63	4.64
53	5.09	5.09
54	5.09	5.09
55	10.60	19.46
56	13.77	11.72
57	14.03	7.82
58	16.66	9.69
59	29.67	9.17
60	100.00	60.00
61	100.00	60.00
62	100.00	60.00
63	100.00	75.00
64	100.00	75.00
65 and over	100.00	100.00

DROP Assumptions

	Rate (%)		Rate (%)
Year Eligible	**Tier 1**	**Year Eligible**	**Tier 2**
First	100	Eligible but Under Age 55	10
Second	0		
Third	0	Years Since Attaining Age 55 and 5 Years of Service	
Thereafter	0	First	40
	0	Second	10
	0	Third	5
	0	Fourth	0

➤ Members are assumed to remain in DROP for 7 years.

Retirement Age and Benefit for Deferred Vested Members:	For current deferred vested members, retirement assumptions are as follows: Tier 1: Age 50 Tier 2: Age 52 It is assumed that 50% of future deferred vested members will continue to work for a reciprocal employer. For those that continue to work for a reciprocal employer, a 4.0% compensation increase per annum is assumed.
Future Benefit Accruals:	1.0 year of service per year.
Unknown Data for Members:	Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.
Inclusion of Deferred Vested Members:	All deferred vested members are included in the valuation.
Percent with Survivor:	85%
Age of Spouse:	Wives are 2 years younger than their husbands.
Election of Optional Forms of Benefit at Retirement::	

	Members with Survivor		Members without Survivor
	Male	**Female**	
Unmodified	40%	40%	100%
Option 2 (A/B)	45%	45%	
Option 3 (A/B)	15%	15%	

Appendix B: Proposed Actuarial Assumptions

Economic Assumptions

Merit and Promotion Salary Increases

Years of Service	Annual Increase (%)
Less than 1	9.50
1	9.50
2	5.00
3	4.00
4	4.00
5	3.50
6	1.25
7	1.00
8	1.00
9	1.00
10 and Above	0.75

Ongoing Pay Elements

➤ To reflect the cash-out of holiday leave to increase salary on an ongoing basis for Fire employees, we have increased the salary for all active Tier 1 employees and Tier 2 management employees by 3.6% and we have increased the salary for all active Tier 2 non-management employees by 1.8%.

➤ Since the salary data provided by the System already reflects the ongoing cash-out of holiday leave for Police employees, no assumption for Police employees is necessary.

Cash-out Elements

➤ There is an additional 1.00% increase for Tier 1 Fire and Police management employees and an additional 0.25% increase for Tier 1 Fire and Police non-management employees to reflect the average leave time cash-outs for management employees to increase final average salary at retirement.

➤ There is an additional 6.00% increase for all Fire and Police employees to reflect the conversion of sick leave to increase final average salary at retirement.

➤ To reflect the cash-out of additional holiday leave balance to increase final average salary at retirement for non-management Tier 2 Police employees, there is an additional increase equal to the actual hours reported in an employee's holiday balance if that balance is greater than

96 hours and for those with a balance less than 96 hours the additional increase is equal to 1.5%.

Demographic Assumptions

Post-Retirement Mortality Rates – Healthy

> **Healthy Members:** Pub-2010 Safety Healthy Retiree Amount-Weighted Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

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

Post-Retirement Mortality Rates – Disabled

> Pub-2010 Safety Disabled Retiree Amount-Weighted Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

Employee Contribution Rates:

> **Healthy Members:** Pub-2010 Safety Healthy Retiree Amount-Weighted Mortality Table (separate tables for males and females), projected 30 years with the two-dimensional mortality improvement scale MP-2018, weighted 90% male and 10% female.

> **Beneficiaries:** Pub-2010 General Healthy Retiree Amount-Weighted Mortality Table (separate tables for males and females) times 105%, projected 30 years with the two-dimensional mortality improvement scale MP-2018, weighted 10% male and 90% female.

Optional Forms of Benefit:

> **Healthy Members:** Pub-2010 Safety Healthy Retiree Amount-Weighted Mortality Table (separate tables for males and females), projected 20 years with the two-dimensional mortality improvement scale MP-2018, weighted 90% male and 10% female.

> **Beneficiaries:** Pub-2010 General Healthy Retiree Amount-Weighted Mortality Table (separate tables for males and females) times 105%, projected 20 years with the two-dimensional mortality improvement scale MP-2018, weighted 10% male and 90% female.

