Local Government Correctional Service Retirement Plan

Four-Year Experience Study

July 1, 2015 through June 30, 2019

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July 10, 2020

Public Employees Retirement Association of Minnesota
Local Government Correctional Service Retirement Plan
St. Paul, Minnesota

Dear Trustees of the Local Government Correctional Service Retirement Plan:

The results of the four-year ***actuarial experience study*** of the Local Government Correctional Service Retirement Plan (LGCSRP) are presented in this report. The investigation was conducted for the purpose of updating the actuarial assumptions used in valuing the actuarial liabilities of the Local Government Correctional Service Retirement Plan.

The investigation was based upon the statistical data furnished for annual active member and retired life actuarial valuations concerning members who died, withdrew, became disabled or retired during the four-year period of the study by the Public Employees Retirement Association of Minnesota (PERA). We checked for internal and year-to-year consistency, but did not audit the data. We are not responsible for the accuracy or completeness of the information provided by PERA.

The investigation covered the four-year period from ***July 1, 2015 to June 30, 2019***, and was carried out using generally accepted actuarial principles and techniques.

We believe that the actuarial assumptions recommended in this experience study report represent individually and in the aggregate reasonable estimates of future experience of the Local Government Correctional Service Retirement Plan.

This report should not be relied on for any purpose other than that described above. It was prepared at the request of PERA and is intended for use by the Retirement Association and those designated or approved by the Trustees. This report may be provided to parties other than the Association only in its entirety and only with the permission of the Trustees.

This report has been prepared by actuaries who have substantial experience valuing public employee retirement systems. To the best of our knowledge and belief, the information contained in this report was performed in accordance with Minnesota Statutes Section 356.215 and the requirements of the Standards for Actuarial Work established by the Legislative Commission on Pensions and Retirement. We certify that, to the best of our knowledge, this report is complete and accurate and was made in accordance with standards of practice promulgated by the Actuarial Standards Board.

277 Coon Rapids Boulevard | Suite 212 | Coon Rapids, Minnesota 55433-2629

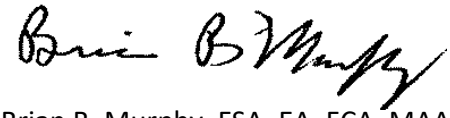
Trustees
Public Employees Retirement Association of Minnesota
Local Government Correctional Service Retirement Plan
July 10, 2020

This report does not reflect the recent and still developing impact of COVID-19, which is likely to influence demographic experience and economic expectations, at least in the short-term. We will continue to monitor these developments and their impact on retirement plans.

Brian B. Murphy and Bonita J. Wurst are independent of the plan sponsor and are Members of the American Academy of Actuaries (MAAA) and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein. In addition, Mr. Murphy meets the requirements of "approved actuary" under Minnesota Statutes Section 356.215, Subdivision 1, Paragraph (c).

Respectfully submitted,

Bonita J. Wurst, ASA, EA, FCA, MAAA



Brian B. Murphy, FSA, EA, FCA, MAAA, PhD

BJW/BBM:sc

Actuarial Experience Study
2015-2019

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SECTION A

OVERVIEW AND SUMMARY OF RESULTS

Summary of Findings

The four-year period (July 1, 2015 to June 30, 2019) covered by this experience study provided sufficient data to form a basis for recommending changes in some of the assumptions and/or methods used in actuarial valuations of the Local Government Correctional Service Retirement Plan. The recommended changes in actuarial assumptions and methods resulting from this experience study are summarized below:

Recommendations

- Decrease the price inflation assumption from 2.50% to 2.25%.
- Decrease the wage inflation (i.e., payroll growth) assumption from 3.25% to 3.00%.
- Adjust rates of merit and seniority, resulting in proposed merit and seniority increases that are approximately 11 basis points lower on average than the current rates, but with a slightly different allocation, with higher increases assumed at younger ages (< age 30) and lower increases assumed at older ages (40 and older). When combined with the proposed decrease in payroll growth assumption, the result is an overall decrease in gross salary increase rates of approximately 36 basis points.
- Adjust assumed retirement rates:
  - Increase the rate of assumed unreduced retirements (i.e., Normal Retirement) at ages 56-59 and age 66 and decrease the rate of assumed unreduced retirements at ages 55, 62, 63 and 68. Overall, proposed rates produce approximately the same number of unreduced retirements as the current rates.
  - Increase rates of assumed early retirement rates at all ages.
- Change the assumed rates of withdrawal (termination of membership before eligible to retire):
  - Increased proposed select rates (during the first three years of employment)
  - Increase proposed ultimate rates (after three years of employment), especially for males younger than age 40 and females younger than age 30.
- Lower rates of disability, especially for those over age 55
- Change the base mortality table to the PUB-2010 public safety mortality table, with rates adjusted to better fit observed plan experience and with future improvement projected using scale MP-2019.
- Minor changes to the percent married and form of payment assumptions.

The recommendations are summarized on the following pages.

Review of the investment return assumption and actuarial methods is outside the scope of this experience study. Please refer to GRS' General Employees Retirement Plan experience study dated June 27, 2019. This report concluded that the current investment return assumption was within a reasonable range as of the date of the report, but that a rate near the median, such as 7.0%, would be likely to be sustainable for a longer period.

It is important to note that, by lowering the assumed rate of inflation but not the assumed investment return rate, the assumptions are actually more optimistic than before because the assumed real rate of return is higher than previously assumed. The 7.50% investment return assumption is required per Minnesota Statutes.

Introduction

Each year as of June 30, the actuarial liabilities of the Association are valued. In order to perform the valuation, assumptions must be made regarding the future experience of the System with regard to the following risk areas:

- Rates of **withdrawal** of active members (leaving before eligible to retire).
- Rates of **disability** among active members.
- Patterns of **pay increases** to active members.
- Rates of **retirement** among active members.
- Rates of **mortality** among active members, retirees, and beneficiaries.
- Long-term rates of **investment return** to be generated by the assets of the System.

Assumptions should be carefully chosen and continually monitored. An unrealistic set of assumptions can lead to:

- Understated costs resulting in either an inability to pay benefits when due, or gradual increases in required contributions as time progresses; and
- Overstated costs resulting in an unnecessarily large burden on the current generation of employers and taxpayers.

All actuarial assumptions are prescribed by Minnesota Statutes, the Legislative Commission on Pensions and Retirement or the PERA Trustees.

A single set of assumptions will not be suitable indefinitely. Things change, and our understanding of things (whether or not they are changing) also changes. The package of assumptions is then adjusted to reflect basic experience trends -- but not random year-to-year fluctuations. Actuarial assumptions were revised for the June 30, 2017 actuarial valuation when mortality assumptions were updated to be the same as PERA's Police and Fire Plan. Economic assumptions were last revised for the June 30, 2018 actuarial valuation. Minor assumption changes to the mortality projection scale were adopted with the June 30, 2019 actuarial valuation. All experience was compared to assumptions in effect as of the June 30, 2019 actuarial valuation.

No single experience period should be given full credibility in the setting of actuarial valuation assumptions. When we see significant differences between what is expected from our assumptions and the actual experience, we generally recommend a change in assumptions that produces results somewhere between the actual and expected experience. In this way, with each experience study the actuarial assumptions become better and better representations of actual experience. Consequently, temporary conditions that might influence a particular experience study period will not unduly influence the choice of long-term assumptions.

We are recommending certain changes in assumptions and methods. The various assumption changes are described on the following pages.

Summary of Decrement Experience
2015-2019

Decrement Risk Area	Actual Number	Expected		
		Present Assumptions	Proposed Assumptions	Change
Unreduced Retirement	301	301.0	301.5	0.5
Reduced Retirement	106	39.1	75.3	36.2
Withdrawal, < 3 years of service				
Males	831	658.5	740.0	81.5
Females	512	386.0	436.0	50.0
Withdrawal, > 3 years of service				
Males	377	246.4	295.3	48.9
Females	233	184.8	198.2	13.4
Disability				
Males	24	36.0	30.3	(5.7)
Females	20	23.6	19.7	(3.9)
Mortality				
Healthy Retired Lives - Male	23	29.7	24.8	(4.9)
- Female	10	11.5	10.4	(1.1)
Disabled Retired Lives - Male	13	4.2	4.5	0.3
- Female	1	1.8	2.0	0.2
Active Lives - Male	13	13.0	8.9	(4.1)
- Female	6	4.1	3.3	(0.8)

The figures in the exhibit above are actual headcounts of occurrences. Calculations in the body of the report are liability weighted for retirement, withdrawal and active mortality and benefit weighted for healthy and disabled retiree mortality.

SECTION B

PAY INCREASES

Pay Increases

Pay increases granted to active members typically consist of two pieces:

- Payroll growth is an across-the-board, economic type of increase granted to most or all members of the group and is associated with a stable or level population. This increase is typically tied to inflation or cost-of-living changes; and

- An increase as a result of merit and seniority. This increase is typically related to the performance of an individual and includes promotions and increased years of experience.

Inflation and Payroll Growth

For the Local Correctional plan, the general inflation assumption is currently 2.50% and the payroll growth assumption is currently 3.25%.

General inflation, as measured by the change in the Consumer Price Index, has averaged about 1.8% over the four-year period ending June 30, 2019. During the 2016 to 2018 calendar year period, the increase in the national average earnings has been about 2.7% (the 2019 national average earnings amount was not available at the time this report was published). Actual annual payroll growth for this plan for the four-year period ending June 30, 2019 has averaged approximately 4.5%. Active membership during this time increased 7.4%, from 3,692 as of July 1, 2015 to 3,965 as of July 1, 2019.

A thorough review of general inflation and payroll growth is presented in Section B of the PERA General Employees Retirement Plan experience study report dated June 27, 2019. In that report, we recommended a general inflation assumption equal to 2.25% and a payroll growth assumption of 3.00%; note that the decrease in payroll growth assumption is due to the change in inflation only (i.e., there was no recommended change to the 0.75% real wage growth assumption).

We recommend reducing the assumed rate to 2.25% for general inflation and 3.00% for payroll growth (i.e., no recommended change to the 0.75% real wage growth assumption). Changing the inflation assumption to 2.25% is supported by experience and is consistent with the assumption used for PERA's General Employees Retirement Plan.

Pay Increases Due to Merit and Seniority

We reviewed the merit and seniority pay increases during the four-year period. For each year, we excluded individual pay increases that were more than 30% and also excluded individual pay increases that were less than -30%. Some occurrences of a negative salary increase are reasonable and expected in a plan that covers part-time employees. While this was a relatively small number of records, the experience would have distorted the experience of the overall group.

The current merit and seniority pay increase assumption is age-based. We reviewed actual experience based on age and also based on service. However, since this plan was created in 1999, a member's years of plan service may not be indicative of the time spent in the career. In fact, no active members have more than 20 years of service as of July 1, 2019. We recommend continuing an age-based merit and seniority pay increase assumption for this reason.

In order to study the merit and seniority portion of the salary increase assumption, it is necessary to separate out the portion attributable to wage inflation for this group. Based on our review of salary experience for LGCSRP members for the period July 1, 2015 through June 30, 2019, we observed salary increases for members age 55 or older averaged about a 3.0% annual increase for this period. We assumed the salary increase amount for these members was attributable to wage inflation only. This assumes that once members reach a certain length of service, merit and seniority increases are much less common.

The assumed wage inflation was 3.50% at the beginning of the study period and 3.25% as of June 30, 2019. However, as described above, we estimated the average actual wage inflation component of pay increases was around 3.0% for members of the Local Government Correctional Service Retirement Plan. This estimated 3.0% wage inflation increase was subtracted from the actual pay increases to obtain the estimated merit/seniority portion of the pay increases. It should be noted the results of the analysis are very sensitive to the estimated wage inflation component.

Pay Increases Due to Merit and Seniority

Findings

Gross actual salary increases averaged 4.82% over the four-year period, ranging from 5.06% in 2016 to 4.48% in 2019. After adjusting for the 3.0% average wage inflation for this period, the average net salary increase (i.e., merit and seniority) averaged 1.82%, ranging from 1.48% to 2.06%.

Fiscal Year Ending	Count	Gross		Net*	
		Expected	Actual	Expected	Actual
2016	2,637	5.20%	5.06%	1.95%	2.06%
2017	2,659	5.24%	5.01%	1.99%	2.01%
2018	2,630	5.26%	4.73%	2.01%	1.73%
2019	2,705	5.33%	4.48%	2.08%	1.48%
Total	**10,631**	**5.26%**	**4.82%**	**2.01%**	**1.82%**

* *Net Expected increases are equal to Gross Expected increases minus the current assumed wage inflation assumption of 3.25%. Net Actual increases are equal to Gross Actual increases minus the estimated actual wage inflation for the period of 3.0%.*

The results of our analysis are shown on the following page. Using the techniques described above, observed merit and seniority pay increases were generally higher than the presently assumed increases at younger ages and generally lower than the current assumption at ages 35 and older. The result is that the proposed merit and seniority increases are 11 basis points lower on average but with a slightly different allocation, with larger increases assumed at younger ages. When combined with the proposed decrease in payroll growth assumption, the result is an overall decrease in gross salary increase rates of approximately 36 basis points.

Recommendation

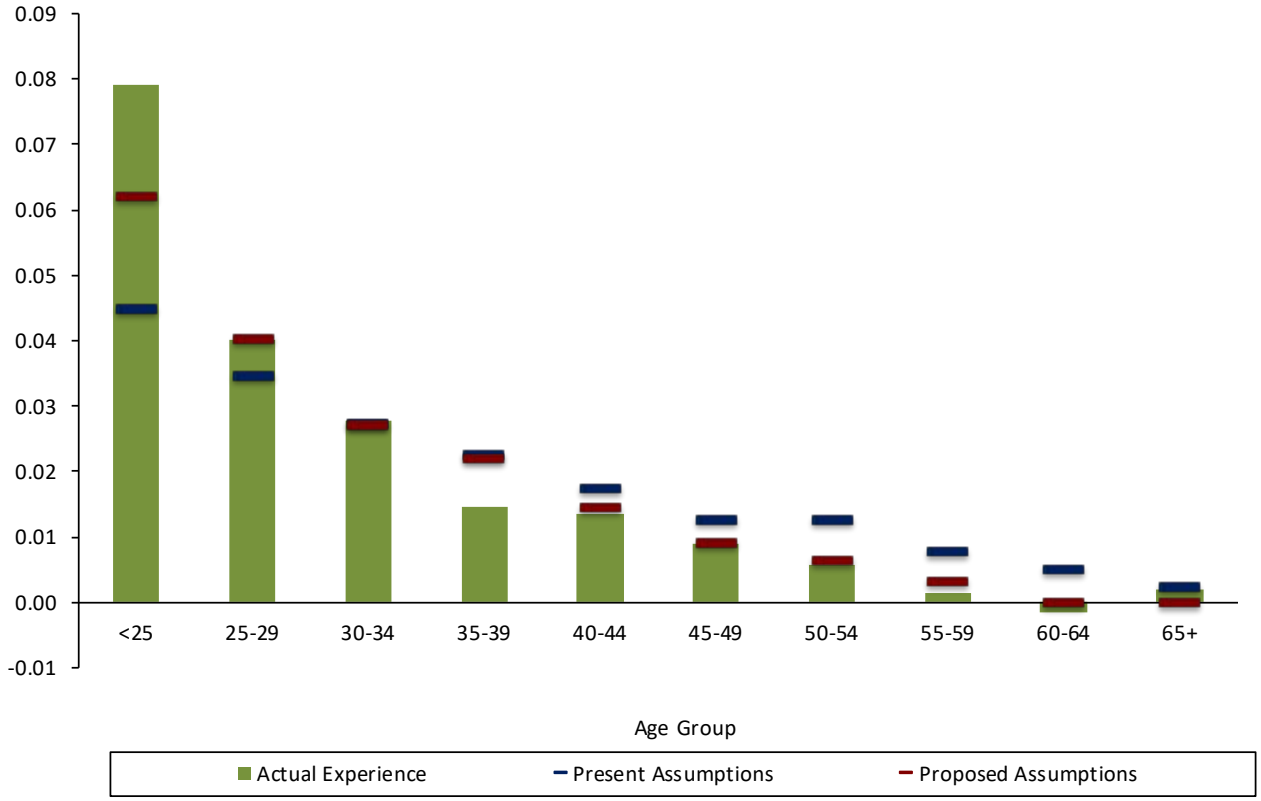
We recommend adjustments to the current merit/seniority pay increase assumption as shown on the following page.

Pay Increases Due to Merit and Seniority

Age	Exposures	Total Salary % Increase			Merit & Seniority % Increase		
		Actual	Current	Proposed	Actual	Current	Proposed
<=20	12	11.18%	8.50%	11.00%	8.18%	5.25%	8.00%
21	31	13.51%	8.25%	10.50%	10.51%	5.00%	7.50%
22	49	12.10%	8.00%	10.00%	9.10%	4.75%	7.00%
23	88	9.62%	7.75%	9.50%	6.62%	4.50%	6.50%
24	182	10.76%	7.50%	8.50%	7.76%	4.25%	5.50%
25	232	7.75%	7.25%	7.75%	4.75%	4.00%	4.75%
26	279	6.91%	7.00%	7.25%	3.91%	3.75%	4.25%
27	286	6.65%	6.75%	7.00%	3.65%	3.50%	4.00%
28	291	6.95%	6.50%	6.75%	3.95%	3.25%	3.75%
29	300	6.97%	6.25%	6.50%	3.97%	3.00%	3.50%
30	311	5.18%	6.25%	6.00%	2.18%	3.00%	3.00%
31	305	5.84%	6.00%	5.75%	2.84%	2.75%	2.75%
32	331	6.14%	6.00%	5.65%	3.14%	2.75%	2.65%
33	342	5.80%	6.00%	5.60%	2.80%	2.75%	2.60%
34	313	5.96%	5.75%	5.55%	2.96%	2.50%	2.55%
35	329	5.53%	5.75%	5.50%	2.53%	2.50%	2.50%
36	318	3.92%	5.50%	5.35%	0.92%	2.25%	2.35%
37	302	4.20%	5.50%	5.20%	1.20%	2.25%	2.20%
38	284	4.24%	5.50%	5.05%	1.24%	2.25%	2.05%
39	293	4.37%	5.25%	4.90%	1.37%	2.00%	1.90%
40	287	4.96%	5.25%	4.75%	1.96%	2.00%	1.75%
41	264	3.92%	5.25%	4.60%	0.92%	2.00%	1.60%
42	304	4.31%	5.00%	4.45%	1.31%	1.75%	1.45%
43	297	4.36%	4.75%	4.30%	1.36%	1.50%	1.30%
44	305	4.16%	4.75%	4.15%	1.16%	1.50%	1.15%
45	313	4.45%	4.50%	4.00%	1.45%	1.25%	1.00%
46	313	3.56%	4.50%	3.95%	0.56%	1.25%	0.95%
47	303	4.11%	4.50%	3.90%	1.11%	1.25%	0.90%
48	303	3.75%	4.50%	3.85%	0.75%	1.25%	0.85%
49	316	3.65%	4.50%	3.80%	0.65%	1.25%	0.80%
50	260	3.31%	4.50%	3.75%	0.31%	1.25%	0.75%
51	287	3.70%	4.50%	3.70%	0.70%	1.25%	0.70%
52	273	2.79%	4.50%	3.65%	-0.21%	1.25%	0.65%
53	257	4.40%	4.50%	3.60%	1.40%	1.25%	0.60%
54	239	3.69%	4.50%	3.55%	0.69%	1.25%	0.55%
55	210	2.88%	4.25%	3.50%	-0.12%	1.00%	0.50%
56	207	2.77%	4.25%	3.40%	-0.23%	1.00%	0.40%
57	182	3.32%	4.00%	3.30%	0.32%	0.75%	0.30%
58	167	3.43%	3.75%	3.20%	0.43%	0.50%	0.20%
59	157	3.42%	3.75%	3.10%	0.42%	0.50%	0.10%
60	140	2.91%	3.75%	3.00%	-0.09%	0.50%	0.00%
61	109	2.15%	3.75%	3.00%	-0.85%	0.50%	0.00%
62	83	4.41%	3.75%	3.00%	1.41%	0.50%	0.00%
63	60	2.10%	3.75%	3.00%	-0.90%	0.50%	0.00%
64	41	2.60%	3.75%	3.00%	-0.40%	0.50%	0.00%
65+	76	3.20%	3.50%	3.00%	0.20%	0.25%	0.00%
Total*	**10,631**	**4.82%**	**5.26%**	**4.90%**	**1.82%**	**2.01%**	**1.90%**

** Totals equal weighted average of results for each service year in the table.*

Pay Increases Due to Merit and Seniority



SECTION C

RETIREMENT EXPERIENCE

Liability-Weighted Analysis

Our experience with similar systems has shown that sometimes the use of assumptions based solely on counts of people retiring or terminating employment does not always reduce the size of the gain or loss in a particular decrement. Sometimes this can be due to the relative magnitude of the actuarial accrued liability of the members that decrement, rather than number counts alone. Consistent with recent experience studies for other PERA plans, we have used "liability-weighted rate" for certain decrements. This represents the crude rate of decrement on a liability-weighted basis as opposed to strictly a number count basis. The liability-weighted rates were found to be more highly correlated with withdrawal and retirement decrements (particularly with reduced retirement) than with the population related rates. This makes some intuitive sense, since retirement and termination decisions are often made based on how much the members have to gain or lose if they retire or change jobs, whereas death and disability are typically not decisions at all but rather events that happen. Comments on specific assumptions are provided on the following pages.

