St. Paul Teachers' Retirement Fund Association

5-Year Experience Study

July 1, 2016 through June 30, 2021

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December 8, 2022

Board of Trustees
St. Paul Teachers' Retirement Fund Association
St. Paul, Minnesota

Dear Board Members:

The results of the five-year ***actuarial experience study*** of the St. Paul Teachers' Retirement Fund Association (SPTRFA) are presented in this report. The investigation was conducted for the purpose of updating the actuarial assumptions used in valuing the actuarial liabilities.

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 five-year period of the study by the St. Paul Teachers' Retirement Fund Association (SPTRFA). 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 SPTRFA.

The investigation covered the five-year period from ***July 1, 2016 to June 30, 2021***, 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 St. Paul Teachers' Retirement Fund Association.

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

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.

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Bonita J. Wurst and Sheryl L. Christensen 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, Gabriel, Roeder, Smith & Company meets the requirements of "approved actuary" under Minnesota Statutes Section 356.215, Subdivision 1, Paragraph (c).

Respectfully submitted,
Gabriel, Roeder, Smith & Company

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Actuarial Experience Study
2016-2021

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SECTION A

OVERVIEW AND SUMMARY OF RESULTS

Introduction

Each year as of June 30, the actuarial liabilities of the System 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 **termination** 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; and
- 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 SPTRFA Board of 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 last revised for the June 30, 2018 actuarial valuations based on the results of the most recent experience study. In addition, the mortality improvement projection scale has been updated for each valuation since 2018. Assumptions in effect prior to June 30, 2021 are ignored for purposes of this report.

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 Recommended Changes

The five-year period (July 1, 2016 to June 30, 2021) 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 St. Paul Teachers' Retirement Fund Association (SPTRFA). The recommended changes in actuarial assumptions and methods resulting from this experience study are summarized below:

- Decrease the current 7.5% investment return assumption to an investment return assumption in the range of 5.85% to 7.00%. Selection of an investment return assumption at the upper end of this range results in a higher risk of increased actuarial contributions in the future.
- Decrease the wage inflation (i.e., payroll growth) assumption from 3.00% to 2.50%, and study future population expectations.
- Adjust rates of merit and seniority, resulting in an overall decrease to the assumed rates of merit and seniority increases:
  - Proposed rates are 0.50% and 0.75% less than the current rates in the first two years of employment; minor adjustments to the current rates after the second year of employment.
  - Average proposed rate averages are approximately 0.2% less than current rate.
  - When combined with the proposed reduction in wage inflation, proposed salary increase rates average approximately 0.7% lower than the current rates.
- Adjust assumed retirement rates:
  - For unreduced retirements (i.e., Normal Retirement), increase the rates at ages 66 and 67 and reduce the rates at ages 68 and 69, for both males and females. Proposed rates reflect, in total, slightly more Normal Retirements.
  - For Rule of 90 retirements, proposed Rule of 90 rates result in a better fit at certain ages but approximately the same number of projected Rule of 90 retirements in total.
  - Decrease the assumed early retirement rates for both males and females:
    - For males, proposed rates reflect fewer retirements below age 58 and between ages 61 and 64. Total proposed rates will produce approximately 18% fewer retirements.
    - For females, proposed rates reflect fewer retirements at age 58 and age 61 to 64, and more retirements at age 59 and 65. Total proposed rates will produce approximately 5% fewer retirements.
  - Change the retirement age assumption for Coordinated deferred members from age 62 to age 63.
- Change the assumed rates of termination (termination of membership before eligible to retire):
  - Generally, proposed rates are lower than current rates, especially after the first year of employment for both males and females.
  - Total proposed rates will reduce liability decrementing due to termination by approximately 28% for males and 21% for females.
- Decrease the assumed rates of disability by 31% in total, with more dramatic reduction in rates after age 50.
- Change the base mortality table to the PUB-2010 mortality table for Teachers, with rates adjusted for some tables in order to better fit observed plan experience and with future improvement projected using scale MP-2021; results in an overall decrease in assumed mortality for male retirees and a slight overall increase in assumed mortality for female retirees.
- Limit the payroll growth assumption used to determine the contribution toward the unfunded actuarial accrued liability to the actual plan average for the last ten years.

Summary of Decrement Experience
2016-2021

Decrement Risk Area		Actual Number	Expected		
			Current Assumptions	Proposed Assumptions	Change
Retirement					
Normal Retirement*	- Male	21	19.60	20.25	0.65
	- Female	100	88.76	94.80	6.04
Rule of 90 Retirements	- Male	34	29.90	31.60	1.70
	- Female	140	139.70	138.75	(0.95)
Early Retirements	- Male	54	83.37	68.73	(14.64)
	- Female	216	229.27	217.57	(11.70)
*Termination ($000s)***					
Males		19,163	31,616.79	22,705.12	(8,911.67)
Females		61,835	97,937.18	76,980.21	(20,956.97)
Disability (males and females)		3	12.53	8.64	(3.89)
*Mortality ($000s)***					
Healthy Retired Lives	- Male	6,979	7,188.85	6,644.68	(544.17)
	- Female	7,375	6,380.59	6,518.66	138.07
Active Lives	- Male	564	1,328.74	1,057.36	(271.38)
	- Female	756	3,280.72	2,438.76	(841.96)

** Normal retirements less than age 70. See Section D for full detail.*

*** Results are liability-weighted for termination and pre-retirement mortality and benefit-weighted for post-retirement mortality.*

SECTION B

ECONOMIC ASSUMPTIONS

Economic Assumptions – Introduction

Economic assumptions include **long-term rates of investment return** (net of administrative and investment expenses), **inflation** (the across-the-board portion of salary increases), **payroll growth**, and pay increases due to **merit and seniority**. Unlike demographic activities, economic activities do not lend themselves to analysis solely on the basis of internal historical patterns because both salary increases and investment return are affected more by external forces; namely inflation (both wage and price), general productivity changes and the local economic environment which defy accurate long-term prediction. Estimates of economic activities are generally selected on the basis of the expectations in an inflation-free environment and then both long-term rates of investment return and wage inflation are increased by a provision for long-term inflation.

Current economic assumptions for SPTRFA are as follows:

Investment Return	7.50%
Inflation	2.50%
Payroll Growth	3.00%

The remainder of this section addresses the economic assumptions other than pay increases due to merit and seniority. Pay increases due to merit and seniority are addressed in Section C.

Sources considered in the analysis of the economic assumptions included:

- Future expectations of independent investment consultants;
- 2022 Social Security Trustees Report;
- Historical observations of inflation statistics and investment returns;
- U.S. Department of the Treasury yield curve rates (www.treasury.gov); and
- National Average Wage Index.

Economic Assumptions – ASOP No. 27

Guidance regarding the selection of economic assumptions for measuring pension obligations is provided by Actuarial Standards of Practice (ASOP) No. 27. The standard requires that the selected economic assumptions be consistent with each other. That is, the selection of the investment return assumption should be consistent with the selection of the payroll growth and inflation assumptions.

The relevant Actuarial Standard of Practice (ASOP) for economic assumptions is ASOP No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*. Under ASOP No. 27, Section 3.6, an economic assumption is reasonable if it has the following characteristics:

- It is appropriate for the purpose of the measurement;
- It reflects the actuary's professional judgment;
- It takes into account current and historical data that is relevant to selecting the assumption for the measurement date, to the extent such relevant data is reasonably available;
- It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data (if any), or a combination thereof; and
- It is expected to have no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included (as discussed in Section 3.5.1) or when alternative assumptions are used for the assessment of risk, in accordance with ASOP No. 51, *Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions*.

Economic Assumptions – Inflation

Inflation. Over the past 60 years, price inflation has averaged 3.8%. This result is heavily affected by the high inflationary period of the 1970s and early 1980s. During the past decade, price inflation averaged 2.1%.

Calendar Year Period	Inflation (CPI)
1950-1959	2.2%
1960-1969	2.5%
1970-1979	7.4%
1980-1989	5.1%
1990-1999	2.9%
2000-2009	2.5%
2010-2019	1.8%
2020	1.4%
2021	7.0%
Last 5 Years	**2.9%**
Last 10 Years	**2.1%**
Last 20 Years	**2.3%**
Last 30 Years	**2.4%**
Last 40 Years	**2.8%**
Last 50 Years	**3.9%**
Last 60 Years	**3.8%**

The SPTRFA currently uses a 2.5% price inflation assumption in the development of its capital market assumptions.

Economic Assumptions – Inflation

Future Expectations

The table below shows forward-looking price inflation forecasts:

Forward-Looking Price Inflation Forecasts[a]	
Congressional Budget Office[b]	
5-Year Annual Average	2.58%
10-Year Annual Average	2.49%
Federal Reserve Bank of Philadelphia[c]	
5-Year Annual Average	2.70%
10-Year Annual Average	2.50%
Federal Reserve Bank of Cleveland[d]	
10-Year Expectation	1.95%
20-Year Expectation	2.08%
30-Year Expectation	2.20%
Federal Reserve Bank of St. Louis[e]	
10-Year Breakeven Inflation	2.85%
20-Year Breakeven Inflation	2.81%
30-Year Breakeven Inflation	2.49%
U.S. Department of the Treasury[f]	
10-Year Breakeven Inflation	2.77%
20-Year Breakeven Inflation	2.68%
30-Year Breakeven Inflation	2.52%
50-Year Breakeven Inflation	2.53%
100-Year Breakeven Inflation	2.55%
Social Security Trustees[g]	
Ultimate Intermediate Assumption	2.40%

a. End of the First Quarter, 2022. Version 2022-04-21 by Gabriel, Roeder, Smith & Company.
b. *The Budget and Economic Outlook: 2021 to 2031,* Release Date: July 2021, Consumer Price Index (CPI-U), Percentage Change from Year to Year, 5-Year Annual Average (2021-2025), 10-Year Annual Average (2021-2030).
c. *First Quarter 2022 Survey of Professional Forecasters,* Release Date: February 11, 2022, Headline CPI, Annualized Percentage Points, 5-Year Annual Average (2022-2026), 10-Year Annual Average (2022-2031).
d. Inflation Expectations, Model output date: March 1, 2022.
e. The breakeven inflation rate represents a measure of expected inflation derived from X-Year Treasury Constant Maturity Securities and X-Year Treasury Inflation-Indexed Constant Maturity Securities. Observation date: March 2022.
f. *The Treasury Breakeven Inflation (TBI) Curve*, Monthly Average Rates, March 2022.
g. *The 2022 Annual Report of The Board of Trustees of The Federal Old-Age And Survivors Insurance and Federal Disability Insurance Trust Funds*, June 2, 2022, Long-range (75-year) assumptions, Intermediate, Consumer Price Index (CPI-W), for 2024 and later.

Economic Assumptions – Inflation

Other Considerations

We also reviewed the forward-looking inflation assumptions used by the 12 independent investment firms that work with public sector plans. These are shown later in the report. The samples from these firms ranged from 2.26% to 3.10%, with an average of 2.53%.

Although current inflation rates are much higher than the 2.50% assumed inflation rate, the future outlook from the sources in the table on the prior page suggest 2.50% continues to be reasonable.

Recommendation

We recommend maintaining an assumed rate of price inflation of 2.50%.

Economic Assumptions – Payroll Growth

Payroll growth (wage inflation) represents the expected growth in total payroll for a stable population. Increases or decreases in covered population that lead to a change in total payroll are not reflected in this assumption. Wage inflation consists of two components, 1) a portion due to pure price inflation (i.e., increases due to changes in the CPI), and 2) increases in average salary levels in excess of pure price inflation (i.e., increases due to changes in productivity levels, supply and demand in the labor market and other macroeconomic factors).

The current payroll growth assumption is 3.00%, which is comprised of a 2.50% price inflation assumption plus a real wage growth assumption of 0.50%. The payroll growth assumption is used to develop the amount necessary to amortize the unfunded actuarial accrued liability using the level percent of pay methodology.

Wage inflation (as measured by increases in the National Average Earnings) has averaged 2.95% over the period from 2015-2020 (the latest data available is 2020), while general inflation averaged 1.96% during this same period. This would imply a real growth rate of 0.99% (i.e., 2.95% - 1.96%). The past decade saw a real growth rate of wages of 1.18%. The 2022 Social Security Trustees report uses 1.15% as the long-range intermediate real-wage differential assumption. The low-cost assumption is 1.77% and the high-cost assumption is 0.53%.

Salary increases for longer-service employees are almost entirely driven by wage inflation. Many of the factors that result in pay increases are largely inapplicable or have diminished importance for longer-service employees. Step or service-related increases have ceased or are minimal. Promotions occur with less frequency. Additional training or acquisition of advanced degrees usually occurs early in the career. Thus, longer service employees' wages are assumed to grow at the overall rate of wage inflation.

SPTRFA salary increases observed in the study level off after about 20 years of service, which is consistent with the salary schedules from the Collective Bargaining Agreements. For members with more than 20 years of service, the observed average salary increase during the five-year period was 1.7%. Inflation during this five-year period averaged 2.9%; average inflation excluding 2021 is 1.9% for the four-year period. Therefore, long-service employees received an average salary increase approximately equal to (or below) inflation.

Based upon the data reviewed, **we recommend changing the current real wage growth assumption from 0.50% to 0.00%.** When combined with the 2.50% price inflation assumption, the recommended payroll growth assumption is 2.50%.

As noted above, the recommended payroll growth assumption is appropriate for a stable population. See our comments and suggestions in Section H (Funding Policy – Amortization) regarding methods for populations that are not stable.

Economic Assumptions – Investment Return

Investment Return. The investment return assumption is the actuarial assumption that has the largest impact on actuarial valuation results. The following chart shows the estimated annual investment return on an actuarial and market value basis for each year in the period under consideration:

Fiscal Year Ending	Actuarial Value of Assets	Market Value of Assets
June 30, 2017	8.80%	13.93%
June 30, 2018	8.50%	9.75%
June 30, 2019	6.00%	5.73%
June 30, 2020	5.55%	0.10%
June 30, 2021	10.94%	32.65%
Average annual investment return July 1, 2016 to June 30, 2021	**7.9%**	**11.9%**

For purposes of budgeting contributions and measuring liabilities for public employee retirement systems, the assumed rate of investment return is used as the discount rate to determine the present value of a system's pension obligations. For most valuations, an actuarial investment return assumption based on expected future experience is a single estimate for all years and, therefore, implicitly assumes that returns above and below expectations will average out over time. In other words, the expected risk premium is reflected in the assumed rate of investment return in advance of being earned, while the investment risk (i.e., volatility) is not reflected until actual experience emerges with each valuation.

The analysis of the investment return assumption in this report is based on forward-looking measures of expected investment return outcomes for the asset classes in the System's current investment policy. For purposes of this analysis, we have analyzed the System's investment policy with the capital market assumptions from 12 nationally recognized investment firms.

Our analysis is based on the GRS 2022 Capital Market Assumption Modeler (CMAM[1]). The purpose of the CMAM is to assess the reasonability of the assumed rate of return for use in the actuarial valuations for the plan. In our professional judgment the CMAM has the capability to provide results that are consistent with this purpose. A description of the strengths, limitations and weaknesses of the model are incorporated in this report. In our opinion, the limitations and weaknesses are not material. We performed tests to ensure that the model reasonably represents that which is intended to be modeled.

We are relying on the GRS actuaries and Internal Software, Training, and Processes Team who developed and maintain the model.

[1] *Issued 2022-06-09.*

Economic Assumptions – Investment Return

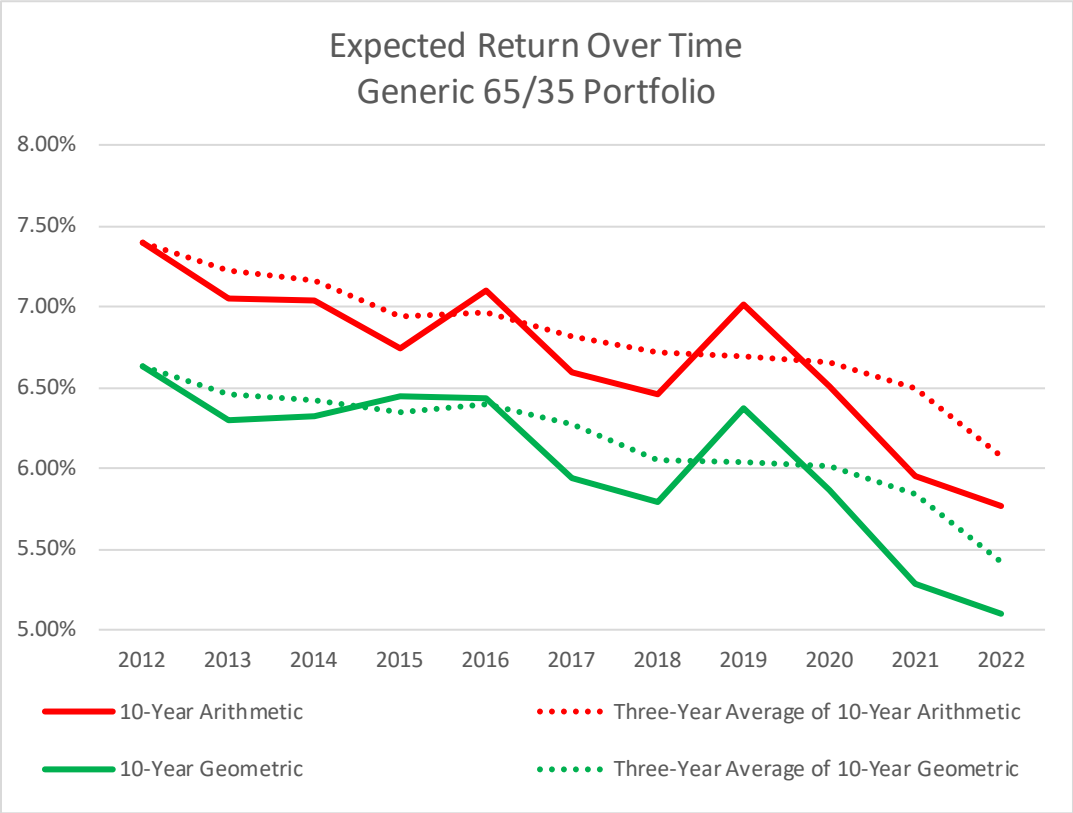
Because GRS is a benefits consulting firm and does not develop or maintain its own capital market expectations, we request and monitor forward-looking expectations developed by several major investment firms. We update our CMAM on an annual basis. The capital market assumptions in the 2022 CMAM are from the following investment firms (in alphabetical order): Aon Hewitt, Blackrock, BNY Mellon, Callan, Cambridge, JPMorgan, Meketa, Mercer, NEPC, RVK, Verus, and Wilshire. We believe that the benefit of performing this analysis using multiple investment firms is to recognize the uncertain nature of the items affecting the selection of the investment return assumption. While there may be differences in asset classes, investment horizons, inflation assumptions, treatment of investment expenses, excess manager performance (i.e., alpha), etc., we have attempted to align the various assumption sets from the different investment firms to be as consistent as possible. In some cases, we have made minor adjustments or assumptions to align the various assumptions sets with our model.

Each investment firm provided capital market assumptions over an investment horizon of approximately 10 years. Although investment firms often refer to this period as "short-term" it is important to remember that 10 years is actually a very long time. In fact, the duration of the liabilities of the SPTRFA is 11 years. Therefore, returns during the next 10 years will affect the plan's funding materially. A subset of six investment firms provided capital market expectations over a longer horizon, varying between 20 and 30 years. For purposes of this report, the analysis is generally based on the 10-year expectations provided by the investment firms.

In general, our understanding is that the methodology for developing these capital market expectations is forward-looking, not purely backward-looking. Over the years, we have observed a general decreasing trend in capital market expectations. However, we have also observed that some of the investment firms' assumption sets are dependent on the market conditions at the time they are developed and consequently may be sensitive to short-term market fluctuations. Some expectations are contrarian – meaning that when the market is high, future expectations are lowered and when the market is low, future expectations are raised. The amount of these fluctuations as they appear in the year-to-year capital market assumptions varies between the various investment firms.

Economic Assumptions – Investment Return

Each year, the GRS CMAM reflects the most up-to-date information at the time the data was collected (typically reflecting the firms' expectations at the beginning of the calendar year). Compared to the 2021 survey, the 2022 survey generally shows slightly higher return expectations for the fixed income asset classes and some modest decline in the forward-looking return expectations for domestic public equity. This is perhaps due in part to the increase in bond yields during the 2021 calendar year from record lows and a strong U.S. stock market performance at the end of 2021. Generally, the forward-looking returns in the 2022 survey are also considerably lower than the return expectations in the 2020 survey. If we consider the three-year average of return expectations, the general decreasing trend continues and the short-term fluctuations are diminished. The chart below illustrates the volatility from year to year from past CMAMs with a generic 65/35 asset allocation. The general declining trend is illustrated with the three-year average of CMAM returns.



To the best of our ability, we have adapted the System's investment policy to fit with the investment firms' assumptions adjusting for these known differences in assumptions and methodology. The asset classes in the system's investment allocation often do not exactly align with the asset classes of all investment firms in the survey. This may require us to make approximations which can introduce some subjectivity into the process. In the following charts, to the extent possible all returns are net of passive investment expenses and administrative expenses and have no assumption for excess manager performance (alpha) in excess of active management fees.

Economic Assumptions – Investment Return

For purposes of this analysis, SPTRFA provided the following investment allocation:

Asset Class	Target Allocation
Cash	0.00%
U.S. Stock - Large Cap	20.00%
U.S. Stock - Small Cap	15.00%
International Equity	21.00%
Emerging Markets Equity	4.00%
U.S. Corporate Bonds	10.00%
Government Bonds	3.00%
TIPS	1.00%
High Yield	3.00%
International Debt	0.00%
Real Estate	9.00%
Private Equity	9.00%
Hedge Funds	0.00%
Other Alternatives	5.00%
Total	100.00%

The arithmetic expected return developed from this asset allocation is shown in the table on the following page. The CMAM begins with the nominal expected return from each Capital Market Assumption (CMA) set (Column 2), takes out each CMA's price inflation assumption (Column 3) to arrive at the real return (Column 4). We then incorporate the current price inflation assumption of 2.50% (Column 5) to get the adjusted nominal return (Column 6). Investment expenses not already netted out of the return and/or administrative expenses paid out of trust assets which are not reflected in the employer contributions (Column 7) are netted out of the return. The final arithmetic expected return is shown in Column 8. We believe that this is reasonable provided that the current price inflation assumption does not differ materially from the assumptions used by the investment firms. Note that the arithmetic return is in general higher than the median return due to the compounding effect of random returns. In general, the difference between the arithmetic and median return will be larger for larger standard deviation of returns. We have shown the standard deviation of returns as the investment risk in Column 9.

The average arithmetic return and standard deviation from the last three years of CMAMs are shown at the bottom of the table for reference.

