

# General Employees Retirement Plan of Minnesota

4-Year Experience Study

July 1, 2014 Through June 30, 2018



June 27, 2019

Public Employees Retirement Association of Minnesota  
General Employees Retirement Plan  
St. Paul, Minnesota

Dear Trustees of the General Employees Retirement Plan:

The results of the four-year **actuarial experience study** of the General Employees Retirement Plan (GERP) are presented in this report. The investigation was conducted for the purpose of updating the actuarial assumptions used in valuing the actuarial liabilities of the General Employees Retirement Plan.

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

The investigation covered the four-year period from **July 1, 2014 to June 30, 2018**, 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 General Employees Retirement Plan.**

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

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

Trustees  
Public Employees Retirement Association of Minnesota  
General Employees Retirement Plan  
June 27, 2019

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

Respectfully submitted,



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



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

BJW/BBM:dj



# Actuarial Experience Study 2014 - 2018

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## SECTION A

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### OVERVIEW AND SUMMARY OF RESULTS

## Summary of Findings

The four-year period (July 1, 2014 to June 30, 2018) 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 General Employees Retirement Plan. The recommended changes in actuarial assumptions and methods resulting from this experience study are summarized below:

### Recommendations

- Decrease the price inflation assumption from 2.50% to 2.25%.
- Decrease the wage inflation (i.e., payroll growth) assumption from 3.25% to 3.00%.
- Adjust rates of merit and seniority, resulting in proposed merit and seniority increases that are approximately the same on average but with a slightly different allocation, with lower increases assumed at the beginning of a member's career. When combined with the proposed decrease in payroll growth assumption, the result is an overall decrease in gross salary increase rates.
- Adjust assumed retirement rates:
  - Increase the rate of assumed unreduced retirements (i.e., Normal Retirement) at all ages.
  - Slightly lower the assumed Rule of 90 retirement rates at ages 61 and 62.
  - Slight adjustments to early retirement rates for Tier 1 and Tier 2 members.
- Change the assumed rates of withdrawal (termination of membership before eligible to retire):
  - Generally, proposed rates are lower than current rates for years 1 to 5 and slightly higher thereafter.
- Lower rates of disability.
- Change the base mortality table to the PUB-2010 general mortality table, with rates adjusted to better fit observed plan experience and with future improvement projected using scale MP-2018.
- No change in the actuarial funding method.
- Consider layered amortization as an alternative to the current 30-year closed period amortization policy.
- Change Minnesota Standards for Actuarial Work requirements related to projected payroll.
- Minor changes to the spouse age difference and form of payment assumptions.

The recommendations are summarized on the following pages.

## Introduction

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

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

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

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

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

A single set of assumptions will not be suitable indefinitely. Things change, and our understanding of things (whether or not they are changing) also changes. The package of assumptions is then adjusted to reflect basic experience trends -- but not random year to year fluctuations. Actuarial assumptions were last revised for the June 30, 2016 and 2018 actuarial valuations based on the results of the most recent experience study. Assumptions in effect prior to June 30, 2018 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 Decrement Experience 2014 - 2018

Decrement Risk Area	Actual Number	Expected		
		Present Assumptions	Proposed Assumptions	Change
<i>Unreduced Retirement</i>				
Normal Retirement	5,064	3,580	4,869	1,289
Rule of 90	3,893	4,202	3,958	(244)
<i>Reduced Retirement</i>				
Tier 1 Early Retirement	2,100	2,272	2,082	(190)
Tier 2 Early Retirement	8,683	8,579	7,934	(645)
<i>Withdrawal</i>				
Males	16,301	14,075	12,295	(1,780)
Females	38,676	31,882	29,797	(2,085)
<i>Disability</i>				
Males	207	360	304	(56)
Females	210	434	369	(65)
<i>Mortality</i>				
Healthy Retired Lives - Male	3,500	3,537	3,418	(119)
- Female	5,029	4,435	4,698	263
Disabled Retired Lives - Male	300	281	279	(2)
- Female	350	384	332	(52)
Active Lives - Male	312	276	289	13
- Female	325	338	332	(6)

Results presented in the exhibit above are based on actual headcounts of occurrences. Results in the body of the report are liability weighted for retirement, withdrawal and active mortality and benefit weighted for healthy and disabled retiree mortality.



## **SECTION B**

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### **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 some provision for long-term inflation.

Current economic assumptions for PERA are as follows:

<b>Investment Return</b>	7.50%
<b>Inflation</b>	2.50%
<b>Payroll Growth</b>	3.25%

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 the State Board of Investment (SBI) for the State of Minnesota, including information in an SBI memo dated March 14, 2019
- Future expectations of other investment consultants
- 2019 Social Security Trustees Report
- Historical observations of inflation statistics and investment returns
- U.S. Department of the Treasury yield curve rates ([www.treasury.gov](http://www.treasury.gov))
- National Average Wage Index

## Economic Assumptions – ASOP No. 27

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 historical and current economic data that is relevant as of the measurement date,
- It reflects the actuary's estimate of future experiences, observations of estimates inherent in market data, or a combination thereof, and
- It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or other factors are included and disclosed under Section 3.5.1, or when alternative assumptions are used for the assessment of risk.

## Economic Assumptions – Inflation

**Inflation.** Over the past 60 years, price inflation has averaged 3.7%. This result is heavily affected by the high inflationary period of the 1970s and early 1980s. During the past decade, price inflation averaged 1.8%.

<b>Calendar Year Period</b>	<b>Inflation (CPI)</b>
1950-1959	2.2%
1960-1969	2.5%
1970-1979	7.4%
1980-1989	5.1%
1990-1999	2.9%
2000-2009	2.5%
2000	3.4%
2001	1.6%
2002	2.4%
2003	1.9%
2004	3.3%
2005	3.4%
2006	2.5%
2007	4.1%
2008	0.1%
2009	2.7%
2010	1.5%
2011	3.0%
2012	1.7%
2013	1.5%
2014	0.8%
2015	0.7%
2016	2.1%
2017	2.1%
2018	1.9%
<b>Last 5 Years</b>	<b>1.5%</b>
<b>Last 10 Years</b>	<b>1.8%</b>
<b>Last 20 Years</b>	<b>2.2%</b>
<b>Last 30 Years</b>	<b>2.5%</b>
<b>Last 40 Years</b>	<b>3.3%</b>
<b>Last 50 Years</b>	<b>4.0%</b>
<b>Last 60 Years</b>	<b>3.7%</b>

The 2016 Asset Liability Study done by Callan for the SBI used a 2.25% price inflation assumption. Most of the investment consulting firms, in setting their capital market assumptions, currently assume that inflation will be less than 2.50%. We examined the capital market assumption sets for fourteen investment consulting firms. The average assumption for inflation was 2.18%, with a range of 1.70% to 2.50%. However, the investment consulting firms typically set their assumptions based on a shorter time horizon, while actuaries must make much longer projections.

# Economic Assumptions – Inflation

## Forward-Looking Economic Data

The assumed rate of price inflation should not give undue weight to recent experience. Some historical economic data may not be appropriate for use in developing assumptions for future periods due to changes in the underlying economic environment. Professional forecasters, economists, and investors are reliable sources to guide in the selection and evaluation of expected future price inflation rates.