While mortality is not a voluntary human behavior, a recent study by the Society of Actuaries found that mortality experience was highly correlated with education and income. That is, people with higher incomes and higher levels of education tended to live longer than others. As such, we also studied mortality rates on a "benefit-weighted" basis. This is discussed in more detail on page F-1.

Age and Service Unreduced (Normal) Retirement

Findings

The benefit provisions of the Local Government Correctional Service Retirement Plan (LGCSRP) establish the minimum age and service requirements for unreduced or normal retirement. However, the actual cost of retirement is determined when members actually retire. The assumption about timing of retirements is a major ingredient in cost calculations. Note that higher rates of retirement with full benefits generally results in higher computed contributions, and vice-versa.

Some members terminate employment with eligibility for retirement but elect to defer the benefit. We included these terminations as retirements for the purposes of this study.

The current assumption ends at age 70; in other words, we assume all members currently under the age of 70 will retire by the age of 70. However, for members currently age 70 or older, we assume retirement one year after the valuation date (effectively 18 months due to mid-year decrementing), as required by the Minnesota Standards for Actuarial Work. As such, there are no Exposures for ages over 70 since the valuation assumption is all of these members work an additional year and then retire. During the four-year period, there were four actual retirements at ages 70 and older.

Overall, on a liability-weighted basis, the plan experienced slightly more unreduced retirements than projected by the present assumptions, but the results varied by age.

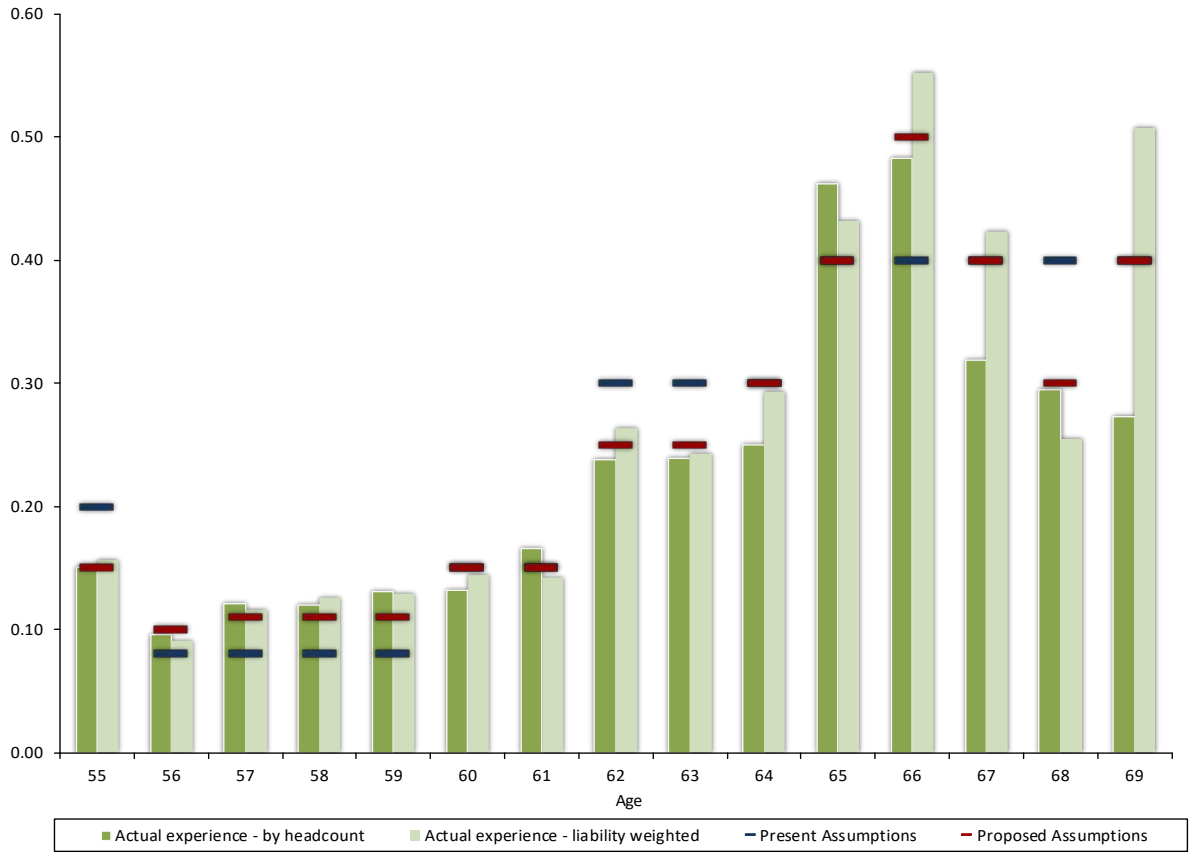
Recommendations

We recommend adjusting the assumed unreduced retirement rates to reflect observed experience, as shown on the next page. In addition, we recommend the Minnesota Standards for Actuarial Work be modified to remove the requirement that members currently over age 70 delay retirement one year and instead assume these members retire mid-year after the valuation date, the same as members younger than age 70.

Age and Service Unreduced (Normal) Retirement

Age	Liability-Weighted ($000s)		Crude Rates		Sample Rates		Expected Retirements* ($000s)		Ratio of Actuals/Expecteds	
	Retirements	Exposure	Liability-Weighted	Population-Weighted	Current	Proposed	Current	Proposed	Current	Proposed
55	10,827	69,450	0.1559	0.1502	0.2000	0.1500	13,890.03	10,417.50	77.9%	103.9%
56	5,791	63,572	0.0911	0.0958	0.0800	0.1000	5,085.75	6,357.20	113.9%	91.1%
57	6,828	59,072	0.1156	0.1205	0.0800	0.1100	4,725.81	6,497.92	144.5%	105.1%
58	6,314	50,218	0.1257	0.1192	0.0800	0.1100	4,017.41	5,523.98	157.2%	114.3%
59	5,866	45,555	0.1288	0.1307	0.0800	0.1100	3,644.41	5,011.05	161.0%	117.1%
60	6,175	42,647	0.1448	0.1321	0.1500	0.1500	6,396.98	6,397.05	96.5%	96.5%
61	5,164	36,226	0.1425	0.1655	0.1500	0.1500	5,433.93	5,433.90	95.0%	95.0%
62	7,731	29,396	0.2630	0.2377	0.3000	0.2500	8,818.69	7,349.00	87.7%	105.2%
63	4,939	20,326	0.2430	0.2391	0.3000	0.2500	6,097.94	5,081.50	81.0%	97.2%
64	4,236	14,488	0.2924	0.2500	0.3000	0.3000	4,346.37	4,346.40	97.5%	97.5%
65	4,205	9,731	0.4321	0.4615	0.4000	0.4000	3,892.17	3,892.40	108.0%	108.0%
66	3,021	5,475	0.5518	0.4828	0.4000	0.5000	2,190.16	2,737.50	137.9%	110.4%
67	1,538	3,632	0.4235	0.3182	0.4000	0.4000	1,452.84	1,452.80	105.9%	105.9%
68	618	2,422	0.2552	0.2941	0.4000	0.3000	968.55	726.60	63.8%	85.1%
69	912	1,797	0.5075	0.2727	0.4000	0.4000	718.68	718.80	126.9%	126.9%
70	*	*	N/A	N/A	N/A	N/A	*	*	N/A	N/A
Totals	**74,165**	**454,007**					**71,679.72**	**71,943.60**	**103.5%**	**103.1%**

** The current assumption prescribed by the Minnesota Standards for Actuarial Work is that members who have reached 100% retirement eligibility will delay retirement for one year. Therefore, even though there are members that are over age 70, these members are not included in the Exposures since retirement is assumed to be delayed one year. There were four actual retirements over age 70.*



Reduced Early Retirement

Findings

LGCSRP members may retire with a reduced benefit prior to the attainment of Normal Retirement. We refer to these cases as early retirements.

For retirements prior to July 1, 2019, early retirement benefits reflect augmentation equal to 3% to age 55 (2.50% if hired after June 30, 2006). This augmentation adjustment is phased out over a five-year period starting July 1, 2019, resulting in pure actuarial equivalence for retirements after June 30, 2024. In other words, there is no subsidy for early retirement. Because of the actuarially equivalent early retirement reduction, these members' benefits have about the same value as the deferred benefit to which they would be eligible if they did not request early commencement of the benefit. Higher rates of early retirement generally result in slightly lower computed contributions, and vice versa.

We reviewed the experience during the study period. On a population-weighted basis, there were almost three times as many early retirements than expected. There were similar results on a liability-weighted basis.

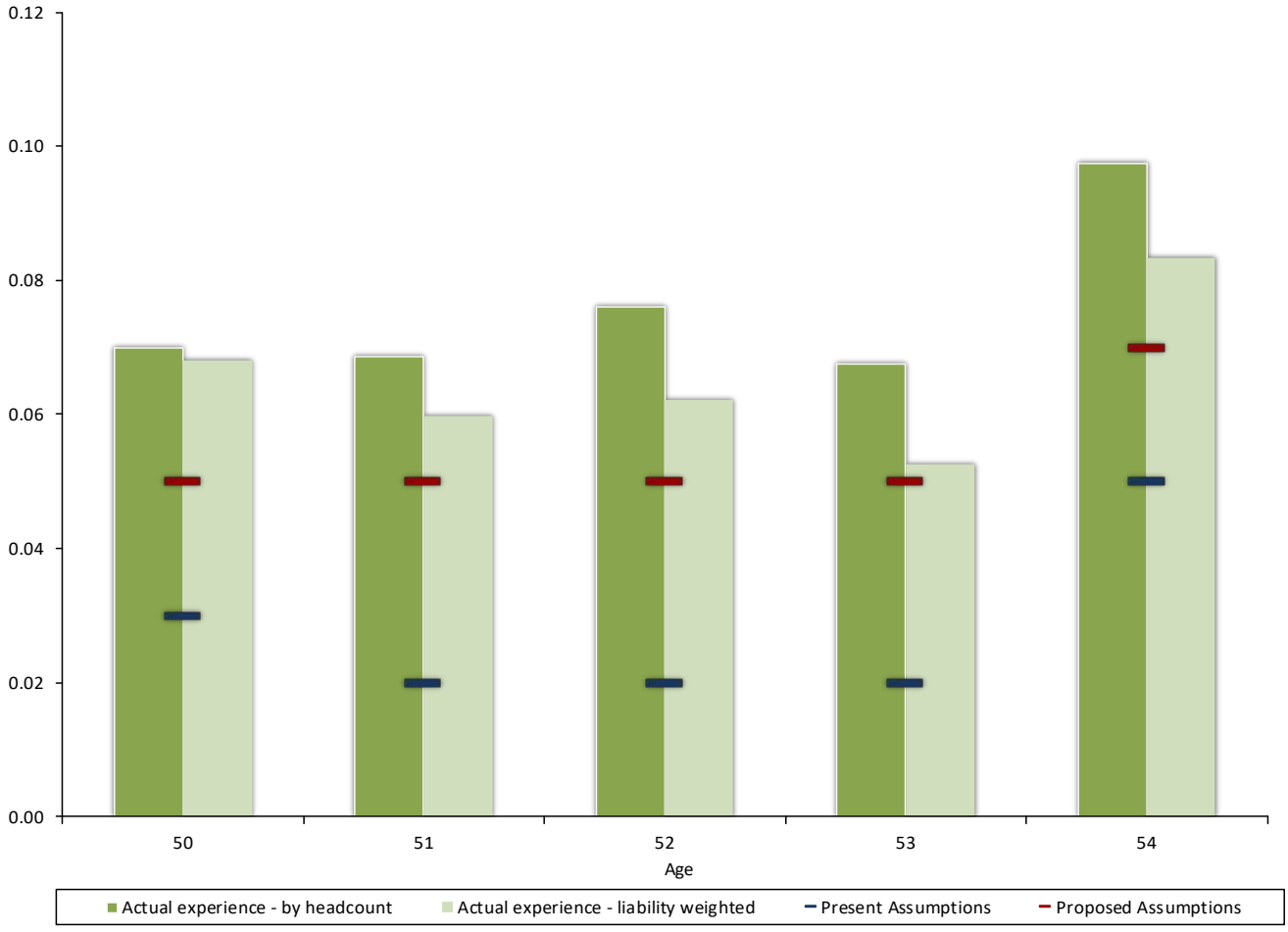
Our recommendation to increase early retirement rates is consistent with the trend of more early retirements, but is less than observed experience due to the changes in early retirement reduction factors described above.

Recommendation

We recommend an increase in early retirement rates, as indicated on the next page.

Reduced Early Retirement

Age	Liability-Weighted ($000s)		Crude Rates		Sample Rates		Expected Retirements ($000s)		Ratio of Actuals/Expecteds	
	Retirements	Exposure	Liability-Weighted	Population-Weighted	Current	Proposed	Current	Proposed	Current	Proposed
50	5,552	81,605	0.0680	0.0699	0.0300	0.0500	2,448.14	4,080.25	226.8%	136.1%
51	4,648	77,832	0.0597	0.0686	0.0200	0.0500	1,556.63	3,891.60	298.6%	119.4%
52	5,160	82,895	0.0622	0.0761	0.0200	0.0500	1,657.89	4,144.75	311.2%	124.5%
53	3,921	74,515	0.0526	0.0674	0.0200	0.0500	1,490.30	3,725.75	263.1%	105.2%
54	6,442	77,355	0.0833	0.0975	0.0500	0.0700	3,867.71	5,414.85	166.6%	119.0%
Total	**25,723**	**394,202**	**0.0653**	**0.0759**			**11,020.67**	**21,257.20**	**233.4%**	**121.0%**



Retirement from Deferred Status

Members who terminate after completing three years of service (five if hired after June 30, 2010) are vested and entitled to either a refund of employee contributions, with interest, or a deferred retirement benefit.

While some members actually elect a refund even if it is less valuable than the deferred annuity, the current valuation assumption is that members will elect a refund only if it is more valuable than the deferred annuity. When a member elects a refund that is less valuable than the member's deferred annuity (or when a member elects the deferred annuity even if the refund is more valuable), the plan experiences a small liability gain. Since the current assumption results in very small gains to the plan, we recommend no change to this assumption.

For those deferred vested members for whom the deferred benefit is more valuable than a refund, the current valuation assumption is that the member will commence benefits at Normal Retirement Age. The benefit is reduced on approximately an actuarially equivalent basis, meaning this assumption results in no significant liability gain or loss to the plan if retirement occurs before Normal Retirement Age. We recommend no change to this set of assumptions.

SECTION D

WITHDRAWAL EXPERIENCE

Withdrawal Experience

Members who leave active employment, for reasons other than retirement, disability or death, may be eligible for the following payments from the pension trust:

- A refund of employee contributions; or
- A deferred retirement benefit, if they are vested.

Deferred retirement benefits are based on the pay and service credit at the time of withdrawal. The benefit is increased with augmentation (if applicable) from termination until January 1, 2019 and is payable at Normal Retirement (or at Early Retirement with a reduction). Consequently, members who withdraw receive much less from the plan than members who stay in employment until retirement. Higher rates of withdrawal result in lower computed contributions, and vice-versa.

Some members are eligible for retirement when they terminate employment but elect to defer the benefit and are consequently reported for the valuation as a termination with a deferred benefit. We included these terminations as retirements for the purposes of this study.

Current valuation termination rates for members are gender-specific and age-based, with higher terminations assumed in the first three years of service. Since this plan was created in 1999, a member's years of plan service may not be indicative of the time spent in the career. In fact, no active members have more than 20 years of service as of July 1, 2019. We recommend continuing age-based termination rates, with higher rates assumed during the first three years of service, for this reason. The withdrawal assumption review was done on a liability-weighted basis, as described earlier in the report.

Withdrawal Experience

Findings

When we reviewed the liability that decremented out of the plan during the prior four-year period, we observed that the plan experienced more liability decrementing from the plan than expected due to terminations.

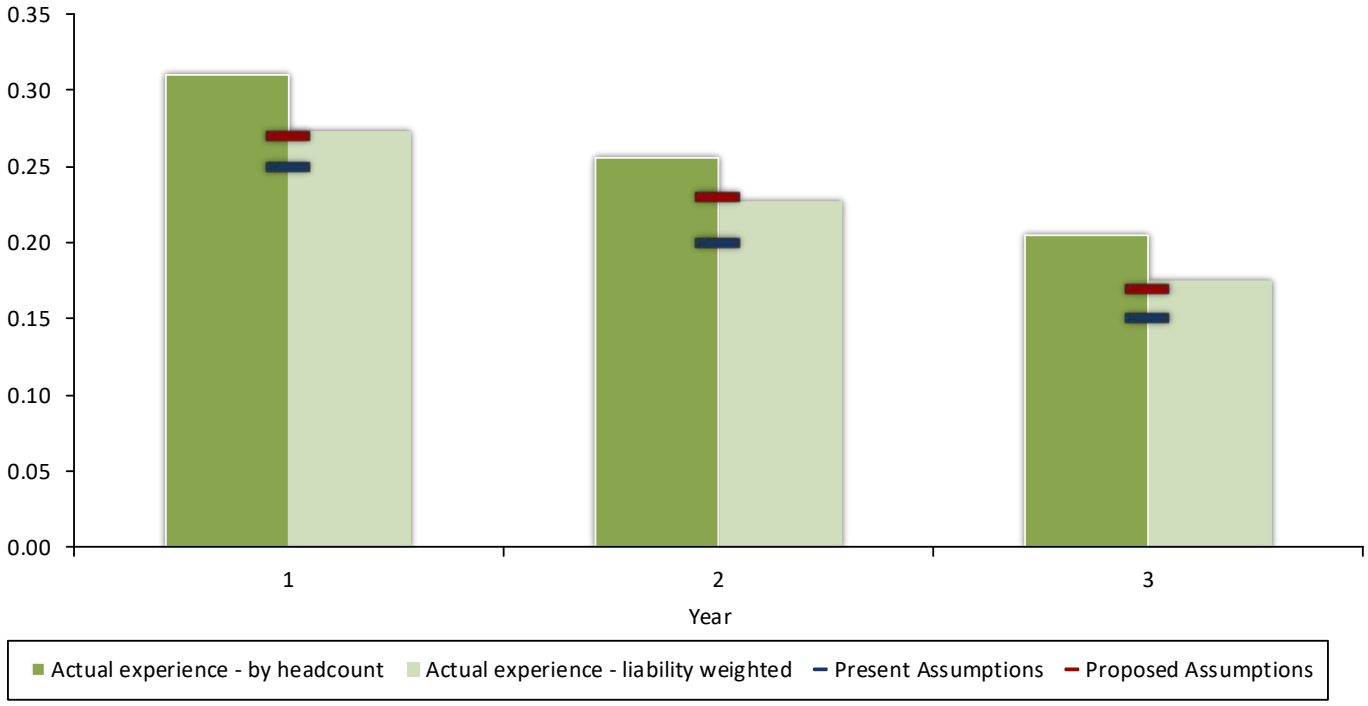
Recommendation

We have recommended increased rates of withdrawal, both during the select period and after, as detailed on the next pages.