ASOP No. 27, Section 3.6.2, states that "[d]ue to the uncertain nature of the items for which assumptions are selected, the actuary may consider several different assumptions reasonable for a given measurement. Different actuaries will apply different professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop, both for an individual actuary and across actuarial practice." This range of different expectations from the CMAs is evident from the summaries we show from our CMAM.

Economic Assumptions – Investment Return

GRS 2022 CMAM								
Capital Market Assumption Set (CMA)	CMA Expected Nominal Return	CMA Inflation Assumption	Expected Real Return (2)–(3)	Actuary Inflation Assumption	Expected Nominal Return (4)+(5)	Investment Expenses	Expected Nominal Return Net of Expenses (6)-(7)	Standard Deviation of Expected Return (1-Year)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	6.30%	3.00%	3.30%	2.50%	5.80%	0.00%	5.80%	13.13%
2	5.92%	2.40%	3.52%	2.50%	6.02%	0.00%	6.02%	13.73%
3	6.20%	2.60%	3.60%	2.50%	6.10%	0.00%	6.10%	13.97%
4	6.20%	2.50%	3.70%	2.50%	6.20%	0.00%	6.20%	12.57%
5	6.18%	2.31%	3.87%	2.50%	6.37%	0.00%	6.37%	12.50%
6	6.49%	2.31%	4.18%	2.50%	6.68%	0.00%	6.68%	14.35%
7	6.95%	2.64%	4.31%	2.50%	6.81%	0.00%	6.81%	14.61%
8	6.75%	2.50%	4.25%	2.50%	6.75%	0.00%	6.75%	14.13%
9	6.98%	2.41%	4.58%	2.50%	7.08%	0.00%	7.08%	13.93%
10	7.07%	2.26%	4.81%	2.50%	7.31%	0.00%	7.31%	14.42%
11	7.32%	2.29%	5.03%	2.50%	7.53%	0.00%	7.53%	13.66%
12	8.73%	3.10%	5.63%	2.50%	8.13%	0.00%	8.13%	14.38%
Average	**6.76%**	**2.53%**	**4.23%**	**2.50%**	**6.73%**	**0.00%**	**6.73%**	**13.78%**
					Average from last 3 CMAMs		**7.03%**	**13.71%**

The average expected nominal return from Column 8 is 6.73%. This is the average arithmetic rate of return. Note that the arithmetic rate of return represents the average future expected return which is higher than the median future expected. Accumulating assets and cash flows at the average arithmetic rate of return is expected to produce the average asset amount over time. However, in any given year it is less than 50% likely that the arithmetic average rate of return will be achieved. Moreover, over a period of longer than one year, the realized rate of return is generally computed as a geometric average. Additional analysis is required to adjust to the median (or geometric average) return.

Next, we compare the probabilities of achieving returns over a 10-year horizon. We compute the 40th, 50th, and 60th percentiles of returns as well as the probability of achieving the current assumption of 7.50% over a 10-year horizon. These estimates are based on the assumption that the distribution of returns for the next 10 years is the same each year. The average median return from the last three years of CMAMs is shown at the bottom of the table for reference.

Economic Assumptions – Investment Return

GRS 2022 CMAM				
Capital Market Assumption Set (CMA)	Distribution of 10-Year Average Geometric Net Nominal Return			Probability of Exceeding
	40th	50th	60th	7.50%
(1)	(2)	(3)	(4)	(5)
1	3.96%	5.00%	6.04%	27.34%
2	4.06%	5.14%	6.23%	29.29%
3	4.09%	5.19%	6.30%	29.99%
4	4.47%	5.46%	6.46%	30.36%
5	4.65%	5.64%	6.64%	31.87%
6	4.59%	5.72%	6.86%	34.70%
7	4.67%	5.82%	6.98%	35.74%
8	4.71%	5.82%	6.95%	35.30%
9	5.09%	6.18%	7.29%	38.19%
10	5.22%	6.35%	7.50%	39.97%
11	5.60%	6.67%	7.76%	42.34%
12	6.05%	7.18%	8.33%	47.20%
Average	**4.76%**	**5.85%**	**6.94%**	**35.19%**
Average from last 3 CMAMs over 10-year horizon		**6.16%**		

The 50th percentile return is also related to the geometric average return. The geometric average of a sequence of returns over a number of years is the compound average of those returns over the number of years compounded. As the number of years in the geometric average increase and if the distributions of returns each year are independent and identically distributed, then the geometric average will converge to the median return. The median return may be considered a reasonable rate of return for purposes of the valuation. The average of 50th percentile returns is 5.85% per year.

In summary, a reasonable range for the assumed rate of return based on the current CMAM's 10-year investment horizon is between the median of 5.85% and the (arithmetic) nominal expected return of 6.73%. Returns outside that range are not necessarily unreasonable, but a separate justification may be needed.

As discussed, the 2022 CMAM generally results in lower expectations than previous years on the 10-year horizon. For reference, the 3-year average CMAM median return is 6.16% and 3-year average CMAM (arithmetic) nominal expected return is 7.03%.

Column 5 of the table on this page shows the estimated probability of achieving the statutory 7.50% assumed rate of return over a 10-year period. The average probability of achieving 7.50% over 10 years is 35%.

Nothing in this report should be construed as GRS giving investment advice.

Economic Assumptions – Investment Return

Comments and Recommendations

Capital market assumptions have declined significantly since the previous experience study. Based on the analysis in this report, **GRS believes the 7.5% statutory rate is outside of the reasonable range for the SPTRFA valuation as of July 1, 2022. We will, of course, comply with statutes and produce the valuation based upon 7.5%, but Actuarial Standards will require us to include a statement indicating that "the prescribed assumption significantly conflicts with what, in our professional judgment, would be reasonable."**

For GASB work, we will need to use an assumption that can be deemed reasonable based upon actuarial standards of practice.

We recommend SPTRFA consider an investment return assumption in the range of 5.85% to 6.73%. Based on the data reviewed, we can support a 7.0% discount rate for the 2022 valuation, but SPTRFA should note that the selection of an investment return assumption near the upper end of this range may not be sustainable. A rate near the bottom of the range, such as 5.85%, would be more likely to be sustainable for a longer period. If in a future year the assumption is deemed unreasonable, we would need to qualify our report and we would not be able to use the assumption in the GASB calculations.

SECTION C

PAY INCREASES

Pay Increases Due to Merit and Seniority

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

- An across-the-board, economic type of increase granted to most or all members of the group. 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.

The assumption for across-the-board increases is the pay inflation assumption discussed in Section B. The merit and seniority portion of pay increases is discussed on this page.

We reviewed the merit and seniority pay increases during the five-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%. While this was a relatively small number of records, the experience distorted the experience of the overall group.

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. General inflation, as measured by the change in the Consumer Price Index, has averaged about 2.9% over the five-year period ending June 30, 2021. Inflation for 2021 was 7.0%; the average of the remaining four years of inflation over the period (2016-2020) was 1.9%.

Wage inflation (as measured by increases in the National Average Earnings) has averaged 3.4% over the period from 2016-2020, while general inflation averaged 1.9% during this same period. This would imply a real growth rate of 1.5% (i.e., 3.4% - 1.9%). The past decade saw a real growth rate of wages of 1.2%. The 2022 Social Security Trustees report uses 1.15% as the long-range intermediate real-wage differential assumption. The low-cost assumption is 1.77% and the high-cost assumption is 0.53%.

Based on our review of salary experience for SPTRFA members for the period July 1, 2016 through June 30, 2021, we observed that members with longer periods of service (i.e., 20 years or more) averaged about 1.7% for this period, which is less than the national average. Members with less service received increases that were higher than 1.7% in general. For our analysis of the merit and seniority portion of total salary increase, we assumed that the salary increase amount in excess of the total salary increase for the longer-service members (i.e., those with 20 or more years of service) was attributable to wage inflation only. This assumes that once members reach a certain length of service, merit and seniority increases are no longer provided.

Pay Increases Due to Merit and Seniority

Findings

The current service-based salary increase assumption ranges from 9.0% in the first year to 3.0% in year 23 and later. The Expected Increases in our analysis and shown in this section take into account the service based current salary increase assumption.

The assumed wage inflation was 3.00% for the period of the study. However, due to low price inflation and real wage growth during the period (as described in Section B), we estimated that during the five years of the study, the average actual wage inflation component of pay increases was around 1.7% for members of the SPTRFA. This estimated actual increase was subtracted from the actual pay increases to obtain the estimated merit/seniority portion of the pay increases. It should be noted that the results of the analysis are very sensitive to the estimated wage inflation component.

Gross actual salary increases averaged 3.58% over the five-year period, ranging from 2.47% in 2018 to 5.00% in 2017. After adjusting for the 1.7% average wage inflation for this period, the average net salary increase (i.e., merit and seniority) averaged 1.88%, ranging from 0.77% to 3.30%.

Fiscal Year Ending	Count	Gross		Net*	
		Expected	Actual	Expected	Actual
2017	2,952	5.15%	5.00%	2.15%	3.30%
2018	3,059	5.22%	2.47%	2.22%	0.77%
2019	2,986	5.17%	3.05%	2.17%	1.35%
2020	2,974	5.17%	2.88%	2.17%	1.18%
2021	3,054	5.29%	4.52%	2.29%	2.82%
Total	**15,025**	**5.20%**	**3.58%**	**2.20%**	**1.88%**

* *Net Expected increases are equal to Gross Expected increases minus assumed wage inflation of 3.0%. Net Actual increases are equal to Gross Actual increases minus the estimated actual wage inflation for the period of 1.7%.*

Pay Increases Due to Merit and Seniority

SPTRFA salary increases observed in the study level off after about 20 years of service which is consistent with the salary schedules in the Collective Bargaining Agreements. The results of our analysis are shown on the following page. Using the techniques described above, observed merit and seniority pay increases were generally lower than the presently assumed increases by about 19 basis points.

The current Collective Bargaining Agreement, effective for the fiscal year ending June 30, 2022 and June 30, 2023 includes 2.0% annual increases in the salary schedule. The proposed salary increase rates reflect additional salary growth due to promotion/step increases.

Recommendation

We recommend adjustments to the current merit/seniority pay increase assumption as summarized below and shown in detail on the following page:

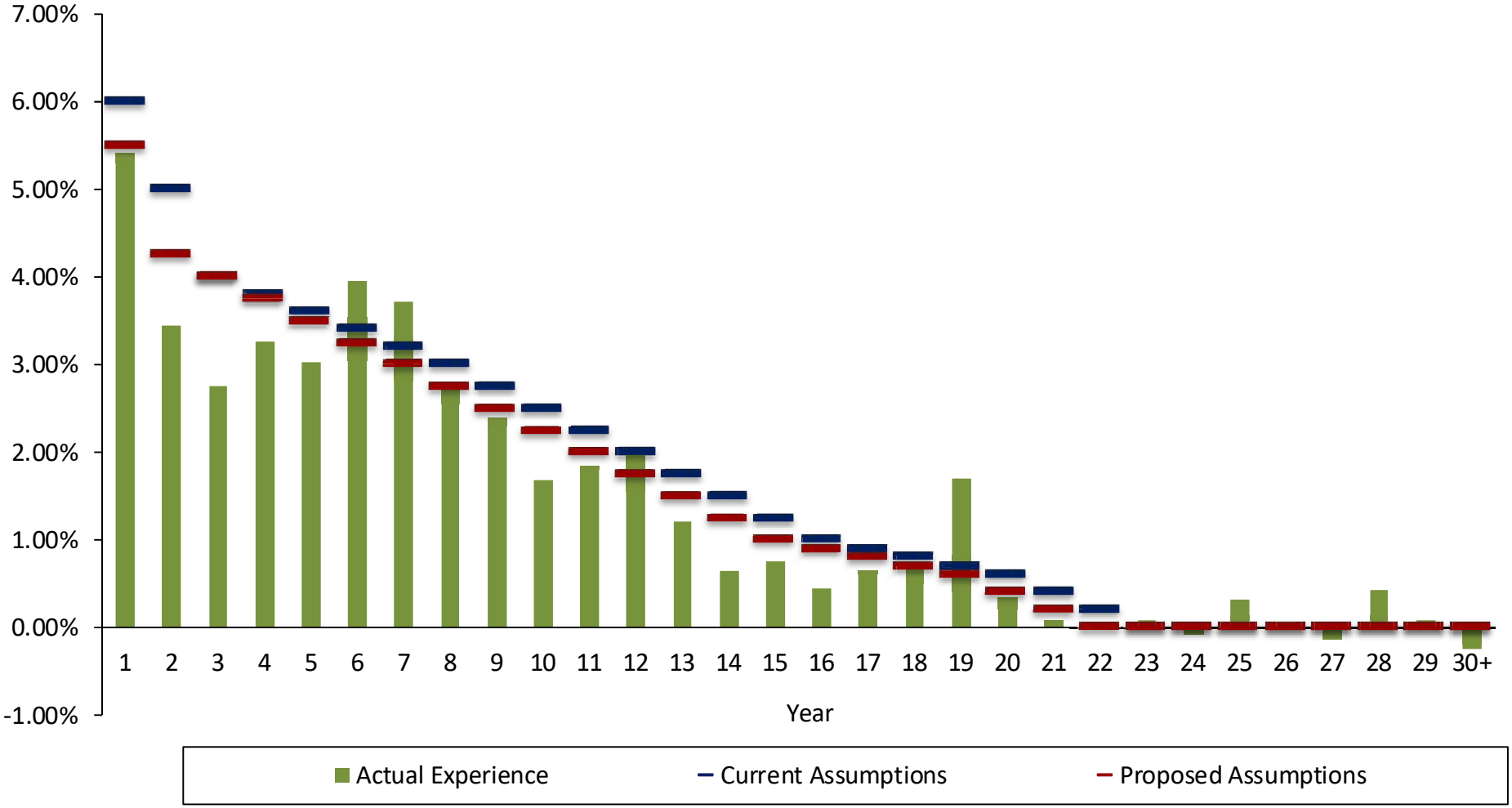
- *Since St. Paul teachers' salaries are governed by Collective Bargaining Agreements that are primarily based on years of service and education level, we recommend continuation of a salary increase assumption that is strictly service-based (rather than age and service based).*
- *The proposed merit and seniority increase rates, on average, are 19 basis points lower than the current assumption.*
- *When combined with the proposed 50 basis point reduction in wage inflation assumption, gross salary increase rates are approximately 69 basis points lower than the current assumption.*

Pay Increases Due to Merit and Seniority

Year	Exposures	Total Salary % Increase			Net* % Increase		
		Actual	Current	Proposed	Actual	Current	Proposed
1	942	7.11%	9.00%	8.00%	5.41%	6.00%	5.50%
2	798	5.14%	8.00%	6.75%	3.44%	5.00%	4.25%
3	807	4.46%	7.00%	6.50%	2.76%	4.00%	4.00%
4	806	4.98%	6.80%	6.25%	3.28%	3.80%	3.75%
5	750	4.73%	6.60%	6.00%	3.03%	3.60%	3.50%
6	679	5.66%	6.40%	5.75%	3.96%	3.40%	3.25%
7	609	5.43%	6.20%	5.50%	3.73%	3.20%	3.00%
8	504	4.48%	6.00%	5.25%	2.78%	3.00%	2.75%
9	444	4.09%	5.75%	5.00%	2.39%	2.75%	2.50%
10	399	3.39%	5.50%	4.75%	1.69%	2.50%	2.25%
11	410	3.56%	5.25%	4.50%	1.86%	2.25%	2.00%
12	450	3.73%	5.00%	4.25%	2.03%	2.00%	1.75%
13	465	2.91%	4.75%	4.00%	1.21%	1.75%	1.50%
14	464	2.35%	4.50%	3.75%	0.65%	1.50%	1.25%
15	514	2.45%	4.25%	3.50%	0.75%	1.25%	1.00%
16	550	2.15%	4.00%	3.40%	0.45%	1.00%	0.90%
17	516	2.35%	3.90%	3.30%	0.65%	0.90%	0.80%
18	524	2.40%	3.80%	3.20%	0.70%	0.80%	0.70%
19	602	3.40%	3.70%	3.10%	1.70%	0.70%	0.60%
20	557	2.04%	3.60%	2.90%	0.34%	0.60%	0.40%
21	509	1.78%	3.40%	2.70%	0.08%	0.40%	0.20%
22	475	1.72%	3.20%	2.50%	0.02%	0.20%	0.00%
23	143	1.80%	3.00%	2.50%	0.10%	0.00%	0.00%
24	355	1.62%	3.00%	2.50%	-0.08%	0.00%	0.00%
25	301	2.03%	3.00%	2.50%	0.33%	0.00%	0.00%
26	265	1.77%	3.00%	2.50%	0.07%	0.00%	0.00%
27	212	1.57%	3.00%	2.50%	-0.13%	0.00%	0.00%
28	187	2.13%	3.00%	2.50%	0.43%	0.00%	0.00%
29	159	1.79%	3.00%	2.50%	0.09%	0.00%	0.00%
30+	629	1.47%	3.00%	2.50%	-0.23%	0.00%	0.00%
Total	**15,025**	**3.58%**	**5.20%**	**4.51%**	**1.88%**	**2.20%**	**2.01%**

* *Net Expected increases are equal to Gross Expected increases minus assumed wage inflation of 3.0%. Net Actual increases are equal to Gross Actual increases minus the estimated actual wage inflation for the period of 1.7%.*

Pay Increases Due to Merit and Seniority



SECTION D

RETIREMENT EXPERIENCE

Retirement Analysis

The benefit provisions of the SPTRFA establish the minimum age and service requirements for retirement. However, the actual cost of retirement is determined by when members actually retire. The assumption about timing of retirements is a major ingredient in cost calculations.

We analyzed normal retirement (retirement at or beyond Normal Retirement Age), Rule of 90 retirements (for pre-July 1, 1989 hires) and early retirements (retirement prior to Normal Retirement Age and/or Rule of 90 eligibility).

Liability-weighted results are discussed on page E-1. For the retirement analysis, we reviewed the salary for active members at various retirement ages to determine if the group was homogenous. At age 60, we found that 57% of active members earned between $85,000 and $95,000. We found similar results at ages 58 and 62. The participant group appears to be sufficiently homogenous, meaning most members of a similar age earn a similar salary. As such, we did not include liability-weighted retirement results in our analysis. We would expect liability-weighted results to be similar to headcount results.

Some members are eligible for retirement but elect to defer the benefit. We included these terminations as retirements for the purposes of this study.

Age and Service Unreduced (Normal) Retirement

Normal Retirement refers to those members that retire on or after Normal Retirement Age. Members hired prior to July 1, 1989 have a Normal Retirement Age of 65 whereas members hired after June 30, 1989 have a Normal Retirement Age equal to Social Security Normal Retirement Age, but not later than age 66.

Note that higher rates of retirement with full benefits generally results in higher computed contributions, and vice-versa.

Members hired after June 30, 1989 may have a Normal Retirement Age prior to age 66 (if born prior to 1943). For purposes of this analysis, any such eligible members retiring at age 65 with an unreduced benefit were included with the eligible members retiring at age 65 with a reduced benefit, for purposes of determining proposed retirement rates.

Findings

Overall, the plan experienced fewer Normal Retirements than projected by the present assumptions (171 expected versus 146 actual – see totals on the following page). If only retirements prior to age 70 are considered, the plan experienced more normal retirements than projected (108 expected versus 121 actual).

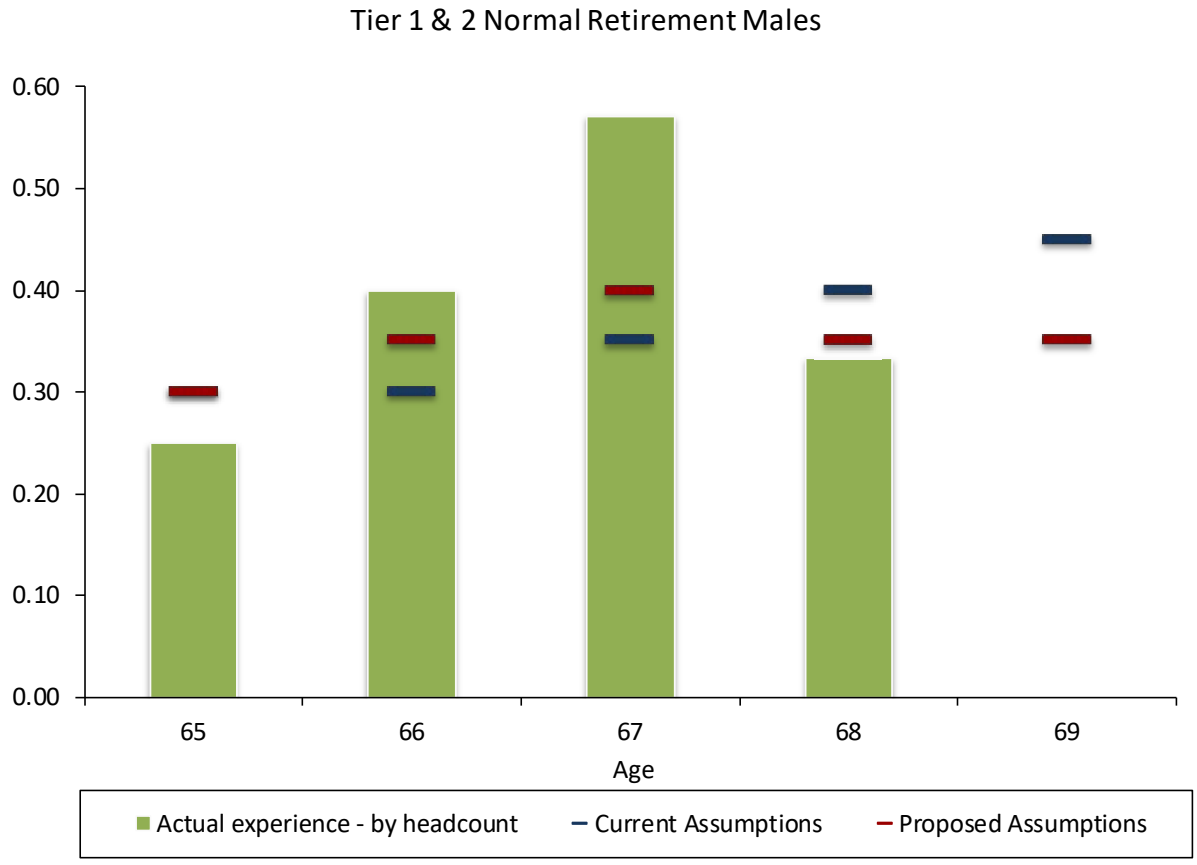
The current assumption ends at age 70; in other words, we assume all members currently under the age of 70 will retire by the age of 70. During the five-year period, there were 25 actual retirements at ages 70 or older, including 11 actual retirements at age 70 and 4 actual retirements at age 71. We believe assuming 100% retirement at age 70 is an appropriately conservative approach.