The Survey of Professional Forecasters, maintained by the Federal Reserve Bank of Philadelphia, is the longest running quarterly survey of macroeconomic forecasts in the U.S. Over 50 forecasters from industry, government, banking, and academics are included in this Survey. With respect to price inflation, their median projections are published quarterly for the annual-average Headline CPI over the next 10 years. Headline CPI is the total CPI, as opposed to Core CPI, which excludes food and energy prices. The following table presents the Survey's quarterly projections through the first quarter of 2019.

**Quarterly Median Projections of the 10-Year Annual-Average Headline CPI-U Inflation  
(Philadelphia Federal Reserve)**

2016-2	2016-3	2016-4	2017-1	2017-2	2017-3	2017-4	2018-1	2018-2	2018-3	2018-4	2019-1
2.20%	2.15%	2.22%	2.30%	2.30%	2.25%	2.20%	2.25%	2.30%	2.20%	2.21%	2.20%

Source: Federal Reserve Bank of Philadelphia – Survey of Professional Forecasters Quarterly (Inflation.xlsx)

The Congressional Budget Office (CBO) regularly publishes its Budget and Economic Outlook. This report includes a forecast of annual CPI-U (All Urban Consumers). The following table presents the CBO's forecast for calendar years 2019 – 2029, as published in its report dated January, 2019.

**Consumer Price Index Forecast (CBO)**

2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	Compound Average
2.20%	2.60%	2.50%	2.50%	2.50%	2.30%	2.30%	2.30%	2.30%	2.30%	2.30%	2.37%

Source: Congressional Budget Office – The Budget and Economic Outlook: 2019 – 2029, Table 2-3 (p. 30)

The Trustees of the Social Security system prepare and publish an annual report. Social Security's economists develop a forecast of future CPI-W (for Urban Wage Earners and Clerical Workers). The following table presents their forecasts in the 2019 annual report.

**Social Security Trustees'  
Ultimate CPI-W Assumption  
for 2021 and Later**

Low-cost	3.20%
Intermediate	2.60%
High-cost	2.00%

Source: 2019 Social Security Trustees' Report

The figures in the table above are based on a horizon that well exceeds the duration of the plan's liabilities.

## Economic Assumptions – Inflation

Another source of information about future price inflation is the market for U.S. Treasury bonds. Comparing spreads between nominal and inflation-indexed treasury securities (TIPS) provides an estimate of the bond market's expectation of inflation over the next decade or more. However, this analysis ignores the inflation risk premium that buyers of U.S. Treasury bonds often demand, and it ignores the differences in liquidity between U.S. Treasury bonds and TIPS.

**Treasury Constant Maturities (2018 Annual Yields)**

<b>Term</b>	<b>Nominal</b>	<b>Inflation-Indexed</b>	<b>Implied Inflation</b>
10-year	2.91%	0.83%	2.08%
20-year	3.02%	0.93%	2.09%
30-year	3.11%	1.01%	2.10%

Source: Board of Governors of the Federal Reserve System, H.15 Selected Interest Rates for March 21, 2019

**Based upon the reviewed data, we recommend changing the inflation assumption from 2.50% to 2.25%.**

## 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 on 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 3.25%, which is comprised of a 2.50% price inflation assumption plus a real wage growth assumption of 0.75%. 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 2.3% over the past decade, while general inflation averaged 1.8% during this same period. This would imply a real growth rate of 0.5% (i.e., 2.3% - 1.8%). Over the past 60 years, measured in the same way, the real growth rate was 0.8%. The 2019 Social Security Trustees report uses 1.2% as the long-range intermediate real-wage differential assumption. The low-cost assumption is 1.8% and the high-cost assumption is 0.6%.

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.

GERP salary increases observed in the study level off after about twenty-five years of service. For members with 25 or more years of service, the observed average salary increase during the four-year period was 3.0%. Inflation during this four-year period averaged 1.7%. Therefore, long-service employees received an average salary increase of 1.3% above inflation.

**Based upon the data reviewed, we recommend maintaining the current real wage growth assumption of 0.75%. When combined with the proposed 2.25% price inflation assumption, the recommended payroll growth assumption is 3.00%.** As noted above, the recommended payroll growth assumption is appropriate for a stable population.

## Economic Assumptions – Investment Return

**Investment Return.** The investment return assumption is the actuarial assumption that has the largest impact on actuarial valuation results.

It is our understanding that the SBI's most recent asset liability study resulted in an expected net rate of return of 7.3%, comprised of an inflation assumption of 2.25%, and a real rate of return assumption of 5.05%. The asset liability study was completed by Callan in 2016.

PERA's Comprehensive Annual Financial Report for the fiscal year ending June 30, 2018 includes the following investment return statistics:

- SBI retirement funds returned 4.6 percentage points above the CPI over the last 20 years.
- The average return over the ten-year period ending June 30, 2018 was 7.8%.

The following chart shows the estimated annual investment return on an actuarial and market value basis for each year in the four-year period under consideration:

<b>Fiscal Year Ending</b>	<b>Actuarial Value of Assets</b>	<b>Market Value of Assets</b>
June 30, 2015	12.1%	4.4%
June 30, 2016	7.6%	- 0.2%
June 30, 2017	9.3%	15.1%
June 30, 2018	9.2%	10.4%
<b>Average annual investment return July 1, 2014 to June 30, 2018</b>	<b>9.5%</b>	<b>7.3%</b>

Historical results provide some useful and interesting information but cannot be the sole basis for forward-looking assumptions.



## Economic Assumptions – Investment Return

For purposes of budgeting contributions as a level percentage of payroll 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 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 likely investment return outcomes for the asset classes in the current investment policy. For purposes of this analysis, we have analyzed the System's investment policy with the capital market assumptions from fourteen nationally recognized investment consultants.

Our analysis is based on the GRS Capital Market Assumption Modeler (CMAM). Because GRS is a benefits consulting firm and does not develop or maintain our own capital market expectations, we request and monitor forward-looking expectations developed by several major investment consulting firms. We update our CMAM on an annual basis. The capital market assumptions in the 2019 CMAM are from the following investment consultants (in alphabetical order): Aon Hewitt, Blackrock, BNY Mellon, Callan, Cambridge, JPMorgan, Marquette Associates, Meketa, Mercer, NEPC, RVK, Verus, Voya and Wilshire. We believe the benefit of performing this analysis using multiple investment consulting 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 consultants to be as consistent as possible.

To the best of our ability, we have adapted the System's investment policy to fit with the consultants' assumptions adjusting for these known differences in assumptions and methodology. 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.

It is important to note that certain alternative asset classes such as hedge funds and private equity may have implicit or explicit expectations of higher returns. In February 2019, the American Academy of Actuaries issued a public policy practice note: Forecasting Investment Returns and Expected Return Assumptions for Pension Actuaries. This Practice Note suggests that for alternative asset classes such as private equity, forecasting returns is challenging due to lack of data. In particular:

Private equity return expectations may be estimated by adding an illiquidity premium to the expected return for public equities. Some research papers identify this illiquidity premium at 2.5% to 3.0% based on historical analysis of available data. However, many practitioners opt for a more modest 1.0% to 2.5% illiquidity premium, as can be seen in their published capital market assumptions reports.