Withdrawal Experience – Select Rates*
Males and Females

Year	Liability-Weighted ($000s)		Crude Rates		Sample Rates		Liability-Weighted ($000s)			
							Expected Withdrawals		Ratio of Actuals/Expecteds	
	Withdrawals	Exposure	Liability-Weighted	Population-Weighted	Current	Proposed	Current	Proposed	Current	Proposed
1	8,355	30,574	0.2733	0.3107	0.2500	0.2700	7,643.52	8,254.98	109.3%	101.2%
2	21,894	96,377	0.2272	0.2553	0.2000	0.2300	19,275.37	22,166.71	113.6%	98.8%
3	17,669	101,073	0.1748	0.2054	0.1500	0.1700	15,160.93	17,182.41	116.5%	102.8%
Totals	**47,918**	**228,024**	**0.2101**	**0.2553**	**0.1845**	**0.2088**	**42,079.82**	**47,604.10**	**113.9%**	**100.7%**

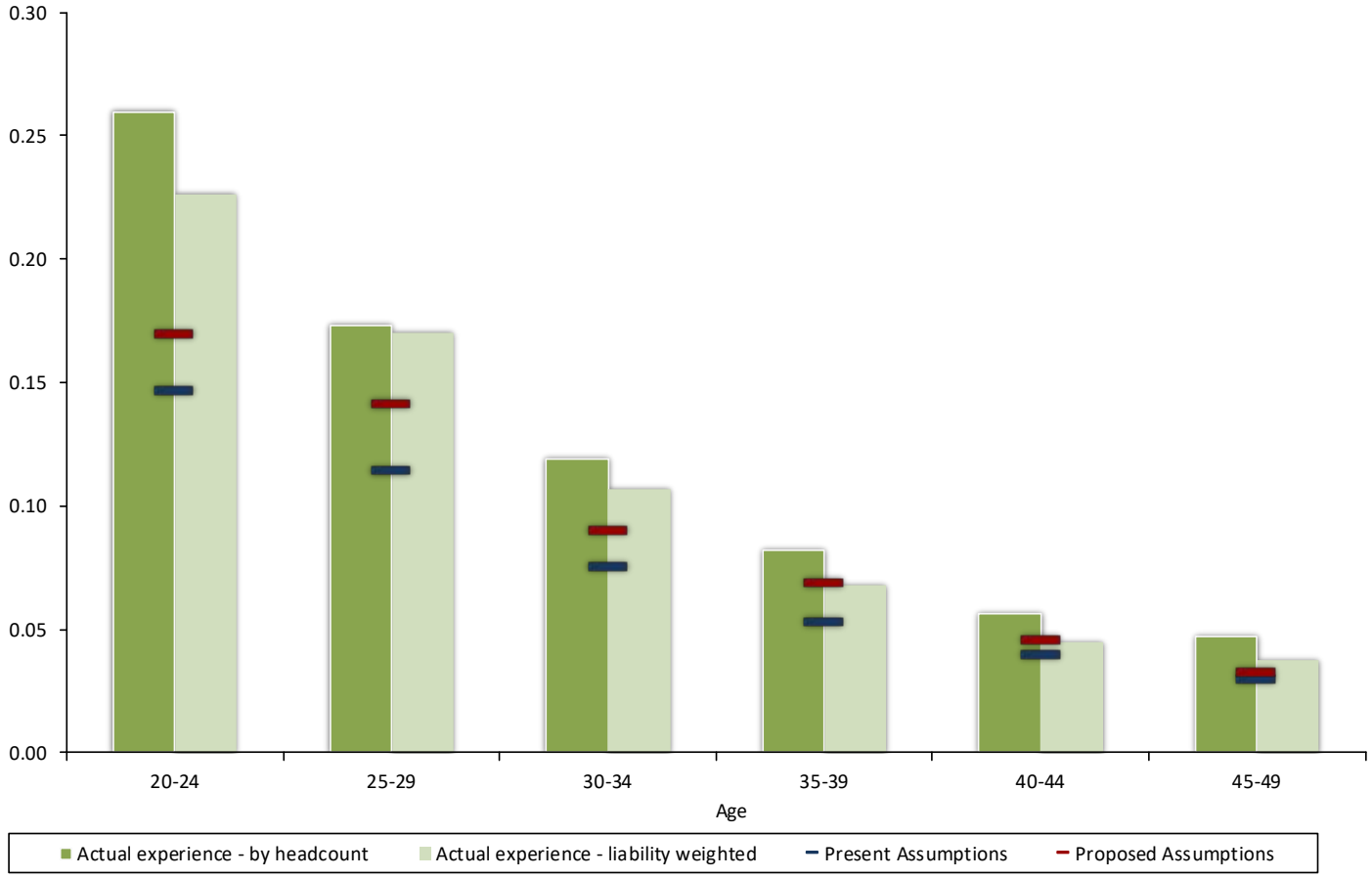
** The current withdrawal assumption is based on service for the first three years of employment and based on age after three years of service.*



Withdrawal Experience – Ultimate Rates*
Males

Age	Liability-Weighted ($000s)		Crude Rates		Sample Rates		Expected Withdrawals*		Ratio of Actuals/Expecteds	
	Withdrawals	Exposure	Liability-Weighted	Population-Weighted	Current	Proposed	Current	Proposed	Current	Proposed
20-24	292	1,291	0.2262	0.2593	0.1470	0.1700	189.78	219.43	153.9%	133.1%
25-29	6,346	37,289	0.1702	0.1728	0.1129	0.1388	4,210.29	5,176.26	150.7%	122.6%
30-34	12,672	118,540	0.1069	0.1191	0.0747	0.0885	8,851.73	10,486.03	143.2%	120.8%
35-39	11,633	170,885	0.0681	0.0823	0.0524	0.0683	8,959.39	11,672.76	129.8%	99.7%
40-44	9,756	219,010	0.0445	0.0560	0.0399	0.0452	8,732.66	9,902.83	111.7%	98.5%
45-49	10,317	276,177	0.0374	0.0469	0.0299	0.0324	8,251.48	8,955.92	125.0%	115.2%
Totals	**51,016**	**823,192**	**0.0620**	**0.0867**	**0.0476**	**0.0564**	**39,195.33**	**46,413.23**	**130.2%**	**109.9%**

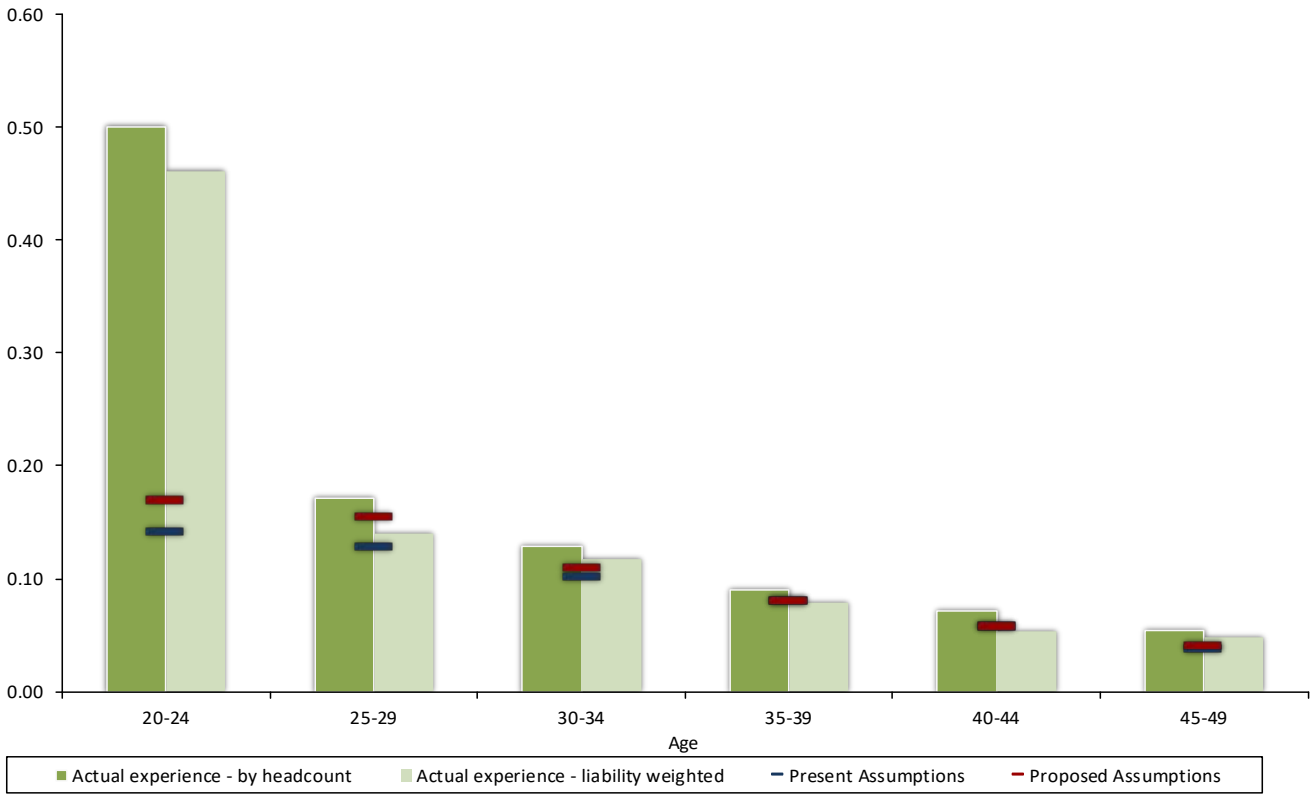
** The current withdrawal assumption is based on service for the first three years of employment and based on age after three years of service.*



Withdrawal Experience – Ultimate Rates*
Females

Age	Liability-Weighted ($000s)		Crude Rates		Sample Rates*		Expected Withdrawals*		Ratio of Actuals/Expecteds	
	Withdrawals	Exposure	Liability-Weighted	Population-Weighted	Current	Proposed	Current	Proposed	Current	Proposed
20-24	76	165	0.4606	0.5000	0.1420	0.1709	23.43	28.20	324.4%	269.5%
25-29	2,121	15,155	0.1400	0.1709	0.1274	0.1530	1,930.00	2,318.47	109.9%	91.5%
30-34	5,840	49,976	0.1169	0.1283	0.1007	0.1076	5,033.88	5,377.44	116.0%	108.6%
35-39	6,784	85,805	0.0791	0.0904	0.0804	0.0797	6,901.14	6,836.87	98.3%	99.2%
40-44	5,581	103,821	0.0538	0.0717	0.0570	0.0578	5,913.53	5,998.11	94.4%	93.0%
45-49	6,762	139,637	0.0484	0.0537	0.0375	0.0412	5,234.80	5,747.08	129.2%	117.7%
Totals	**27,164**	**394,559**	**0.0688**	**0.0965**	**0.0635**	**0.0667**	**25,036.78**	**26,306.17**	**108.5%**	**103.3%**

** The current withdrawal assumption is based on service for the first three years of employment and based on age after three years of service.*



SECTION E

DISABILITY EXPERIENCE

Disability Experience

Local Correctional members who are unable to perform normal duties are eligible to receive a disability benefit. Members must have at least one year of service unless disability is duty-related.

The current disability benefit is equal to 1.9% of average salary for each year of service, with a minimum benefit equal to 19% of average salary (47.5% of average salary if disability is duty-related).

The assumed rates of disability (leaving active service due to injury or illness while not entitled to age and service retirement benefits) are a minor ingredient in cost calculations, since the incidence of disability is low. Higher rates of disability generally result in somewhat higher computed contributions, and vice-versa.

All disabilities are assumed to be duty-related since actual disability status (duty or non-duty related) is not reported in the valuation data.

Findings

The process of qualifying for a disability benefit requires some burden of proof. This process may result in a member being reported as a termination or withdrawal while the disability application is being reviewed. In fact, over the course of the four-year period, there were approximately 16 members who were reclassified as a disability retirement after first being reported as a termination. In recognition of this process, we included these members in our analysis and recommend rates including these incidences.

We reviewed the disability experience during the four-year period. The results are shown on the following pages. Overall, the actual number of disability retirements (44) is about 72 percent of the number projected by the present assumption (61 – see charts on the following pages).

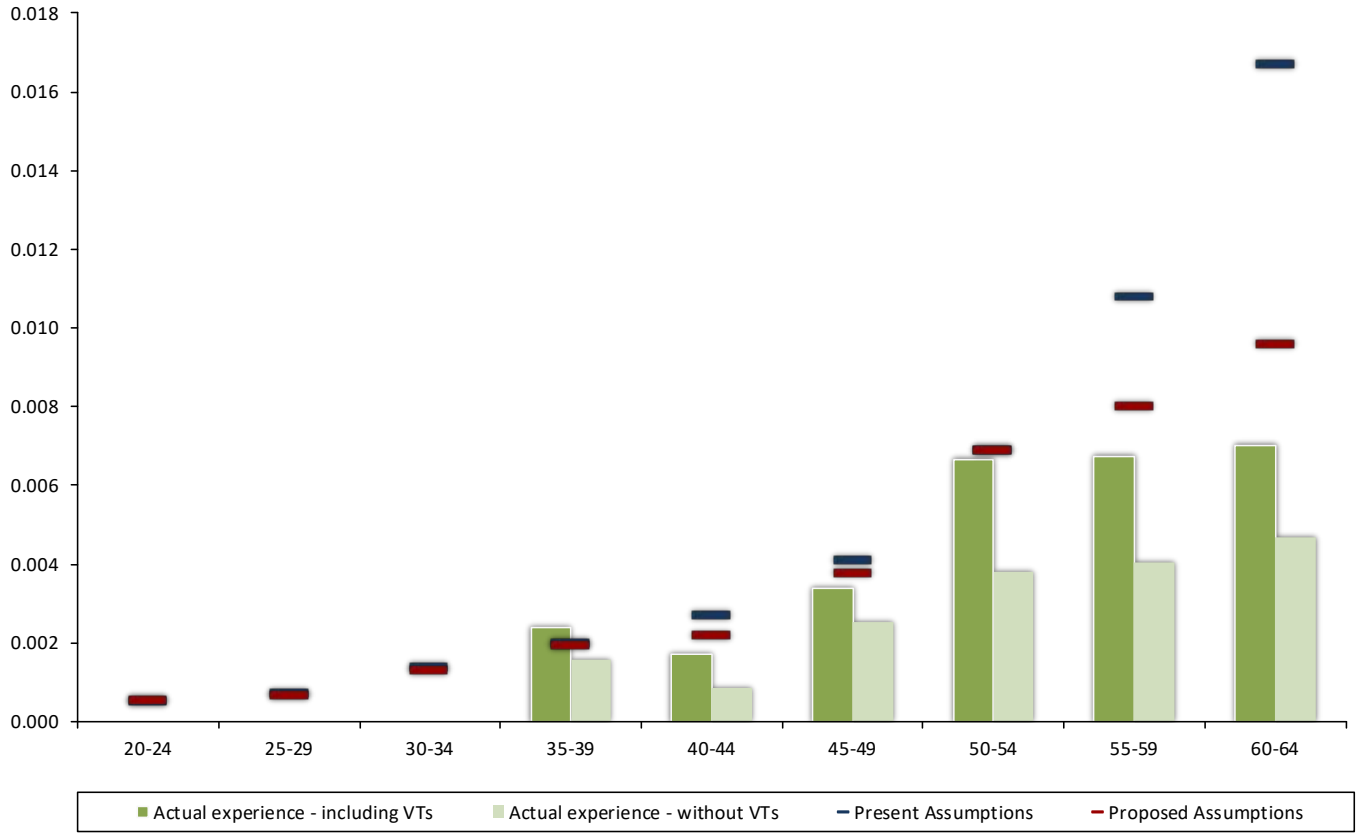
Recommendation

We recommend adopting higher rates of disability for females ages 35-39 and lower rates of disability for females age 53 and older. For males, we recommend adopting lower rates of disability at ages 37 to 49 and ages 55 and older.

Disability Experience
Males

Age	Disabilities Including Terminations	Exposure	Crude Rates With Terminations	Crude Rates Without Terminations	Sample Rates* Current	Sample Rates* Proposed	Expected Disabilities Current	Expected Disabilities Proposed	Ratio of Actuals/Expecteds Current	Ratio of Actuals/Expecteds Proposed
20-24	-	598	0.0000	0.0000	0.0005	0.0005	0.32	0.32	0.0%	0.0%
25-29	-	1,726	0.0000	0.0000	0.0007	0.0007	1.17	1.17	0.0%	0.0%
30-34	-	1,551	0.0000	0.0000	0.0014	0.0013	2.05	2.05	0.0%	0.0%
35-39	3	1,265	0.0024	0.0016	0.0020	0.0019	2.45	2.45	122.7%	122.4%
40-44	2	1,164	0.0017	0.0009	0.0027	0.0022	3.13	2.56	63.8%	78.1%
45-49	4	1,182	0.0034	0.0025	0.0041	0.0038	4.94	4.45	81.0%	89.9%
50-54	7	1,053	0.0066	0.0038	0.0069	0.0069	7.26	7.26	96.4%	96.4%
55-59	5	741	0.0067	0.0040	0.0108	0.0080	7.92	5.93	63.1%	84.3%
60-64	3	429	0.0070	0.0047	0.0167	0.0096	6.73	4.12	44.6%	72.8%
Totals	**24**	**9,709**	**0.0025**	**0.0015**	**0.0037**	**0.0031**	**35.98**	**30.31**	**66.7%**	**79.2%**