Recommendations

We recommend changes to the retirement rates as indicated on the following pages, which, in general, increases normal retirements for both males and females.

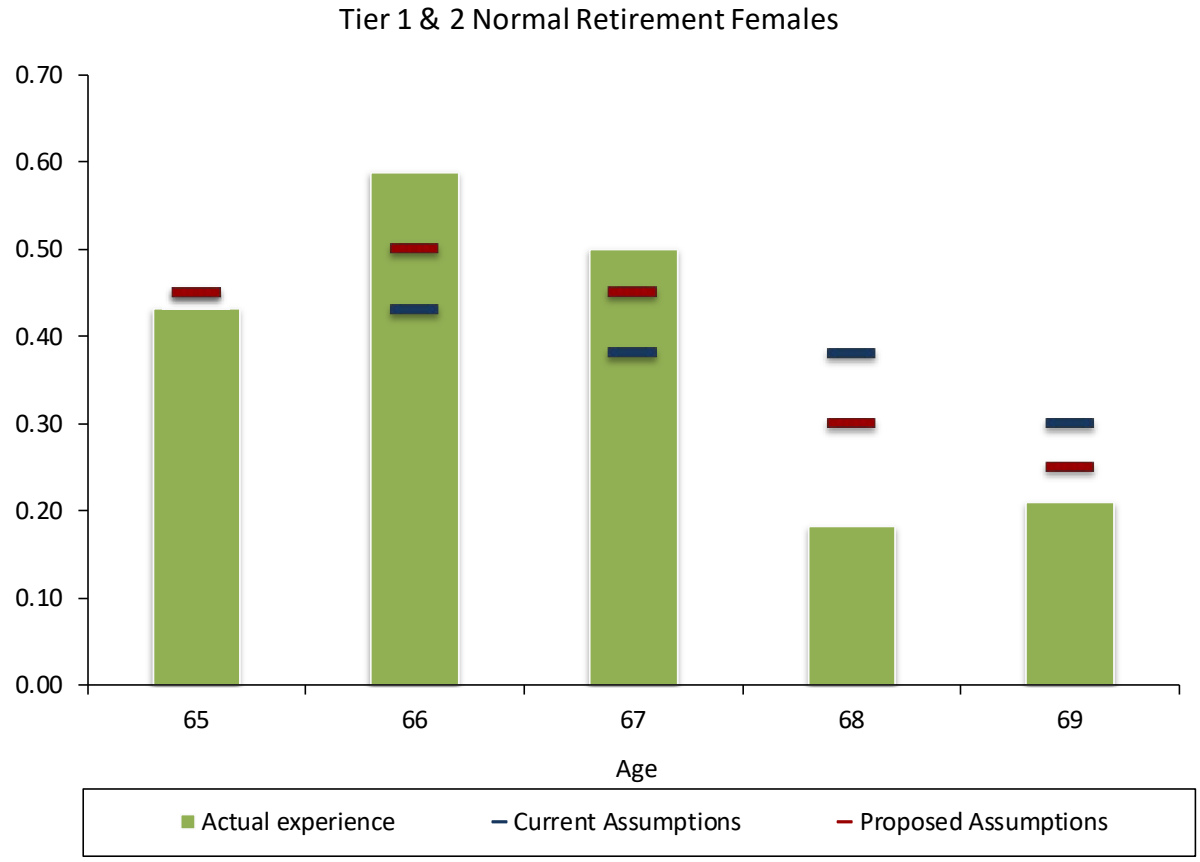
Age and Service Unreduced (Normal) Retirement
Males

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Current	Proposed	Current	Proposed	Current	Proposed
65	2	8	25.0%	30.00%	30.00%	2.40	2.40	83.3%	83.3%
66	8	20	40.0%	30.00%	35.00%	6.00	7.00	133.3%	114.3%
67	8	14	57.1%	35.00%	40.00%	4.90	5.60	163.3%	142.9%
68	3	9	33.3%	40.00%	35.00%	3.60	3.15	83.3%	95.2%
69	-	6	0.0%	45.00%	35.00%	2.70	2.10	0.0%	0.0%
Subtotal	**21**	**57**				**19.60**	**20.25**	**107.1%**	**103.7%**
70+	8	13	61.5%	100.00%	100.00%	13.00	13.00	61.5%	61.5%
Totals	**29**	**70**				**32.60**	**33.25**	**89.0%**	**87.2%**



Age and Service Unreduced (Normal) Retirement
Females

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Current	Proposed	Current	Proposed	Current	Proposed
65	22	51	43.1%	45.00%	45.00%	22.95	22.95	95.9%	95.9%
66	50	85	58.8%	43.00%	50.00%	36.55	42.50	136.8%	117.6%
67	20	40	50.0%	38.00%	45.00%	15.20	18.00	131.6%	111.1%
68	4	22	18.2%	38.00%	30.00%	8.36	6.60	47.8%	60.6%
69	4	19	21.1%	30.00%	25.00%	5.70	4.75	70.2%	84.2%
Subtotal	**100**	**217**				**88.76**	**94.80**	**112.7%**	**105.5%**
70+	17	50	34.0%	100.00%	100.00%	50.00	50.00	34.0%	34.0%
Totals	**117**	**267**				**138.76**	**144.80**	**84.3%**	**80.8%**



Rule of 90 (Unreduced) Early Retirement

SPTRFA members who were hired prior to July 1, 1989 may retire with an unreduced benefit when age plus service is at least 90 years. We refer to these cases as Rule of 90 early retirements.

Generally, because of the subsidized early retirement benefit, these members are expected to retire at a higher rate than those members that do not qualify for Rule of 90. Generally, higher rates of early retirement generally result in higher computed contributions due to the enhanced benefit, and vice-versa.

Findings

We reviewed the experience during the study period. Overall, the plan experienced slightly more Rule of 90 early retirements than projected by the present assumptions (170 expected versus 174 actual – see totals on the following page).

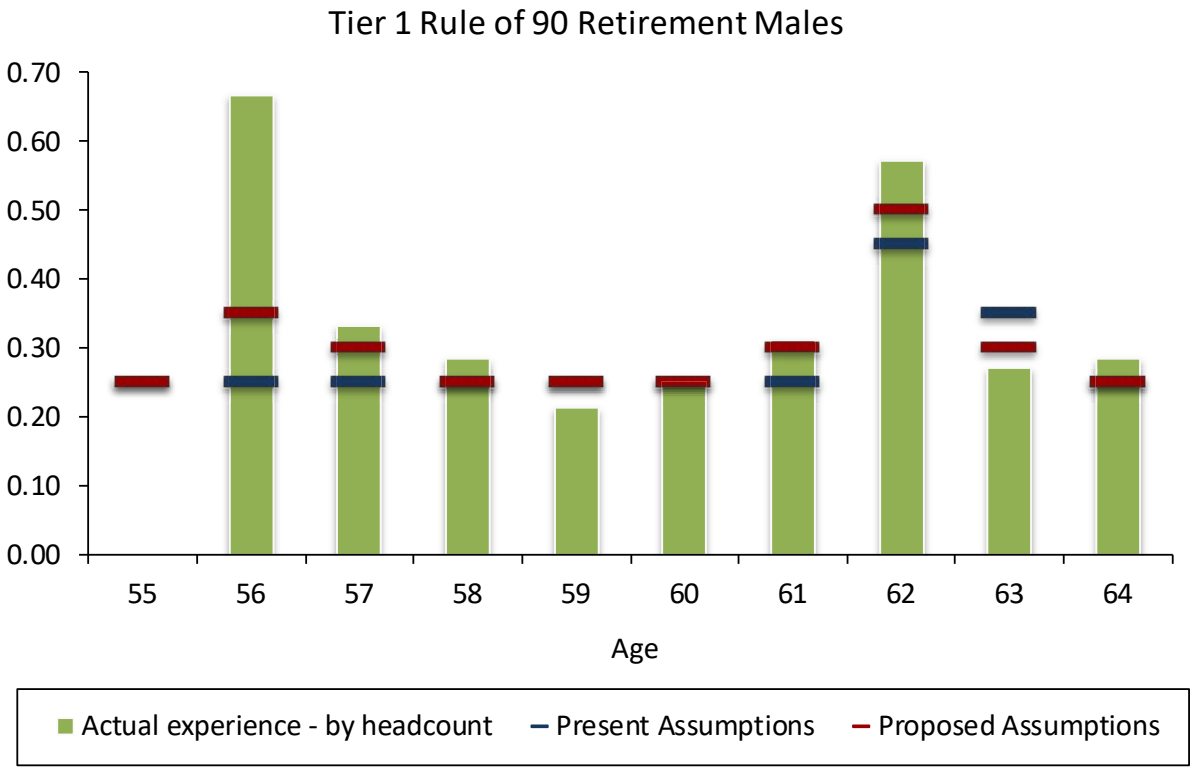
There were significantly more Rule of 90 retirements during the July 1, 2016 to June 30, 2021 period than during the previous experience study period. Our recommendation to increase Rule of 90 early retirement rates is consistent with the trend of more Rule of 90 early retirements, but is less than observed experience due to the change in trend.

Recommendation

We recommend changes to the assumed Rule of 90 retirement rates for males and females, as indicated on the next page.

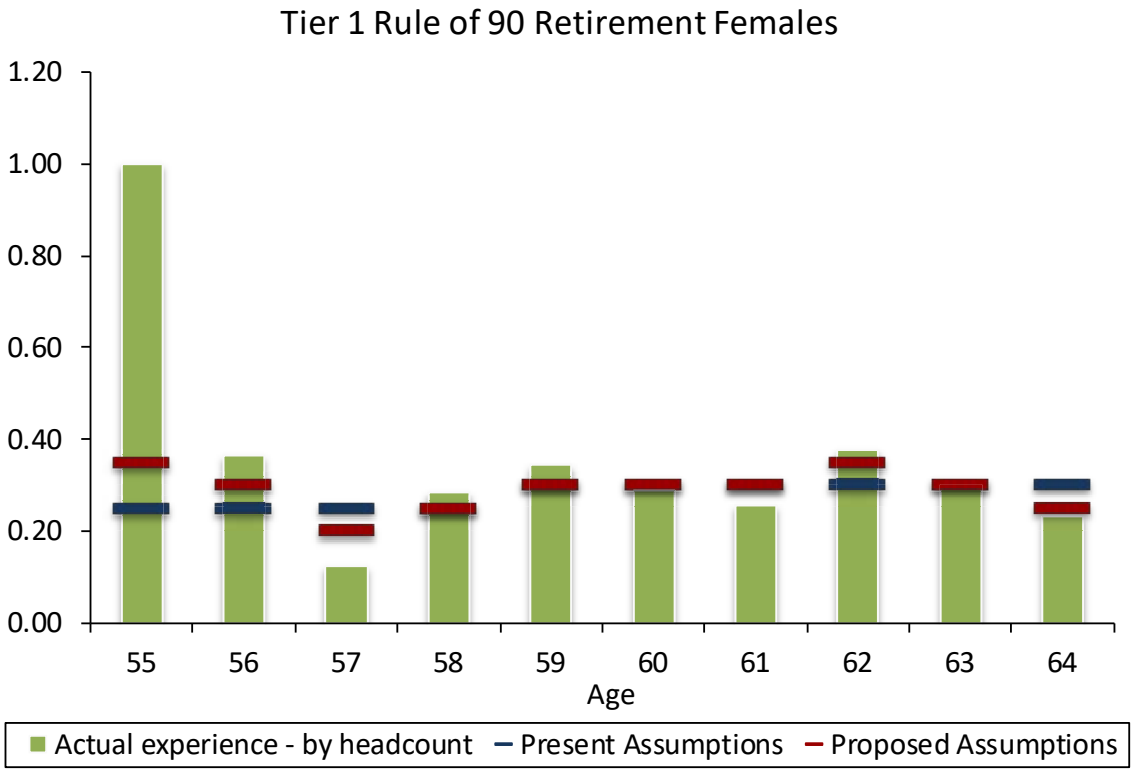
Rule of 90 (Unreduced) Early Retirement
Males

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Current	Proposed	Current	Proposed	Current	Proposed
55	-	-	N/A	25.00%	25.00%	-	-	N/A	N/A
56	2	3	66.7%	25.00%	35.00%	0.75	1.05	266.7%	190.5%
57	3	9	33.3%	25.00%	30.00%	2.25	2.70	133.3%	111.1%
58	4	14	28.6%	25.00%	25.00%	3.50	3.50	114.3%	114.3%
59	3	14	21.4%	25.00%	25.00%	3.50	3.50	85.7%	85.7%
60	4	16	25.0%	25.00%	25.00%	4.00	4.00	100.0%	100.0%
61	5	16	31.3%	25.00%	30.00%	4.00	4.80	125.0%	104.2%
62	8	14	57.1%	45.00%	50.00%	6.30	7.00	127.0%	114.3%
63	3	11	27.3%	35.00%	30.00%	3.85	3.30	77.9%	90.9%
64	2	7	28.6%	25.00%	25.00%	1.75	1.75	114.3%	114.3%
Totals	**34**	**104**				**29.90**	**31.60**	**113.7%**	**107.6%**



Rule of 90 (Unreduced) Early Retirement
Females

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Current	Proposed	Current	Proposed	Current	Proposed
55	1	1	100.0%	25.00%	35.00%	0.25	0.35	400.0%	285.7%
56	4	11	36.4%	25.00%	30.00%	2.75	3.30	145.5%	121.2%
57	5	41	12.2%	25.00%	20.00%	10.25	8.20	48.8%	61.0%
58	18	63	28.6%	25.00%	25.00%	15.75	15.75	114.3%	114.3%
59	26	75	34.7%	30.00%	30.00%	22.50	22.50	115.6%	115.6%
60	19	66	28.8%	30.00%	30.00%	19.80	19.80	96.0%	96.0%
61	16	62	25.8%	30.00%	30.00%	18.60	18.60	86.0%	86.0%
62	23	61	37.7%	30.00%	35.00%	18.30	21.35	125.7%	107.7%
63	16	53	30.2%	30.00%	30.00%	15.90	15.90	100.6%	100.6%
64	12	52	23.1%	30.00%	25.00%	15.60	13.00	76.9%	92.3%
Totals	**140**	**485**				**139.70**	**138.75**	**100.2%**	**100.9%**



Reduced Early Retirement

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

The early retirement benefit payable to members hired prior to July 1, 1989 is the greater of (a) or (b) and the early retirement benefit payable to members hired after June 30, 1989 is (b):

(a) 1.2% of average salary for each of the first ten years of service prior to July 1, 2015 plus 1.4% of average salary for each year of service after June 30, 2015. Additionally, for each subsequent year of service in excess of ten years, 1.7% of average salary for each subsequent year of service prior to July 1, 2015 plus 1.9% of average salary for each year rendered after June 30, 2015. There is a reduction equal to 0.25% for each month the member is under age 65 (or age 62 if 30 or more years of service).

(b) 1.7% of average salary for each year of service rendered before July 1, 2015 and 1.9% of average salary for each year of service rendered after June 30, 2015, reduced for each month the member is under Normal Retirement Age using linear interpolation of the factors in the table listed below:

	Under Age 62 or Less Than 30 Years of Service		Age 62 or Older with 30 Years of Service	
Normal Retirement Age:	**65**	**66**	**65**	**66**
Age at Retirement				
55	0.5376	0.4592		
56	0.5745	0.4992		
57	0.6092	0.5370		
58	0.6419	0.5726		
59	0.6726	0.6062		
60	0.7354	0.6726		
61	0.7947	0.7354		
62	0.8507	0.7947	0.8831	0.8389
63	0.9035	0.8507	0.9246	0.8831
64	0.9533	0.9035	0.9635	0.9246
65	1.0000	0.9533	1.0000	0.9635
66		1.0000		1.0000

Members hired prior to July 1, 1989 have a Normal Retirement Age of 65 whereas members hired after June 30, 1989 have a Normal Retirement Age equal to Social Security Normal Retirement Age, but not later than age 66.

Generally, higher rates of early retirement generally result in higher computed contributions due to the enhanced benefit, and vice-versa.

Findings

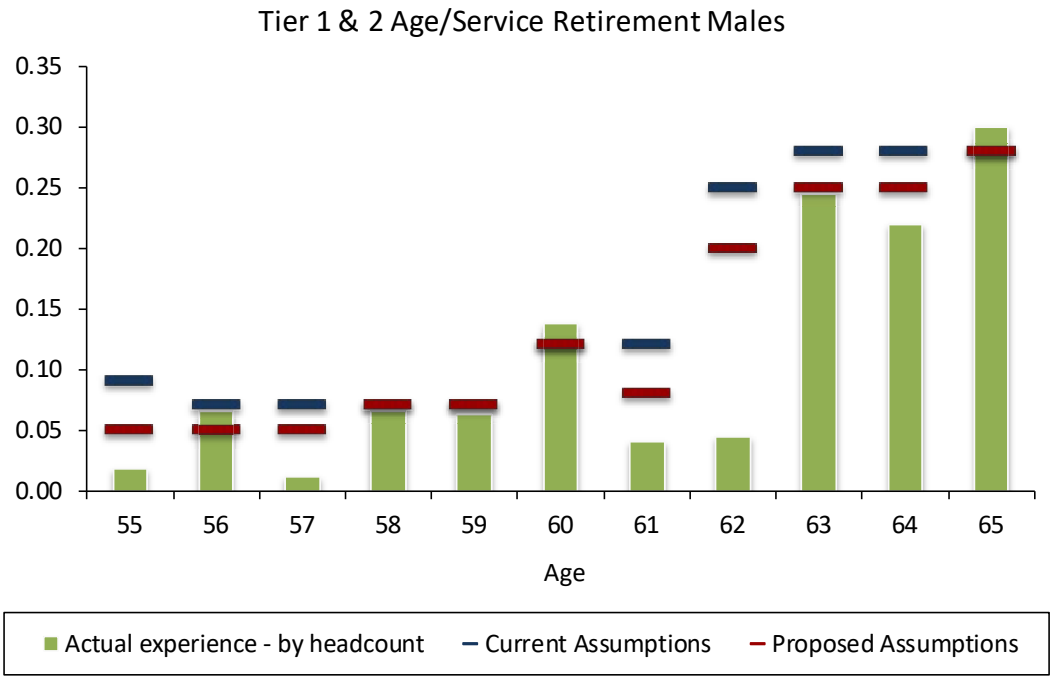
Overall, the plan experienced fewer reduced early retirements than projected by the present assumptions (313 expected versus 270 actual – see totals on the following pages). While we did not separately analyze retirements for members age 62 or older with 30 years of service, the utilization of early retirement at ages 62 and older was much lower than expected.

Recommendation

We recommend adjustments to the early retirement assumptions shown on the following pages.

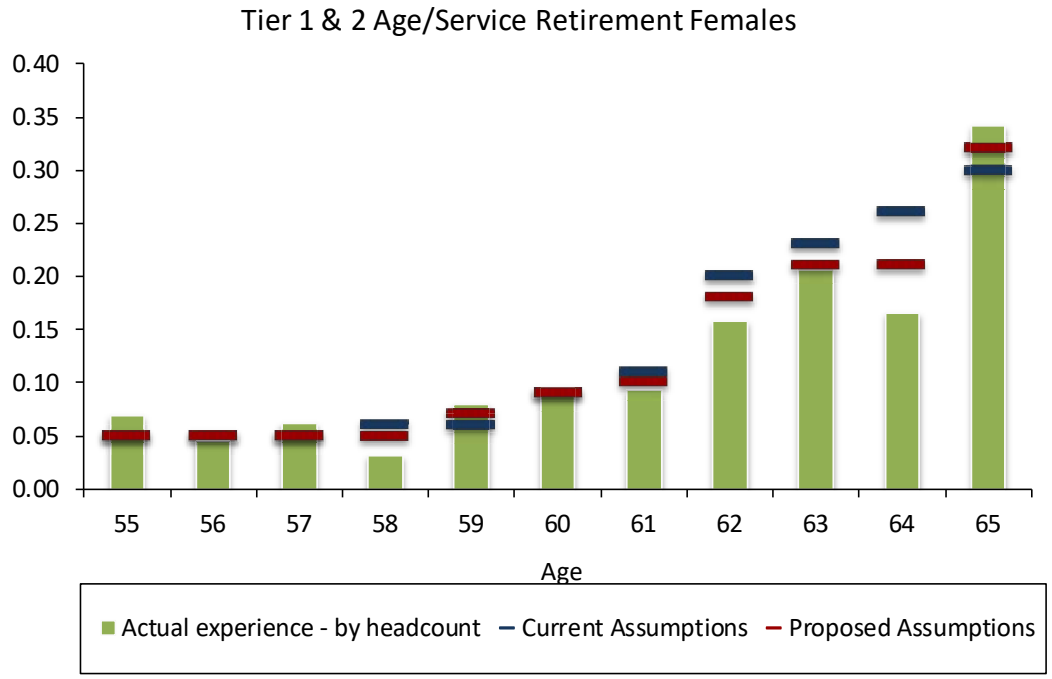
Reduced Early Retirement
Males

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Current	Proposed	Current	Proposed	Current	Proposed
55	2	108	1.9%	9.00%	5.00%	9.72	5.40	20.6%	37.0%
56	7	108	6.5%	7.00%	5.00%	7.56	5.40	92.6%	129.6%
57	1	88	1.1%	7.00%	5.00%	6.16	4.40	16.2%	22.7%
58	5	76	6.6%	7.00%	7.00%	5.32	5.32	94.0%	94.0%
59	4	64	6.3%	7.00%	7.00%	4.48	4.48	89.3%	89.3%
60	8	58	13.8%	12.00%	12.00%	6.96	6.96	114.9%	114.9%
61	2	49	4.1%	12.00%	8.00%	5.88	3.92	34.0%	51.0%
62	2	45	4.4%	25.00%	20.00%	11.25	9.00	17.8%	22.2%
63	10	41	24.4%	28.00%	25.00%	11.48	10.25	87.1%	97.6%
64	7	32	21.9%	28.00%	25.00%	8.96	8.00	78.1%	87.5%
65	6	20	30.0%	28.00%	28.00%	5.60	5.60	107.1%	107.1%
Totals	**54**	**689**				**83.37**	**68.73**	**64.8%**	**78.6%**



Reduced Early Retirement
Females

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Current	Proposed	Current	Proposed	Current	Proposed
55	24	347	6.9%	5.00%	5.00%	17.35	17.35	138.3%	138.3%
56	15	337	4.5%	5.00%	5.00%	16.85	16.85	89.0%	89.0%
57	19	306	6.2%	5.00%	5.00%	15.30	15.30	124.2%	124.2%
58	8	260	3.1%	6.00%	5.00%	15.60	13.00	51.3%	61.5%
59	19	238	8.0%	6.00%	7.00%	14.28	16.66	133.1%	114.0%
60	20	211	9.5%	9.00%	9.00%	18.99	18.99	105.3%	105.3%
61	17	183	9.3%	11.00%	10.00%	20.13	18.30	84.5%	92.9%
62	24	152	15.8%	20.00%	18.00%	30.40	27.36	78.9%	87.7%
63	27	131	20.6%	23.00%	21.00%	30.13	27.51	89.6%	98.1%
64	18	109	16.5%	26.00%	21.00%	28.34	22.89	63.5%	78.6%
65	25	73	34.2%	30.00%	32.00%	21.90	23.36	114.2%	107.0%
Totals	**216**	**2,347**				**229.27**	**217.57**	**94.2%**	**99.3%**



Retirement from Deferred Status

Members who terminate after completing three years of service are vested and entitled to either a refund of employee contributions, with interest, or a deferred retirement benefit.