## Economic Assumptions – Investment Return

One approach is to analyze the implied capital market line of the average expectations of the various asset classes of all the investment consultants. A regression analysis of these average expectations suggests that the return expectations for private equity in the CMAM may be 1.0% to 1.5% higher than implied by the level of risk. A similar analysis for hedge funds in the CMAM may be 0.5% to 1.0% higher than implied by the level of risk. For purposes of this analysis, no adjustment has been made.

Presented below is the current target asset allocation, provided to GRS by the SBI for use in this study:

Asset Class	Asset Allocation
Domestic Equity	36%
International Equity	17
Fixed Income	20
Private Markets	25
Cash	2

Additionally, the SBI provided the following clarifications:

- The percentage weightings for SBI's private market investment portfolio (market value and unfunded commitments) as of June 30, 2018 are 13.5% private equity, 2.1% private credit, 4.5% real assets, 2.2% real estate, and 2.8% distressed/opportunistic.
- The SBI does not establish an allocation target for each segment within private markets. The weightings shown above are not targets.

We note that any uninvested portion of the Private Markets allocation is held in public equity. The actual investment mix as of March 31, 2019, compared to the policy target, is as follows:

Asset Class	Policy Target Asset Allocation	Actual Asset Allocation
Public Equity	53%	63%
Fixed Income	12	11
Private Markets	25	15
Treasuries	8	9
Cash	2	2

## Economic Assumptions – Investment Return

The arithmetic expected return developed from the actual asset allocation is shown in the table below.

The CMAM begins with the nominal expected return from each consultant (column 2), takes out each consultant's price inflation assumption (column 3) to arrive at the real return (column 4). We then incorporate the current price inflation assumption of 2.25% (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. 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.

ASOP No. 27, Section 3.6.2, states that the actuary "should recognize the uncertain nature of the items for which assumptions are selected and, as a result, may consider several different assumptions reasonable for a given measurement." This range of reasonable assumptions is evident from the summaries we show from our CMAM.

Investment Consultant	Investment Consultant Expected Nominal Return	Investment Consultant 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	5.90%	2.20%	3.70%	2.25%	5.95%	0.00%	5.95%	12.59%
2	6.65%	2.50%	4.15%	2.25%	6.40%	0.00%	6.40%	13.90%
3	7.18%	2.50%	4.68%	2.25%	6.93%	0.00%	6.93%	15.30%
4	6.94%	2.20%	4.74%	2.25%	6.99%	0.00%	6.99%	11.81%
5	7.14%	2.00%	5.14%	2.25%	7.39%	0.00%	7.39%	12.73%
6	7.76%	2.21%	5.55%	2.25%	7.80%	0.00%	7.80%	15.65%
7	7.81%	2.25%	5.56%	2.25%	7.81%	0.00%	7.81%	15.14%
8	7.56%	2.00%	5.56%	2.25%	7.81%	0.00%	7.81%	14.19%
9	8.23%	2.26%	5.97%	2.25%	8.22%	0.00%	8.22%	16.72%
10	8.19%	2.31%	5.88%	2.25%	8.13%	0.00%	8.13%	14.90%
11	8.31%	2.15%	6.16%	2.25%	8.41%	0.00%	8.41%	14.20%
12	8.82%	2.30%	6.52%	2.25%	8.77%	0.00%	8.77%	14.46%
13	8.39%	1.70%	6.69%	2.25%	8.94%	0.00%	8.94%	14.75%
14	8.55%	2.00%	6.55%	2.25%	8.80%	0.00%	8.80%	13.27%
<b>Average</b>	<b>7.67%</b>	<b>2.18%</b>	<b>5.49%</b>	<b>2.25%</b>	<b>7.74%</b>	<b>0.00%</b>	<b>7.74%</b>	<b>14.26%</b>

The average expected nominal return from column 8 is 7.74%. 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. Setting the valuation assumption at the arithmetic expected return means that over time it is less than 50% likely that this return will be achieved. Additional analysis is required to adjust to the median (or geometric average) return which produces the 50<sup>th</sup> percentile of expectation.

## Economic Assumptions – Investment 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. Note that the investment horizon for most of the capital market assumption sets is between 5 and 10 years (the average is 9.7 or roughly 10 years) <sup>1</sup>.

Investment Consultant	Distribution of 10-Year Average Geometric Net Nominal Return			Probability of Exceeding 7.50%
	40th	50th	60th	
(1)	(2)	(3)	(4)	(5)
1	4.22%	5.21%	6.22%	28.28%
2	4.41%	5.51%	6.61%	32.45%
3	4.65%	5.85%	7.07%	36.57%
4	5.41%	6.35%	7.29%	37.82%
5	5.64%	6.64%	7.66%	41.54%
6	5.45%	6.68%	7.92%	43.33%
7	5.57%	6.76%	7.96%	43.78%
8	5.77%	6.89%	8.02%	44.52%
9	5.65%	6.95%	8.28%	45.83%
10	5.95%	7.12%	8.30%	46.75%
11	6.38%	7.49%	8.62%	49.93%
12	6.68%	7.82%	8.97%	52.83%
13	6.79%	7.95%	9.12%	53.91%
14	6.96%	8.00%	9.06%	54.82%
<b>Average</b>	<b>5.68%</b>	<b>6.80%</b>	<b>7.94%</b>	<b>43.74%</b>

<sup>1</sup> We requested capital market assumptions over a longer horizon from each of the fourteen investment consultants. Six of the investment consultants provided capital market assumptions over a period of 20, 25, or 30 years, the other eight did not provide assumptions over a period longer than 10 years. Each of the six that provided assumptions over a longer horizon had different expectations after the first 10 years. However, two of those six indicated that return expectations after the 10<sup>th</sup> year were set based on historical return experience, as opposed to a market-based or forward-looking methodology that is predominately used in the development of the 10-year expectations. The other investment consultants did not provide a description of methodology for the longer horizon.

## Economic Assumptions – Investment Return

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 increases 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 6.80% per year.

Column 5 of table 2 shows the estimated probability of achieving this 7.50% assumed rate of return over a 10-year period. The average probability of achieving 7.50% over 10 years is 44%.

As noted above, the investment horizon for most of the capital market assumption sets is between 5 and 10 years. We developed a revised model that is based on additional capital market assumptions provided to GRS. We adjusted the standard model to include assumptions applying to time horizons of 20 to 30 years. The capital market assumptions in this revised model are from the following investment consultants (in alphabetical order) Aon Hewitt, BlackRock, Cambridge, Meketa, Mercer and NEPC.

In the revised model, the average expected nominal return increases from 7.74% to 8.41%, and the average of 50th percentile returns for the six investment consultants in the revised model increases from 6.80% to 7.42% per year. The probability of exceeding 7.50% increases from 44% to 49%.

Keep in mind that the short-term does matter. Investment returns realized in the short-term have a significant bearing on the long-term average return. As shown in the chart on the following page, a significant portion (43%) of liabilities will actually be paid out over the next ten years and 59% is estimated to be paid over the next fifteen years. Many of the investment consultants forecast relatively low returns for the next 10 or so years, followed by higher returns. Once the money is paid out, it will not be available to participate in the better returns that consultants predict for the longer term future.