> **Disabled Members:** Pub-2010 Safety Disabled Retiree Amount-Weighted Mortality Table (separate tables for males and females), projected 20 years with the two-dimensional mortality improvement scale MP-2018, weighted 90% male and 10% female.

Pre-Retirement Mortality Rates

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

	Rate (%)	
Age	**Male**	**Female**
25	0.04	0.02
30	0.04	0.03
35	0.05	0.04
40	0.06	0.05
45	0.08	0.07
50	0.12	0.09
55	0.18	0.12
60	0.26	0.17
65	0.41	0.23
70	0.77	0.45

> Note that generational projections beyond the base year (2010) are not reflected in the above mortality rates. All pre-retirement deaths are assumed to be duty.

Disability Incidence Rates

	Rate (%)			
	Tier 1		Tier 2	
Age	**Duty**	**Ordinary**	**Duty**	**Ordinary**
20	0.02	0.00	0.06	0.00
25	0.14	0.01	0.16	0.01
30	0.26	0.01	0.50	0.01
35	0.39	0.03	0.88	0.03
40	0.60	0.12	1.12	0.12
45	0.88	0.25	1.20	0.25
50	2.80	0.20	1.56	0.20
55	8.20	0.00	3.90	0.00
60	0.00	0.00	9.62	0.00
65	0.00	0.00	0.00	0.00

Termination Rates

Less than Five Years of Service (%)		
Years of Service	Tier 1	Tier 2
Less than 1	4.47	10.00
1	4.47	6.00
2	4.47	3.00
3	4.47	3.00
4	4.47	3.00

➤ 100% of members are assumed to elect a withdrawal of contributions. No termination is assumed after a member is assumed to retire.

Five or More Years of Service (%)			
Age	Tier 1		Tier 2
	5 - 10 Years	10+ Years	
20	2.87	3.57	3.00
25	2.87	3.57	3.00
30	1.88	2.63	3.00
35	0.87	1.44	2.40
40	0.44	0.92	1.52
45	0.19	0.63	0.96
50	0.00	0.00	0.00

➤ 100% of Tier 1 members with 5 - 10 years of service, 0% of Tier 1 members with 10+ years of service and 40% of Tier 2 members with 5+ years of service are assumed to elect a withdrawal of contributions. The remaining members are assumed to elect a deferred vested benefit. No termination is assumed after a member is assumed to retire.

Retirement Rates

Age	Tier 1	Tier 2
50	12.72	4.00
51	7.63	2.00
52	7.63	2.00
53	5.09	3.00
54	5.09	3.00
55	10.60	10.00
56	13.77	10.00
57	14.03	5.00
58	16.66	5.00
59	29.67	5.00
60	100.00	30.00
61	100.00	30.00
62	100.00	30.00
63	100.00	50.00
64	100.00	50.00
65 and over	100.00	100.00

DROP Assumptions

	Rate (%)
Year Eligible	Tier 1
First	100
Second	0
Third	0
Thereafter	0

	Tier 2 - Years of Service (%)		
Age	5 – 14	15 – 19	20 and Above
50	2.0	2.0	6.0
51	2.0	2.0	6.0
52	2.0	2.0	6.0
53	2.0	2.0	6.0
54	2.0	20.0	35.0
55	2.0	50.0	70.0
56	2.0	30.0	35.0
57	2.0	30.0	30.0
58	2.0	30.0	30.0
59	2.0	30.0	30.0
60	2.0	30.0	30.0
61	2.0	30.0	30.0
62	2.0	30.0	30.0
63 and Over	0.0	0.0	0.0

➤ Members are assumed to remain in DROP for 7 years.

Retirement Age and Benefit for Deferred Vested Members:	For current deferred vested members, retirement assumptions are as follows: Tier 1: Age 50 Tier 2: Age 52 It is assumed that 45% of future deferred vested members will continue to work for a reciprocal employer. For those that continue to work for a reciprocal employer, a 4.0% compensation increase per annum is assumed.
Future Benefit Accruals:	1.0 year of service per year.
Unknown Data for Members:	Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.
Inclusion of Deferred Vested Members:	All deferred vested members are included in the valuation.
Percent with Survivor:	85% of male members and 80% of female members
Age of Spouse:	Wives are 2 years younger than their husbands.

Election of Optional Forms of Benefit at Retirement:		Members with Survivor		Members without Survivor
		Male	Female	
	Unmodified	35%	45%	100%
	Option 2 (A/B)	50%	40%	
	Option 3 (A/B)	15%	15%	