Election of Refunds

While some members may 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.

Commencement of Benefits – Deferred Members

For deferred vested members, the current valuation assumption is that the member will commence benefits at age 62 (61 for Basic members).

We recommend no change to this assumption for Basic members. There is only one remaining Basic deferred vested member as of July 1, 2021.

For Coordinated members younger than age 70 in deferred status, there were 314 actual retirements over the five-year period of the study (there were an additional 34 at or over age 70). Of the 314 actual retirements, there were 164 retirements of members hired prior to July 1, 1989 and 150 retirements of members hired on or after July 1, 1989. These members receive an unreduced benefit at age 65 or 66, respectively. The average actual retirement age for these groups was 62.5 years and 63.1 years, respectively, with a total average retirement age of 62.8 years.

We recommend changing the retirement age assumption for Coordinated deferred members from age 62 to age 63.

SECTION E

TERMINATION EXPERIENCE

Termination Experience

Members who leave active employment, for reasons other than retirement 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 termination. The benefit is payable at Normal Retirement (or at Early Retirement with a reduction). Consequently, members who terminate receive much less from the plan than members who stay in employment until retirement. Higher rates of termination result in lower computed contributions, and vice-versa.

Our experience with similar systems has shown that sometimes the use of assumptions based solely on counts of people 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. For example, consider a plan with only two members who are both the same age and assume member one has an actuarial accrued liability of $10,000 and member two has an actuarial accrued liability of $90,000. If one of the members leaves and forfeits all of his or her liability, the rate of decrement is one out of two for a rate of 50%. However, the magnitude of the net gain or loss to the system is affected much more if member two leaves employment than if member one leaves employment.

As a result, our analysis is based on liability-weighted rates. 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 termination than with other decrements. This makes some intuitive sense, since termination decisions are often made based on how much the member has to gain or lose if they change jobs, whereas death and disability is typically not a decision at all, but rather an event that happens to someone.

Some members are eligible for retirement 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 purpose of this study.

Current valuation termination rates for members are gender-specific and service based.

Termination Experience

Findings

The number of terminations on a population weighted basis was lower than the number observed in the prior experience study. Similarly, the plan experienced less liability leaving the plan than projected by the present assumptions ($81 million in actual terminations versus $130 million expected).

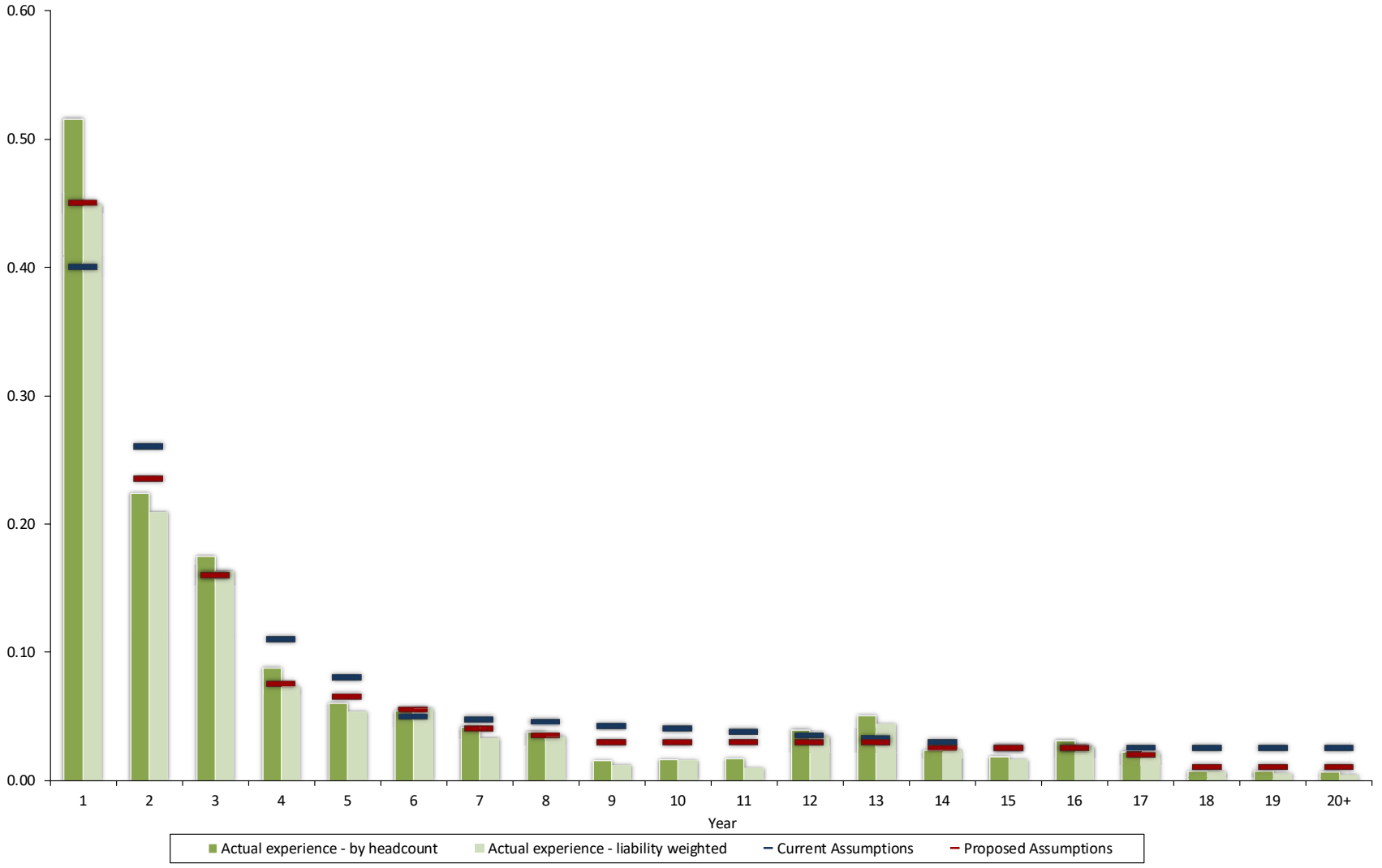
Recommendation

As we examined the patterns of termination, the experience continues to have a strong relationship to service. We recommend adjustments to the current service-based termination table, as indicated on the following pages.

Termination Experience
Males

Year	Liability Weighted ($ 000s)		Crude Rates		Sample Rates		Liability Weighted ($ 000s)			
							Expected Terminations		Ratio of Actuals/Expecteds	
	Actual Terminations	Exposure	Liability Weighted	Population Weighted	Current	Proposed	Current	Proposed	Current	Proposed
1	1,476	3,288	0.4489	0.5152	0.4000	0.4500	1,315.20	1,479.65	112.2%	99.8%
2	3,487	16,640	0.2096	0.2238	0.2600	0.2350	4,326.40	3,910.04	80.6%	89.2%
3	2,716	16,650	0.1631	0.1745	0.1600	0.1600	2,664.00	2,664.00	102.0%	102.0%
4	1,317	17,956	0.0733	0.0878	0.1100	0.0750	1,975.16	1,346.75	66.7%	97.8%
5	1,076	19,925	0.0540	0.0603	0.0800	0.0650	1,594.00	1,295.13	67.5%	83.1%
6	1,103	19,787	0.0557	0.0543	0.0500	0.0550	989.35	1,088.27	111.5%	101.4%
7	642	19,566	0.0328	0.0412	0.0475	0.0400	929.39	782.63	69.1%	82.0%
8	649	18,779	0.0346	0.0377	0.0450	0.0350	845.07	657.25	76.8%	98.7%
9	211	16,884	0.0125	0.0153	0.0425	0.0300	717.57	506.50	29.4%	41.7%
10	288	17,776	0.0162	0.0159	0.0400	0.0300	711.04	533.30	40.5%	54.0%
11	173	17,330	0.0100	0.0169	0.0375	0.0300	649.89	519.90	26.6%	33.3%
12	687	20,038	0.0343	0.0394	0.0350	0.0300	701.34	601.14	98.0%	114.3%
13	1,024	23,318	0.0439	0.0507	0.0325	0.0300	757.85	699.54	135.1%	146.4%
14	532	22,338	0.0238	0.0240	0.0300	0.0250	670.14	558.49	79.4%	95.3%
15	331	20,205	0.0164	0.0183	0.0250	0.0250	505.15	505.12	65.5%	65.5%
16	665	25,197	0.0264	0.0310	0.0250	0.0250	629.94	629.90	105.6%	105.6%
17	587	27,338	0.0215	0.0224	0.0250	0.0200	683.46	546.78	85.9%	107.4%
18	208	28,710	0.0072	0.0075	0.0250	0.0100	717.77	287.10	29.0%	72.4%
19	175	31,610	0.0055	0.0072	0.0250	0.0100	790.25	316.09	22.1%	55.4%
20+	1,816	377,752	0.0048	0.0067	0.0250	0.0100	9,443.82	3,777.54	19.2%	48.1%
Totals	**19,163**	**761,087**	**0.0252**	**0.0736**	**0.0415**	**0.0298**	**31,616.79**	**22,705.12**	**60.6%**	**84.4%**

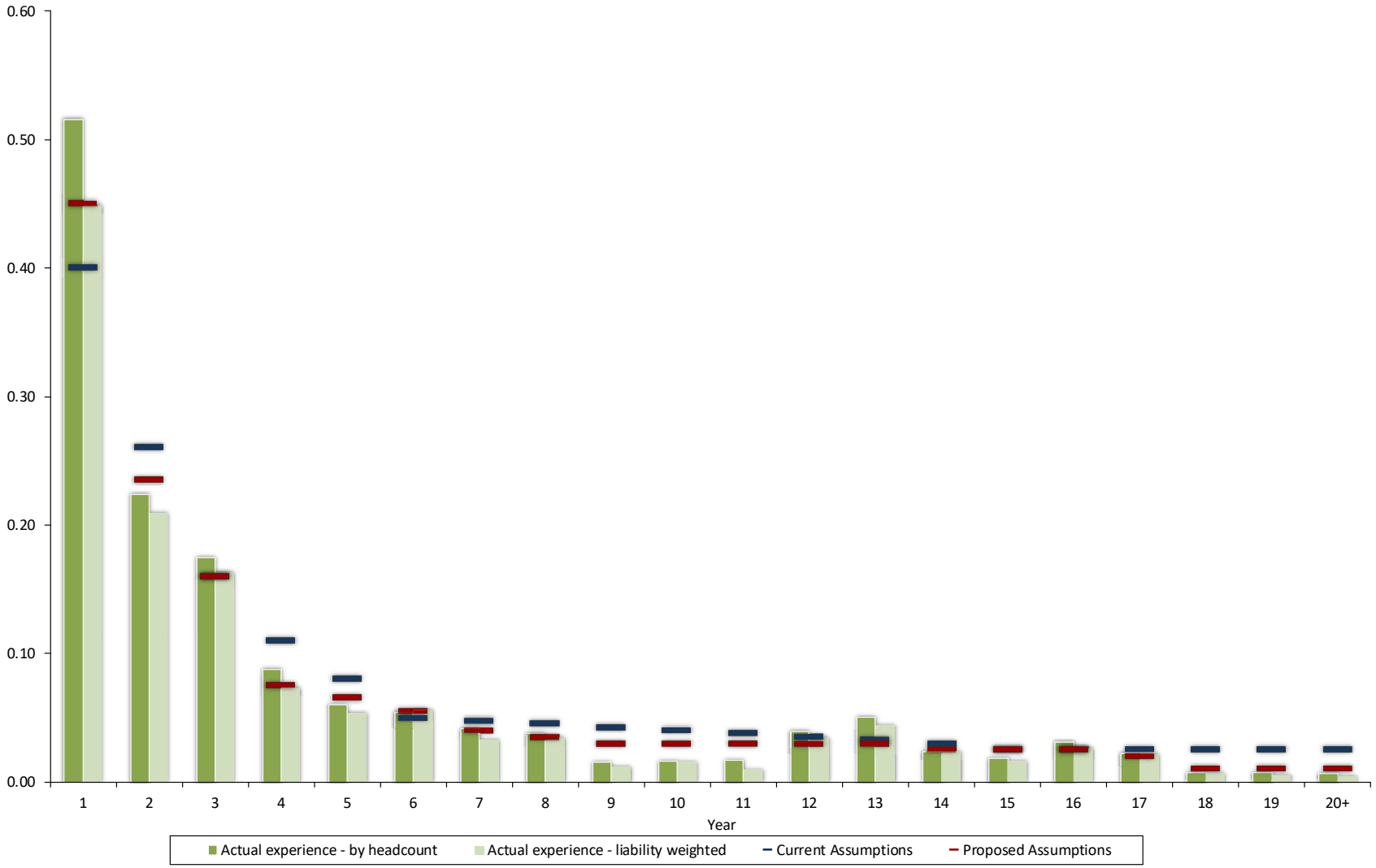
Termination Experience
Males



Termination Experience
Females

Year	Liability Weighted ($ 000s)		Crude Rates		Sample Rates		Liability Weighted ($ 000s)			
	Actual Terminations	Exposure	Liability Weighted	Population Weighted	Current	Proposed	Expected Terminations		Ratio of Actuals/Expecteds	
							Current	Proposed	Current	Proposed
1	4,730	9,944	0.4757	0.5332	0.4000	0.4500	3,977.60	4,475.01	118.9%	105.7%
2	8,867	48,207	0.1839	0.2138	0.2200	0.2000	10,605.54	9,641.53	83.6%	92.0%
3	5,039	51,340	0.0981	0.1034	0.1500	0.1200	7,701.00	6,160.83	65.4%	81.8%
4	4,158	60,085	0.0692	0.0694	0.1200	0.0950	7,210.20	5,708.04	57.7%	72.8%
5	3,509	66,849	0.0525	0.0609	0.1000	0.0750	6,684.90	5,013.67	52.5%	70.0%
6	4,533	70,330	0.0645	0.0694	0.0850	0.0700	5,978.06	4,923.16	75.8%	92.1%
7	3,415	67,488	0.0506	0.0480	0.0700	0.0600	4,724.16	4,049.36	72.3%	84.3%
8	3,099	64,926	0.0477	0.0561	0.0550	0.0500	3,570.94	3,246.30	86.8%	95.5%
9	2,770	57,862	0.0479	0.0502	0.0450	0.0500	2,603.80	2,893.12	106.4%	95.7%
10	2,805	53,073	0.0529	0.0537	0.0400	0.0500	2,122.92	2,653.67	132.1%	105.7%
11	1,983	50,149	0.0395	0.0479	0.0375	0.0400	1,880.59	2,005.97	105.4%	98.9%
12	852	51,939	0.0164	0.0130	0.0350	0.0300	1,817.87	1,558.18	46.9%	54.7%
13	878	61,937	0.0142	0.0174	0.0300	0.0250	1,858.11	1,548.45	47.3%	56.7%
14	1,538	72,356	0.0213	0.0216	0.0250	0.0200	1,808.91	1,447.11	85.0%	106.3%
15	2,712	78,624	0.0345	0.0356	0.0200	0.0200	1,572.48	1,572.47	172.5%	172.5%
16	1,043	90,283	0.0116	0.0117	0.0200	0.0200	1,805.66	1,805.67	57.8%	57.8%
17	1,954	101,849	0.0192	0.0218	0.0200	0.0200	2,036.98	2,036.97	95.9%	95.9%
18	1,568	98,899	0.0159	0.0189	0.0200	0.0175	1,977.98	1,730.73	79.3%	90.6%
19	1,542	102,035	0.0151	0.0169	0.0200	0.0150	2,040.70	1,530.54	75.6%	100.7%
20+	4,840	1,297,939	0.0037	0.0047	0.0200	0.0100	25,958.78	12,979.43	18.6%	37.3%
Totals	**61,835**	**2,556,114**	**0.0242**	**0.0695**	**0.0383**	**0.0301**	**97,937.18**	**76,980.21**	**63.1%**	**80.3%**

Termination Experience
Females



SECTION F

DISABILITY EXPERIENCE

Disability Experience

Findings

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.

We reviewed the disability experience during the five-year period. The results are shown on the following page. Overall, the actual number of disability retirements is less than predicted by the current assumption (3 actual versus 12.5 expected, see chart on the following page).

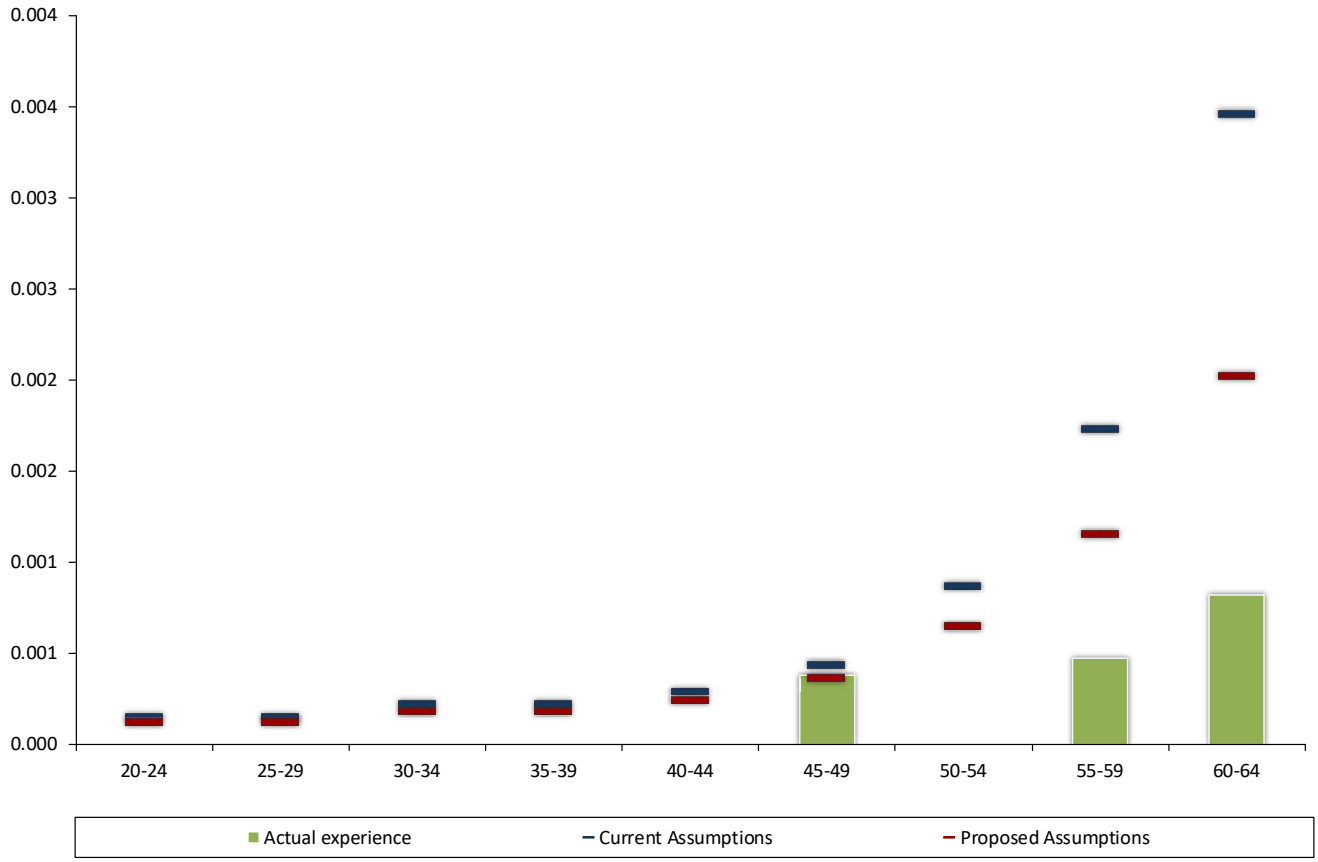
There were 9 disability retirements during the 2011-2016 experience study (three times the current amount). This experience, combined with the 2016-2021 experience, was taken into account when setting the new proposed rates.

Recommendation

We recommend reducing the rates of disability incidence as shown on the following page. The new rates will predict approximately 31% fewer disability retirements on average.

Disability Experience
Males and Females

Age	Disabilities	Exposure	Crude Rates	Sample Rates		Expected Disabilities		Ratio of Actuals/Expecteds	
				Current	Proposed	Current	Proposed	Current	Proposed
20-24	-	4	0.0000%	0.0144%	0.0120%	-	0.00	N/A	0.0%
25-29	-	604	0.0000%	0.0144%	0.0120%	0.07	0.07	0.0%	0.0%
30-34	-	1,599	0.0000%	0.0216%	0.0180%	0.34	0.29	0.0%	0.0%
35-39	-	2,115	0.0000%	0.0216%	0.0180%	0.45	0.38	0.0%	0.0%
40-44	-	2,357	0.0000%	0.0288%	0.0240%	0.68	0.57	0.0%	0.0%
45-49	1	2,614	0.0383%	0.0432%	0.0360%	1.12	0.94	89.3%	106.3%
50-54	-	2,331	0.0000%	0.0864%	0.0648%	2.01	1.51	0.0%	0.0%
55-59	1	2,104	0.0475%	0.1728%	0.1152%	3.65	2.42	27.4%	41.3%
60-64	1	1,219	0.0820%	0.3456%	0.2016%	4.21	2.46	23.8%	40.7%
Totals	**3**	**14,947**	**0.0201%**	**0.0795%**	**0.0554%**	**12.53**	**8.64**	**23.9%**	**34.7%**



SECTION G

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, because of the relatively low frequency of pre-retirement deaths. Assumptions are typically based on a standard table rather than actual plan experience, because experience is usually not statistically significant, except for very large retirement systems.

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 SPTRFA retiree and disability mortality on a "benefit-weighted" basis and have shown the results on pages G-4 through G-5 of this report. Consistent with the SOA study, SPTRFA 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 SPTRFA 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-2021 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 five-year period, there were 164 male retiree deaths and 241 female retiree deaths. The healthy retiree mortality experience is not considered to be fully credible since there were less than 1,000 deaths. Therefore, we recommend a blend of the standard industry table and the plan's experience. Pre-retirement mortality is also not considered to be fully credible.