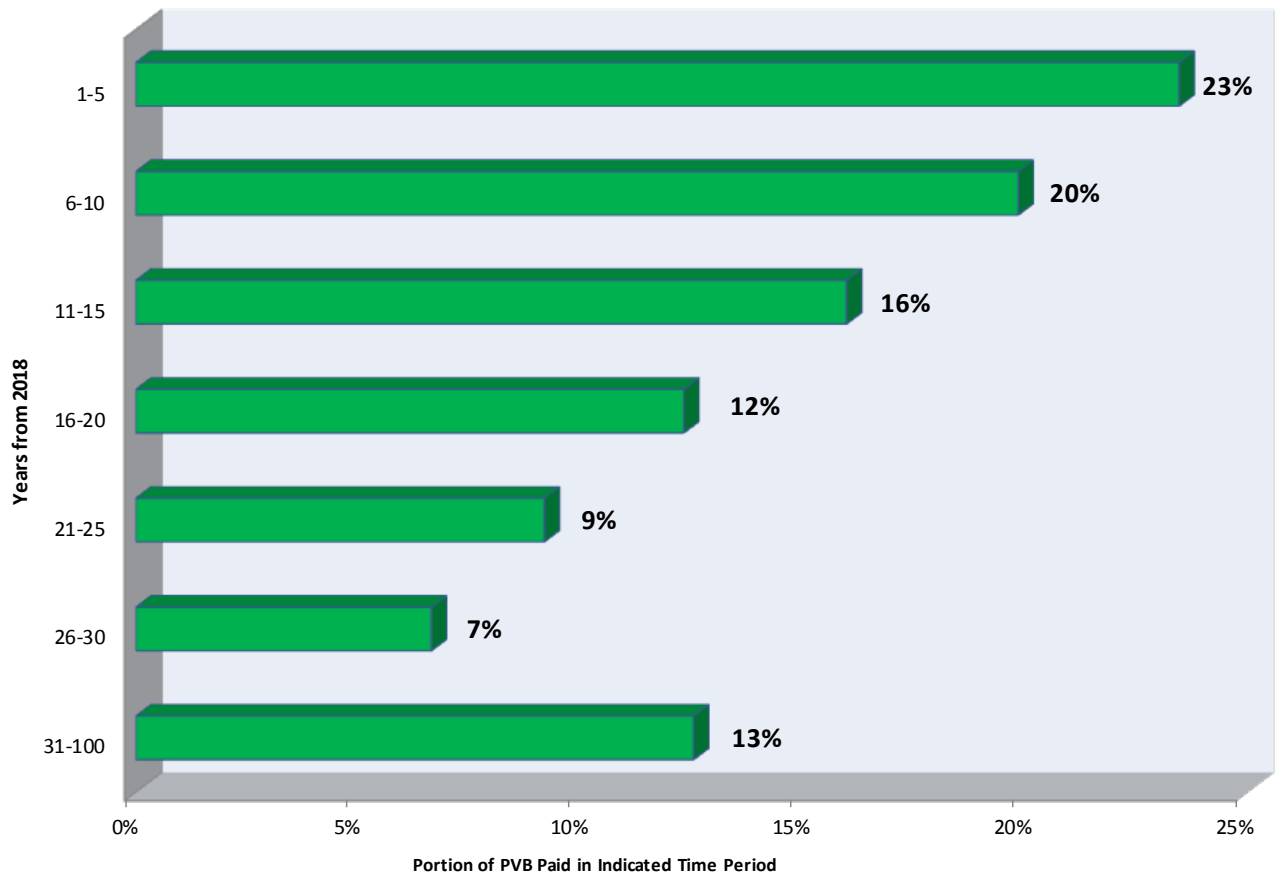
The “right answer” is somewhere in between the two models, but is probably closer to the model based on shorter duration capital market assumptions.

**In our opinion, the assumed rate of return of 7.50% is a reasonable assumption based on this analysis.**

PERA should note that the investment return assumption must be reviewed each year for reasonability based on actuarial standards. A rate near the median, such as 7.0%, 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.

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

### Present Value of Benefit Payout by Time Period



## SECTION C

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### 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 four-year period. For each year, we excluded individual pay increases that were more than 30% and also excluded individual pay increases that were less than -30%. Some occurrences of a negative salary increase are reasonable and expected in a plan that covers part-time employees. While this was a relatively small number of records, the experience 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 1.7% over the four-year period ending June 30, 2018. During the same four-year period, the increase in the national average earnings has been about 2.8%, or 1.1% higher than inflation. Based on our review of salary experience for GERP members for the period July 1, 2014 through June 30, 2018, we observed that members with longer service averaged about a 3.0% annual increase for this period. 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 25 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 much less common.



# Pay Increases Due to Merit and Seniority

## Findings

The assumed wage inflation was 3.75% at the beginning of the study period and 3.25% as of June 30, 2018. During the four years of the study, we estimated that the average actual wage inflation component of pay increases was around 3.0% for members of the General Employees Retirement Plan. 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 4.70% over the four-year period, ranging from 4.58% in 2018 to 4.76% in 2015 and 2017. After adjusting for the 3.0% average wage inflation for this period, the average net salary increase (i.e., merit and seniority) averaged 1.70%, ranging from 1.58% to 1.76%.

Fiscal Year Ending	Count	Gross		Net*	
		Expected	Actual	Expected	Actual
2015	105,599	4.86%	4.76%	1.61%	1.76%
2016	107,993	4.98%	4.69%	1.73%	1.69%
2017	111,186	5.08%	4.76%	1.83%	1.76%
2018	112,040	5.09%	4.58%	1.84%	1.58%
<b>Total</b>	<b>436,818</b>	<b>5.01%</b>	<b>4.70%</b>	<b>1.76%</b>	<b>1.70%</b>

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

The results of our analysis are shown on the following page. Using the techniques described above, observed merit and seniority pay increases were generally slightly lower than the presently assumed increases during the first few years and generally slightly higher than the current assumption during years ten and later. The result is that the proposed merit and seniority increases are approximately the same on average but with a slightly different allocation, with lower increases assumed at the beginning of a member's career. When combined with the proposed decrease in payroll growth assumption, the result is an overall decrease in gross salary increase rates.