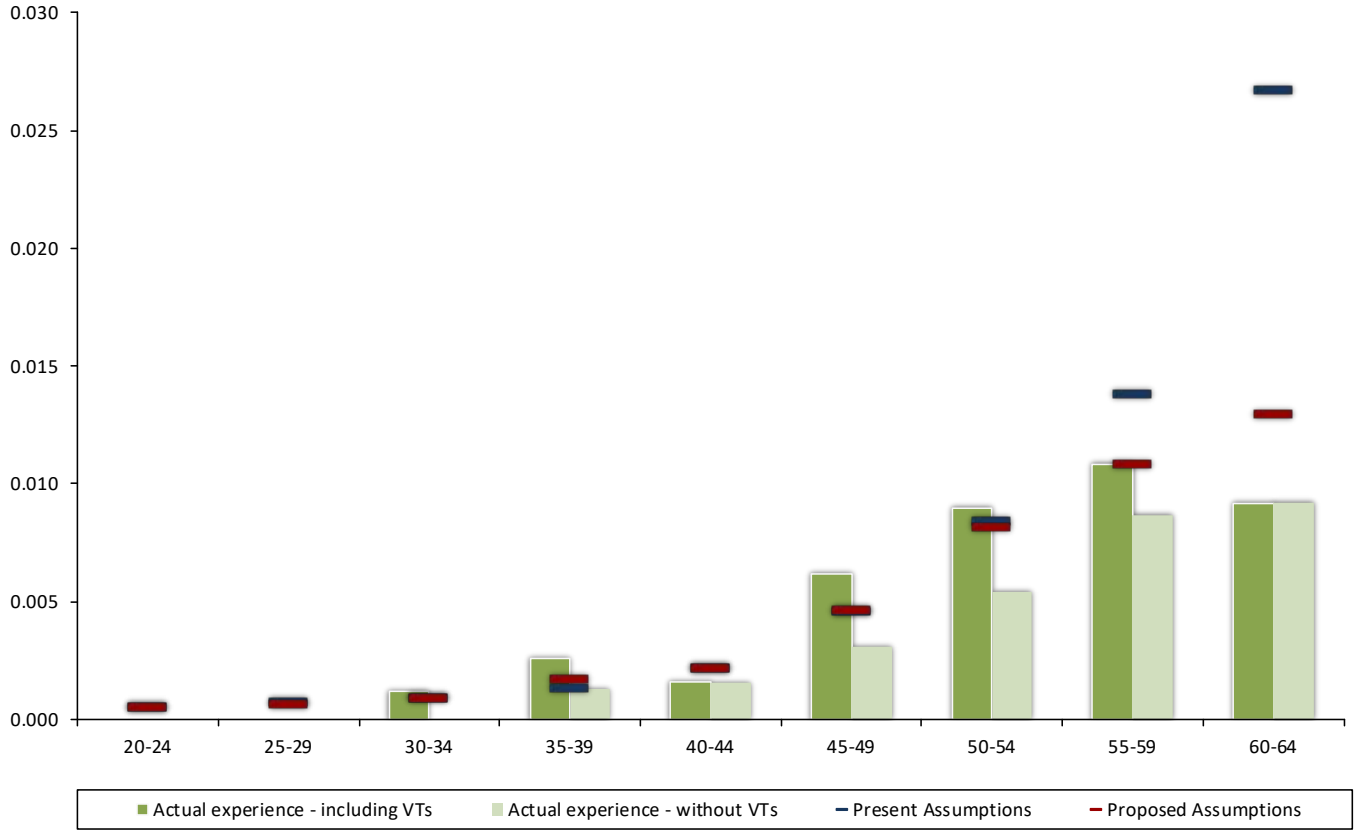
** Sample rates taken from the mid-point of the age group.*



Disability Experience
Females

Age	Disabilities Including Terminations	Exposure	Crude Rates With Terminations	Crude Rates Without Terminations	Sample Rates* Current	Sample Rates* Proposed	Expected Disabilities Current	Expected Disabilities Proposed	Ratio of Actuals/Expecteds Current	Ratio of Actuals/Expecteds Proposed
20-24	-	373	0.0000	0.0000	0.0005	0.0005	0.20	0.20	0.0%	0.0%
25-29	-	957	0.0000	0.0000	0.0007	0.0007	0.64	0.64	0.0%	0.0%
30-34	1	848	0.0012	0.0000	0.0009	0.0009	0.78	0.78	128.2%	128.2%
35-39	2	770	0.0026	0.0013	0.0013	0.0017	1.02	1.32	196.1%	151.5%
40-44	1	639	0.0016	0.0016	0.0022	0.0022	1.40	1.40	71.4%	71.4%
45-49	4	646	0.0062	0.0031	0.0046	0.0047	3.01	3.01	132.9%	132.9%
50-54	5	556	0.0090	0.0054	0.0084	0.0082	4.71	4.54	106.2%	110.1%
55-59	5	462	0.0108	0.0087	0.0138	0.0108	6.27	5.00	79.7%	100.0%
60-64	2	218	0.0092	0.0092	0.0267	0.0130	5.59	2.83	35.8%	70.7%
Totals	**20**	**5,469**	**0.0037**	**0.0024**	**0.0043**	**0.0036**	**23.62**	**19.72**	**84.7%**	**101.4%**

** Sample rates taken from the mid-point of the age group.*



SECTION F

MORTALITY EXPERIENCE

Mortality Experience

Post-retirement mortality is an important component in cost calculations and should be updated from time-to-time to reflect current and expected future longevity improvements. Pre-retirement mortality is a relatively minor component in cost calculations. The frequency of pre-retirement deaths is so low that mortality assumptions based on actual experience can only be produced for very large retirement systems, if at all.

Actuarial Standards of Practice

Actuarial Standards of Practice (ASOP) No. 35 Disclosure Section 4.1.1 states, "The disclosure of the mortality assumption should contain sufficient detail to permit another qualified actuary to understand the provision made for future mortality improvement. If the actuary assumes zero mortality improvement after the measurement date, the actuary should state that no provision was made for future mortality improvement." The current mortality rates used in the valuation include a provision for future mortality improvement.

The New Mortality Tables and Projection Scale

Recently, the Society of Actuaries published a mortality study that was specific to public sector retirement systems. This is a very comprehensive study and there are numerous mortality tables created for each classification of employee (General members, Public Safety, Teachers, Survivors, Juvenile, headcount-weighted, benefit-weighted, above median income, below median income).

One of the key findings of the study is that there is a high correlation between longevity and income and education. As such, the SOA highly recommended the use of 'benefit-weighted' rates when developing mortality tables. We were able to review LGCSRP retiree and disability mortality on a "benefit-weighted" basis and have shown the results on pages F-4 through F-7 of this report. Consistent with the SOA study, LGCSRP members with higher benefits generally appear to experience longer lifespans, resulting in lower mortality rates.

Projection Scale

Fully generational tables, which are utilized for the PERA valuations, help take into account future improvements in mortality that are expected to occur. The Society of Actuaries updates the projection scale annually and the latest published table is called the MP-2019 Projection Scale.

Mortality Experience

Findings

Most pension systems will have insufficient data for full credibility in setting a mortality assumption. The general rule of thumb is that approximately 1,000 deaths are required of each gender in the experience period for full credibility with a 90% confidence level. When less than 1,000 deaths occur during the experience study period, partial credibility can be given to the plan's experience based on the actual number of deaths that occurred.

During the four-year period, there were 23 male retiree deaths and 10 female retiree deaths. The healthy retiree mortality experience is not considered to be credible since there were so few deaths. Pre-retirement mortality and disabled retiree experience is also not considered to be credible. We recommend using the same mortality assumption as PERA's Police and Fire Retirement Plan.

We reviewed the mortality experience during the four-year period. The results are shown on the following pages.

Healthy Retirees

Due to potential anti-selection bias as well as data needs which are outside the scope of the annual valuation process, we did not include beneficiary and survivor mortality experience in our study.
In total, on a benefit weighted basis, the plan experienced fewer male deaths than expected ($197,000 actual versus $242,000 expected) and fewer female deaths than expected ($84,000 actual versus $93,000 expected).

Disabled Retirees

On a benefit-weighted basis, the plan experienced more deaths among disabled males ($186,000) than projected by the present assumptions ($67,000). The actual number of deaths on a benefit-weighted basis among disabled females ($1,000) was far less than the number projected by the present assumptions ($32,000).

Active Members

On a liability-weighted basis, the actual number of male deaths among active members ($2,670,000) was approximately the same as the number projected by the present assumption ($2,693,000). The plan experienced more deaths on a liability-weighted basis among females ($1,174,000) than projected by the present assumptions ($794,000).

Mortality Experience

Recommendations

Due to the size of this plan, the experience is not considered credible. As such, we recommend adoption of the same mortality tables as the Police and Fire Retirement Plan. All recommended tables are Benefit-Weighted.

We recommend adoption of the following mortality tables:

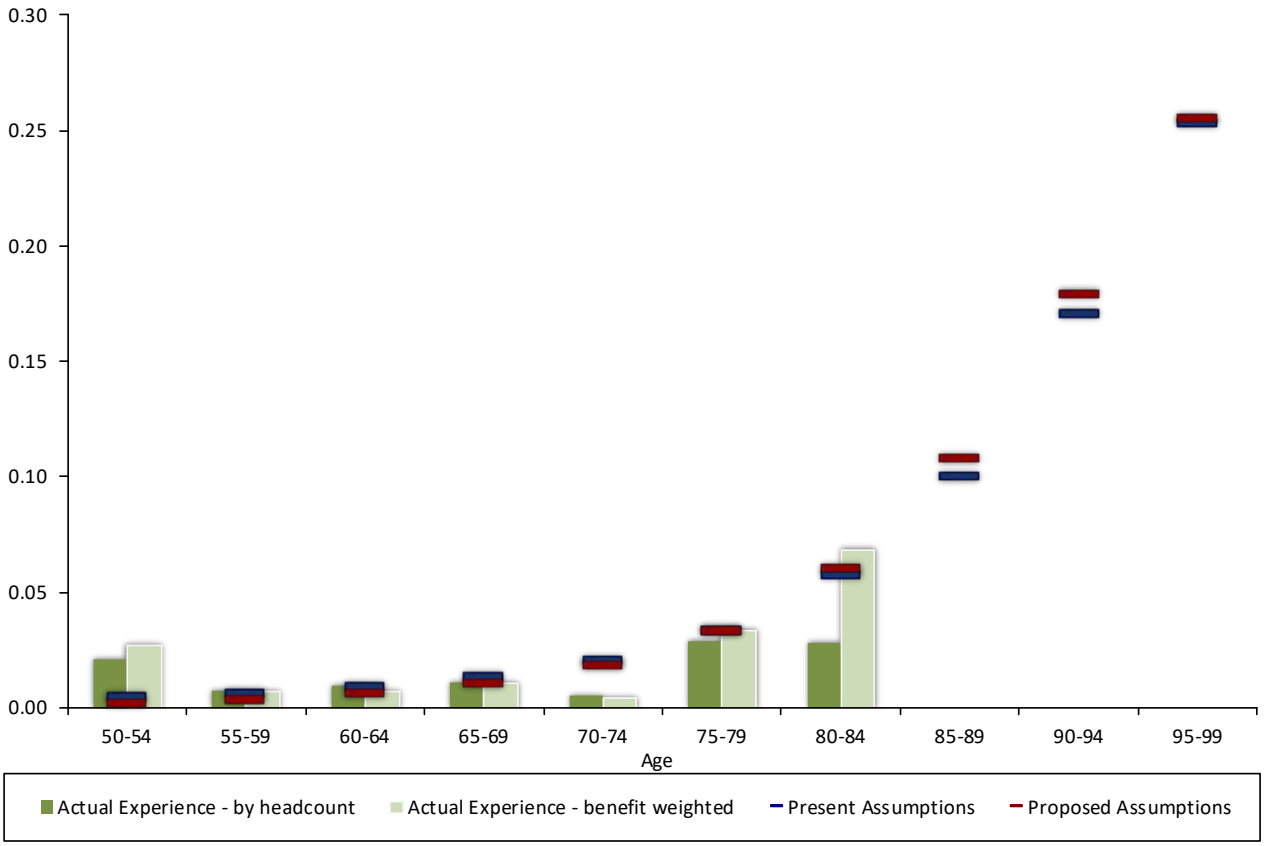
Healthy Male Retirees:	Pub-2010 Male Healthy Retired Public Safety Mortality Table adjusted for mortality improvements using projection scale MP-2019. Rates are adjusted by a factor of 0.98.
Healthy Female Retirees:	Pub-2010 Female Healthy Retired Public Safety Mortality Table, adjusted for mortality improvements using projection scale MP-2019.
Disabled Male Retirees:	Pub-2010 Male Public Safety Disabled Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2019. Rates are adjusted by a factor of 1.05.
Disabled Female Retirees:	Pub-2010 Female Public Safety Disabled Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2019.
Male Active Members:	Pub-2010 Male Public Safety Mortality Table adjusted for mortality improvements using projection scale MP-2019.
Female Active Members:	Pub-2010 Female Public Safety Mortality Table adjusted for mortality improvements using projection scale MP-2019.

Although the recommended pre-retirement mortality tables appear to be very conservative based on the plan's experience, the plan's experience is not considered to be credible, as noted earlier in this report. The number of active member deaths during the four-year period was very low (13 males and 6 females).

Post-Retirement Mortality Experience
Healthy Males

			Crude Rates				Benefit-Weighted ($000s)		Ratio of	
	Benefit-Weighted ($000s)		Benefit-	Population-	Sample Rates		Expected Deaths		Actuals/Expecteds	
Age	Deaths	Exposure	Weighted	Weighted	Current	Proposed*	Current	Proposed*	Current	Proposed*
50-54	26	973	0.026721	0.021053	0.004660	0.002190	4.82	2.32	540.0%	1120.7%
55-59	21	2,949	0.007121	0.007353	0.006498	0.003753	19.39	11.31	108.3%	185.7%
60-64	45	6,571	0.006848	0.009259	0.009200	0.006451	61.53	43.45	73.1%	103.6%
65-69	66	6,231	0.010592	0.010703	0.013318	0.010695	81.96	65.53	80.5%	100.7%
70-74	11	2,521	0.004363	0.005540	0.020383	0.018434	48.80	43.67	22.5%	25.2%
75-79	21	636	0.033019	0.028571	0.033353	0.033222	19.85	19.63	105.8%	107.0%
80-84	7	103	0.067961	0.027778	0.057165	0.060542	5.30	5.59	132.2%	125.2%
85-89	-	4	0.000000	0.000000	0.100530	0.108131	0.32	0.35	0.0%	0.0%
90-94	-	-	N/A	N/A	0.170397	0.179473	-	-	N/A	N/A
95-99	-	-	N/A	N/A	0.253627	0.255310	-	-	N/A	N/A
Totals	**197**	**19,988**	**0.009856**	**0.010947**	**0.012106**	**0.009482**	**241.97**	**189.53**	**81.4%**	**103.9%**

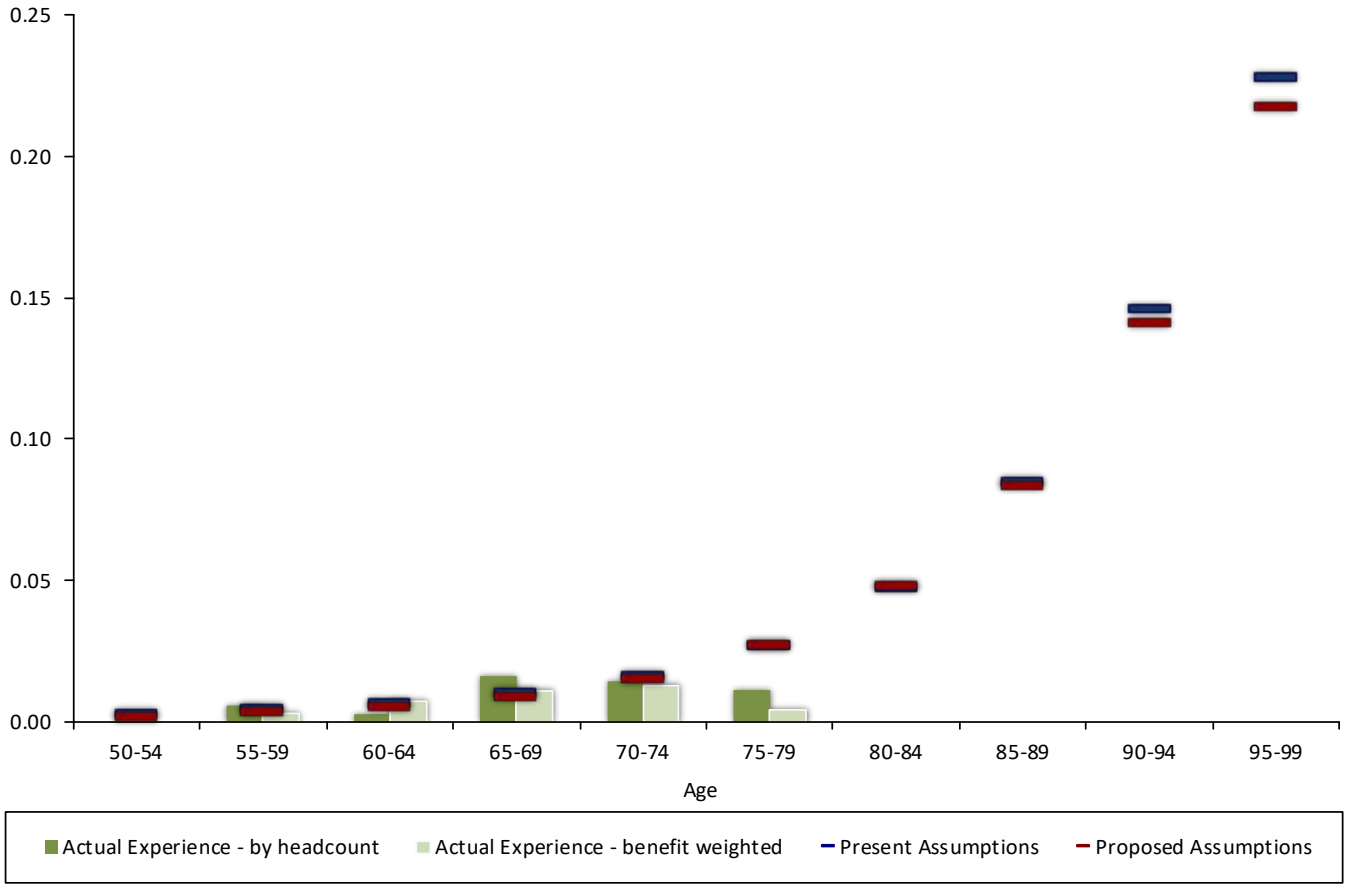
** In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.*



Post-Retirement Mortality Experience
Healthy Females

	Benefit-Weighted ($000s)		Crude Rates		Sample Rates		Benefit-Weighted ($000s) Expected Deaths		Ratio of Actuals/Expecteds	
Age	Deaths	Exposure	Benefit-Weighted	Population-Weighted	Current	Proposed*	Current	Proposed*	Current	Proposed*
50-54	-	377	0.000000	0.000000	0.003159	0.001894	1.25	0.78	0.0%	0.0%
55-59	6	2,037	0.002946	0.005848	0.004607	0.003439	9.70	7.32	61.9%	82.0%
60-64	27	3,649	0.007399	0.002976	0.006851	0.005664	25.39	21.04	106.3%	128.3%
65-69	37	3,428	0.010793	0.016077	0.010231	0.009097	34.24	30.37	108.0%	121.8%
70-74	13	1,011	0.012859	0.014599	0.016274	0.015524	15.59	14.82	83.4%	87.7%
75-79	1	230	0.004348	0.011236	0.027158	0.027374	5.90	5.94	17.0%	16.8%
80-84	-	6	0.000000	0.000000	0.047373	0.048158	0.30	0.30	0.0%	0.0%
85-89	-	4	0.000000	0.000000	0.084787	0.083571	0.28	0.28	0.0%	0.0%
90-94	-	-	N/A	N/A	0.146425	0.140993	-	-	N/A	N/A
95-99	-	-	N/A	N/A	0.228282	0.217819	-	-	N/A	N/A
Totals	**84**	**10,742**	**0.007820**	**0.009132**	**0.008625**	**0.007454**	**92.65**	**80.07**	**90.7%**	**104.9%**