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

Healthy Retirees

We reviewed the mortality experience of healthy retirees during the five-year period. 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 ($6,979,000 actual versus $7,189,000 expected) and more female deaths than expected ($7,376,000 actual versus $6,381,000 expected).

Disabled Retirees

SPTRFA does not have enough disabled deaths to allow for assumption setting based on actual data. In addition, members who leave active status due to a disability are reclassified as retirees at Normal Retirement age. These members are included in the healthy retiree analysis.

Active Members

On a liability-weighted basis, the plan experienced fewer male deaths than expected ($564,000 actual versus $1,329,000 expected) and fewer female deaths than expected ($756,000 actual versus $3,281,000 expected).

Mortality Experience

Recommendations

The experience of the St. Paul Teachers' Retirement Fund Association is not large enough to be considered credible for purposes of setting mortality assumptions. As such, we recommend adoption of standard mortality tables. The recommended adjustment factors are based on credibility theory formulas. For example, the proposed female retiree mortality table predicts too few deaths. If the experience were fully credible (i.e., more than 1,000 deaths), we would adjust the table by a factor of 1.08. However, since there were only 241 female retiree deaths (on a head-count weighted basis) during the five-year period, we restrict the credibility of the plan's experience and limit the adjustment applied to the standard table to a factor of 1.03. In addition, since the data does not distinguish disabled retirees from healthy retirees after Normal Retirement Age, we recommend utilizing the same mortality for disabled members as healthy members.

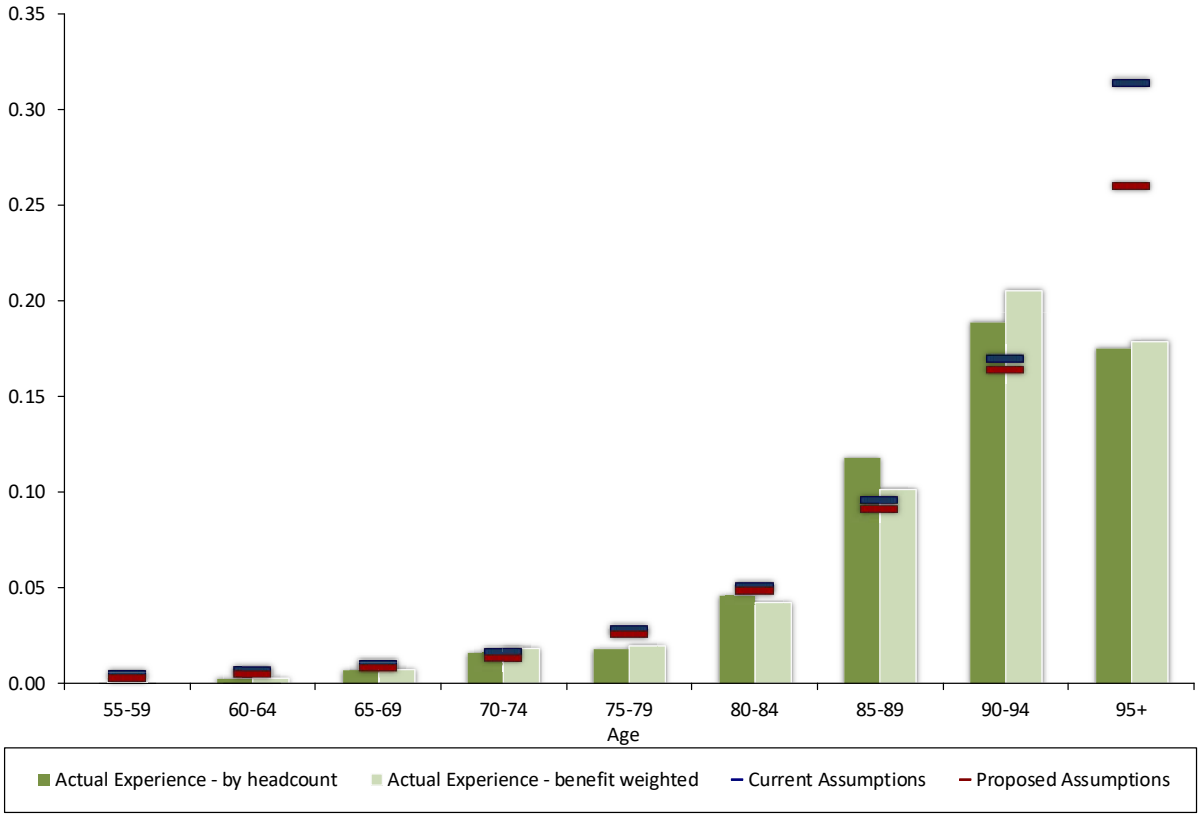
We recommend adoption of the following mortality tables:

Healthy and Disabled Male Retirees:	Pub-2010 Male Healthy Teacher Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2021 from 2010. Rates are multiplied by a factor of 1.03.
Healthy and Disabled Female Retirees:	Pub-2010 Female Healthy Teacher Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2021 from 2010. Rates are multiplied by a factor of 1.03.
Male Active Members:	Pub-2010 Male Healthy Teacher Employee Mortality Table, adjusted for mortality improvements using projection scale MP-2021 from 2010.
Female Active Members:	Pub-2010 Female Healthy Teacher Employee Mortality Table, adjusted for mortality improvements using projection scale MP-2021 from 2010.

Post-Retirement Mortality Experience
Healthy and Disabled Males

Age	Benefit Weighted ($ 000s)		Crude Rates		Sample Rates		Benefit-Weighted ($000s) Expected Deaths		Ratio of Actuals/Expecteds	
	Actual Deaths	Exposure	Liability Weighted	Population Weighted	Current	Proposed*	Current	Proposed*	Current	Proposed*
55-59	-	1,547	0.0000%	0.0000%	0.4579%	0.2822%	7.56	4.85	0.0%	0.0%
60-64	24	8,453	0.2839%	0.2660%	0.6552%	0.4679%	57.73	41.68	41.6%	57.6%
65-69	182	25,779	0.7060%	0.6737%	0.9826%	0.7574%	263.26	204.03	69.1%	89.2%
70-74	817	44,083	1.8533%	1.5970%	1.6114%	1.3294%	711.80	587.39	114.8%	139.1%
75-79	782	39,842	1.9628%	1.7740%	2.8072%	2.5137%	1,110.87	993.88	70.4%	78.7%
80-84	1,487	34,942	4.2556%	4.5822%	5.0997%	4.8076%	1,743.57	1,641.82	85.3%	90.6%
85-89	2,159	21,273	10.1490%	11.7936%	9.5239%	9.1268%	1,960.65	1,878.90	110.1%	114.9%
90-94	1,290	6,293	20.4990%	18.8811%	16.9490%	16.3523%	1,004.23	966.50	128.5%	133.5%
95+	238	1,334	17.8411%	17.5000%	31.3554%	25.9830%	329.18	325.63	72.3%	73.1%
Totals	**6,979**	**183,546**	**3.8023%**	**3.1418%**	**3.9166%**	**3.6202%**	**7,188.85**	**6,644.68**	**97.1%**	**105.0%**

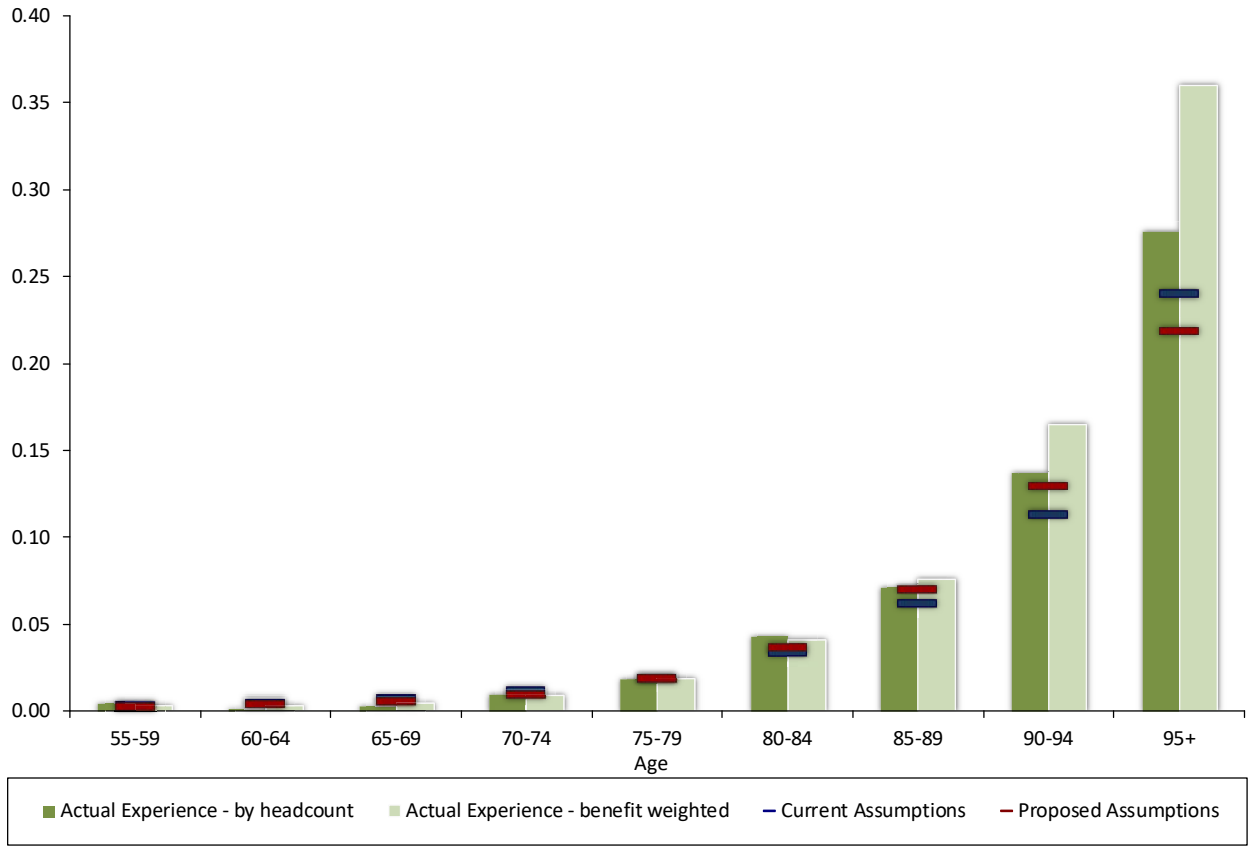
* *In order to show the fit for the five-year period of the study, New Sample Rates and New Expected Deaths were determined using the proposed mortality rates projected to the mid-point of the study (2019) using projection scale MP-2021.*



Post-Retirement Mortality Experience
Healthy and Disabled Females

Age	Benefit Weighted ($ 000s)		Crude Rates		Sample Rates		Benefit-Weighted ($000s) Expected Deaths		Ratio of Actuals/Expecteds	
	Actual Deaths	Exposure	Liability Weighted	Population Weighted	Current	Proposed*	Current	Proposed*	Current	Proposed*
55-59	15	5,179	0.2896%	0.4167%	0.2933%	0.2449%	16.43	13.92	91.3%	107.8%
60-64	109	36,239	0.3008%	0.1415%	0.4337%	0.3569%	164.46	133.88	66.3%	81.4%
65-69	356	81,933	0.4345%	0.3052%	0.6837%	0.5286%	570.41	441.55	62.4%	80.6%
70-74	804	91,960	0.8743%	0.9474%	1.0921%	0.9351%	987.29	841.14	81.4%	95.6%
75-79	916	50,058	1.8299%	1.8211%	1.8647%	1.8434%	914.65	899.87	100.1%	101.8%
80-84	1,510	37,045	4.0761%	4.2535%	3.3273%	3.6350%	1,204.56	1,312.16	125.4%	115.1%
85-89	1,561	20,676	7.5498%	7.1097%	6.1340%	6.9847%	1,227.14	1,396.18	127.2%	111.8%
90-94	1,439	8,725	16.4928%	13.7255%	11.2882%	12.9017%	947.05	1,082.58	151.9%	132.9%
95+	665	1,846	36.0238%	27.5862%	23.9967%	21.8339%	348.60	397.38	190.8%	167.3%
Totals	**7,375**	**333,661**	**2.2103%**	**1.9581%**	**1.9123%**	**1.9537%**	**6,380.59**	**6,518.66**	**115.6%**	**113.1%**

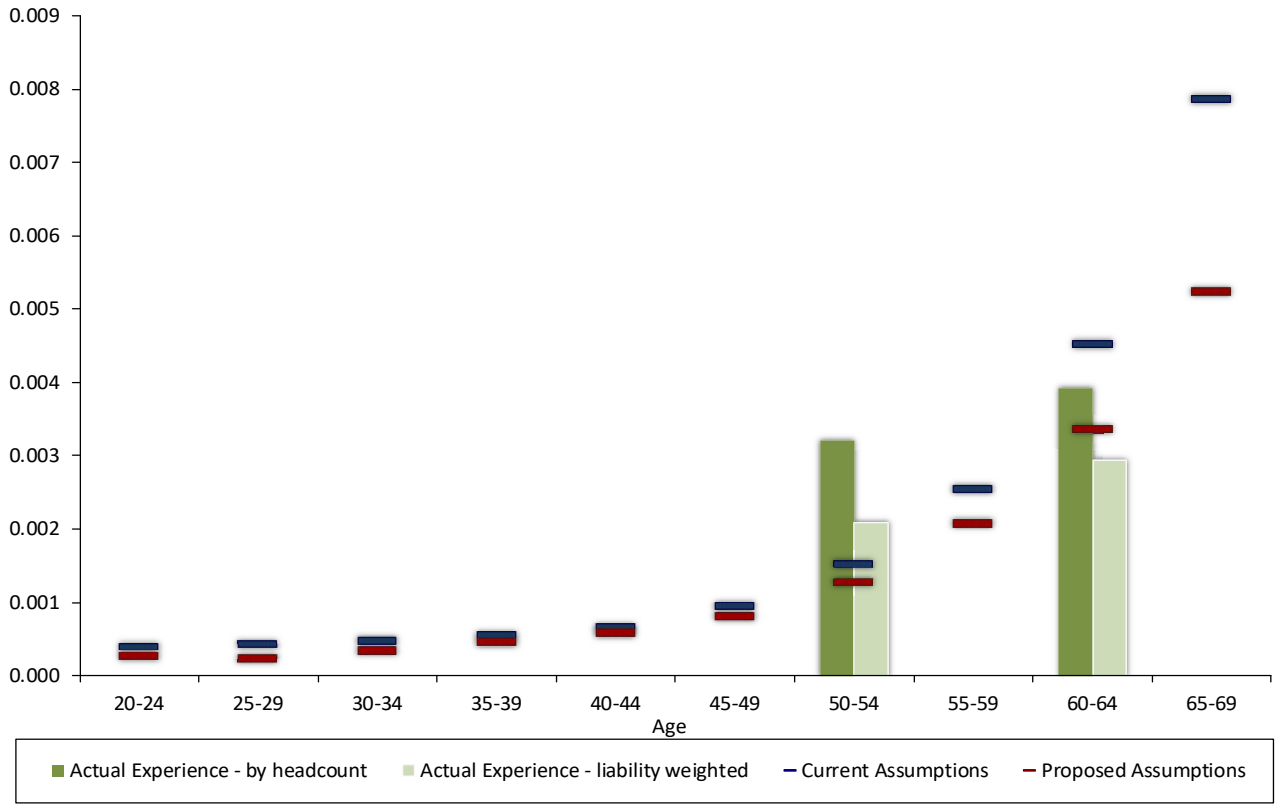
* *In order to show the fit for the five-year period of the study, New Sample Rates and New Expected Deaths were determined using the proposed mortality rates projected to the mid-point of the study (2019) using projection scale MP-2021.*



Pre-Retirement Mortality Experience
Healthy Males

Age	Liability-Weighted ($000s)		Crude Rates		Sample Rates		Liability-Weighted ($000s) Expected Deaths		Ratio of Actuals/Expecteds	
	Liability-Weighted	Exposure	Liability-Weighted	Population-Weighted	Current	Proposed*	Current	Proposed*	Current	Proposed
20-24	-	-	N/A		0.0387%	0.0268%	-	-	N/A	N/A
25-29	-	6,894	0.0000%	0.0000%	0.0415%	0.0222%	2.85	1.69	0.0%	0.0%
30-34	-	32,650	0.0000%	0.0000%	0.0477%	0.0340%	15.82	11.43	0.0%	0.0%
35-39	-	61,669	0.0000%	0.0000%	0.0544%	0.0453%	33.63	28.18	0.0%	0.0%
40-44	-	95,118	0.0000%	0.0000%	0.0642%	0.0569%	61.78	54.82	0.0%	0.0%
45-49	-	144,152	0.0000%	0.0000%	0.0934%	0.0804%	136.09	117.04	0.0%	0.0%
50-54	323	154,627	0.2091%	0.3210%	0.1515%	0.1273%	233.52	196.27	138.5%	164.8%
55-59	-	144,991	0.0000%	0.0000%	0.2532%	0.2065%	361.70	295.63	0.0%	0.0%
60-64	241	81,792	0.2944%	0.3922%	0.4527%	0.3357%	354.46	265.13	67.9%	90.8%
65-69	-	17,783	0.0000%	0.0000%	0.7856%	0.5222%	128.89	87.17	0.0%	0.0%
Totals	**564**	**739,676**	**0.0763%**	**0.0808%**	**0.1796%**	**0.1429%**	**1,328.74**	**1,057.36**	**42.5%**	**53.4%**

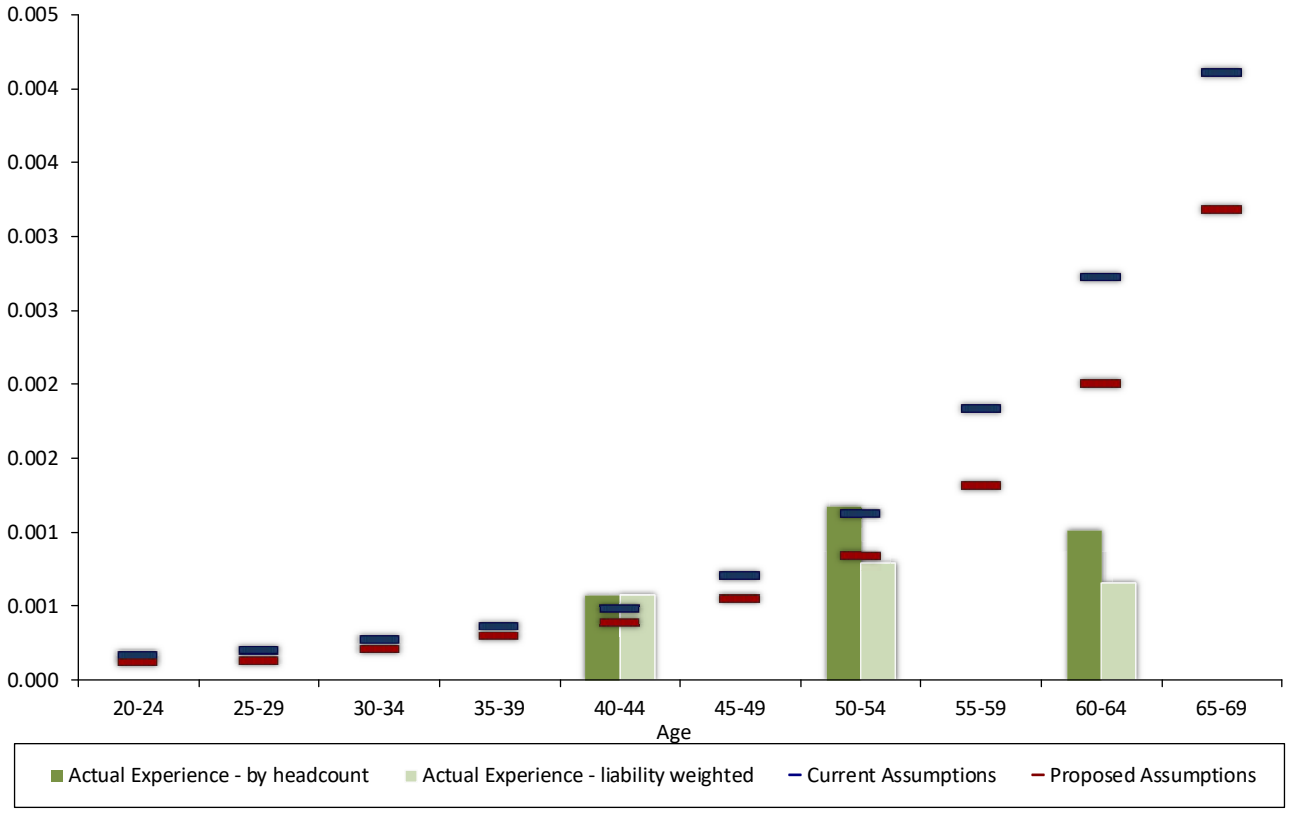
** In order to show the fit for the five-year period of the study, New Sample Rates and New Expected Deaths were determined using the proposed mortality rates projected to the mid-point of the study (2019) using projection scale MP-2021.*



Pre-Retirement Mortality Experience
Healthy Females

	Liability-Weighted ($000s)		Crude Rates		Sample Rates		Liability-Weighted ($000s) Expected Deaths		Ratio of Actuals/Expecteds	
Age	Liability-Weighted	Exposure	Liability-Weighted	Population-Weighted	Current	Proposed*	Current	Proposed*	Current	Proposed
20-24	-	216	0.0000%	0.0000%	0.0165%	0.0116%	0.04	0.02	0.0%	0.0%
25-29	-	35,214	0.0000%	0.0000%	0.0199%	0.0128%	7.43	4.87	0.0%	0.0%
30-34	-	118,671	0.0000%	0.0000%	0.0273%	0.0212%	32.94	25.70	0.0%	0.0%
35-39	-	213,006	0.0000%	0.0000%	0.0358%	0.0296%	77.07	63.82	0.0%	0.0%
40-44	170	293,410	0.0579%	0.0574%	0.0475%	0.0389%	140.42	115.08	121.0%	147.7%
45-49	-	405,979	0.0000%	0.0000%	0.0703%	0.0545%	288.50	223.53	0.0%	0.0%
50-54	356	451,776	0.0787%	0.1171%	0.1128%	0.0835%	512.22	379.14	69.4%	93.8%
55-59	-	548,310	0.0000%	0.0000%	0.1830%	0.1312%	997.33	715.15	0.0%	0.0%
60-64	230	350,086	0.0658%	0.1007%	0.2721%	0.2008%	935.21	687.53	24.6%	33.5%
65-69	-	78,476	0.0000%	0.0000%	0.4101%	0.3177%	289.57	223.92	0.0%	0.0%
Totals	**756**	**2,495,145**	**0.0303%**	**0.0346%**	**0.1315%**	**0.0977%**	**3,280.72**	**2,438.76**	**23.0%**	**31.0%**

* *In order to show the fit for the five-year period of the study, New Sample Rates and New Expected Deaths were determined using the proposed mortality rates projected to the mid-point of the study (2019) using projection scale MP-2021.*



SECTION H

ACTUARIAL METHODS

Asset Valuation Method

Background

Employer contribution calculations are based on a smoothed asset valuation method (the actuarial value of assets). Such smoothed valuation methods aid in developing a contribution amount calculated to remain approximately level from year to year.