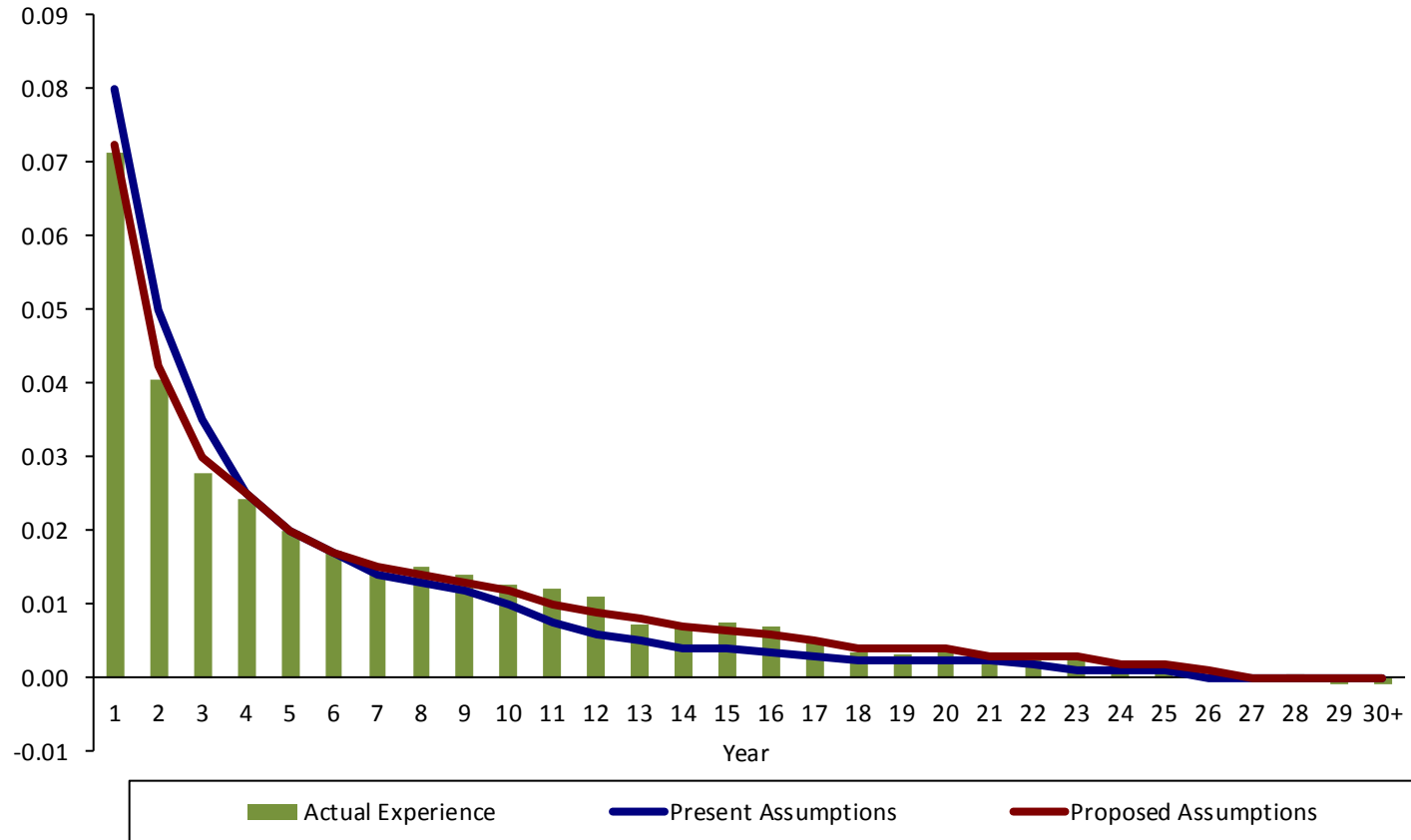
## Recommendation

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

## Pay Increases Due to Merit and Seniority

Year	Exposures	Total Salary % Increase			Merit & Seniority % Increase		
		Actual	Current	Proposed	Actual	Current	Proposed
1	25,475	10.14%	11.25%	10.25%	7.14%	8.00%	7.25%
2	36,345	7.06%	8.25%	7.25%	4.06%	5.00%	4.25%
3	30,945	5.78%	6.75%	6.00%	2.78%	3.50%	3.00%
4	25,070	5.43%	5.75%	5.50%	2.43%	2.50%	2.50%
5	19,982	5.00%	5.25%	5.00%	2.00%	2.00%	2.00%
6	16,916	4.72%	4.95%	4.70%	1.72%	1.70%	1.70%
7	16,202	4.43%	4.65%	4.50%	1.43%	1.40%	1.50%
8	16,573	4.51%	4.55%	4.40%	1.51%	1.30%	1.40%
9	17,394	4.41%	4.45%	4.30%	1.41%	1.20%	1.30%
10	17,136	4.27%	4.25%	4.20%	1.27%	1.00%	1.20%
11	15,339	4.23%	4.00%	4.00%	1.23%	0.75%	1.00%
12	14,051	4.10%	3.85%	3.90%	1.10%	0.60%	0.90%
13	13,224	3.72%	3.75%	3.80%	0.72%	0.50%	0.80%
14	13,491	3.69%	3.65%	3.70%	0.69%	0.40%	0.70%
15	13,874	3.76%	3.65%	3.65%	0.76%	0.40%	0.65%
16	13,870	3.70%	3.60%	3.60%	0.70%	0.35%	0.60%
17	13,279	3.54%	3.55%	3.50%	0.54%	0.30%	0.50%
18	12,053	3.35%	3.50%	3.40%	0.35%	0.25%	0.40%
19	10,808	3.33%	3.50%	3.40%	0.33%	0.25%	0.40%
20	9,791	3.43%	3.50%	3.40%	0.43%	0.25%	0.40%
21	8,964	3.33%	3.50%	3.30%	0.33%	0.25%	0.30%
22	8,172	3.25%	3.45%	3.30%	0.25%	0.20%	0.30%
23	7,447	3.30%	3.35%	3.30%	0.30%	0.10%	0.30%
24	6,943	3.15%	3.35%	3.20%	0.15%	0.10%	0.20%
25	6,503	3.22%	3.35%	3.20%	0.22%	0.10%	0.20%
26	6,224	3.06%	3.25%	3.10%	0.06%	0.00%	0.10%
27	5,958	2.97%	3.25%	3.00%	-0.03%	0.00%	0.00%
28	5,405	3.05%	3.25%	3.00%	0.05%	0.00%	0.00%
29	4,838	2.92%	3.25%	3.00%	-0.08%	0.00%	0.00%
30+	24,546	2.93%	3.25%	3.00%	-0.07%	0.00%	0.00%
<b>Total</b>	<b>436,818</b>	<b>4.70%</b>	<b>5.01%</b>	<b>4.76%</b>	<b>1.70%</b>	<b>1.76%</b>	<b>1.76%</b>

## Pay Increases Due to Merit and Seniority



## SECTION D

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### RETIREMENT EXPERIENCE

## Liability Weighted Analysis

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

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

# Age and Service Unreduced (Normal) Retirement

## Findings

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

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

The current assumption ends at age 71; in other words, we assume all members currently under the age of 71 will retire by the age of 71. However, for members currently age 71 or older, we assume retirement one year after the valuation date (effectively 18 months due to mid-year decrementing), as required by the Minnesota Standards for Actuarial Work. As such, there are no Exposures for ages over 71 since the valuation assumption is all of these members work an additional year and then retire. During the four-year period, there were 885 actual retirements at ages 71 and older including 200 actual retirements at age 71. We believe assuming 100% retirement at age 71 is an appropriately conservative approach.

Overall, on both a population-weighted and liability-weighted basis, the plan experienced more unreduced retirements than projected by the present assumptions. We recommend increasing the assumed unreduced retirement rates, as shown on the next page.