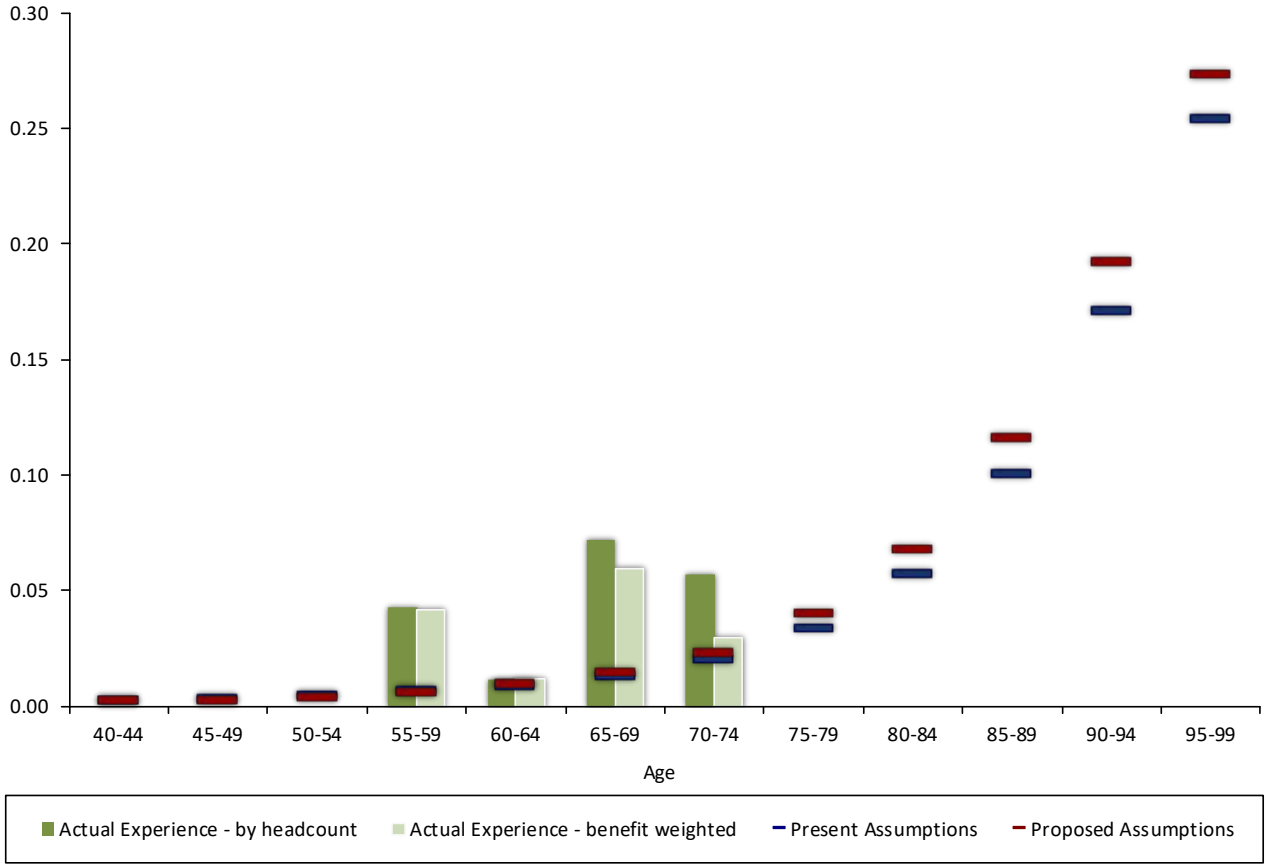
** In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.*



Post-Retirement Mortality Experience
Disabled Males

			Crude Rates				Benefit-Weighted ($000s)		Ratio of	
	Benefit-Weighted ($000s)		Benefit-	Population-	Sample Rates		Expected Deaths		Actuals/Expecteds	
Age	Deaths	Exposure	Weighted	Weighted	Current	Proposed*	Current	Proposed*	Current	Proposed*
40-44	-	270	0.000000	0.000000	0.002339	0.002198	0.65	0.60	0.0%	0.0%
45-49	-	815	0.000000	0.000000	0.003244	0.002818	2.72	2.36	0.0%	0.0%
50-54	-	1,075	0.000000	0.000000	0.004676	0.004004	4.90	4.22	0.0%	0.0%
55-59	58	1,387	0.041817	0.042857	0.006512	0.006060	9.13	8.56	635.5%	677.6%
60-64	16	1,354	0.011817	0.011494	0.009197	0.009716	12.33	12.98	129.8%	123.3%
65-69	94	1,575	0.059683	0.072165	0.013315	0.014775	21.02	23.34	447.1%	402.7%
70-74	18	616	0.029221	0.057143	0.020434	0.023213	11.80	13.39	152.5%	134.4%
75-79	-	166	0.000000	0.000000	0.033489	0.040318	4.94	5.94	0.0%	0.0%
80-84	-	-	N/A	N/A	0.057403	0.068232	-	-	N/A	N/A
85-89	-	-	N/A	N/A	0.100907	0.116010	-	-	N/A	N/A
90-94	-	-	N/A	N/A	0.170976	0.192292	-	-	N/A	N/A
95-99	-	-	N/A	N/A	0.254403	0.273546	-	-	N/A	N/A
Totals	**186**	**7,258**	**0.025627**	**0.030374**	**0.009298**	**0.009836**	**67.48**	**71.39**	**275.6%**	**260.5%**

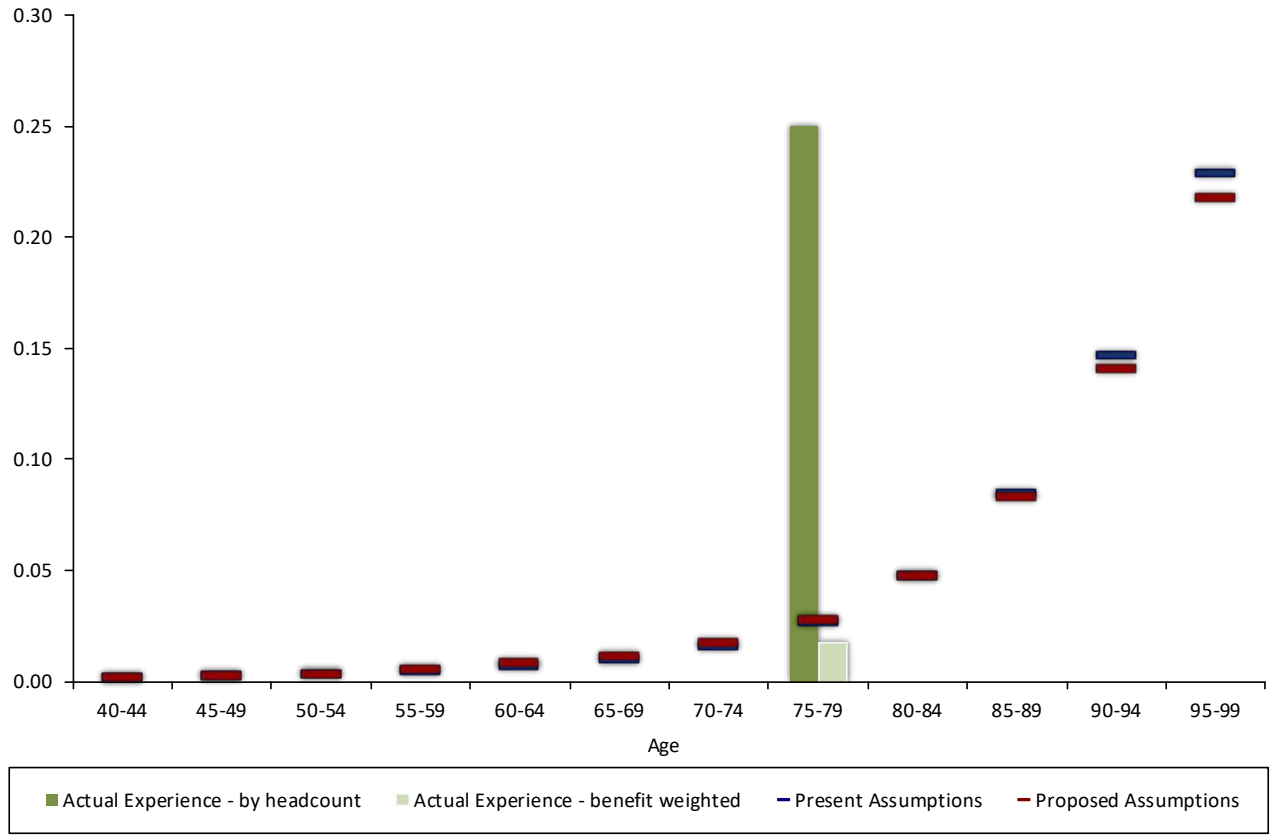
** In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.*



Post-Retirement Mortality Experience
Disabled Females

	Benefit-Weighted ($000s)		Crude Rates		Sample Rates		Benefit-Weighted ($000s) Expected Deaths		Ratio of Actuals/Expecteds	
Age	Deaths	Exposure	Benefit-Weighted	Population-Weighted	Current	Proposed*	Current	Proposed*	Current	Proposed*
40-44	-	109	0.000000	0.000000	0.001963	0.001917	0.21	0.21	0.0%	0.0%
45-49	-	187	0.000000	0.000000	0.002418	0.002437	0.47	0.47	0.0%	0.0%
50-54	-	768	0.000000	0.000000	0.003166	0.003638	2.43	2.81	0.0%	0.0%
55-59	-	904	0.000000	0.000000	0.004604	0.005805	4.15	5.22	0.0%	0.0%
60-64	-	958	0.000000	0.000000	0.006840	0.008405	6.48	7.96	0.0%	0.0%
65-69	-	989	0.000000	0.000000	0.010247	0.011860	10.11	11.72	0.0%	0.0%
70-74	-	355	0.000000	0.000000	0.016345	0.017773	5.40	5.97	0.0%	0.0%
75-79	1	56	0.017857	0.250000	0.027275	0.027913	1.42	1.48	70.4%	67.6%
80-84	-	43	0.000000	0.000000	0.047528	0.048158	1.80	1.84	0.0%	0.0%
85-89	-	-	N/A	N/A	0.085007	0.083571	-	-	N/A	N/A
90-94	-	-	N/A	N/A	0.146789	0.140993	-	-	N/A	N/A
95-99	-	-	N/A	N/A	0.228819	0.217819	-	-	N/A	N/A
Totals	**1**	**4,369**	**0.000229**	**0.004149**	**0.007432**	**0.008624**	**32.47**	**37.68**	**3.1%**	**2.7%**

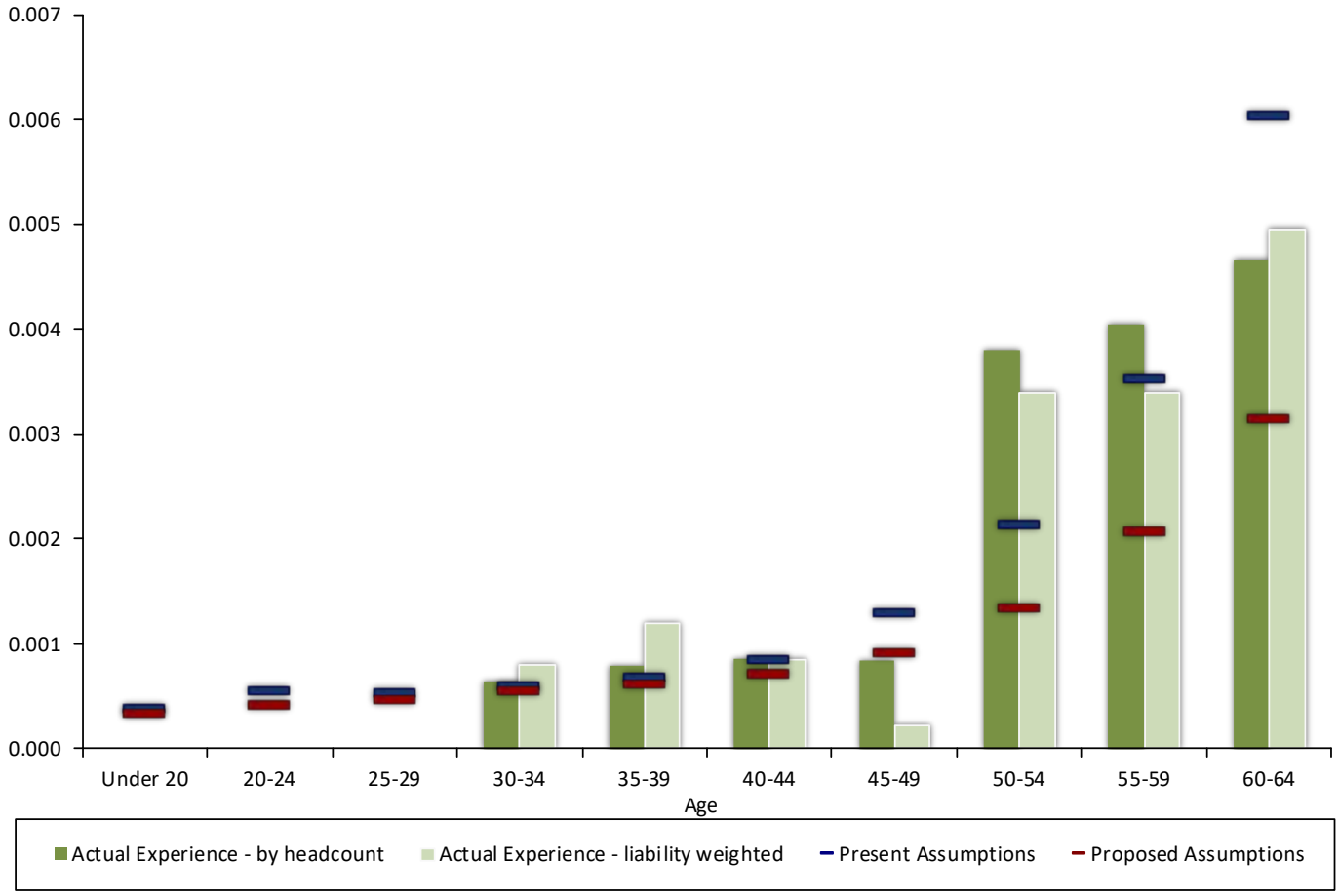
** In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.*



Pre-Retirement Mortality Experience
Healthy Males

	Liability-Weighted ($000s)		Crude Rates		Sample Rates		Liability-Weighted ($000s) Expected Deaths		Ratio of Actuals/Expecteds	
Age	Deaths	Exposure	Liability-Weighted	Population-Weighted	Current	Proposed	Current	Proposed*	Current	Proposed*
Under 20	-	4	0.0000	0.0000	0.0004	0.0003	0.00	-	0.0%	0.0%
20-24	-	15,599	0.0000	0.0000	0.0006	0.0004	8.61	6.49	0.0%	0.0%
25-29	-	92,639	0.0000	0.0000	0.0005	0.0005	49.82	43.11	0.0%	0.0%
30-34	125	155,261	0.0008	0.0006	0.0006	0.0005	94.33	85.28	132.5%	146.6%
35-39	229	191,241	0.0012	0.0008	0.0007	0.0006	131.64	118.89	174.0%	192.6%
40-44	198	232,977	0.0008	0.0009	0.0008	0.0007	196.29	165.34	100.9%	119.8%
45-49	63	286,060	0.0002	0.0008	0.0013	0.0009	368.85	260.99	17.1%	24.1%
50-54	937	276,828	0.0034	0.0038	0.0021	0.0013	591.15	370.71	158.5%	252.8%
55-59	622	183,600	0.0034	0.0040	0.0035	0.0021	647.04	379.91	96.1%	163.7%
60-64	496	100,281	0.0049	0.0047	0.0060	0.0031	605.37	314.77	81.9%	157.6%
Totals	**2,670**	**1,534,490**	**0.0017**	**0.0013**	**0.0018**	**0.0011**	**2,693.11**	**1,745.49**	**99.1%**	**153.0%**

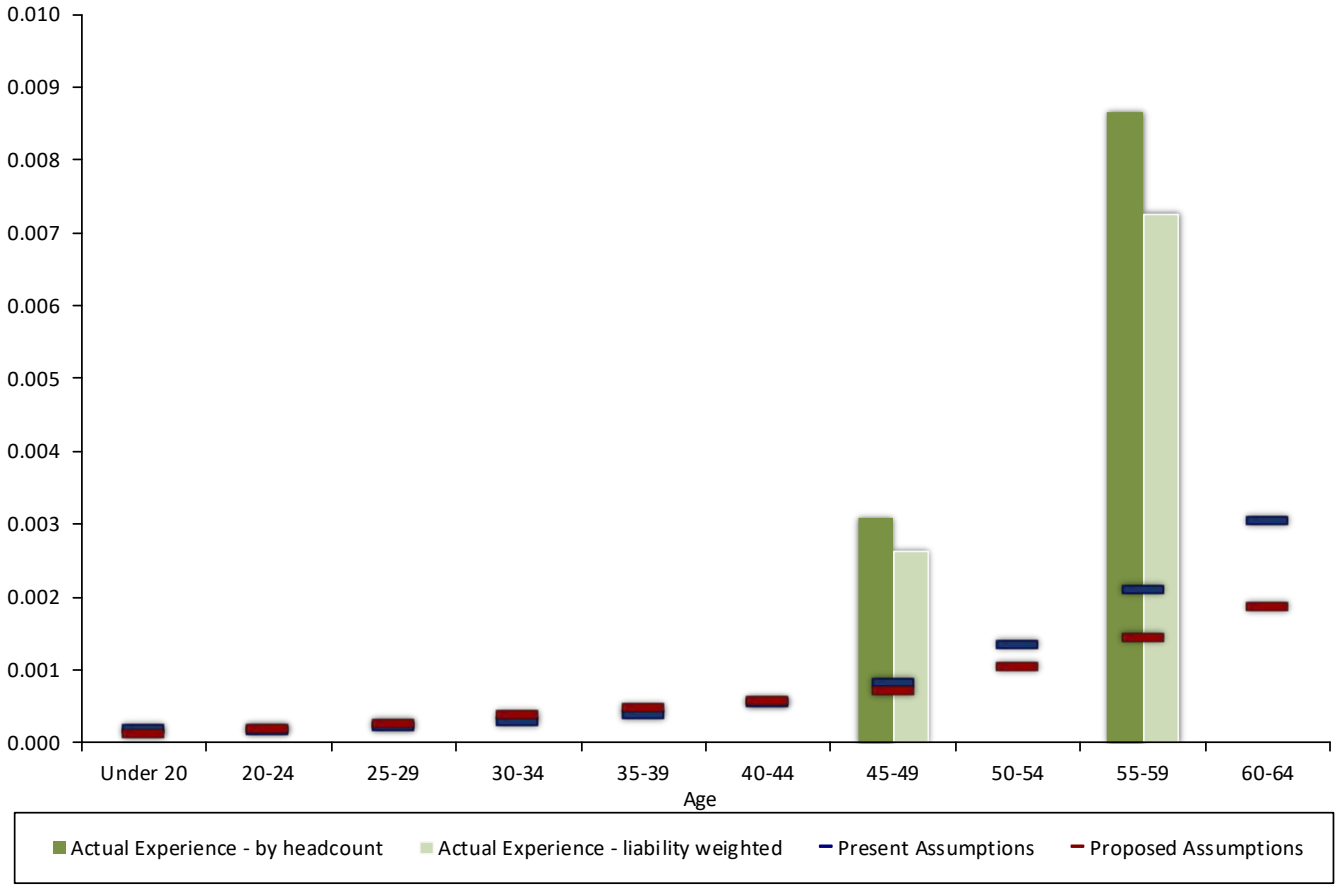
** In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.*



Pre-Retirement Mortality Experience
Healthy Females

	Liability-Weighted ($000s)		Crude Rates		Sample Rates		Liability-Weighted ($000s) Expected Deaths		Ratio of Actuals/Expecteds	
Age	Deaths	Exposure	Liability-Weighted	Population-Weighted	Current	Proposed	Current	Proposed*	Current	Proposed*
Under 20	-	21	0.0000	0.0000	0.0002	0.0001	0.00	-	0.0%	0.0%
20-24	-	6,988	0.0000	0.0000	0.0002	0.0002	1.28	1.44	0.0%	0.0%
25-29	-	35,836	0.0000	0.0000	0.0002	0.0003	7.77	9.60	0.0%	0.0%
30-34	-	62,127	0.0000	0.0000	0.0003	0.0004	18.35	23.52	0.0%	0.0%
35-39	-	96,086	0.0000	0.0000	0.0004	0.0005	38.01	45.78	0.0%	0.0%
40-44	-	112,389	0.0000	0.0000	0.0006	0.0006	61.97	64.80	0.0%	0.0%
45-49	382	145,783	0.0026	0.0031	0.0008	0.0007	121.64	105.90	314.0%	360.7%
50-54	-	130,224	0.0000	0.0000	0.0014	0.0010	176.97	135.27	0.0%	0.0%
55-59	792	109,129	0.0073	0.0087	0.0021	0.0015	231.00	159.14	342.9%	497.7%
60-64	-	44,728	0.0000	0.0000	0.0031	0.0019	136.75	83.95	0.0%	0.0%
Totals	**1,174**	**743,311**	**0.0016**	**0.0011**	**0.0011**	**0.0008**	**793.74**	**629.40**	**147.9%**	**186.5%**

** In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.*



SECTION G

MISCELLANEOUS AND TECHNICAL ASSUMPTIONS

Post-Retirement Benefit Increases

Effective January 1, 2019, benefit increases after retirement equal 100% of the Social Security Cost-of-Living Adjustment, not less than 1.0%, and not more than 2.5%. If the funding status declines to 85% for two consecutive years or 80% for one year, the maximum increase will be lowered to 1.5%.