Per Minnesota Statute 356.215(f), the actuarial value of assets is based on a five-year moving average of expected and market values determined as follows:

- At the end of each plan year, an average asset value is calculated as the average of the market asset value at the beginning and end of the fiscal year, net of investment income for the fiscal year;
- The investment gain or (loss) is equal to the excess of actual investment income over the expected investment income based on the average asset value as calculated above;
- The investment gain or (loss) so determined is recognized over five years at 20% per year; and
- The asset value is the sum of the expected asset value plus the schedule recognition of investment gains or (losses) during the current and the preceding four plan years.

During periods when investment performance exceeds the assumed rate, the actuarial value of assets will tend to be less than the market value of assets. During periods when investment performance is less than the assumed rate, the actuarial value of assets will tend to be greater than the market value of assets. If assumed rates are exactly realized for four consecutive years, the actuarial value of assets will become equal to market value of assets.

This asset valuation method satisfies current standards of practice, which require that the asset valuation method reflect some function of market value, be unbiased in relation to market value, and recognize gains and losses consistently and over a reasonable period.

In 2007, the Actuarial Standards Board issued a standard on asset valuation methods which requires that the asset valuation method bear a reasonable relationship to current market value. There may be some concern that if the deviation between the funding value of assets and the market value of assets becomes too large, it could be considered unreasonable. The alternative to allowing large deviations usually involves setting upper and lower bounds (corridors) for the relationship between funding value and market value. Once a corridor limit is reached, any further market experience in the same direction is recognized immediately, which can introduce substantial fluctuations in the results of the actuarial valuation. If a 20% corridor were applied to the June 30, 2021 actuarial value of assets, it would not change the numerical result (the asset value would be unchanged).

Recommendation

We recommend continued use of the current asset valuation method. SPTRFA should continue to consider results based on the market value of assets as well as the actuarial value of assets, especially when the two values are significantly different.

Funding Policy – Actuarial Funding Method

An actuarial funding method is a set of techniques for conversion of the actuarial present values of benefits into contribution information. Minnesota Statute requires the actuary to use the entry age actuarial cost method, characterized by:

1. **Normal Cost** – the level percent of payroll contribution, paid from each member's date of plan entry to date of retirement, which will accumulate enough assets at retirement to fund the member's projected benefits from retirement to death.

2. **Actuarial Accrued Liability** – the assets which would have accumulated to date had contributions been made at the level of the normal cost since the date of the first benefit accrual, all actuarial assumptions had been exactly realized, and there had been no benefit changes.

The total contribution produced by an actuarial method is the total of the normal cost and an amount to amortize any unfunded actuarial accrued liability.

The entry age actuarial method is the most prevalent funding method in the public sector. It is appropriate for the public sector because it produces costs that remain stable as a percentage of payroll over time, resulting in intergenerational equity for taxpayers.

Recommendations

We recommend continued use of the entry age actuarial cost method.

Funding Policy – Amortization

Amortization Period

Minnesota Statute 356.215, Subdivision 11 specifies June 30, 2048 as the established date for full funding of the St. Paul Teachers' Retirement Fund Association (SPTRFA). If the unfunded liability increases due to changes in benefits, assumptions, or methods, the statutory amortization date may be extended (limited to 30 years). The June 30, 2021 actuarial valuation amortizes the UAAL over a 27-year period (i.e., June 30, 2048). The amortization period decreases each year by one year (like a typical mortgage).

In 2018, legislation changed the statutory amortization date from June 30, 2042 to June 30, 2048. Past practice has typically been to re-establish a new 30-year statutory amortization period occasionally in order to minimize volatility and manage cost requirements. This practice shifts costs to the future. In lieu of this, SPTRFA could consider using a shorter maximum period, such as 15, 20 or 25 years, so as to ensure funding of benefits earned today is not shifted unreasonably far into the future. Actuarial practice, including Governmental Accounting Standards Board policy, is moving toward shorter amortization periods than in the past.

Another option to consider is the use of "layered" amortization – which continues to amortize the initial unfunded liability over the closed amortization period, but spreads out gains and losses as they occur over a separate closed period. This methodology maintains steady progress toward eliminating the unfunded liability.

Amortization Method

Because SPTRFA is an open retirement plan (new employees enter the plan), level percent of payroll amortization payments are used.

Longer amortization periods combined with the level percent of pay methodology results in initial payments that are less than the "interest only" payment on the unfunded actuarial accrued liability, i.e., "negative amortization." Payments less than the interest only amount will result in the UAAL increasing for an initial period of time. However, expected contributions to the SPTRFA are projected to reduce the unfunded actuarial accrued liability due to the current contribution sufficiency.

It should be noted that actual growth in SPTRFA payroll over the past five years has fallen short of the expected rate of 3.0% (proposed payroll growth rate is 2.5%). When payroll grows slower than expected, contributions collected will also be less than expected, and insufficient to eliminate the UAAL by the statutory amortization date.

Funding Policy – Amortization

The following table shows actual covered payroll for the St. Paul Teachers' Retirement Fund Association over the last 20 years.

Year Ended June 30	Actual Covered Payroll (000s)	Increase in Actual Covered Payroll
1997	$ 151,363	
1998	168,564	11.4%
1999	178,254	5.7%
2000	187,950	5.4%
2001	202,915	8.0%
2002	201,456	-0.7%
2003	205,655	2.1%
2004	221,685	7.8%
2005	223,762	0.9%
2006	226,351	1.2%
2007	229,172	1.2%
2008	235,993	3.0%
2009	243,166	3.0%
2010	239,996	-1.3%
2011	239,738	-0.1%
2012	239,053	-0.3%
2013	247,432	3.5%
2014	259,740	5.0%
2015	263,844	1.6%
2016	258,787	-1.9%
2017	264,342	2.1%
2018	263,122	-0.5%
2019	268,614	2.1%
2020	274,667	2.3%
2021	279,916	1.9%

5-year average:	**1.6%**
10-year average:	**1.6%**
15-year average:	**1.4%**

Funding Policy – Payroll Growth

Actual payroll growth has averaged approximately 1.6% for the prior five years (1.3% less than price inflation for calendar years 2016-2021 and 0.3% less than price inflation if 2021 inflation is excluded). For the past decade, actual payroll growth is 0.5% less than price inflation for calendar years 2011-2021 and equal to price inflation if 2021 is excluded). The low rate of total payroll growth fell far short of the assumption that it would grow 3% per year (proposed payroll growth assumption is 2.5%).

Active membership has declined in recent years, from 3,577 on July 1, 2018 to 3,399 on July 1, 2021. The greatest decrease occurred in the 2018-2019 year (down 3.1%, to 3,467 active members on July 1, 2019). Many factors could be responsible for the membership decline from 2019 to 2021, including the recent pandemic, which significantly impacted many schools.

When the payroll does not grow at the assumed rate, contributions to pay the unfunded actuarial accrued liability must increase over time to make up for the assumption not being met. Based on the statistics in this report, we believe it is important for SPTRFA to monitor this potential trend and adjust policies, if necessary, to recognize lower than expected payroll growth.

One way to address this would be to adopt a level dollar funding policy rather than a level percent of payroll methodology. This would increase initial costs, but future contributions would not be dependent on assumed future payroll growth.

An alternate approach would be to require that the payroll growth assumption used to determine the contribution toward the unfunded actuarial accrued liability not be greater than the actual plan average for the last ten years. For example, based on the above data, actual ten-year payroll growth was 1.6%. Instead of using the proposed payroll growth appropriate for a stable population of 2.5% to determine the amortization contribution, a payroll growth assumption of 1.6% would be used in the current valuation. This would be tested annually and the rate adjusted as necessary. After initial implementation, this method change will recognize a lower rate of payroll growth gradually and prevent actuarial losses.

Recommendation

We recommend continued use of the current amortization policy of reducing the amortization period each year by one year until the next study, at which point the method should be re-evaluated.

We also recommend the payroll growth assumption used to determine the contribution toward the unfunded actuarial accrued liability be limited to the actual plan average for the last ten years.

Funding Policy – Projected Payroll

Required contributions are expressed as a percent of payroll. The Minnesota Standards for Actuarial Work state that the projected payroll will be developed from the reported payroll in the base year by increasing each person's pay by one full year's pay increase according to the actuarial salary scale. This appears to make sense on the surface, but in our judgement such a calculation is not fully in compliance with level percent of payroll funding. There are two issues:

1. With respect to the total payroll used for the amortization of the unfunded liability: Total payroll is expected to increase at 3.0% according to the actuarial assumptions. (This experience study is proposing a change to this assumption, from 3.0% to 2.5%.) The total payroll, increased at the assumed payroll growth rate is the proper series of payroll amounts over which to fund the unfunded liability. The first-year payroll stated in the Minnesota Standards is not consistent with this principle.

2. With respect to the normal cost dollar amount: The normal cost percentage for active members is developed as the ratio of the present value of future benefits at entry age to the present value of future pay at entry age. The present value of future pay must take into account both the timing of pay increases within the year, and the probability that an individual may exit the active member group during the year. The first-year payroll stated in the Minnesota Standards is not mathematically consistent with this principle since it assumes the member will earn an entire year of payroll, even though there may be a probability of decrement for the member during the year.

In addition, the census data as of the valuation date reflects retirements and terminations occurring during the months of May and June; however, it does not necessarily reflect the replacements hired to fill these positions who may have hire dates in August and September. We adjust projected payroll by including pay (equal to the entry salary level for teachers with a Bachelor of Arts degree) for replacement teachers for May and June retirements.

Recommendation

We recommend that the Minnesota Standards for Actuarial Work be amended to be less prescriptive and more principle-based, so that the actuaries for the Systems may use their best judgment to calculate contribution rates and liabilities in a mathematically consistent manner and in accordance with actuarial standards of practice.

We recommend no change to the adjustment to projected payroll for teachers hired after the valuation date to replace May and June retirements.

SECTION I

MISCELLANEOUS AND TECHNICAL ASSUMPTIONS

Retirement Statistics

Percentage Married: Married members will frequently make different annuity selections than non-married members. The current valuation assumption is 75% of male members are married and 60% of female members are married. Actual marital status is used for retired members.

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 two years younger and female members have a beneficiary two years older.

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 is payable to a beneficiary upon the member's death.
- **Guaranteed Refund** – the benefit is paid for the lifetime of the member with the guarantee that an amount equal to any remaining balance of accumulated contributions is paid to a beneficiary upon the member's death.
- **15-Year Certain and Life** – a reduced benefit is paid for the lifetime of the member. If the member dies before 180 payments have been made, the benefit continues to be paid to a beneficiary until 180 payments have been made.
- **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.
- **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 a Single life annuity. Since optional forms are generally actuarially equivalent to the single life annuity, this approach produces liabilities materially similar to liabilities based on more complicated approaches reflecting optional form elections.

Findings

We reviewed the form of payment election of new retirees over the five-year period of the study and concluded the bounce-back feature that is subsidized by the plan for retirees who elect a joint and survivor benefit has a minimal effect on the liability.

Marital status and age of survivor is provided on the valuation data file for new retirees that elect to cover a spouse and not for new retirees who do not elect spouse coverage, active members or deferred members. We will work with SPTRFA to collect additional data before the next experience study.

Recommendation

We recommend no change to the percentage married, age difference and form of payment assumptions for new married retirees.

Actuarial Equivalent Optional Form Factors

Joint and Survivor and Certain and Life benefits are actuarially equivalent to the Single-life annuity. Current actuarial equivalent factors are based on the RP-2014 mortality rates for a member turning age 62 in 2021, reflecting projected mortality improvements using Scale MP-2017 from a base year of 2006, with white collar adjustments, set back two years for females, blended 20% males, 7.50% interest.

Recommendation

We recommend the actuarial equivalent factors be updated to reflect changes in expected mortality and interest rate, as applicable.

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.

Recommendation

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	Termination decrements do not operate during retirement eligibility.
Decrement Timing	Retirement and termination decrements of all types are assumed to occur at the end of the valuation year (consistent with the end of the school year). All other decrements 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.
Incidence of Contributions	Contributions are assumed to be received on a monthly basis, per the Standards of Actuarial Work.
Liability Adjustments	Liabilities for former vested members are increased by 20% and liabilities for former non-vested members are increased by 9% to account for the effect of some participants having eligibility for a Combined Service Annuity. These rates are based on analysis completed by the LCPR actuary and documented in a report dated October 2016.
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 J

PROPOSED ASSUMPTION LISTING

Proposed Actuarial Assumptions
Based on 2016-2021 Experience Study

Merit and Seniority Pay Increases

% Merit & Seniority Increases in Salaries Next Year	
Year	**Rate**
1	5.50%
2	4.25%
3	4.00%
4	3.75%
5	3.50%
6	3.25%
7	3.00%
8	2.75%
9	2.50%
10	2.25%
11	2.00%
12	1.75%
13	1.50%
14	1.25%
15	1.00%
16	0.90%
17	0.80%
18	0.70%
19	0.60%
20	0.40%
21	0.20%
22	0.00%
23+	0.00%

Proposed Actuarial Assumptions
Based on 2016-2021 Experience Study

Age and Service Retirement Pattern
Unreduced (Normal) Retirement

	% Retiring	
Age	**Male**	**Female**
65	30%	45%
66	35%	50%
67	40%	45%
68	35%	30%
69	35%	25%
70+	100%	100%

Proposed Actuarial Assumptions
Based on 2016-2021 Experience Study

Rule of 90 Retirement Pattern

	% Retiring	
Age	Male	Female
55	25%	35%
56	35%	30%
57	30%	20%
58	25%	25%
59	25%	30%
60	25%	30%
61	30%	30%
62	50%	35%
63	30%	30%
64	25%	25%

Proposed Actuarial Assumptions
Based on 2016-2021 Experience Study

Age and Service Retirement Pattern
Reduced (Early) Retirement

	% Retiring	
Age	Male	Female
55	5%	5%
56	5%	5%
57	5%	5%
58	7%	5%
59	7%	7%
60	12%	9%
61	8%	10%
62	20%	18%
63	25%	21%
64	25%	21%
65	28%	32%

Proposed Actuarial Assumptions
Based on 2016-2021 Experience Study

Termination

Year	% Terminations	
	Male	Female
1	45.00%	45.00%
2	23.50%	20.00%
3	16.00%	12.00%
4	7.50%	9.50%
5	6.50%	7.50%
6	5.50%	7.00%
7	4.00%	6.00%
8	3.50%	5.00%
9	3.00%	5.00%
10	3.00%	5.00%
11	3.00%	4.00%
12	3.00%	3.00%
13	3.00%	2.50%
14	2.50%	2.00%
15	2.50%	2.00%
16	2.50%	2.00%
17	2.00%	2.00%
18	1.00%	1.75%
19	1.00%	1.50%
20+	1.00%	1.00%

Proposed Actuarial Assumptions
Based on 2016-2021 Experience Study

Disability Rates

Age	% Becoming Disabled	
	Male	Female
20	0.0120%	0.0120%
21	0.0120%	0.0120%
22	0.0120%	0.0120%
23	0.0120%	0.0120%
24	0.0120%	0.0120%
25	0.0120%	0.0120%
26	0.0120%	0.0120%
27	0.0120%	0.0120%
28	0.0120%	0.0120%
29	0.0120%	0.0120%
30	0.0180%	0.0180%
31	0.0180%	0.0180%
32	0.0180%	0.0180%
33	0.0180%	0.0180%
34	0.0180%	0.0180%
35	0.0180%	0.0180%
36	0.0180%	0.0180%
37	0.0180%	0.0180%
38	0.0180%	0.0180%
39	0.0180%	0.0180%
40	0.0240%	0.0240%
41	0.0240%	0.0240%
42	0.0240%	0.0240%
43	0.0240%	0.0240%
44	0.0240%	0.0240%
45	0.0360%	0.0360%
46	0.0360%	0.0360%
47	0.0360%	0.0360%
48	0.0360%	0.0360%
49	0.0360%	0.0360%
50	0.0648%	0.0648%
51	0.0648%	0.0648%
52	0.0648%	0.0648%
53	0.0648%	0.0648%
54	0.0648%	0.0648%
55	0.1152%	0.1152%
56	0.1152%	0.1152%
57	0.1152%	0.1152%
58	0.1152%	0.1152%
59	0.1152%	0.1152%
60+	0.2016%	0.2016%

Proposed Actuarial Assumptions
Based on 2016-2021 Experience Study

Healthy Post-Retirement Mortality Rates

Age in 2021	% Dying Next Year*	
	Male	Female
50	0.1103%	0.0770%
51	0.1252%	0.0923%
52	0.1437%	0.1112%
53	0.1649%	0.1351%
54	0.1901%	0.1643%
55	0.2216%	0.1997%
56	0.2474%	0.2202%
57	0.2761%	0.2415%
58	0.3087%	0.2642%
59	0.3434%	0.2866%
60	0.3809%	0.3093%
61	0.4215%	0.3330%
62	0.4653%	0.3563%
63	0.5108%	0.3814%
64	0.5616%	0.4082%
65	0.6164%	0.4394%
66	0.6779%	0.4741%
67	0.7476%	0.5158%
68	0.8272%	0.5660%
69	0.9185%	0.6271%
70	1.0244%	0.7014%
71	1.1478%	0.7902%
72	1.2908%	0.8960%
73	1.4583%	1.0216%
74	1.6517%	1.1695%
75	1.8752%	1.3420%
76	2.1343%	1.5428%
77	2.4301%	1.7735%
78	2.7665%	2.0381%
79	3.1506%	2.3407%
80	3.5870%	2.6851%

Age in 2021	% Dying Next Year*	
	Male	Female
81	4.0861%	3.0787%
82	4.6579%	3.5260%
83	5.3091%	4.0347%
84	6.0535%	4.6131%
85	6.8986%	5.2663%
86	7.8497%	6.0026%
87	8.9131%	6.8305%
88	10.0992%	7.7618%
89	11.4162%	8.8032%
90	12.8665%	9.9672%
91	14.4471%	11.2719%
92	16.1366%	12.7123%
93	17.9204%	14.2833%
94	19.7736%	15.9598%
95	21.6631%	17.7321%
96	23.6921%	19.6552%
97	25.7520%	21.6549%
98	27.8383%	23.7134%
99	29.9473%	25.8159%
100	32.0580%	27.9578%
101	34.1535%	30.1201%
102	36.2313%	32.3014%
103	38.2961%	34.4946%
104	40.3141%	36.6660%
105	42.2679%	38.8159%
106	44.1625%	40.9039%
107	45.9847%	42.9308%
108	47.7080%	44.8828%
109	49.3556%	46.7421%
110	50.6820%	48.5053%

* *The rates shown are PUB-2010 healthy annuitant mortality for teachers, with adjustments if applicable (see Section G). Recommended rates include mortality improvements using projection scale MP-2021.*

Proposed Actuarial Assumptions
Based on 2016-2021 Experience Study

Healthy Pre-Retirement Mortality Rates

Age in 2021	% Dying Next Year*	
	Male	Female
20	0.0349%	0.0140%
21	0.0313%	0.0132%
22	0.0267%	0.0113%
23	0.0230%	0.0104%
24	0.0203%	0.0106%
25	0.0187%	0.0109%
26	0.0206%	0.0124%
27	0.0226%	0.0127%
28	0.0247%	0.0144%
29	0.0281%	0.0160%
30	0.0303%	0.0190%
31	0.0339%	0.0206%
32	0.0359%	0.0222%
33	0.0393%	0.0236%
34	0.0410%	0.0262%
35	0.0439%	0.0272%
36	0.0464%	0.0293%
37	0.0485%	0.0312%
38	0.0515%	0.0327%
39	0.0526%	0.0351%
40	0.0547%	0.0360%
41	0.0575%	0.0379%
42	0.0598%	0.0396%
43	0.0630%	0.0422%
44	0.0659%	0.0438%
45	0.0707%	0.0464%

Age in 2021	% Dying Next Year*	
	Male	Female
46	0.0755%	0.0501%
47	0.0812%	0.0539%
48	0.0880%	0.0580%
49	0.0950%	0.0625%
50	0.1043%	0.0674%
51	0.1141%	0.0737%
52	0.1245%	0.0815%
53	0.1375%	0.0888%
54	0.1513%	0.0975%
55	0.1659%	0.1075%
56	0.1833%	0.1176%
57	0.2023%	0.1286%
58	0.2238%	0.1413%
59	0.2472%	0.1544%
60	0.2735%	0.1685%
61	0.3030%	0.1834%
62	0.3341%	0.2000%
63	0.3665%	0.2171%
64	0.4017%	0.2368%
65	0.4397%	0.2583%
66	0.4782%	0.2825%
67	0.5197%	0.3100%
68	0.5632%	0.3429%
69	0.6105%	0.3824%
70	0.6590%	0.4290%

* *The rates shown are PUB-2010 employee mortality for teachers, with adjustments if applicable (see Section G). Recommended rates include mortality improvements using projection scale MP-2021.*

SECTION K

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, termination, 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, terminations, 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 terminated 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 termination), 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 median age of the five-year grouping.

SECTION L

APPENDIX

Appendix – Detailed Experience Analysis

In this section, we present the annual experience for each major assumption that was analyzed for the study. Please note that totals may not sum correctly due to rounding of intermediate results.