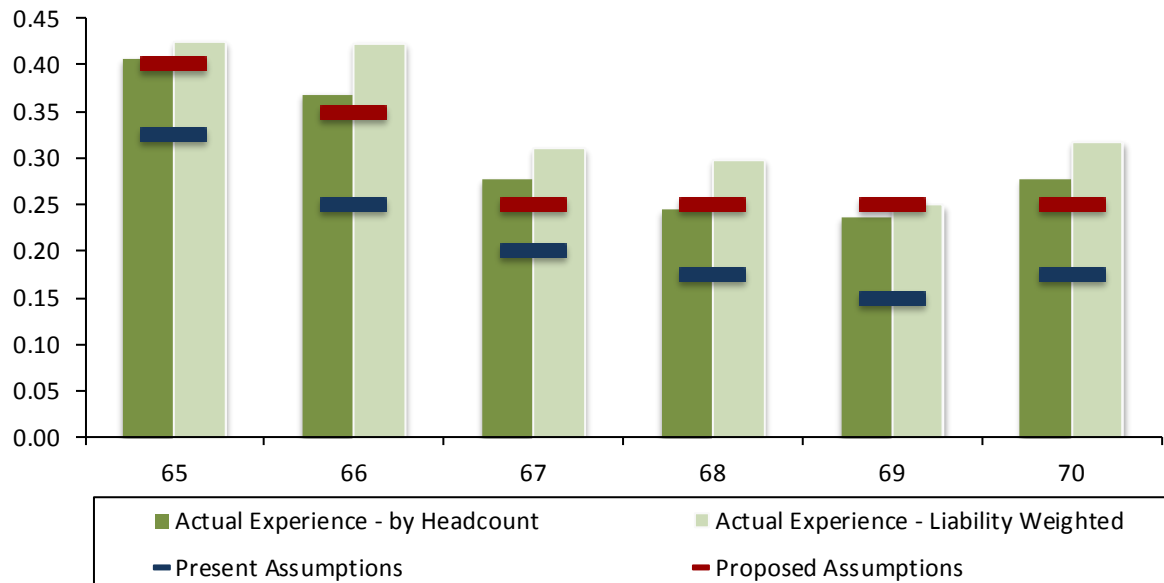
# Age and Service Unreduced (Normal) Retirement

## Recommendations

We recommend changes to the retirement rates as indicated below, which increase rates at all ages but not as much as the liability weighted actual experience suggests. In addition, we recommend the Minnesota Standards for Actuarial Work be modified to remove the requirement that members currently over age 70 delay retirement one year and instead assume these members retire mid-year, the same as members younger than age 71.

Age	Actual Retirements (\$000s)	Exposure (\$000s)	Crude Rates		Rates		Expected Retirements		Actual / Expected	
			Population Weighted	Liability Weighted	Present	Proposed	Present (\$000s)	Proposed (\$000s)	Present	Proposed
65	317,787	747,638	40.7%	42.5%	32.5%	40.0%	242,982	299,055	130.8%	106.3%
66	319,216	753,345	43.5%	42.4%	25.0%	35.0%	188,336	263,671	169.5%	121.1%
67	131,143	421,270	29.5%	31.1%	20.0%	25.0%	84,254	105,318	155.7%	124.5%
68	89,886	300,549	28.5%	29.9%	17.5%	25.0%	52,596	75,137	170.9%	119.6%
69	54,094	216,271	25.5%	25.0%	15.0%	25.0%	32,441	54,068	166.7%	100.0%
70	48,122	151,190	31.6%	31.8%	17.5%	25.0%	26,458	37,798	181.9%	127.3%
71+	*	*	N/A	N/A	100.0%	*	0	0	N/A	N/A
<b>Totals</b>	<b>960,248</b>	<b>2,590,263</b>					<b>627,068</b>	<b>835,046</b>	<b>153.1%</b>	<b>115.0%</b>

\* The current assumption prescribed by the Minnesota Standards for Actuarial Work is that members who have reached 100% retirement eligibility will delay retirement for one year. Therefore, even though there are members that are over age 70, these members are not included in the Exposures since retirement is assumed to be delayed one year. There were 885 actual retirements over age 70.



# Rule of 90 (Unreduced) Early Retirement

## Findings

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

We reviewed the experience during the study period. Overall, on both a population-weighted and liability-weighted basis, the plan experienced fewer Rule of 90 early retirements than projected by the present assumptions. Similar experience was observed in the 2004 – 2008 period.

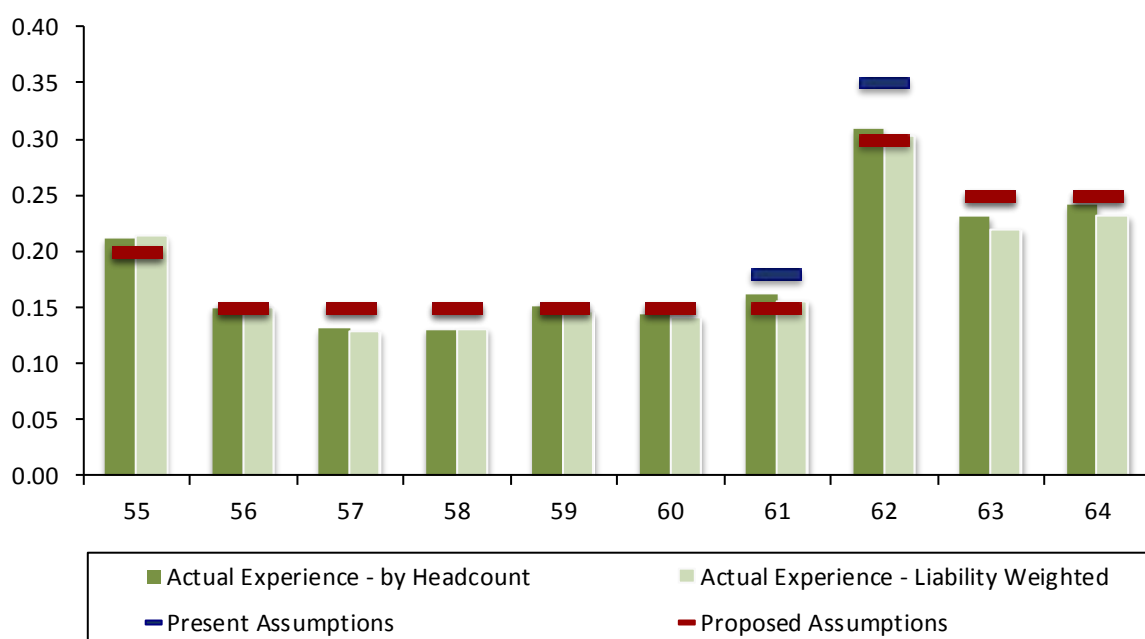
## Recommendation

*We recommend slightly lowering the assumed Rule of 90 retirement rates to reflect the lower utilization observed.*