For valuation purposes, we must make an assumption about future post-retirement benefit increases. The current post-retirement benefit increase assumption is 2% based on analysis completed in 2018.

We examined the capital market inflation assumptions for 14 investment consulting firms based on the GRS Capital Market Assumption Modeler (CMAM). Because GRS is a benefits consulting firm and does not develop or maintain its own capital market expectations, we request and monitor forward-looking expectations developed by several major investment consulting firms. We update our CMAM on an annual basis. The capital market assumptions in the 2019 CMAM are from the following investment consultants (in alphabetical order): Aon, Blackrock, BNY Mellon, Callan, Cambridge, JPMorgan, Marquette, Meketa, Mercer, NEPC, RVK, Verus, Voya and Wilshire.

The average assumption for inflation was 2.24%, with a range of 1.70% to 3.00%, and the average standard deviation was 1.79% (note that not every investment consulting firm provided a standard deviation). However, the investment consulting firms typically set their assumptions based on a shorter time horizon, while actuaries must make much longer projections.

We normalized these parameters slightly so that they would correspond to the proposed inflation assumption of 2.25%. Then, based on a Monte Carlo simulation (1,000 simulations) of the post-retirement benefit increases as described above, we determined that the following assumption would be appropriate to model the effect of the post-retirement benefit increases as described below:

	Post-Retirement Benefit Increase	**Actuarial Assumption**
LGCSRP	100% of the Social Security Cost-of-Living Adjustment, not less than 1.0% and not more than 2.5%	2.0% per year

Note that for LGCSRP, the result of the simulation was 1.91%; our recommended actuarial assumption of 2.0% reflects conservatism and minor rounding. The assumptions will be quite sensitive to the inflation assumption, and to its assumed standard deviation.

Actual benefit increases since this plan provision was enacted are summarized in the table below:

Effective Date	**Benefit increase**
January 1, 2019	2.5%
January 1, 2020	1.6%

Recommendation

We recommend no change to the assumed future post-retirement benefit increase.

Marital Status

Married members will frequently make different annuity selections than non-married members. The current valuation assumption is 85% of members are married. Actual marital status is used for retired members.

Findings

We reviewed the marital status of healthy members retiring from active status during the four-year period. The results are shown below:

Gender	Married New Retirees	Total New Retirees	Crude Rates	Sample Rates		Expected Married Retirees		Ratio of Actuals/Expecteds	
				Present	Proposed	Present	Proposed	Present	Proposed
Males	132	175	0.7543	0.8500	0.7500	148.75	131.25	88.7%	100.6%
Females	57	86	0.6628	0.8500	0.7500	73.10	64.50	78.0%	88.4%
Total	**189**	**261**	**0.7241**			**221.85**	**195.75**	**85.2%**	**96.6%**

In the analysis of retirements during the four-year period presented in Section C of this report, we included members who terminated employment after retirement eligibility but did not begin receiving payments. The analysis above includes only those members that terminated employment and began receiving payments.

The experience shows that the number of married new retirees is lower than expected.

Recommendation

We recommend changing the marital status assumption from 85% married to 75% married.

Age of Survivor

Joint & Survivor annuity benefit amounts are determined based on the member's and survivor's age. Currently, the valuation assumes that male members have a beneficiary three years younger and female members have a beneficiary three years older.

Findings

We reviewed the ages of married new retirees and their beneficiaries during the four-year period. The results are shown below:

Gender	Married New Retirees	Average Age Difference	Expected Age Difference		Ratio of Actuals/Expecteds	
			Present	Proposed	Present	Proposed
Males	132	3.07	3.00	3.00	102.3%	102.3%
Females	57	(0.84)	(3.00)	(3.00)	28.0%	28.0%
Total	**189**					

The experience shows that the average age difference for females is less than one year. However, the year-by-year experience ranges from +0.94 years (2015-2016 experience of 20 retirees) to -3.06 years (2016-2017 experience of 13 retirees).

Recommendation

Due to the varied experience and the low number of retirements, we recommend continuing the present assumption.

Form of Payment

Upon retirement, a member can elect any of the following forms of payment:

- Single-life annuity – the benefit is paid for the lifetime of the member. No benefit (other than a refund of remaining employee contributions, if applicable) is payable to a beneficiary upon the member's death.
- 25% Joint & Survivor – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 25% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.
- 50% Joint & Survivor – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 50% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.
- 75% Joint & Survivor – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 75% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.
- 100% Joint & Survivor – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 100% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.

There is no actuarial reduction for the bounce-back feature (i.e., this is subsidized by the plan). Married members retiring from active status are currently assumed to elect annuities as follows:

Males:	5% elect 25% Joint & Survivor option
	10% elect 50% Joint & Survivor option
	10% elect 75% Joint & Survivor option
	35% elect 100% Joint & Survivor option
Females:	5% elect 25% Joint & Survivor option
	5% elect 50% Joint & Survivor option
	5% elect 75% Joint & Survivor option
	5% elect 100% Joint & Survivor option

Remaining married and unmarried members are assumed to elect the Single-life option.

Findings

We reviewed the benefit elections of married new retirees during the four-year period. The results are shown on the following pages.

We found more married new retirees are electing the joint & survivor options for both males and females.

Recommendation

We recommend increasing the assumed percentage electing the joint and survivor annuities as shown on the next page and reducing the assumed percentage electing the single life annuity accordingly.

Form of Payment

Male Experience

Form of Payment	Actual Electing Annuity	Married New Retirees	Crude Rates	Sample Rates		Expected Electing Annuity		Ratio of Actuals/Expecteds	
				Present	Proposed	Present	Proposed	Present	Proposed
Life annuity	26	132	0.1970	0.4000	0.2000	52.80	26.40	49.2%	98.5%
25% joint & survivor	14	132	0.1061	0.0500	0.1000	6.60	13.20	212.1%	106.1%
50% joint & survivor	18	132	0.1364	0.1000	0.1500	13.20	19.80	136.4%	90.9%
75% joint & survivor	4	132	0.0303	0.1000	0.0500	13.20	6.60	30.3%	60.6%
100% joint & survivor	70	132	0.5303	0.3500	0.5000	46.20	66.00	151.5%	106.1%
Total	**132**	**132**	**1.0000**	**1.0000**	**1.0000**	**132.00**	**132.00**		

Female Experience

Form of Payment	Actual Electing Annuity	Married New Retirees	Crude Rates	Sample Rates		Expected Electing Annuity		Ratio of Actuals/Expecteds	
				Old	New	Old	New	Old	New
Life annuity	31	57	0.5439	0.8000	0.5000	45.60	28.50	68.0%	108.8%
25% joint & survivor	4	57	0.0702	0.0500	0.1000	2.85	5.70	140.4%	70.2%
50% joint & survivor	6	57	0.1053	0.0500	0.1000	2.85	5.70	210.5%	105.3%
75% joint & survivor	2	57	0.0351	0.0500	0.0500	2.85	2.85	70.2%	70.2%
100% joint & survivor	14	57	0.2456	0.0500	0.2500	2.85	14.25	491.2%	98.2%
Total	**57**	**57**	**1.0000**	**1.0000**	**1.0000**	**57.00**	**57.00**		

Actuarial Equivalent Factors

Early retirement and Joint and Survivor benefits are actuarially equivalent to the Single-life annuity, except there is no actuarial reduction for the bounce-back feature (i.e., this is subsidized by the plan). Effective July 1, 2019, actuarial equivalent factors are based on the RP-2014 mortality table for healthy annuitants, reflecting projected mortality improvements for a member turning age 55 in 2021 using Scale MP-2017, white collar adjustment, male rates multiplied by 0.96, blended 65% males, 4.88% post-retirement interest and 7.5% pre-retirement interest. Reflecting statutory requirements, joint and survivor factors are based on an interest assumption of 6.5%.

Recommendation

We recommend updating the actuarial equivalent factors to reflect changes in expected mortality and developing an appropriate implementation schedule.

Proposed Miscellaneous and Technical Assumptions

Background

A number of miscellaneous and technical assumptions are used in the actuarial valuation. The present assumptions are listed on the following page.

The Allowance for Combined Service Annuity assumptions are based on an analysis completed by the LCPR actuary and documented in a report dated October 2016. Updating the analysis of these assumptions is outside the scope of this assignment due to significant data requirements.

Recommendation

Miscellaneous and Technical Assumptions are listed on page G-8. We recommend continued use of the other Miscellaneous and Technical Assumptions.

Miscellaneous and Technical Assumptions

Benefit Service	Exact fractional service is used to determine the amount of benefit payable.
Decrement Operation	Withdrawal decrements do not operate during retirement eligibility.
Decrement Timing	Decrements of all types are assumed to occur mid-year.
Eligibility Testing	Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur.
Forfeitures	For vested separations from service, it is assumed that members separating will withdraw their contributions and forfeit an employer financed benefit when the value of member contributions is greater than the value of the employer financed benefit.
Incidence of Contributions	Contributions are assumed to be received on a monthly basis, per the Standards of Actuarial Work.
Liability Adjustments	Liabilities for former members are increased by 35% for vested members and 1% for non-vested members to account for the effect of some participants having eligibility for a Combined Service Annuity.
Pay Increase Timing	Pay increases were assumed to be at the beginning of the fiscal year. This is equivalent to assuming that reported pays represent amounts paid to members during the year ended on the valuation date.
Service Credit Accruals	Members were assumed to accrue one year of service credit per year.

SECTION H

PROPOSED ASSUMPTION LISTING

Proposed Actuarial Assumptions
Based on 2015-2019 Experience Study

Merit and Seniority Pay Increases

% Merit Increases in Salaries Next Year	
Age	**Rate**
20	8.00%
21	7.50%
22	7.00%
23	6.50%
24	5.50%
25	4.75%
26	4.25%
27	4.00%
28	3.75%
29	3.50%
30	3.00%
31	2.75%
32	2.65%
33	2.60%
34	2.55%
35	2.50%
36	2.35%
37	2.20%
38	2.05%
39	1.90%
40	1.75%
41	1.60%
42	1.45%
43	1.30%
44	1.15%
45	1.00%
46	0.95%
47	0.90%
48	0.85%
49	0.80%
50	0.75%
51	0.70%
52	0.65%
53	0.60%
54	0.55%
55	0.50%
56	0.40%
57	0.30%
58	0.20%
59	0.10%
60+	0.00%

Proposed Actuarial Assumptions
Based on 2015-2019 Experience Study

Age and Service Retirement Pattern
Unreduced (Normal) Retirement

Age	% Retiring
55	15.0%
56	10.0%
57	11.0%
58	11.0%
59	11.0%
60	15.0%
61	15.0%
62	25.0%
63	25.0%
64	30.0%
65	40.0%
66	50.0%
67	40.0%
68	30.0%
69	40.0%
70+*	100%

** The current assumption prescribed by the Minnesota Standards for Actuarial Work is that members who have reached 100% retirement eligibility will delay retirement one year.*

Proposed Actuarial Assumptions
Based on 2015-2019 Experience Study

Age and Service Retirement Pattern
Reduced (Early) Retirement

Age	% Retiring
50	5.0%
51	5.0%
52	5.0%
53	5.0%
54	7.0%

Proposed Actuarial Assumptions
Based on 2015-2019 Experience Study

Withdrawal

Year	% First Three Years	
	Male	Female
1	27.0%	27.0%
2	23.0%	23.0%
3	17.0%	17.0%

Age	% after Third Year	
	Male	Female
25	17.00%	17.00%
26	17.00%	17.00%
27	16.00%	16.00%
28	13.00%	15.00%
29	12.00%	14.00%
30	11.00%	13.00%
31	10.00%	12.00%
32	9.00%	11.00%
33	8.00%	10.00%
34	7.75%	9.50%
35	7.50%	9.00%
36	7.25%	8.50%
37	7.00%	8.00%
38	6.50%	7.50%
39	6.00%	7.00%
40	5.50%	6.50%
41	5.00%	6.25%
42	4.50%	6.00%
43	4.00%	5.50%
44	3.75%	5.00%
45	3.50%	4.75%
46	3.50%	4.50%
47	3.25%	4.25%
48	3.00%	4.00%
49	3.00%	3.00%

Proposed Actuarial Assumptions
Based on 2015-2019 Experience Study

Disability Rates

Age	% Becoming Disabled	
	Male	Female
20	0.040%	0.040%
21	0.040%	0.040%
22	0.050%	0.050%
23	0.050%	0.050%
24	0.060%	0.060%
25	0.060%	0.060%
26	0.060%	0.060%
27	0.070%	0.070%
28	0.070%	0.070%
29	0.080%	0.080%
30	0.100%	0.080%
31	0.120%	0.090%
32	0.140%	0.090%
33	0.140%	0.100%
34	0.160%	0.100%
35	0.180%	0.165%
36	0.180%	0.168%
37	0.187%	0.169%
38	0.194%	0.180%
39	0.201%	0.180%
40	0.208%	0.180%
41	0.215%	0.200%
42	0.216%	0.220%
43	0.232%	0.240%
44	0.248%	0.260%
45	0.306%	0.390%
46	0.333%	0.420%
47	0.369%	0.460%
48	0.414%	0.510%
49	0.459%	0.560%
50	0.550%	0.700%
51	0.620%	0.770%
52	0.690%	0.840%
53	0.720%	0.870%
54	0.750%	0.900%
55	0.780%	0.930%
56	0.784%	1.024%
57	0.810%	1.104%
58	0.826%	1.184%
59	0.903%	1.272%
60	0.917%	1.300%
61	0.924%	1.300%
62	1.002%	1.300%
63	1.002%	1.300%
64	1.002%	1.30%

Proposed Actuarial Assumptions
Based on 2015-2019 Experience Study

Healthy Post-Retirement Mortality Rates

Age in 2019	% Dying Next Year*	
	Male	Female
50	0.1761%	0.1437%
51	0.1942%	0.1635%
52	0.2142%	0.1853%
53	0.2373%	0.2102%
54	0.2640%	0.2389%
55	0.2949%	0.2714%
56	0.3296%	0.3068%
57	0.3692%	0.3447%
58	0.4142%	0.3853%
59	0.4643%	0.4278%
60	0.5197%	0.4738%
61	0.5805%	0.5205%
62	0.6453%	0.5698%
63	0.7148%	0.6227%
64	0.7900%	0.6806%
65	0.8713%	0.7436%
66	0.9604%	0.8135%
67	1.0596%	0.8931%
68	1.1705%	0.9851%
69	1.2972%	1.0894%
70	1.4415%	1.2103%
71	1.6076%	1.3478%
72	1.7970%	1.5051%
73	2.0133%	1.6840%
74	2.2606%	1.8865%
75	2.5419%	2.1158%
76	2.8620%	2.3738%
77	3.2251%	2.6631%
78	3.6380%	2.9886%
79	4.1049%	3.3522%
80	4.6332%	3.7591%

Age in 2019	% Dying Next Year*	
	Male	Female
81	5.2297%	4.2131%
82	5.8992%	4.7162%
83	6.6482%	5.2770%
84	7.4837%	5.8987%
85	8.4129%	6.5888%
86	9.4451%	7.3555%
87	10.5833%	8.2079%
88	11.8434%	9.1575%
89	13.2267%	10.2124%
90	14.7513%	11.3882%
91	16.3028%	12.6464%
92	17.8269%	13.9592%
93	19.2879%	15.3209%
94	20.6948%	16.7324%
95	22.0699%	18.2083%
96	23.5930%	19.8154%
97	25.1748%	21.5332%
98	26.8732%	23.3577%
99	28.6871%	25.2882%
100	30.6117%	27.3181%
101	32.6062%	29.4221%
102	34.5967%	31.5433%
103	36.5539%	33.6715%
104	38.4685%	35.7732%
105	40.3289%	37.8479%
106	42.1323%	39.8838%
107	43.8531%	41.8393%
108	45.5011%	43.7197%
109	47.0444%	45.5171%
110	48.3037%	47.2105%

** The rates shown are PUB-2010 mortality for healthy annuitants, Public Safety table, with adjustments, if applicable (see Section F). Recommended rates include mortality improvements using projection scale MP-2019.*

Proposed Actuarial Assumptions
Based on 2015-2019 Experience Study

Disabled Post-Retirement Mortality Rates

Age in 2019	% Dying Next Year*	
	Male	Female
20	0.1320%	0.0576%
21	0.1343%	0.0620%
22	0.1339%	0.0655%
23	0.1326%	0.0692%
24	0.1326%	0.0731%
25	0.1326%	0.0783%
26	0.1437%	0.0861%
27	0.1507%	0.0928%
28	0.1578%	0.1009%
29	0.1660%	0.1089%
30	0.1723%	0.1168%
31	0.1797%	0.1258%
32	0.1860%	0.1342%
33	0.1914%	0.1420%
34	0.1956%	0.1502%
35	0.1999%	0.1574%
36	0.2042%	0.1647%
37	0.2083%	0.1708%
38	0.2122%	0.1758%
39	0.2160%	0.1820%
40	0.2209%	0.1862%
41	0.2245%	0.1919%
42	0.2309%	0.1973%
43	0.2368%	0.2036%
44	0.2447%	0.2101%
45	0.2547%	0.2182%
46	0.2666%	0.2292%
47	0.2814%	0.2414%
48	0.2994%	0.2560%
49	0.3217%	0.2733%
50	0.3468%	0.2933%
51	0.3678%	0.3230%
52	0.3926%	0.3576%
53	0.4220%	0.3960%
54	0.4559%	0.4386%
55	0.4955%	0.4849%

Age in 2019	% Dying Next Year*	
	Male	Female
56	0.5418%	0.5338%
57	0.5965%	0.5842%
58	0.6592%	0.6372%
59	0.7293%	0.6894%
60	0.8056%	0.7425%
61	0.8889%	0.7959%
62	0.9752%	0.8495%
63	1.0662%	0.9048%
64	1.1594%	0.9626%
65	1.2568%	1.0247%
66	1.3595%	1.0932%
67	1.4706%	1.1703%
68	1.5914%	1.2572%
69	1.7257%	1.3546%
70	1.8783%	1.4663%
71	2.0534%	1.5915%
72	2.2601%	1.7319%
73	2.5031%	1.8885%
74	2.7894%	2.0616%
75	3.1234%	2.2523%
76	3.5043%	2.4646%
77	3.9326%	2.7013%
78	4.4020%	2.9886%
79	4.9065%	3.3522%
80	5.4457%	3.7591%
81	6.0286%	4.2131%
82	6.6659%	4.7162%
83	7.3753%	5.2770%
84	8.1747%	5.8987%
85	9.0908%	6.5888%
86	10.1198%	7.3555%
87	11.3393%	8.2079%
88	12.6894%	9.1575%
89	14.1714%	10.2124%
90	15.8049%	11.3882%

** The rates shown are PUB-2010 mortality for disabled annuitants, Public Safety table, with adjustments, if applicable (see Section F). Recommended rates include mortality improvements using projection scale MP-2019.*

Proposed Actuarial Assumptions
Based on 2015-2019 Experience Study

Healthy Pre-Retirement Mortality Rates

Age in 2019	% Dying Next Year*	
	Male	Female
20	0.0426%	0.0174%
21	0.0434%	0.0188%
22	0.0432%	0.0192%
23	0.0432%	0.0208%
24	0.0432%	0.0224%
25	0.0432%	0.0241%
26	0.0460%	0.0258%
27	0.0487%	0.0276%
28	0.0514%	0.0306%
29	0.0540%	0.0324%
30	0.0552%	0.0354%
31	0.0575%	0.0371%
32	0.0595%	0.0399%
33	0.0612%	0.0425%
34	0.0626%	0.0448%
35	0.0648%	0.0468%
36	0.0666%	0.0485%
37	0.0666%	0.0511%
38	0.0687%	0.0521%
39	0.0702%	0.0540%
40	0.0713%	0.0556%
41	0.0721%	0.0570%
42	0.0748%	0.0594%
43	0.0762%	0.0607%
44	0.0787%	0.0630%
45	0.0822%	0.0656%

Age in 2019	% Dying Next Year*	
	Male	Female
46	0.0859%	0.0684%
47	0.0909%	0.0725%
48	0.0963%	0.0761%
49	0.1040%	0.0812%
50	0.1123%	0.0878%
51	0.1212%	0.0949%
52	0.1325%	0.1026%
53	0.1445%	0.1107%
54	0.1570%	0.1200%
55	0.1721%	0.1294%
56	0.1896%	0.1396%
57	0.2076%	0.1503%
58	0.2288%	0.1593%
59	0.2519%	0.1694%
60	0.2756%	0.1785%
61	0.3014%	0.1864%
62	0.3287%	0.1954%
63	0.3564%	0.2035%
64	0.3841%	0.2121%
65	0.4138%	0.2202%
66	0.4617%	0.2484%
67	0.5138%	0.2800%
68	0.5741%	0.3182%
69	0.6415%	0.3622%
70	0.7186%	0.4135%

** The rates shown are PUB-2010 mortality for employees, Public Safety table, with adjustments, if applicable (see Section F). Recommended rates include mortality improvements using projection scale MP-2019.*

SECTION I

GLOSSARY

Glossary

The following glossary is intended to provide definitions of a number of terms which are used throughout this report and which are somewhat unique to the discussion of an Experience Study.