Appendix – Detailed Experience Analysis
Salary Increases

2016-2021 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	942	7.11%	9.00%
2	798	5.14%	8.00%
3	807	4.46%	7.00%
4	806	4.98%	6.80%
5	750	4.73%	6.60%
6	679	5.66%	6.40%
7	609	5.43%	6.20%
8	504	4.48%	6.00%
9	444	4.09%	5.75%
10	399	3.39%	5.50%
11	410	3.56%	5.25%
12	450	3.73%	5.00%
13	465	2.91%	4.75%
14	464	2.35%	4.50%
15	514	2.45%	4.25%
16	550	2.15%	4.00%
17	516	2.35%	3.90%
18	524	2.40%	3.80%
19	602	3.40%	3.70%
20	557	2.04%	3.60%
21	509	1.78%	3.40%
22	475	1.72%	3.20%
23	143	1.80%	3.00%
24	355	1.62%	3.00%
25	301	2.03%	3.00%
26	265	1.77%	3.00%
27	212	1.57%	3.00%
28	187	2.13%	3.00%
29	159	1.79%	3.00%
30+	629	1.47%	3.00%
Totals	**15,025**	**3.58%**	**5.20%**

Appendix – Detailed Experience Analysis
Salary Increases

2016-2017 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	132	8.21%	9.00%
2	183	6.55%	8.00%
3	200	6.18%	7.00%
4	164	7.07%	6.80%
5	127	5.93%	6.60%
6	80	8.14%	6.40%
7	89	6.73%	6.20%
8	92	7.33%	6.00%
9	93	6.59%	5.75%
10	70	3.75%	5.50%
11	95	4.45%	5.25%
12	127	4.45%	5.00%
13	113	4.22%	4.75%
14	88	3.32%	4.50%
15	136	3.82%	4.25%
16	119	3.54%	4.00%
17	122	3.11%	3.90%
18	121	3.77%	3.80%
19	159	5.25%	3.70%
20	96	3.81%	3.60%
21	72	4.56%	3.40%
22	86	3.00%	3.20%
23	27	2.81%	3.00%
24	53	2.63%	3.00%
25	54	3.57%	3.00%
26	35	3.30%	3.00%
27	20	3.02%	3.00%
28	44	4.23%	3.00%
29	27	3.26%	3.00%
30+	128	2.77%	3.00%
Totals	**2,952**	**5.00%**	**5.15%**

Appendix – Detailed Experience Analysis
Salary Increases

2017-2018 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	198	5.90%	9.00%
2	143	4.07%	8.00%
3	181	3.43%	7.00%
4	199	3.91%	6.80%
5	164	4.28%	6.60%
6	125	4.99%	6.40%
7	90	4.93%	6.20%
8	81	2.99%	6.00%
9	87	3.28%	5.75%
10	94	2.60%	5.50%
11	69	2.15%	5.25%
12	95	2.50%	5.00%
13	123	1.68%	4.75%
14	112	1.43%	4.50%
15	81	1.58%	4.25%
16	137	0.35%	4.00%
17	113	1.29%	3.90%
18	118	0.79%	3.80%
19	116	1.78%	3.70%
20	142	0.90%	3.60%
21	91	1.03%	3.40%
22	71	1.26%	3.20%
23	27	0.75%	3.00%
24	78	0.36%	3.00%
25	49	0.81%	3.00%
26	55	0.46%	3.00%
27	33	0.44%	3.00%
28	19	0.73%	3.00%
29	42	0.37%	3.00%
30+	126	0.31%	3.00%
Totals	**3,059**	**2.47%**	**5.22%**

Appendix – Detailed Experience Analysis
Salary Increases

2018-2019 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	166	6.92%	9.00%
2	162	5.23%	8.00%
3	135	3.83%	7.00%
4	167	4.05%	6.80%
5	187	4.29%	6.60%
6	151	5.10%	6.40%
7	116	5.04%	6.20%
8	76	3.94%	6.00%
9	80	3.44%	5.75%
10	85	3.45%	5.50%
11	87	1.63%	5.25%
12	65	3.68%	5.00%
13	89	2.86%	4.75%
14	115	1.89%	4.50%
15	109	1.32%	4.25%
16	78	1.52%	4.00%
17	118	2.22%	3.90%
18	109	2.22%	3.80%
19	113	2.79%	3.70%
20	108	1.83%	3.60%
21	139	0.69%	3.40%
22	89	0.78%	3.20%
23	24	0.76%	3.00%
24	62	1.01%	3.00%
25	73	1.81%	3.00%
26	45	2.36%	3.00%
27	49	0.87%	3.00%
28	33	1.66%	3.00%
29	15	0.98%	3.00%
30+	141	1.11%	3.00%
Totals	**2,986**	**3.05%**	**5.17%**

Appendix – Detailed Experience Analysis
Salary Increases

2019-2020 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	178	5.78%	9.00%
2	150	3.93%	8.00%
3	152	3.18%	7.00%
4	127	4.31%	6.80%
5	149	4.04%	6.60%
6	179	5.45%	6.40%
7	142	4.95%	6.20%
8	119	3.38%	6.00%
9	72	3.02%	5.75%
10	84	2.07%	5.50%
11	79	4.74%	5.25%
12	86	3.52%	5.00%
13	61	2.13%	4.75%
14	87	2.47%	4.50%
15	110	1.92%	4.25%
16	105	2.10%	4.00%
17	70	1.77%	3.90%
18	110	2.13%	3.80%
19	109	2.13%	3.70%
20	105	1.28%	3.60%
21	105	0.71%	3.40%
22	132	0.96%	3.20%
23	29	0.69%	3.00%
24	63	1.10%	3.00%
25	62	1.05%	3.00%
26	68	1.19%	3.00%
27	45	0.78%	3.00%
28	50	0.73%	3.00%
29	31	1.67%	3.00%
30+	115	0.80%	3.00%
Totals	**2,974**	**2.88%**	**5.17%**

Appendix – Detailed Experience Analysis
Salary Increases

2020-2021 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	268	8.45%	9.00%
2	160	5.55%	8.00%
3	139	5.36%	7.00%
4	149	5.71%	6.80%
5	123	5.58%	6.60%
6	144	5.73%	6.40%
7	172	5.66%	6.20%
8	136	4.70%	6.00%
9	112	3.79%	5.75%
10	66	5.77%	5.50%
11	80	4.64%	5.25%
12	77	4.36%	5.00%
13	79	3.60%	4.75%
14	62	3.30%	4.50%
15	78	3.31%	4.25%
16	111	3.37%	4.00%
17	93	3.22%	3.90%
18	66	3.54%	3.80%
19	105	4.34%	3.70%
20	106	2.91%	3.60%
21	102	3.08%	3.40%
22	97	2.84%	3.20%
23	36	3.41%	3.00%
24	99	2.78%	3.00%
25	63	2.89%	3.00%
26	62	2.26%	3.00%
27	65	2.78%	3.00%
28	41	2.62%	3.00%
29	44	2.60%	3.00%
30+	119	2.36%	3.00%
Totals	**3,054**	**4.52%**	**5.29%**

Appendix – Detailed Experience Analysis
Rule of 90 Retirement

2016-2021 Experience

Age Group	Males				Females			
	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	1	1	0.25	400.0%
56	2	3	0.75	266.7%	4	11	2.75	145.5%
57	3	9	2.25	133.3%	5	41	10.25	48.8%
58	4	14	3.50	114.3%	18	63	15.75	114.3%
59	3	14	3.50	85.7%	26	75	22.50	115.6%
60	4	16	4.00	100.0%	19	66	19.80	96.0%
61	5	16	4.00	125.0%	16	62	18.60	86.0%
62	8	14	6.30	127.0%	23	61	18.30	125.7%
63	3	11	3.85	77.9%	16	53	15.90	100.6%
64	2	7	1.75	114.3%	12	52	15.60	76.9%
Totals	**34**	**104**	**29.90**	**113.7%**	**140**	**485**	**139.70**	**100.2%**

Appendix – Detailed Experience Analysis
Rule of 90 Retirement

2016-2017 Experience

	Males				Females			
Age Group	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	-	-	-	N/A
56	-	-	-	N/A	-	1	0.25	0.0%
57	-	1	0.25	0.0%	-	3	0.75	0.0%
58	-	2	0.50	0.0%	2	10	2.50	80.0%
59	2	2	0.50	400.0%	5	15	4.50	111.1%
60	1	3	0.75	133.3%	3	14	4.20	71.4%
61	1	2	0.50	200.0%	5	15	4.50	111.1%
62	2	3	1.35	148.1%	2	11	3.30	60.6%
63	-	3	1.05	0.0%	3	16	4.80	62.5%
64	1	1	0.25	400.0%	4	11	3.30	121.2%
Totals	**7**	**17**	**5.15**	**135.9%**	**24**	**96**	**28.10**	**85.4%**

2017-2018 Experience

	Males				Females			
Age Group	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	-	-	-	N/A
56	-	-	-	N/A	1	2	0.50	200.0%
57	1	1	0.25	400.0%	2	12	3.00	66.7%
58	2	5	1.25	160.0%	3	9	2.25	133.3%
59	-	5	1.25	0.0%	3	10	3.00	100.0%
60	-	1	0.25	0.0%	4	13	3.90	102.6%
61	-	2	0.50	0.0%	1	19	5.70	17.5%
62	1	2	0.90	111.1%	4	11	3.30	121.2%
63	1	1	0.35	285.7%	2	11	3.30	60.6%
64	1	3	0.75	133.3%	3	13	3.90	76.9%
Totals	**6**	**20**	**5.50**	**109.1%**	**23**	**100**	**28.85**	**79.7%**

2018-2019 Experience

	Males				Females			
Age Group	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	-	-	-	N/A
56	1	1	0.25	400.0%	-	2	0.50	0.0%
57	1	2	0.50	200.0%	-	10	2.50	0.0%
58	-	-	-	N/A	4	16	4.00	100.0%
59	1	4	1.00	100.0%	5	15	4.50	111.1%
60	1	6	1.50	66.7%	2	9	2.70	74.1%
61	-	1	0.25	0.0%	4	9	2.70	148.1%
62	3	3	1.35	222.2%	8	20	6.00	133.3%
63	1	3	1.05	95.2%	4	8	2.40	166.7%
64	-	-	-	N/A	3	12	3.60	83.3%
Totals	**8**	**20**	**5.90**	**135.6%**	**30**	**101**	**28.90**	**103.8%**

Appendix – Detailed Experience Analysis
Rule of 90 Retirement

2019-2020 Experience

Age Group	Males				Females			
	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	-	-	-	N/A
56	1	2	0.50	200.0%	2	4	1.00	200.0%
57	-	3	0.75	0.0%	2	6	1.50	133.3%
58	2	4	1.00	200.0%	7	20	5.00	140.0%
59	-	-	-	N/A	10	19	5.70	175.4%
60	2	6	1.50	133.3%	6	15	4.50	133.3%
61	3	6	1.50	200.0%	3	10	3.00	100.0%
62	-	3	1.35	0.0%	3	9	2.70	111.1%
63	-	1	0.35	0.0%	2	12	3.60	55.6%
64	-	2	0.50	0.0%	1	5	1.50	66.7%
Totals	**8**	**27**	**7.45**	**107.4%**	**36**	**100**	**28.50**	**126.3%**

2020-2021 Experience

Age Group	Males				Females			
	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	1	1	0.25	400.0%
56	-	-	-	N/A	1	2	0.50	200.0%
57	1	2	0.50	200.0%	1	10	2.50	40.0%
58	-	3	0.75	0.0%	2	8	2.00	100.0%
59	-	3	0.75	0.0%	3	16	4.80	62.5%
60	-	-	-	N/A	4	15	4.50	88.9%
61	1	5	1.25	80.0%	3	9	2.70	111.1%
62	2	3	1.35	148.1%	6	10	3.00	200.0%
63	1	3	1.05	95.2%	5	6	1.80	277.8%
64	-	1	0.25	0.0%	1	11	3.30	30.3%
Totals	**5**	**20**	**5.90**	**84.7%**	**27**	**88**	**25.35**	**106.5%**

Appendix – Detailed Experience Analysis
Non-Rule of 90 Retirement

2016-2021 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	2	108	9.72	20.6%	24	347	17.35	138.3%
56	7	108	7.56	92.6%	15	337	16.85	89.0%
57	1	88	6.16	16.2%	19	306	15.30	124.2%
58	5	76	5.32	94.0%	8	260	15.60	51.3%
59	4	64	4.48	89.3%	19	238	14.28	133.1%
60	8	58	6.96	114.9%	20	211	18.99	105.3%
61	2	49	5.88	34.0%	17	183	20.13	84.5%
62	2	45	11.25	17.8%	24	152	30.40	78.9%
63	10	41	11.48	87.1%	27	131	30.13	89.6%
64	7	32	8.96	78.1%	18	109	28.34	63.5%
65	8	28	8.00	100.0%	47	124	44.85	104.8%
66	8	20	6.00	133.3%	50	85	36.55	136.8%
67	8	14	4.90	163.3%	20	40	15.20	131.6%
68	3	9	3.60	83.3%	4	22	8.36	47.8%
69	-	6	2.70	0.0%	4	19	5.70	70.2%
70+	8	13	13.00	61.5%	17	50	50.00	34.0%
Totals	**83**	**759**	**115.97**	**71.6%**	**333**	**2,614**	**368.03**	**90.5%**

Appendix – Detailed Experience Analysis
Non-Rule of 90 Retirement

2016-2017 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	15	1.35	0.0%	6	85	4.25	141.2%
56	2	19	1.33	150.4%	2	74	3.70	54.1%
57	-	19	1.33	0.0%	4	64	3.20	125.0%
58	2	14	0.98	204.1%	-	52	3.12	0.0%
59	1	13	0.91	109.9%	2	43	2.58	77.5%
60	1	11	1.32	75.8%	6	46	4.14	144.9%
61	1	14	1.68	59.5%	6	37	4.07	147.4%
62	-	10	2.50	0.0%	5	27	5.40	92.6%
63	2	6	1.68	119.0%	8	35	8.05	99.4%
64	2	4	1.12	178.6%	4	20	5.20	76.9%
65	2	4	1.14	175.4%	10	22	8.10	123.5%
66	3	7	2.10	142.9%	17	22	9.46	179.7%
67	2	4	1.40	142.9%	5	11	4.18	119.6%
68	2	3	1.20	166.7%	-	4	1.52	0.0%
69	-	-	-	N/A	1	3	0.90	111.1%
70+	3	4	4.00	75.0%	3	10	10.00	30.0%
Totals	**23**	**147**	**24.04**	**95.7%**	**79**	**555**	**77.87**	**101.5%**

2017-2018 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	1	24	2.16	46.3%	6	60	3.00	200.0%
56	-	15	1.05	0.0%	2	77	3.85	51.9%
57	1	17	1.19	84.0%	3	64	3.20	93.8%
58	1	16	1.12	89.3%	2	54	3.24	61.7%
59	-	9	0.63	0.0%	3	51	3.06	98.0%
60	2	11	1.32	151.5%	8	39	3.51	227.9%
61	-	10	1.20	0.0%	2	33	3.63	55.1%
62	1	13	3.25	30.8%	4	31	6.20	64.5%
63	2	10	2.80	71.4%	4	20	4.60	87.0%
64	1	4	1.12	89.3%	6	29	7.54	79.6%
65	1	2	0.56	178.6%	8	23	8.10	98.8%
66	-	2	0.60	0.0%	7	15	6.45	108.5%
67	2	4	1.40	142.9%	3	7	2.66	112.8%
68	-	2	0.80	0.0%	1	6	2.28	43.9%
69	-	1	0.45	0.0%	2	4	1.20	166.7%
70+	-	1	1.00	0.0%	5	9	9.00	55.6%
Totals	**12**	**141**	**20.65**	**58.1%**	**66**	**522**	**71.52**	**92.3%**

2018-2019 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	22	1.98	0.0%	6	79	3.95	151.9%
56	1	22	1.54	64.9%	4	56	2.80	142.9%
57	-	14	0.98	0.0%	6	69	3.45	173.9%
58	1	17	1.19	84.0%	2	57	3.42	58.5%
59	2	15	1.05	190.5%	6	45	2.70	222.2%
60	1	9	1.08	92.6%	2	47	4.23	47.3%
61	-	9	1.08	0.0%	7	33	3.63	192.8%
62	1	8	2.00	50.0%	3	30	6.00	50.0%
63	3	12	3.36	89.3%	4	27	6.21	64.4%
64	1	9	2.52	39.7%	5	16	4.16	120.2%
65	1	5	1.44	69.4%	14	33	12.15	115.2%
66	-	1	0.30	0.0%	8	15	6.45	124.0%
67	2	3	1.05	190.5%	4	8	3.04	131.6%
68	-	3	1.20	0.0%	-	5	1.90	0.0%
69	-	2	0.90	0.0%	1	6	1.80	55.6%
70+	1	2	2.00	50.0%	2	7	7.00	28.6%
Totals	**14**	**153**	**23.67**	**59.1%**	**74**	**533**	**72.89**	**101.5%**

Appendix – Detailed Experience Analysis
Non-Rule of 90 Retirement

2019-2020 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	1	30	2.70	37.0%	4	66	3.30	121.2%
56	2	22	1.54	129.9%	3	69	3.45	87.0%
57	-	18	1.26	0.0%	5	51	2.55	196.1%
58	-	11	0.77	0.0%	3	53	3.18	94.3%
59	1	16	1.12	89.3%	3	50	3.00	100.0%
60	2	11	1.32	151.5%	2	38	3.42	58.5%
61	1	8	0.96	104.2%	-	42	4.62	0.0%
62	-	7	1.75	0.0%	3	23	4.60	65.2%
63	-	6	1.68	0.0%	4	27	6.21	64.4%
64	2	9	2.52	79.4%	2	22	5.72	35.0%
65	2	8	2.28	87.7%	8	22	8.10	98.8%
66	2	4	1.20	166.7%	12	19	8.17	146.9%
67	1	1	0.35	285.7%	4	7	2.66	150.4%
68	1	1	0.40	250.0%	3	4	1.52	197.4%
69	-	3	1.35	0.0%	-	5	1.50	0.0%
70+	3	3	3.00	100.0%	2	10	10.00	20.0%
Totals	**18**	**158**	**24.20**	**74.4%**	**58**	**508**	**72.00**	**80.6%**

2020-2021 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	17	1.53	0.0%	2	57	2.85	70.2%
56	2	30	2.10	95.2%	4	61	3.05	131.1%
57	-	20	1.40	0.0%	1	58	2.90	34.5%
58	1	18	1.26	79.4%	1	44	2.64	37.9%
59	-	11	0.77	0.0%	5	49	2.94	170.1%
60	2	16	1.92	104.2%	2	41	3.69	54.2%
61	-	8	0.96	0.0%	2	38	4.18	47.8%
62	-	7	1.75	0.0%	9	41	8.20	109.8%
63	3	7	1.96	153.1%	7	22	5.06	138.3%
64	1	6	1.68	59.5%	1	22	5.72	17.5%
65	2	9	2.58	77.5%	7	24	8.40	83.3%
66	3	6	1.80	166.7%	6	14	6.02	99.7%
67	1	2	0.70	142.9%	4	7	2.66	150.4%
68	-	-	-	N/A	-	3	1.14	0.0%
69	-	-	-	N/A	-	1	0.30	0.0%
70+	1	3	3.00	33.3%	5	14	14.00	35.7%
Totals	**16**	**160**	**23.41**	**68.3%**	**56**	**496**	**73.75**	**75.9%**

Appendix – Detailed Experience Analysis
Terminations, Service Based ($000s)

2016-2021 Experience

	Males				Females			
Year	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected
1	1,476	3,288	1,315.20	112.2%	4,730	9,944	3,977.60	118.9%
2	3,487	16,640	4,326.40	80.6%	8,867	48,207	10,605.54	83.6%
3	2,716	16,650	2,664.00	102.0%	5,039	51,340	7,701.00	65.4%
4	1,317	17,956	1,975.16	66.7%	4,158	60,085	7,210.20	57.7%
5	1,076	19,925	1,594.00	67.5%	3,509	66,849	6,684.90	52.5%
6	1,103	19,787	989.35	111.5%	4,533	70,330	5,978.06	75.8%
7	642	19,566	929.39	69.1%	3,415	67,488	4,724.16	72.3%
8	649	18,779	845.07	76.8%	3,099	64,926	3,570.94	86.8%
9	211	16,884	717.57	29.4%	2,770	57,862	2,603.80	106.4%
10	288	17,776	711.04	40.5%	2,805	53,073	2,122.92	132.1%
11	173	17,330	649.89	26.6%	1,983	50,149	1,880.59	105.4%
12	687	20,038	701.34	98.0%	852	51,939	1,817.87	46.9%
13	1,024	23,318	757.85	135.1%	878	61,937	1,858.11	47.3%
14	532	22,338	670.14	79.4%	1,538	72,356	1,808.91	85.0%
15	331	20,205	505.15	65.5%	2,712	78,624	1,572.48	172.5%
16	665	25,197	629.94	105.6%	1,043	90,283	1,805.66	57.8%
17	587	27,338	683.46	85.9%	1,954	101,849	2,036.98	95.9%
18	208	28,710	717.77	29.0%	1,568	98,899	1,977.98	79.3%
19	175	31,610	790.25	22.1%	1,542	102,035	2,040.70	75.6%
20 & Over	1,816	377,752	9,443.82	19.2%	4,840	1,297,939	25,958.78	18.6%
Totals	**19,163**	**761,087**	**31,616.79**	**60.6%**	**61,835**	**2,556,114**	**97,937.18**	**63.1%**

** Results are liability-weighted*

Appendix – Detailed Experience Analysis
Terminations, Service Based ($000s)

2016-2017 Experience

	Males				Females			
Year	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected
1	333	729	291.60	114.2%	808	1,940	776.00	104.1%
2	582	2,595	674.70	86.3%	1,695	8,310	1,828.20	92.7%
3	285	3,873	619.68	46.0%	1,203	12,449	1,867.35	64.4%
4	485	4,970	546.70	88.7%	1,261	15,856	1,902.72	66.3%
5	221	3,557	284.56	77.7%	908	14,298	1,429.80	63.5%
6	517	3,103	155.15	333.2%	897	12,271	1,043.04	86.0%
7	-	2,310	109.73	0.0%	998	8,328	582.96	171.2%
8	188	3,417	153.77	122.3%	328	8,247	453.59	72.3%
9	-	3,547	150.75	0.0%	124	9,616	432.72	28.7%
10	-	4,201	168.04	0.0%	947	10,977	439.08	215.7%
11	-	2,218	83.18	0.0%	260	9,868	370.05	70.3%
12	-	5,778	202.23	0.0%	150	10,815	378.53	39.6%
13	-	5,110	166.08	0.0%	138	19,059	571.77	24.1%
14	328	4,010	120.30	272.7%	597	19,309	482.73	123.7%
15	-	3,255	81.38	0.0%	440	14,791	295.82	148.7%
16	338	6,475	161.88	208.8%	179	24,532	490.64	36.5%
17	-	7,775	194.38	0.0%	184	19,510	390.20	47.2%
18	-	7,436	185.90	0.0%	127	22,730	454.60	27.9%
19	-	7,398	184.95	0.0%	659	23,611	472.22	139.6%
20 & Over	461	65,681	1,642.03	28.1%	776	242,537	4,850.74	16.0%
Totals	**3,738**	**147,438**	**6,176.99**	**60.5%**	**12,679**	**509,054**	**19,512.76**	**65.0%**