## Rule of 90 (Unreduced) Early Retirement

Age	Actual Retirements (\$000s)	Exposure (\$000s)	Crude Rates		Rates		Expected Retirements		Actual / Expected	
			Population Weighted	Liability Weighted	Present	Proposed	Present (\$000s)	Proposed (\$000s)	Present	Proposed
55	34,785	162,764	21.1%	21.4%	20.0%	20.0%	32,553	32,553	106.9%	106.9%
56	48,348	322,901	15.0%	15.0%	15.0%	15.0%	48,435	48,435	99.8%	99.8%
57	70,400	544,223	13.1%	12.9%	15.0%	15.0%	81,633	81,633	86.2%	86.2%
58	92,602	702,389	13.1%	13.2%	15.0%	15.0%	105,358	105,358	87.9%	87.9%
59	126,315	861,216	15.2%	14.7%	15.0%	15.0%	129,182	129,182	97.8%	97.8%
60	140,054	989,364	14.5%	14.2%	15.0%	15.0%	148,405	148,405	94.4%	94.4%
61	173,357	1,107,677	16.2%	15.7%	18.0%	15.0%	199,382	166,152	86.9%	104.3%
62	344,323	1,133,265	31.0%	30.4%	35.0%	30.0%	396,643	339,980	86.8%	101.3%
63	200,103	910,031	23.1%	22.0%	25.0%	25.0%	227,508	227,508	88.0%	88.0%
64	180,267	776,985	24.2%	23.2%	25.0%	25.0%	194,246	194,246	92.8%	92.8%
<b>Totals</b>	<b>1,410,554</b>	<b>7,510,815</b>	<b>19.5%</b>	<b>18.8%</b>	<b>20.8%</b>	<b>19.6%</b>	<b>1,563,345</b>	<b>1,473,452</b>	<b>90.2%</b>	<b>95.7%</b>



# Tier 1 Reduced Early Retirement

## Findings

GERP members who were hired prior to July 1, 1989 (Tier 1 members) may also retire with a reduced benefit prior to the attainment of Normal Retirement. We refer to these cases as Tier 1 early retirements.

The early retirement benefit payable to Tier 1 members is the greater of (a) or (b):

- (a) 1.2% of average salary for each of the first ten years of service and 1.7% for each subsequent year with 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 with actuarial reduction for each month the member is under age 65.

Because these benefits are reduced, these members are expected to retire at a lower rate than Tier 1 members who have attained Rule of 90. Higher rates of early retirement generally result in higher computed contributions due to the enhanced benefit, and vice-versa.

We reviewed the experience during the study period. Overall, on both a population-weighted and liability-weighted basis, the plan experienced fewer Tier 1 reduced early retirements than projected by the present assumptions.

Early retirement benefits were changed as follows effective June 30, 2018:

- the augmentation adjustment in actuarial early retirement factors is eliminated over a five-year period starting July 1, 2019, resulting in actuarial equivalence after June 30, 2024; and
- the first benefit increase is delayed until Normal Retirement Age for retirements on or after January 1, 2024

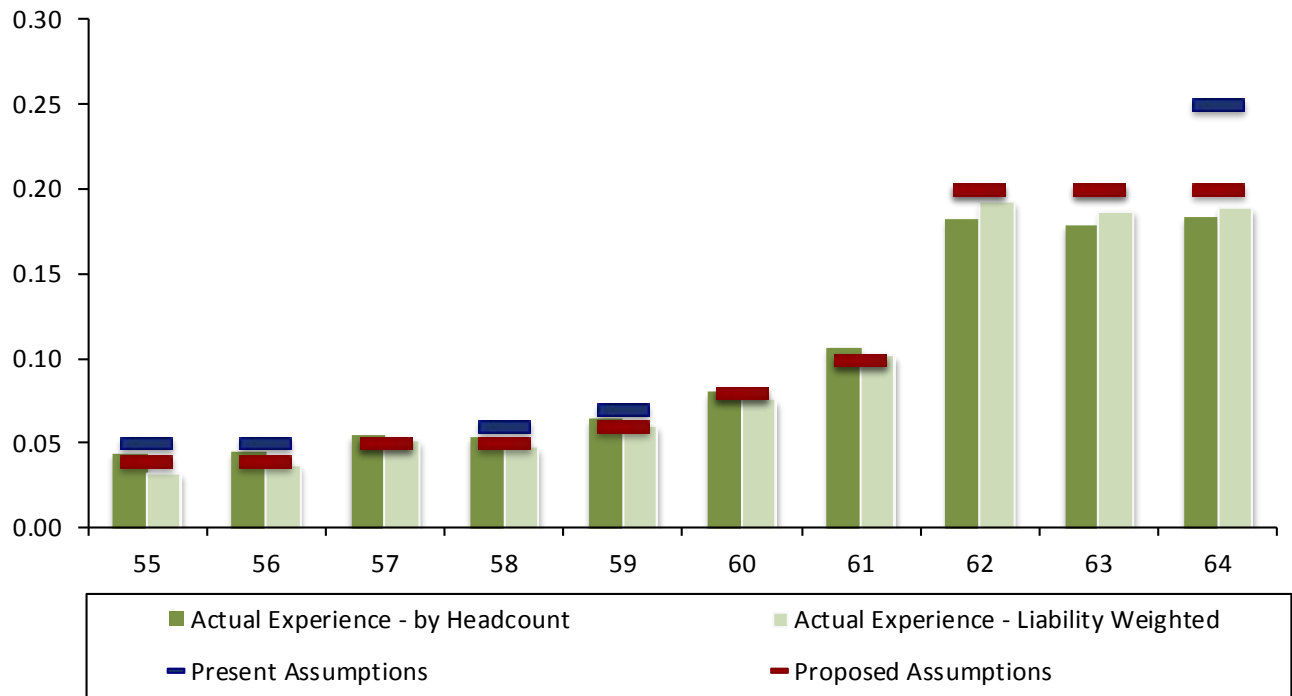
These changes may impact retirement behavior in the future and will be analyzed in the next experience study. Our recommendation to reduce Tier 1 early retirement rates is consistent with the expected behavior changes.

## Recommendation

*We recommend reductions to the Tier 1 Reduced early retirement rates, as indicated on the next page.*

## Tier 1 Reduced Early Retirement

Age	Actual Retirements (\$000s)	Exposure (\$000s)	Crude Rates		Rates		Expected Retirements		Actual / Expected	
			Population Weighted	Liability Weighted	Present	Proposed	Present (\$000s)	Proposed (\$000s)	Present	Proposed
55	32,836	1,000,477	4.4%	3.3%	5.0%	4.0%	50,024	40,019	65.6%	82.1%
56	36,789	977,184	4.6%	3.8%	5.0%	4.0%	48,859	39,087	75.3%	94.1%
57	44,154	846,301	5.5%	5.2%	5.0%	5.0%	42,315	42,315	104.3%	104.3%
58	35,774	750,092	5.4%	4.8%	6.0%	5.0%	45,006	37,505	79.5%	95.4%
59	39,648	654,083	6.5%	6.1%	7.0%	6.0%	45,786	39,245	86.6%	101.0%
60	38,292	504,772	8.0%	7.6%	8.0%	8.0%	40,382	40,382	94.8%	94.8%
61	38,751	380,648	10.7%	10.2%	10.0%	10.0%	38,065	38,065	101.8%	101.8%
62	53,804	279,414	18.2%	19.3%	20.0%	20.0%	55,883	55,883	96.3%	96.3%
63	35,905	191,790	17.9%	18.7%	20.0%	20.0%	38,358	38,358	93.6%	93.6%
64	26,167	138,666	18.3%	18.9%	25.0%	20.0%	34,667	27,733	75.5%	94.4%
<b>Totals</b>	<b>382,120</b>	<b>5,723,427</b>	<b>8.0%</b>	<b>6.7%</b>	<b>7.7%</b>	<b>7.0%</b>	<b>439,343</b>	<b>398,592</b>	<b>87.0%</b>	<b>95.9%</b>



## Tier 2 Reduced Early Retirement

### Findings

GERP members who were hired after June 30, 1989 (Tier 2 members) may retire with a reduced benefit prior to the attainment of Normal Retirement. We refer to these cases as Tier 2 early retirements.