Actuarial Decrement. The actual number of decrements which occurred during the study. This number is a straight tabulation of the actual number of occurrences of the particular decrement in question. Normally, the actual number of decrements will be subdivided by age and possibly sex.

Aggregate Assumptions. Assumptions which vary only by sex and/or age. The impact of year of service on the decrement is ignored. All experience is combined by age and/or sex without regard to service. Rates of death and disablement are more appropriate to aggregate measurement in a retirement system.

Crude Rate of Decrement. The rate of decrement determined by dividing the actual number of the respective decrement for that age and sex by the corresponding exposure for that age and sex. The rate is described as a crude rate because no smoothing or elimination of statistical fluctuations has been made. It is indicative of the underlying true rate of the decrement and is the basis used in graduation to obtain the graduated or tabular rate.

Decrements. The decrements are the means by which a member ceases to be a member. For active members, the decrements are death, withdrawal, service retirement, and disability retirement. For retired members, the only decrement is death. The purpose of the Experience Study is to determine the underlying rates of each decrement.

Expected Decrement. This is the number of occurrences of a given decrement expected to occur for a given age and sex based on the number of lives exposed to the risk of the particular decrement and the current assumed rate for that decrement. It may also be referred to as the tabular number of decrements. It is the number of deaths, withdrawals, retirements, or disabilities (whichever is applicable) that would have actually occurred had the actuarial assumptions been exactly realized.

Exposure. The number of lives exposed to a given risk of decrement for a particular age and sex. It represents the number of members who could have potentially died, retired, become disabled, or withdrawn at that particular age and for that particular sex. This term will also be described as “the number exposed to a given risk.”

Graduated Rates. Graduation is the mathematical process by which a set of crude rates of a particular type is translated into graduated or tabular rates. The graduation process attempts to smooth out statistical fluctuations and to arrive at a set of rates that adequately fit the underlying actual experience of the crude rates that are being graduated. The graduation process involves smoothing the results, but at the same time trying to fit the results to be consistent with the original data. It requires that the actuary exercise his or her judgment in what the underlying shape of the risk curve should look like.

Interpolated Rates. For the active rates of decrement (death, disability, retirement, and withdrawal), the actuary will develop graduated rates based on quinquennial age groupings (see definition). To arrive at the rates of decrement for ages between two quinquennial ages, the graduated quinquennial rates must be interpolated for these intermediate ages. The interpolated results are arrived at by applying a mathematical interpolation formula to the quinquennial graduated rates.

Glossary

Merit and Seniority Pay Increase Rate. The portion of the total salary scale which varies by service. It reflects the impact of moving up the salary grid in a given year, rather than the increase in the overall grid. It includes the salary increase associated with promotions during the year.

Quinquennial Age Groupings. For the active decrements, it is preferable to group the experience in five-year age groups for graduation and analysis purposes so as to minimize statistical fluctuations resulting from a lack of exposure which may occur for individual ages. Quinquennial age grouping is the five-year age grouping which is used to develop the graduated rates of decrement for active membership. The quinquennial age is the central age of the five-year grouping.

SECTION J

APPENDIX

Appendix – Detailed Experience Analysis

In this section, we present the annual experience for each major assumption that was analyzed for the study. Results are based on liability-weighted experience for withdrawal, retirement and pre-retirement mortality, benefit-weighted for post-retirement and disabled mortality, and population-weighted for all other analysis. Please note that totals may not sum correctly due to rounding of intermediate results.

Appendix – Detailed Experience Analysis
Salary Increases

2015-2019 Experience

Age	Exposure	Gross Actual Increases	Gross Expected Increases
<25	362	10.91%	7.73%
25-29	1,388	7.02%	6.72%
30-34	1,602	5.79%	6.00%
35-39	1,526	4.47%	5.51%
40-44	1,457	4.35%	4.99%
45-49	1,548	3.90%	4.50%
50-54	1,316	3.57%	4.50%
55-59	923	3.13%	4.03%
60-64	433	2.86%	3.75%
65+	76	3.20%	3.50%
Totals	**10,631**	**4.82%**	**5.26%**

Appendix – Detailed Experience Analysis
Salary Increases

2015-2016 Experience

Age	Exposure	Gross Actual Increases	Gross Expected Increases
<25	80	13.14%	7.69%
25-29	292	7.83%	6.71%
30-34	411	5.93%	6.00%
35-39	358	4.50%	5.51%
40-44	383	4.20%	4.98%
45-49	392	4.16%	4.50%
50-54	354	4.42%	4.50%
55-59	242	2.67%	4.02%
60-64	107	4.10%	3.75%
65+	18	4.54%	3.50%
Totals	**2,637**	**5.06%**	**5.20%**

2016-2017 Experience

Age	Exposure	Gross Actual Increases	Gross Expected Increases
<25	77	11.64%	7.72%
25-29	331	6.84%	6.75%
30-34	407	6.66%	6.00%
35-39	393	4.09%	5.51%
40-44	361	4.94%	4.99%
45-49	385	4.39%	4.50%
50-54	333	2.96%	4.50%
55-59	242	4.26%	4.02%
60-64	106	3.04%	3.75%
65+	24	1.75%	3.50%
Totals	**2,659**	**5.01%**	**5.24%**

Appendix – Detailed Experience Analysis
Salary Increases

2017-2018 Experience

Age	Exposure	Gross Actual Increases	Gross Expected Increases
<25	84	7.92%	7.69%
25-29	359	6.74%	6.74%
30-34	382	5.99%	5.99%
35-39	388	4.76%	5.50%
40-44	365	4.39%	4.99%
45-49	385	3.94%	4.50%
50-54	319	4.01%	4.50%
55-59	223	2.63%	4.03%
60-64	111	1.64%	3.75%
65+	14	3.07%	3.50%
Totals	**2,630**	**4.73%**	**5.26%**

2018-2019 Experience

Age	Exposure	Gross Actual Increases	Gross Expected Increases
<25	121	11.06%	7.77%
25-29	406	6.82%	6.71%
30-34	402	4.57%	6.01%
35-39	387	4.54%	5.51%
40-44	348	3.86%	5.00%
45-49	386	3.13%	4.50%
50-54	310	2.81%	4.50%
55-59	216	2.91%	4.02%
60-64	109	2.71%	3.75%
65+	20	3.81%	3.50%
Totals	**2,705**	**4.48%**	**5.33%**

Appendix – Detailed Experience Analysis
Retirements

2015-2019 Experience ($000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	5,552	81,605	2,448.14	226.8%
51	4,648	77,832	1,556.63	298.6%
52	5,160	82,895	1,657.89	311.2%
53	3,921	74,515	1,490.30	263.1%
54	6,442	77,355	3,867.71	166.6%
55	10,827	69,450	13,890.03	77.9%
56	5,791	63,572	5,085.75	113.9%
57	6,828	59,072	4,725.81	144.5%
58	6,314	50,218	4,017.41	157.2%
59	5,866	45,555	3,644.41	161.0%
60	6,175	42,647	6,396.98	96.5%
61	5,164	36,226	5,433.93	95.0%
62	7,731	29,396	8,818.69	87.7%
63	4,939	20,326	6,097.94	81.0%
64	4,236	14,488	4,346.37	97.5%
65	4,205	9,731	3,892.17	108.0%
66	3,021	5,475	2,190.16	137.9%
67	1,538	3,632	1,452.84	105.9%
68	618	2,422	968.55	63.8%
69	912	1,797	718.68	126.9%
Totals	**99,888**	**848,209**	**82,700.39**	**120.8%**

Appendix – Detailed Experience Analysis
Retirements

2015-2016 Experience ($000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	1,192	17,227	516.82	230.6%
51	953	19,371	387.41	246.0%
52	1,302	16,737	334.74	389.0%
53	428	15,561	311.22	137.5%
54	1,187	19,359	967.93	122.6%
55	2,214	14,197	2,839.47	78.0%
56	1,771	13,542	1,083.37	163.5%
57	933	11,865	949.24	98.3%
58	1,094	12,037	962.96	113.6%
59	1,016	11,124	889.93	114.2%
60	1,519	9,370	1,405.45	108.1%
61	1,891	8,143	1,221.49	154.8%
62	1,092	5,728	1,718.48	63.5%
63	897	3,055	916.58	97.9%
64	1,095	3,539	1,061.67	103.1%
65	914	1,643	657.12	139.1%
66	926	1,770	708.11	130.8%
67	403	1,533	613.27	65.7%
68	198	522	208.68	94.9%
69	-	130	51.82	0.0%
Totals	**21,025**	**186,453**	**17,805.76**	**118.1%**

2016-2017 Experience ($000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	2,289	26,217	786.50	291.0%
51	1,324	19,410	388.20	341.1%
52	2,270	22,708	454.16	499.8%
53	1,258	18,341	366.82	342.9%
54	2,262	18,580	928.98	243.5%
55	2,240	21,865	4,373.00	51.2%
56	1,676	14,046	1,123.65	149.2%
57	789	14,035	1,122.81	70.3%
58	1,222	12,933	1,034.61	118.1%
59	1,993	12,442	995.33	200.2%
60	2,988	11,947	1,792.00	166.7%
61	1,109	8,949	1,342.34	82.6%
62	1,781	7,223	2,166.75	82.2%
63	1,439	5,445	1,633.61	88.1%
64	504	2,505	751.39	67.1%
65	844	2,834	1,133.58	74.5%
66	394	835	334.05	117.9%
67	685	980	392.09	174.7%
68	260	1,317	526.68	49.4%
69	-	383	153.32	0.0%
Totals	**27,327**	**222,995**	**21,799.87**	**125.4%**

Appendix – Detailed Experience Analysis
Retirements

2017-2018 Experience ($000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	1,459	14,793	443.78	328.8%
51	1,212	25,655	513.11	236.2%
52	361	18,520	370.40	97.5%
53	826	22,026	440.52	187.5%
54	1,575	17,897	894.86	176.0%
55	2,802	17,601	3,520.11	79.6%
56	740	20,661	1,652.90	44.8%
57	2,190	13,244	1,059.50	206.7%
58	3,684	14,085	1,126.79	326.9%
59	1,464	11,626	930.11	157.4%
60	1,178	11,038	1,655.67	71.1%
61	1,340	9,207	1,380.99	97.0%
62	2,452	8,456	2,536.83	96.7%
63	1,611	5,736	1,720.70	93.6%
64	1,119	4,257	1,277.10	87.6%
65	1,266	2,107	842.87	150.2%
66	1,345	2,063	825.19	163.0%
67	194	462	184.81	105.0%
68	160	317	126.77	126.2%
69	912	1,122	448.65	203.3%
Totals	**27,890**	**220,873**	**21,951.66**	**127.1%**

2018-2019 Experience ($000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	612	23,368	701.04	87.3%
51	1,159	13,396	267.91	432.6%
52	1,227	24,930	498.59	246.1%
53	1,409	18,587	371.74	379.0%
54	1,418	21,519	1,075.94	131.8%
55	3,571	15,787	3,157.45	113.1%
56	1,604	15,323	1,225.83	130.9%
57	2,916	19,928	1,594.26	182.9%
58	314	11,163	893.05	35.2%
59	1,393	10,363	829.04	168.0%
60	490	10,292	1,543.86	31.7%
61	824	9,927	1,489.11	55.3%
62	2,406	7,989	2,396.63	100.4%
63	992	6,090	1,827.05	54.3%
64	1,518	4,187	1,256.21	120.8%
65	1,181	3,147	1,258.60	93.8%
66	356	807	322.81	110.3%
67	256	657	262.67	97.5%
68	-	266	106.42	0.0%
69	-	162	64.89	0.0%
Totals	**23,646**	**217,888**	**21,143.10**	**111.8%**

Appendix – Detailed Experience Analysis
Terminations – First Three Years

2015-2019 Experience, ($000s)

	Males and Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	8,355	30,574	7,643.52	109.3%
2	21,894	96,377	19,275.37	113.6%
3	17,669	101,073	15,160.93	116.5%
Totals	**47,918**	**228,024**	**42,079.82**	**113.9%**

Appendix – Detailed Experience Analysis
Terminations – First Three Years

2015-2016 Experience, ($000s)

	Males and Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	1,584	6,303	1,575.75	100.5%
2	3,583	18,269	3,653.80	98.1%
3	3,102	17,104	2,565.60	120.9%
Totals	**8,269**	**41,676**	**7,795.15**	**106.1%**

2016-2017 Experience, ($000s)

	Males and Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	2,191	7,810	1,952.50	112.2%
2	5,645	25,361	5,072.20	111.3%
3	5,147	26,578	3,986.70	129.1%
Totals	**12,983**	**59,749**	**11,011.40**	**117.9%**

Appendix – Detailed Experience Analysis
Terminations – First Three Years

2017-2018 Experience, ($000s)

	Males and Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	2,350	7,941	1,985.25	118.4%
2	6,263	24,570	4,914.00	127.5%
3	5,343	29,744	4,461.60	119.8%
Totals	**13,956**	**62,255**	**11,360.85**	**122.8%**

2018-2019 Experience, ($000s)

	Males and Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	2,230	8,520	2,130.02	104.7%
2	6,403	28,177	5,635.37	113.6%
3	4,077	27,647	4,147.03	98.3%
Totals	**12,710**	**64,344**	**11,912.42**	**106.7%**

Appendix – Detailed Experience Analysis
Terminations – After Third Year

2015-2019 Experience, ($000s)

	Males				Females				
Age Group	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Age Group	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	292	1,291	189.78	153.9%	20-24	76	165	23.43	324.4%
25-29	6,346	37,289	4,210.29	150.7%	25-29	2,121	15,155	1,930.00	109.9%
30-34	12,672	118,540	8,851.73	143.2%	30-34	5,840	49,976	5,033.88	116.0%
35-39	11,633	170,885	8,959.39	129.8%	35-39	6,784	85,805	6,901.14	98.3%
40-44	9,756	219,010	8,732.66	111.7%	40-44	5,581	103,821	5,913.53	94.4%
45-49	10,317	276,177	8,251.48	125.0%	45-49	6,762	139,637	5,234.80	129.2%
Totals	**51,016**	**823,192**	**39,195.33**	**130.2%**	**Totals**	**27,164**	**394,559**	**25,036.78**	**108.5%**

Appendix – Detailed Experience Analysis
Terminations – After Third Year

2015-2016 Experience, ($000s)

	Males				Females				
Age Group	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Age Group	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	184	234	34.40	534.9%	20-24	-	-	-	N/A
25-29	1,402	6,511	721.49	194.3%	25-29	489	2,724	343.79	142.2%
30-34	2,831	26,413	1,980.43	142.9%	30-34	830	12,017	1,218.01	68.1%
35-39	2,255	36,859	1,925.40	117.1%	35-39	1,541	17,272	1,397.58	110.3%
40-44	1,682	47,613	1,896.74	88.7%	40-44	791	25,062	1,407.83	56.2%
45-49	977	59,806	1,792.44	54.5%	45-49	753	28,084	1,046.22	72.0%
Totals	**9,331**	**177,436**	**8,350.89**	**111.7%**	**Totals**	**4,404**	**85,159**	**5,413.44**	**81.4%**

2016-2017 Experience, ($000s)

	Males				Females				
Age Group	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Age Group	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	-	199	29.25	0.0%	20-24	39	39	5.54	704.2%
25-29	1,512	8,453	955.28	158.3%	25-29	700	3,464	444.76	157.4%
30-34	3,187	31,308	2,335.16	136.5%	30-34	2,116	14,036	1,412.78	149.8%
35-39	3,590	43,347	2,266.79	158.4%	35-39	1,301	22,042	1,781.15	73.0%
40-44	3,066	57,526	2,298.94	133.4%	40-44	1,053	26,916	1,516.62	69.4%
45-49	3,676	68,831	2,074.66	177.2%	45-49	1,112	35,063	1,329.22	83.7%
Totals	**15,031**	**209,664**	**9,960.09**	**150.9%**	**Totals**	**6,321**	**101,560**	**6,490.06**	**97.4%**

Appendix – Detailed Experience Analysis
Terminations – After Third Year

2017-2018 Experience, ($000s)

	Males				Females				
Age Group	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Age Group	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	60	355	52.19	115.0%	20-24	-	49	6.96	0.0%
25-29	2,271	10,967	1,235.30	183.8%	25-29	525	4,187	531.42	98.8%
30-34	3,516	31,361	2,321.32	151.5%	30-34	1,800	12,779	1,276.63	141.0%
35-39	2,938	44,278	2,316.36	126.8%	35-39	2,097	24,171	1,934.33	108.4%
40-44	2,222	55,964	2,241.53	99.1%	40-44	2,161	26,256	1,492.99	144.7%
45-49	2,060	76,521	2,288.64	90.0%	45-49	2,265	39,469	1,473.51	153.7%
Totals	**13,067**	**219,446**	**10,455.33**	**125.0%**	**Totals**	**8,848**	**106,911**	**6,715.84**	**131.7%**

2018-2019 Experience, ($000s)