2017-2018 Experience

	Males				Females			
Year	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected
1	297	717	286.80	103.6%	976	2,048	819.20	119.1%
2	879	4,003	1,040.78	84.5%	1,418	9,914	2,181.08	65.0%
3	913	3,150	504.00	181.2%	1,288	10,600	1,590.00	81.0%
4	206	4,816	529.76	38.9%	1,183	14,094	1,691.28	69.9%
5	517	5,923	473.84	109.1%	735	17,987	1,798.70	40.9%
6	-	4,172	208.60	0.0%	1,260	17,178	1,460.13	86.3%
7	-	2,937	139.51	0.0%	112	13,384	936.88	12.0%
8	-	3,158	142.11	0.0%	122	9,520	523.60	23.3%
9	96	3,640	154.70	62.1%	504	9,691	436.10	115.6%
10	288	4,226	169.04	170.4%	835	11,467	458.68	182.0%
11	-	4,905	183.94	0.0%	163	12,031	451.16	36.1%
12	148	2,524	88.34	167.5%	-	10,512	367.92	0.0%
13	365	6,915	224.74	162.4%	172	12,241	367.23	46.8%
14	-	5,788	173.64	0.0%	409	21,006	525.15	77.9%
15	163	4,149	103.73	157.1%	851	21,727	434.54	195.8%
16	196	3,662	91.55	214.1%	215	16,407	328.14	65.5%
17	213	6,774	169.35	125.8%	258	26,734	534.68	48.3%
18	-	8,015	200.38	0.0%	252	20,692	413.84	60.9%
19	175	7,836	195.90	89.3%	274	24,094	481.88	56.9%
20 & Over	236	73,289	1,832.23	12.9%	1,169	262,685	5,253.70	22.3%
Totals	**4,692**	**160,599**	**6,912.94**	**67.9%**	**12,196**	**544,012**	**21,053.89**	**57.9%**

** Results are liability-weighted*

Appendix – Detailed Experience Analysis
Terminations, Service Based ($000s)

2018-2019 Experience

	Males				Females			
Year	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected
1	478	873	349.20	136.9%	1,255	2,412	964.80	130.1%
2	429	2,555	664.30	64.6%	2,246	8,885	1,954.70	114.9%
3	942	3,606	576.96	163.3%	1,113	9,634	1,445.10	77.0%
4	259	2,183	240.13	107.9%	665	9,715	1,165.80	57.0%
5	249	4,656	372.48	66.8%	589	12,541	1,254.10	47.0%
6	307	5,084	254.20	120.8%	1,034	16,791	1,427.24	72.4%
7	366	3,965	188.34	194.3%	915	14,425	1,009.75	90.6%
8	192	2,672	120.24	159.7%	1,007	13,166	724.13	139.1%
9	115	2,868	121.89	94.3%	763	8,344	375.48	203.2%
10	-	3,129	125.16	0.0%	227	8,754	350.16	64.8%
11	-	3,673	137.74	0.0%	543	9,973	373.99	145.2%
12	-	4,465	156.28	0.0%	180	10,544	369.04	48.8%
13	378	2,419	78.62	480.8%	416	10,186	305.58	136.1%
14	-	5,577	167.31	0.0%	191	10,971	274.28	69.6%
15	-	5,123	128.08	0.0%	887	18,485	369.70	239.9%
16	131	3,823	95.58	137.1%	649	20,099	401.98	161.5%
17	-	3,209	80.23	0.0%	126	15,215	304.30	41.4%
18	-	5,841	146.03	0.0%	675	22,802	456.04	148.0%
19	-	7,014	175.35	0.0%	-	19,103	382.06	0.0%
20 & Over	642	74,606	1,865.15	34.4%	966	260,563	5,211.26	18.5%
Totals	**4,488**	**147,341**	**6,043.27**	**74.3%**	**14,447**	**502,608**	**19,119.49**	**75.6%**

2019-2020 Experience

	Males				Females			
Year	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected
1	191	590	236.00	80.9%	958	2,077	830.80	115.3%
2	732	3,075	799.50	91.6%	1,716	8,893	1,956.46	87.7%
3	333	2,743	438.88	75.9%	691	9,389	1,408.35	49.1%
4	174	3,232	355.52	48.9%	397	10,151	1,218.12	32.6%
5	89	2,304	184.32	48.3%	767	10,693	1,069.30	71.7%
6	279	4,935	246.75	113.1%	1,066	12,684	1,078.14	98.9%
7	185	5,171	245.62	75.3%	1,172	17,852	1,249.64	93.8%
8	138	3,913	176.09	78.4%	1,185	15,663	861.47	137.6%
9	-	2,621	111.39	0.0%	515	13,825	622.13	82.8%
10	-	2,897	115.88	0.0%	317	8,279	331.16	95.7%
11	173	3,534	132.53	130.5%	226	9,861	369.79	61.1%
12	249	3,848	134.68	184.9%	-	9,696	339.36	0.0%
13	281	4,778	155.29	181.0%	-	10,637	319.11	0.0%
14	-	2,107	63.21	0.0%	341	9,926	248.15	137.4%
15	168	5,613	140.33	119.7%	270	12,000	240.00	112.5%
16	-	5,413	135.33	0.0%	-	17,917	358.34	0.0%
17	-	4,018	100.45	0.0%	773	20,440	408.80	189.1%
18	208	3,553	88.83	234.2%	300	13,746	274.92	109.1%
19	-	6,034	150.85	0.0%	381	21,381	427.62	89.1%
20 & Over	193	79,939	1,998.48	9.7%	1,334	265,798	5,315.96	25.1%
Totals	**3,393**	**150,318**	**6,009.93**	**56.5%**	**12,409**	**500,908**	**18,927.62**	**65.6%**

** Results are liability-weighted*

Appendix – Detailed Experience Analysis
Terminations, Service Based ($000s)

2020-2021 Experience

	Males				Females			
Year	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected	Actual Terminations*	Exposure*	Expected Terminations*	Actual/ Expected
1	177	379	151.60	116.8%	733	1,467	586.80	124.9%
2	865	4,412	1,147.12	75.4%	1,792	12,205	2,685.10	66.7%
3	243	3,278	524.48	46.3%	744	9,268	1,390.20	53.5%
4	193	2,755	303.05	63.7%	652	10,269	1,232.28	52.9%
5	-	3,485	278.80	0.0%	510	11,330	1,133.00	45.0%
6	-	2,493	124.65	0.0%	276	11,406	969.51	28.5%
7	91	5,183	246.19	37.0%	218	13,499	944.93	23.1%
8	131	5,619	252.86	51.8%	457	18,330	1,008.15	45.3%
9	-	4,208	178.84	0.0%	864	16,386	737.37	117.2%
10	-	3,323	132.92	0.0%	479	13,596	543.84	88.1%
11	-	3,000	112.50	0.0%	791	8,416	315.60	250.6%
12	290	3,423	119.81	242.0%	522	10,372	363.02	143.8%
13	-	4,096	133.12	0.0%	152	9,814	294.42	51.6%
14	204	4,856	145.68	140.0%	-	11,144	278.60	0.0%
15	-	2,065	51.63	0.0%	264	11,621	232.42	113.6%
16	-	5,824	145.60	0.0%	-	11,328	226.56	0.0%
17	374	5,562	139.05	269.0%	613	19,950	399.00	153.6%
18	-	3,865	96.63	0.0%	214	18,929	378.58	56.5%
19	-	3,328	83.20	0.0%	228	13,846	276.92	82.3%
20 & Over	284	84,237	2,105.93	13.5%	595	266,356	5,327.12	11.2%
Totals	**2,852**	**155,391**	**6,473.66**	**44.1%**	**10,104**	**499,532**	**19,323.42**	**52.3%**

** Results are liability-weighted*

Appendix – Detailed Experience Analysis
Disability Retirements

2016-2021 Experience

Age Group	Total			
	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	4	-	N/A
25-29	-	604	0.07	0.0%
30-34	-	1,599	0.34	0.0%
35-39	-	2,115	0.45	0.0%
40-44	-	2,357	0.68	0.0%
45-49	1	2,614	1.12	89.3%
50-54	-	2,331	2.01	0.0%
55-59	1	2,104	3.65	27.4%
60-64	1	1,219	4.21	23.8%
Totals	**3**	**14,947**	**12.53**	**23.9%**

Appendix – Detailed Experience Analysis
Disability Retirements

2016-2017 Experience

Age Group	Total Actual Disabilities	Total Exposure	Total Expected Disabilities	Total Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	1	-	N/A
25-29	-	147	0.02	0.0%
30-34	-	337	0.08	0.0%
35-39	-	417	0.09	0.0%
40-44	-	495	0.14	0.0%
45-49	-	525	0.22	0.0%
50-54	-	438	0.37	0.0%
55-59	-	413	0.72	0.0%
60-64	-	256	0.89	0.0%
Totals	**-**	**3,029**	**2.53**	**0.0%**

2017-2018 Experience

Age Group	Total Actual Disabilities	Total Exposure	Total Expected Disabilities	Total Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	1	-	N/A
25-29	-	131	0.02	0.0%
30-34	-	331	0.08	0.0%
35-39	-	431	0.09	0.0%
40-44	-	475	0.14	0.0%
45-49	-	531	0.23	0.0%
50-54	-	445	0.39	0.0%
55-59	-	427	0.73	0.0%
60-64	-	249	0.86	0.0%
Totals	**-**	**3,021**	**2.54**	**0.0%**

2018-2019 Experience

Age Group	Total Actual Disabilities	Total Exposure	Total Expected Disabilities	Total Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	-	-	N/A
25-29	-	120	0.01	0.0%
30-34	-	316	0.06	0.0%
35-39	-	437	0.09	0.0%
40-44	-	485	0.14	0.0%
45-49	1	525	0.23	434.8%
50-54	-	465	0.40	0.0%
55-59	-	421	0.73	0.0%
60-64	-	245	0.85	0.0%
Totals	**1**	**3,014**	**2.51**	**39.8%**

Appendix – Detailed Experience Analysis
Disability Retirements

2019-2020 Experience

	Total			
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	-	-	N/A
25-29	-	108	0.01	0.0%
30-34	-	307	0.06	0.0%
35-39	-	427	0.09	0.0%
40-44	-	450	0.13	0.0%
45-49	-	518	0.22	0.0%
50-54	-	484	0.42	0.0%
55-59	1	437	0.76	131.6%
60-64	-	222	0.76	0.0%
Totals	**1**	**2,953**	**2.45**	**40.8%**

2020-2021 Experience

	Total			
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	2	-	N/A
25-29	-	98	0.01	0.0%
30-34	-	308	0.06	0.0%
35-39	-	403	0.09	0.0%
40-44	-	452	0.13	0.0%
45-49	-	515	0.22	0.0%
50-54	-	499	0.43	0.0%
55-59	-	406	0.71	0.0%
60-64	1	247	0.85	117.6%
Totals	**1**	**2,930**	**2.50**	**40.0%**

Appendix – Detailed Experience Analysis
Post-Retirement Mortality ($000s)

2016-2021 Experience

Age Group	Males				Females			
	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
55-59	-	1,547	7.56	0.0%	15	5,179	16.43	91.3%
60-64	24	8,453	57.73	41.6%	109	36,239	164.46	66.3%
65-69	182	25,779	263.26	69.1%	356	81,933	570.41	62.4%
70-74	817	44,083	711.80	114.8%	804	91,960	987.29	81.4%
75-79	782	39,842	1,110.87	70.4%	916	50,058	914.65	100.1%
80-84	1,487	34,942	1,743.57	85.3%	1,510	37,045	1,204.56	125.4%
85-89	2,159	21,273	1,960.65	110.1%	1,561	20,676	1,227.14	127.2%
90-94	1,290	6,293	1,004.23	128.5%	1,439	8,725	947.05	151.9%
95+	238	1,334	329.18	72.3%	665	1,846	348.60	190.8%
Totals	**6,979**	**183,546**	**7,188.85**	**97.1%**	**7,375**	**333,661**	**6,380.59**	**115.6%**

** Results are benefit-weighted*

Appendix – Detailed Experience Analysis
Post-Retirement Mortality ($000s)

2016-2017 Experience

Age Group	Males				Females			
	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
55-59	-	196	0.93	0.0%	-	931	3.04	0.0%
60-64	24	2,034	13.73	174.8%	-	7,991	35.85	0.0%
65-69	38	7,456	75.94	50.0%	-	18,938	132.18	0.0%
70-74	193	8,974	146.49	131.7%	135	14,823	158.21	85.3%
75-79	119	7,447	210.69	56.5%	168	8,719	166.45	100.9%
80-84	323	6,224	302.45	106.8%	223	6,214	205.91	108.3%
85-89	603	4,357	380.74	158.4%	163	3,235	190.03	85.8%
90-94	139	1,041	173.31	80.2%	387	1,761	188.07	205.8%
95+	34	84	19.09	178.1%	148	295	59.17	250.1%
Totals	**1,473**	**37,813**	**1,323.37**	**111.3%**	**1,224**	**62,907**	**1,138.91**	**107.5%**

2017-2018 Experience

Age Group	Males				Females			
	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
55-59	-	280	1.40	0.0%	-	782	2.49	0.0%
60-64	-	1,984	13.70	0.0%	-	8,115	36.75	0.0%
65-69	8	5,913	60.43	13.2%	68	17,071	119.11	57.1%
70-74	61	9,255	148.46	41.1%	75	17,136	179.98	41.7%
75-79	102	8,002	224.80	45.4%	182	9,107	167.02	109.0%
80-84	298	6,615	328.77	90.6%	319	6,844	215.94	147.7%
85-89	567	3,949	357.63	158.5%	320	4,221	243.97	131.2%
90-94	112	1,229	199.11	56.3%	363	1,671	186.81	194.3%
95+	26	187	42.95	60.5%	43	215	46.42	92.6%
Totals	**1,174**	**37,414**	**1,377.25**	**85.2%**	**1,370**	**65,162**	**1,198.49**	**114.3%**

2018-2019 Experience

Age Group	Males				Females			
	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
55-59	-	228	1.10	0.0%	-	711	2.19	0.0%
60-64	-	1,698	11.74	0.0%	67	7,398	33.70	198.8%
65-69	53	5,113	53.02	100.0%	128	16,403	114.41	111.9%
70-74	287	8,606	137.39	208.9%	82	18,967	201.72	40.7%
75-79	151	8,245	224.71	67.2%	93	9,528	171.87	54.1%
80-84	380	7,188	352.81	107.7%	373	7,820	251.02	148.6%
85-89	146	4,258	393.36	37.1%	299	4,286	258.74	115.6%
90-94	316	1,157	186.30	169.6%	88	1,559	177.47	49.6%
95+	68	377	88.35	77.0%	17	251	50.04	34.0%
Totals	**1,401**	**36,870**	**1,448.78**	**96.7%**	**1,147**	**66,923**	**1,261.16**	**90.9%**

** Results are benefit-weighted*

Appendix – Detailed Experience Analysis
Post-Retirement Mortality ($000s)

2019-2020 Experience

Age Group	Males				Females			
	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
55-59	-	373	1.82	0.0%	15	1,127	3.54	423.7%
60-64	-	1,320	9.15	0.0%	42	6,496	29.60	141.9%
65-69	24	3,859	39.42	60.9%	133	15,117	104.60	127.2%
70-74	143	8,832	141.45	101.1%	198	20,316	218.68	90.5%
75-79	146	8,216	229.14	63.7%	213	10,759	193.71	110.0%
80-84	234	7,339	373.36	62.7%	296	7,897	256.20	115.5%
85-89	432	4,542	441.36	97.9%	227	4,269	250.41	90.7%
90-94	368	1,072	172.72	213.1%	327	2,023	212.97	153.5%
95+	63	368	92.43	68.2%	274	546	100.03	273.9%
Totals	**1,410**	**35,921**	**1,500.85**	**93.9%**	**1,725**	**68,550**	**1,369.74**	**125.9%**

2020-2021 Experience

Age Group	Males				Females			
	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
55-59	-	470	2.31	0.0%	-	1,628	5.17	0.0%
60-64	-	1,417	9.41	0.0%	-	6,239	28.56	0.0%
65-69	59	3,438	34.45	171.3%	27	14,404	100.11	27.0%
70-74	133	8,416	138.01	96.4%	314	20,718	228.70	137.3%
75-79	264	7,932	221.53	119.2%	260	11,945	215.60	120.6%
80-84	252	7,576	386.18	65.3%	299	8,270	275.49	108.5%
85-89	411	4,167	387.56	106.0%	552	4,665	283.99	194.4%
90-94	355	1,794	272.79	130.1%	274	1,711	181.73	150.8%
95+	47	318	86.36	54.4%	183	539	92.94	196.9%
Totals	**1,521**	**35,528**	**1,538.60**	**98.9%**	**1,909**	**70,119**	**1,412.29**	**135.2%**

* *Results are benefit-weighted*

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality ($000s)

2016-2021 Experience

Age Group	Males				Females			
	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
20-24	-	-	-	N/A	-	216	0.04	0.0%
25-29	-	6,894	2.85	0.0%	-	35,214	7.43	0.0%
30-34	-	32,650	15.82	0.0%	-	118,670	32.94	0.0%
35-39	-	61,669	33.63	0.0%	-	213,005	77.07	0.0%
40-44	-	95,118	61.78	0.0%	170	293,413	140.42	121.1%
45-49	-	144,152	136.09	0.0%	-	405,977	288.50	0.0%
50-54	323	154,627	233.52	138.3%	356	451,776	512.22	69.5%
55-59	-	144,991	361.70	0.0%	-	548,311	997.33	0.0%
60-64	241	81,792	354.46	68.0%	230	350,085	935.21	24.6%
65-69	-	17,783	128.89	0.0%	-	78,476	289.57	0.0%
Totals	**564**	**739,676**	**1,328.74**	**42.4%**	**756**	**2,495,143**	**3,280.72**	**23.0%**

** Results are liability-weighted*

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality ($000s)

2016-2017 Experience

	Males				Females			
Age Group	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
20-24	-	-	-	N/A	-	52	0.01	0.0%
25-29	-	1,578	0.65	0.0%	-	8,685	1.82	0.0%
30-34	-	7,271	3.52	0.0%	-	23,868	6.59	0.0%
35-39	-	11,536	6.29	0.0%	-	43,251	15.55	0.0%
40-44	-	21,609	14.00	0.0%	-	59,570	28.57	0.0%
45-49	-	29,344	27.56	0.0%	-	82,107	58.19	0.0%
50-54	-	28,077	42.87	0.0%	-	89,146	103.22	0.0%
55-59	-	25,607	64.29	0.0%	-	102,413	184.29	0.0%
60-64	-	14,374	60.58	0.0%	-	71,605	190.34	0.0%
65-69	-	4,300	30.98	0.0%	-	16,638	60.45	0.0%
Totals	**-**	**143,696**	**250.74**	**0.0%**	**-**	**497,335**	**649.03**	**0.0%**

2017-2018 Experience

	Males				Females			
Age Group	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
20-24	-	-	-	N/A	-	63	0.01	0.0%
25-29	-	1,729	0.71	0.0%	-	8,675	1.82	0.0%
30-34	-	7,636	3.69	0.0%	-	27,227	7.56	0.0%
35-39	-	13,960	7.61	0.0%	-	49,827	18.04	0.0%
40-44	-	22,533	14.65	0.0%	-	64,220	30.88	0.0%
45-49	-	33,410	31.89	0.0%	-	89,665	63.72	0.0%
50-54	-	29,429	44.77	0.0%	-	91,584	104.46	0.0%
55-59	-	28,403	70.45	0.0%	-	116,033	209.99	0.0%
60-64	241	15,421	65.79	366.3%	230	70,112	188.84	121.8%
65-69	-	2,823	20.91	0.0%	-	13,713	51.98	0.0%
Totals	**241**	**155,344**	**260.47**	**92.5%**	**230**	**531,119**	**677.32**	**34.0%**

2018-2019 Experience

	Males				Females			
Age Group	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
20-24	-	-	-	N/A	-	-	-	N/A
25-29	-	1,196	0.49	0.0%	-	6,730	1.42	0.0%
30-34	-	5,892	2.86	0.0%	-	22,628	6.31	0.0%
35-39	-	12,638	6.90	0.0%	-	39,625	14.31	0.0%
40-44	-	17,974	11.75	0.0%	-	57,705	27.69	0.0%
45-49	-	26,857	25.43	0.0%	-	78,242	56.03	0.0%
50-54	183	30,362	45.69	400.5%	-	87,289	99.43	0.0%
55-59	-	29,442	73.65	0.0%	-	111,432	202.68	0.0%
60-64	-	17,172	76.37	0.0%	-	70,561	188.16	0.0%
65-69	-	2,361	19.61	0.0%	-	16,257	59.08	0.0%
Totals	**183**	**143,894**	**262.75**	**69.6%**	**-**	**490,469**	**655.12**	**0.0%**

* *Results are liability-weighted*

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality ($000s)

2019-2020 Experience

	Males				Females			
Age Group	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
20-24	-	-	-	N/A	-	-	-	N/A
25-29	-	1,084	0.45	0.0%	-	5,987	1.27	0.0%
30-34	-	5,946	2.88	0.0%	-	22,254	6.18	0.0%
35-39	-	11,573	6.31	0.0%	-	41,395	15.04	0.0%
40-44	-	17,088	11.14	0.0%	170	54,381	26.00	653.9%
45-49	-	26,734	25.11	0.0%	-	78,104	55.42	0.0%
50-54	-	32,671	48.93	0.0%	356	89,267	99.53	357.7%
55-59	-	29,768	74.11	0.0%	-	116,378	213.95	0.0%
60-64	-	17,173	73.54	0.0%	-	63,985	170.91	0.0%
65-69	-	4,262	29.66	0.0%	-	18,447	68.95	0.0%
Totals	**-**	**146,299**	**272.12**	**0.0%**	**526**	**490,198**	**657.24**	**80.0%**

2020-2021 Experience

	Males				Females			
Age Group	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected	Actual Deaths*	Exposure*	Expected Deaths*	Actual/ Expected
20-24	-	-	-	N/A	-	101	0.02	0.0%
25-29	-	1,307	0.54	0.0%	-	5,137	1.09	0.0%
30-34	-	5,905	2.88	0.0%	-	22,693	6.30	0.0%
35-39	-	11,962	6.52	0.0%	-	38,907	14.11	0.0%
40-44	-	15,914	10.24	0.0%	-	57,537	27.27	0.0%
45-49	-	27,807	26.10	0.0%	-	77,859	55.15	0.0%
50-54	140	34,088	51.27	273.1%	-	94,490	105.59	0.0%
55-59	-	31,771	79.21	0.0%	-	102,055	186.41	0.0%
60-64	-	17,652	78.18	0.0%	-	73,822	196.96	0.0%
65-69	-	4,037	27.72	0.0%	-	13,421	49.11	0.0%
Totals	**140**	**150,443**	**282.66**	**49.5%**	**-**	**486,022**	**642.01**	**0.0%**

** Results are liability-weighted*