	Males				Females				
Age Group	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Age Group	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	48	503	73.94	64.9%	20-24	37	77	10.93	338.4%
25-29	1,161	11,358	1,298.22	89.4%	25-29	407	4,780	610.03	66.7%
30-34	3,138	29,458	2,214.82	141.7%	30-34	1,094	11,144	1,126.46	97.1%
35-39	2,850	46,401	2,450.84	116.3%	35-39	1,845	22,320	1,788.08	103.2%
40-44	2,786	57,907	2,295.45	121.4%	40-44	1,576	25,587	1,496.09	105.3%
45-49	3,604	71,019	2,095.75	172.0%	45-49	2,632	37,021	1,385.85	189.9%
Totals	**13,587**	**216,646**	**10,429.02**	**130.3%**	**Totals**	**7,591**	**100,929**	**6,417.44**	**118.3%**

Appendix – Detailed Experience Analysis
Disability Retirements

2015-2019 Experience

	Males				Females				
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected	Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
20-24	-	598	0.32	0.0%	20-24	-	373	0.20	0.0%
25-29	-	1,726	1.17	0.0%	25-29	-	957	0.64	0.0%
30-34	-	1,551	2.05	0.0%	30-34	1	848	0.78	128.1%
35-39	3	1,265	2.45	122.7%	35-39	2	770	1.02	195.8%
40-44	2	1,164	3.13	63.8%	40-44	1	639	1.40	71.4%
45-49	4	1,182	4.94	81.0%	45-49	4	646	3.01	132.8%
50-54	7	1,053	7.26	96.4%	50-54	5	556	4.71	106.2%
55-59	5	741	7.92	63.1%	55-59	5	462	6.27	79.8%
60-64	3	429	6.73	44.6%	60-64	2	218	5.59	35.8%
Totals	**24**	**9,709**	**35.98**	**66.7%**	**Totals**	**20**	**5,469**	**23.62**	**84.7%**

Appendix – Detailed Experience Analysis
Disability Retirements

2015-2016 Experience

	Males				Females				
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected	Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
20-24	-	129	0.07	0.0%	20-24	-	84	0.05	0.0%
25-29	-	378	0.26	0.0%	25-29	-	214	0.14	0.0%
30-34	-	368	0.49	0.0%	30-34	-	228	0.21	0.0%
35-39	-	299	0.58	0.0%	35-39	-	188	0.25	0.0%
40-44	-	282	0.76	0.0%	40-44	-	158	0.35	0.0%
45-49	1	294	1.23	81.6%	45-49	2	153	0.71	280.2%
50-54	-	264	1.82	0.0%	50-54	1	149	1.28	78.4%
55-59	1	188	2.01	49.7%	55-59	-	112	1.52	0.0%
60-64	1	114	1.78	56.3%	60-64	-	48	1.24	0.0%
Totals	**3**	**2,316**	**8.99**	**33.4%**	**Totals**	**3**	**1,334**	**5.75**	**52.2%**

2016-2017 Experience

	Males				Females				
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected	Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
20-24	-	151	0.08	0.0%	20-24	-	89	0.05	0.0%
25-29	-	437	0.30	0.0%	25-29	-	229	0.15	0.0%
30-34	-	389	0.51	0.0%	30-34	-	213	0.20	0.0%
35-39	-	308	0.60	0.0%	35-39	-	194	0.26	0.0%
40-44	-	290	0.78	0.0%	40-44	1	156	0.34	290.9%
45-49	2	292	1.21	165.9%	45-49	1	160	0.74	136.0%
50-54	2	266	1.81	110.5%	50-54	2	143	1.21	165.4%
55-59	1	191	2.03	49.2%	55-59	2	118	1.58	126.6%
60-64	1	108	1.69	59.1%	60-64	-	52	1.32	0.0%
Totals	**6**	**2,432**	**9.01**	**66.6%**	**Totals**	**6**	**1,354**	**5.85**	**102.6%**

Appendix – Detailed Experience Analysis
Disability Retirements

2017-2018 Experience

	Males				Females				
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected	Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
20-24	-	139	0.07	0.0%	20-24	-	89	0.05	0.0%
25-29	-	446	0.30	0.0%	25-29	-	238	0.16	0.0%
30-34	-	386	0.51	0.0%	30-34	1	212	0.20	511.2%
35-39	2	321	0.62	322.4%	35-39	1	194	0.26	385.2%
40-44	1	289	0.77	129.5%	40-44	-	158	0.34	0.0%
45-49	1	305	1.27	78.4%	45-49	1	175	0.82	121.5%
50-54	1	253	1.74	57.3%	50-54	2	125	1.06	188.9%
55-59	2	188	2.00	99.8%	55-59	2	119	1.62	123.8%
60-64	-	106	1.67	0.0%	60-64	1	57	1.46	68.6%
Totals	**7**	**2,433**	**8.97**	**78.0%**	**Totals**	**8**	**1,367**	**5.96**	**134.2%**

2018-2019 Experience

	Males				Females				
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected	Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
20-24	-	179	0.09	0.0%	20-24	-	111	0.06	0.0%
25-29	-	465	0.32	0.0%	25-29	-	276	0.19	0.0%
30-34	-	408	0.54	0.0%	30-34	-	195	0.18	0.0%
35-39	1	337	0.65	153.8%	35-39	1	194	0.26	388.0%
40-44	1	303	0.82	122.3%	40-44	-	167	0.36	0.0%
45-49	-	291	1.23	0.0%	45-49	-	158	0.74	0.0%
50-54	4	270	1.89	211.8%	50-54	-	139	1.16	0.0%
55-59	1	174	1.87	53.4%	55-59	1	113	1.55	64.7%
60-64	1	101	1.59	62.9%	60-64	1	61	1.57	63.8%
Totals	**8**	**2,528**	**9.00**	**88.9%**	**Totals**	**3**	**1,414**	**6.06**	**49.5%**

Appendix – Detailed Experience Analysis
Post-Retirement Mortality

2015-2019 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
50-54	26	973	4.82	540.0%	50-54	-	377	1.25	0.0%
55-59	21	2,949	19.39	108.3%	55-59	6	2,037	9.70	61.9%
60-64	45	6,571	61.53	73.1%	60-64	27	3,649	25.39	106.3%
65-69	66	6,231	81.96	80.5%	65-69	37	3,428	34.24	108.0%
70-74	11	2,521	48.80	22.5%	70-74	13	1,011	15.59	83.4%
75-79	21	636	19.85	105.8%	75-79	1	230	5.90	17.0%
80-84	7	103	5.30	132.2%	80-84	-	6	0.30	0.0%
85-89	-	4	0.32	0.0%	85-89	-	4	0.28	0.0%
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95+	-	-	-	N/A	95+	-	-	-	N/A
Totals	**197**	**19,988**	**241.97**	**81.4%**	**Totals**	**84**	**10,742**	**92.65**	**90.7%**

Appendix – Detailed Experience Analysis
Post-Retirement Mortality

2015-2016 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
50-54	-	183	0.89	0.0%	50-54	-	66	0.21	0.0%
55-59	-	343	2.29	0.0%	55-59	-	382	1.81	0.0%
60-64	19	1,409	13.15	144.5%	60-64	-	708	4.76	0.0%
65-69	6	1,114	14.72	40.8%	65-69	-	558	5.47	0.0%
70-74	-	367	7.25	0.0%	70-74	13	148	2.27	571.6%
75-79	-	96	2.99	0.0%	75-79	-	36	0.83	0.0%
80-84	-	12	0.58	0.0%	80-84	-	2	0.11	0.0%
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95+	-	-	-	N/A	95+	-	-	-	N/A
Totals	**25**	**3,524**	**41.87**	**59.7%**	**Totals**	**13**	**1,900**	**15.46**	**84.1%**

2016-2017 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
50-54	-	249	1.23	0.0%	50-54	-	74	0.24	0.0%
55-59	-	524	3.42	0.0%	55-59	-	470	2.26	0.0%
60-64	17	1,435	13.50	125.9%	60-64	-	869	6.03	0.0%
65-69	-	1,374	18.00	0.0%	65-69	37	801	8.01	461.8%
70-74	-	528	10.22	0.0%	70-74	-	188	2.90	0.0%
75-79	9	136	4.26	211.4%	75-79	-	48	1.18	0.0%
80-84	-	19	0.96	0.0%	80-84	-	2	0.12	0.0%
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95+	-	-	-	N/A	95+	-	-	-	N/A
Totals	**26**	**4,265**	**51.59**	**50.4%**	**Totals**	**37**	**2,452**	**20.75**	**178.3%**

Appendix – Detailed Experience Analysis
Post-Retirement Mortality

2017-2018 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
50-54	26	287	1.45	1792.6%	50-54	-	143	0.48	0.0%
55-59	19	911	5.98	317.6%	55-59	6	518	2.45	245.3%
60-64	9	1,619	15.12	59.5%	60-64	-	1,085	7.63	0.0%
65-69	54	1,730	22.55	239.4%	65-69	-	883	8.84	0.0%
70-74	11	699	13.32	82.6%	70-74	-	303	4.61	0.0%
75-79	12	190	5.85	205.2%	75-79	-	63	1.65	0.0%
80-84	7	35	1.78	393.1%	80-84	-	-	-	N/A
85-89	-	1	0.08	0.0%	85-89	-	2	0.13	0.0%
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95+	-	-	-	N/A	95+	-	-	-	N/A
Totals	**138**	**5,472**	**66.13**	**208.7%**	**Totals**	**6**	**2,997**	**25.78**	**23.3%**

2018-2019 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
50-54	-	254	1.24	0.0%	50-54	-	94	0.32	0.0%
55-59	2	1,171	7.70	26.0%	55-59	-	667	3.18	0.0%
60-64	-	2,108	19.76	0.0%	60-64	27	987	6.97	387.3%
65-69	6	2,013	26.68	22.5%	65-69	-	1,186	11.92	0.0%
70-74	-	927	18.01	0.0%	70-74	-	372	5.80	0.0%
75-79	-	214	6.76	0.0%	75-79	1	83	2.23	44.9%
80-84	-	37	1.98	0.0%	80-84	-	2	0.07	0.0%
85-89	-	3	0.24	0.0%	85-89	-	2	0.15	0.0%
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95+	-	-	-	N/A	95+	-	-	-	N/A
Totals	**8**	**6,727**	**82.37**	**9.7%**	**Totals**	**28**	**3,393**	**30.65**	**91.4%**

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality

2015-2019 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
Under 20	-	4	0.00	0.0%	Under 20	-	21	0.00	0.0%
20-24	-	15,599	8.61	0.0%	20-24	-	6,988	1.28	0.0%
25-29	-	92,639	49.82	0.0%	25-29	-	35,836	7.77	0.0%
30-34	125	155,261	94.33	132.5%	30-34	-	62,127	18.35	0.0%
35-39	229	191,241	131.64	174.0%	35-39	-	96,086	38.01	0.0%
40-44	198	232,977	196.29	100.9%	40-44	-	112,389	61.97	0.0%
45-49	63	286,060	368.85	17.1%	45-49	382	145,783	121.64	314.0%
50-54	937	276,828	591.15	158.5%	50-54	-	130,224	176.97	0.0%
55-59	622	183,600	647.04	96.1%	55-59	792	109,129	231.00	342.9%
60-64	496	100,281	605.37	81.9%	60-64	-	44,728	136.75	0.0%
Totals	**2,670**	**1,534,490**	**2,693.11**	**99.1%**	**Totals**	**1,174**	**743,311**	**793.74**	**147.9%**

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality

2015-2016 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	-	2,697	1.48	0.0%	20-24	-	1,231	0.22	0.0%
25-29	-	16,966	8.87	0.0%	25-29	-	6,460	1.35	0.0%
30-34	-	32,715	18.97	0.0%	30-34	-	14,498	4.10	0.0%
35-39	-	40,431	26.59	0.0%	35-39	-	19,560	7.39	0.0%
40-44	198	50,015	41.22	480.3%	40-44	-	26,114	14.35	0.0%
45-49	-	62,221	80.11	0.0%	45-49	-	29,242	24.70	0.0%
50-54	-	59,751	128.97	0.0%	50-54	-	30,702	42.40	0.0%
55-59	-	40,620	145.59	0.0%	55-59	218	23,103	48.51	449.4%
60-64	496	22,083	129.59	382.7%	60-64	-	8,141	25.18	0.0%
Totals	**694**	**327,499**	**581.38**	**119.4%**	**Totals**	**218**	**159,051**	**168.20**	**129.6%**

2016-2017 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	-	3,966	2.18	0.0%	20-24	-	1,704	0.31	0.0%
25-29	-	23,698	12.65	0.0%	25-29	-	9,005	1.92	0.0%
30-34	-	40,419	24.24	0.0%	30-34	-	17,080	4.99	0.0%
35-39	-	48,719	33.05	0.0%	35-39	-	25,568	9.96	0.0%
40-44	-	61,049	50.97	0.0%	40-44	-	28,682	15.83	0.0%
45-49	-	71,236	90.68	0.0%	45-49	382	36,698	30.18	1265.6%
50-54	283	72,531	153.31	184.6%	50-54	-	35,616	48.15	0.0%
55-59	274	48,777	172.67	158.7%	55-59	233	27,948	58.21	400.3%
60-64	-	25,959	154.54	0.0%	60-64	-	10,646	32.08	0.0%
Totals	**557**	**396,354**	**694.29**	**80.2%**	**Totals**	**615**	**192,947**	**201.63**	**305.0%**

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality

2017-2018 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
Under 20	-	-	-	N/A	Under 20	-	21	0.00	0.0%
20-24	-	4,025	2.22	0.0%	20-24	-	1,702	0.31	0.0%
25-29	-	26,127	14.17	0.0%	25-29	-	9,773	2.14	0.0%
30-34	125	41,439	25.58	488.6%	30-34	-	16,218	4.90	0.0%
35-39	229	50,019	34.90	656.2%	35-39	-	26,515	10.67	0.0%
40-44	-	59,932	50.50	0.0%	40-44	-	29,122	16.10	0.0%
45-49	-	78,966	101.63	0.0%	45-49	-	41,310	34.66	0.0%
50-54	322	70,713	150.89	213.4%	50-54	-	31,211	42.79	0.0%
55-59	111	48,164	168.43	65.9%	55-59	1	30,251	64.52	1.5%
60-64	-	27,234	166.42	0.0%	60-64	-	11,909	36.57	0.0%
Totals	**787**	**406,619**	**714.74**	**110.1%**	**Totals**	**1**	**198,032**	**212.67**	**0.5%**

2018-2019 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
Under 20	-	4	0.00	0.0%	Under 20	-	-	-	N/A
20-24	-	4,911	2.73	0.0%	20-24	-	2,351	0.43	0.0%
25-29	-	25,848	14.14	0.0%	25-29	-	10,598	2.35	0.0%
30-34	-	40,688	25.54	0.0%	30-34	-	14,331	4.36	0.0%
35-39	-	52,072	37.11	0.0%	35-39	-	24,443	9.99	0.0%
40-44	-	61,981	53.60	0.0%	40-44	-	28,471	15.69	0.0%
45-49	63	73,637	96.44	65.3%	45-49	-	38,533	32.10	0.0%
50-54	332	73,833	157.98	210.2%	50-54	-	32,695	43.64	0.0%
55-59	237	46,039	160.34	147.8%	55-59	340	27,827	59.76	568.9%
60-64	-	25,005	154.81	0.0%	60-64	-	14,032	42.91	0.0%
Totals	**632**	**404,018**	**702.69**	**89.9%**	**Totals**	**340**	**193,281**	**211.24**	**161.0%**

Appendix – Detailed Experience Analysis
Disabled Mortality

2015-2019 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
40-44	-	270	0.65	0.0%	40-44	-	109	0.21	0.0%
45-49	-	815	2.72	0.0%	45-49	-	187	0.47	0.0%
50-54	-	1,075	4.90	0.0%	50-54	-	768	2.43	0.0%
55-59	58	1,387	9.13	635.5%	55-59	-	904	4.15	0.0%
60-64	16	1,354	12.33	129.8%	60-64	-	958	6.48	0.0%
65-69	94	1,575	21.02	447.1%	65-69	-	989	10.11	0.0%
70-74	18	616	11.80	152.5%	70-74	-	355	5.40	0.0%
75-79	-	166	4.94	0.0%	75-79	1	56	1.42	70.3%
80-84	-	-	-	N/A	80-84	-	43	1.80	0.0%
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
Totals	**186**	**7,258**	**67.48**	**275.6%**	**Totals**	**1**	**4,369**	**32.47**	**3.1%**

Appendix – Detailed Experience Analysis
Disabled Mortality

2015-2016 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
40-44	-	79	0.19	0.0%	40-44	-	23	0.04	0.0%
45-49	-	242	0.82	0.0%	45-49	-	84	0.22	0.0%
50-54	-	184	0.87	0.0%	50-54	-	135	0.45	0.0%
55-59	-	390	2.57	0.0%	55-59	-	175	0.83	0.0%
60-64	-	289	2.64	0.0%	60-64	-	240	1.67	0.0%
65-69	29	452	5.89	492.7%	65-69	-	199	2.02	0.0%
70-74	8	83	1.77	453.1%	70-74	-	43	0.70	0.0%
75-79	-	11	0.30	0.0%	75-79	1	14	0.47	214.0%
80-84	-	-	-	N/A	80-84	-	-	-	N/A
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
Totals	**37**	**1,730**	**15.05**	**245.9%**	**Totals**	**1**	**913**	**6.40**	**15.6%**

2016-2017 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
40-44	-	62	0.15	0.0%	40-44	-	23	0.04	0.0%
45-49	-	215	0.72	0.0%	45-49	-	2	0.01	0.0%
50-54	-	249	1.14	0.0%	50-54	-	235	0.74	0.0%
55-59	16	342	2.31	691.6%	55-59	-	159	0.74	0.0%
60-64	-	320	2.92	0.0%	60-64	-	210	1.38	0.0%
65-69	39	424	5.68	686.5%	65-69	-	279	2.80	0.0%
70-74	-	104	1.96	0.0%	70-74	-	65	1.06	0.0%
75-79	-	41	1.14	0.0%	75-79	-	-	-	N/A
80-84	-	-	-	N/A	80-84	-	14	0.52	0.0%
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
Totals	**55**	**1,757**	**16.02**	**343.3%**	**Totals**	**-**	**987**	**7.29**	**0.0%**

Appendix – Detailed Experience Analysis
Disabled Mortality

2017-2018 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
40-44	-	59	0.14	0.0%	40-44	-	39	0.08	0.0%
45-49	-	218	0.72	0.0%	45-49	-	26	0.07	0.0%
50-54	-	286	1.31	0.0%	50-54	-	176	0.55	0.0%
55-59	42	314	2.04	2054.3%	55-59	-	262	1.18	0.0%
60-64	16	407	3.68	435.1%	60-64	-	219	1.44	0.0%
65-69	15	347	4.72	318.0%	65-69	-	303	3.14	0.0%
70-74	-	186	3.52	0.0%	70-74	-	72	1.09	0.0%
75-79	-	43	1.31	0.0%	75-79	-	21	0.45	0.0%
80-84	-	-	-	N/A	80-84	-	14	0.58	0.0%
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
Totals	**73**	**1,860**	**17.44**	**418.5%**	**Totals**	**-**	**1,132**	**8.59**	**0.0%**

2018-2019 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
40-44	-	70	0.17	0.0%	40-44	-	24	0.05	0.0%
45-49	-	140	0.45	0.0%	45-49	-	75	0.17	0.0%
50-54	-	356	1.58	0.0%	50-54	-	222	0.69	0.0%
55-59	-	341	2.20	0.0%	55-59	-	308	1.40	0.0%
60-64	-	338	3.09	0.0%	60-64	-	289	1.98	0.0%
65-69	11	352	4.74	232.2%	65-69	-	208	2.15	0.0%
70-74	10	243	4.55	219.7%	70-74	-	175	2.55	0.0%
75-79	-	71	2.19	0.0%	75-79	-	21	0.50	0.0%
80-84	-	-	-	N/A	80-84	-	15	0.69	0.0%
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
Totals	**21**	**1,911**	**18.97**	**110.7%**	**Totals**	**-**	**1,337**	**10.19**	**0.0%**