The Tier 2 early retirement benefit is the actuarial equivalent of the member's Normal Retirement benefit. In other words, there is no subsidy for early retirement. Because of the actuarially equivalent early retirement reduction, these members' benefits have about the same value as the deferred benefit to which they would be eligible if they did not request early commencement of the benefit. Higher rates of early retirement generally result in slightly lower computed contributions, and vice-versa.

We reviewed the experience during the study period. On a population-weighted basis, the assumptions projected approximately the same number of retirements as actually occurred. However, on a liability-weighted basis, there were fewer Tier 2 reduced early retirements than projected by the present assumptions.

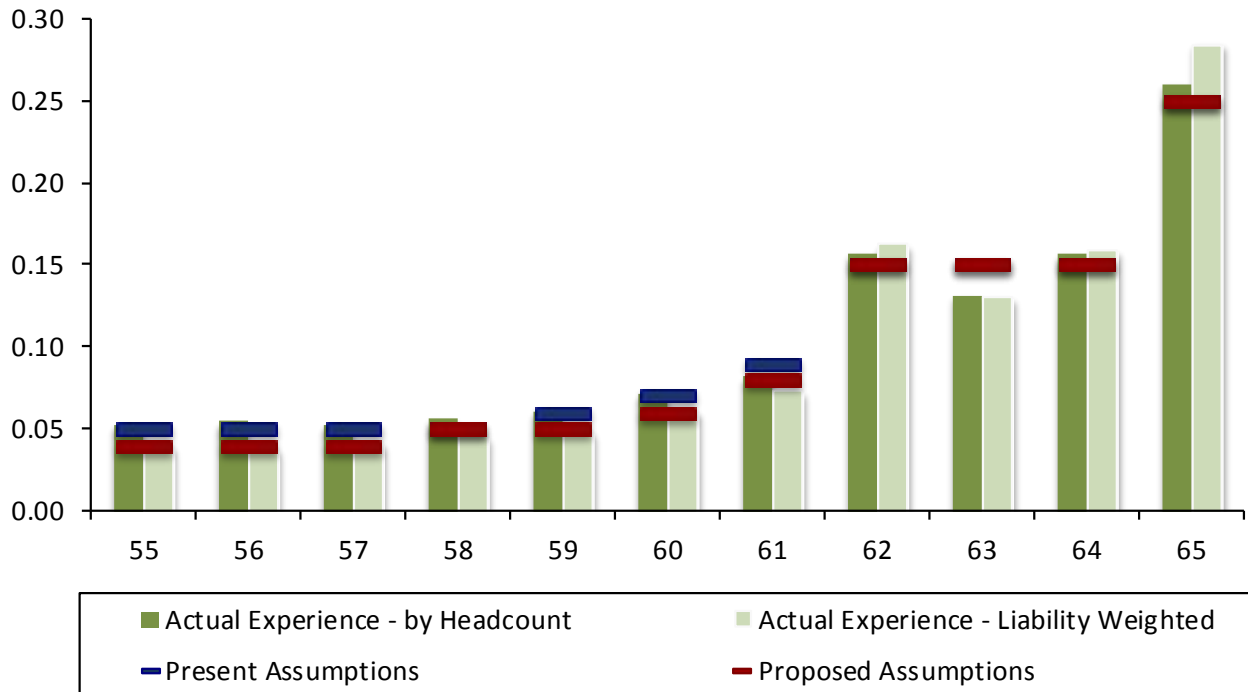
Legislative changes to early retirement benefits are described on page D-6. Our recommendation to reduce Tier 2 early retirement rates is consistent with the expected behavior changes.

### Recommendation

*We recommend reductions in Tier 2 early retirement rates, as indicated on the next page.*

## Tier 2 Reduced Early Retirement

Age	Actual Retirements (\$000s)	Exposure (\$000s)	Crude Rates		Rates		Expected Retirements		Actual / Expected	
			Population Weighted	Liability Weighted	Present	Proposed	Present (\$000s)	Proposed (\$000s)	Present	Proposed
55	51,840	1,323,956	5.2%	3.9%	5.0%	4.0%	66,198	52,958	78.3%	97.9%
56	49,252	1,300,779	5.4%	3.8%	5.0%	4.0%	65,039	52,031	75.7%	94.7%
57	52,390	1,276,395	5.2%	4.1%	5.0%	4.0%	63,820	51,056	82.1%	102.6%
58	56,031	1,231,133	5.6%	4.6%	5.0%	5.0%	61,557	61,557	91.0%	91.0%
59	56,707	1,177,385	6.0%	4.8%	6.0%	5.0%	70,643	58,869	80.3%	96.3%
60	68,128	1,122,297	7.1%	6.1%	7.0%	6.0%	78,561	67,338	86.7%	101.2%
61	75,456	1,034,224	8.1%	7.3%	9.0%	8.0%	93,080	82,738	81.1%	91.2%
62	149,911	926,699	15.7%	16.2%	15.0%	15.0%	139,005	139,005	107.8%	107.8%
63	99,784	768,743	13.1%	13.0%	15.0%	15.0%	115,311	115,311	86.5%	86.5%
64	100,885	637,526	15.7%	15.8%	15.0%	15.0%	95,629	95,629	105.5%	105.5%
65	141,709	499,630	26.0%	28.4%	25.0%	25.0%	124,908	124,908	113.5%	113.5%
<b>Totals</b>	<b>902,093</b>	<b>11,298,767</b>	<b>8.7%</b>	<b>8.0%</b>	<b>8.6%</b>	<b>8.0%</b>	<b>973,750</b>	<b>901,400</b>	<b>92.6%</b>	<b>100.1%</b>



## Retirement from Deferred Status

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

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

For those deferred vested members for whom the deferred benefit is more valuable than a refund, the current valuation assumption is that the member will commence benefits at Normal Retirement Age. Except for long-service members hired prior to July 1, 1989 that may qualify for a subsidized reduction, when a member elects to commence benefits prior to Normal Retirement Age, the benefit is reduced on an actuarially equivalent basis, meaning there is no liability gain or loss to the plan. We recommend no change to this set of assumptions.

## SECTION E

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### WITHDRAWAL EXPERIENCE

## Withdrawal Experience

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

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

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

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

Current valuation termination rates for members are gender-specific and service-based. The withdrawal assumption review was done on a liability-weighted basis, as described earlier in the report.



# Withdrawal Experience

## Findings

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

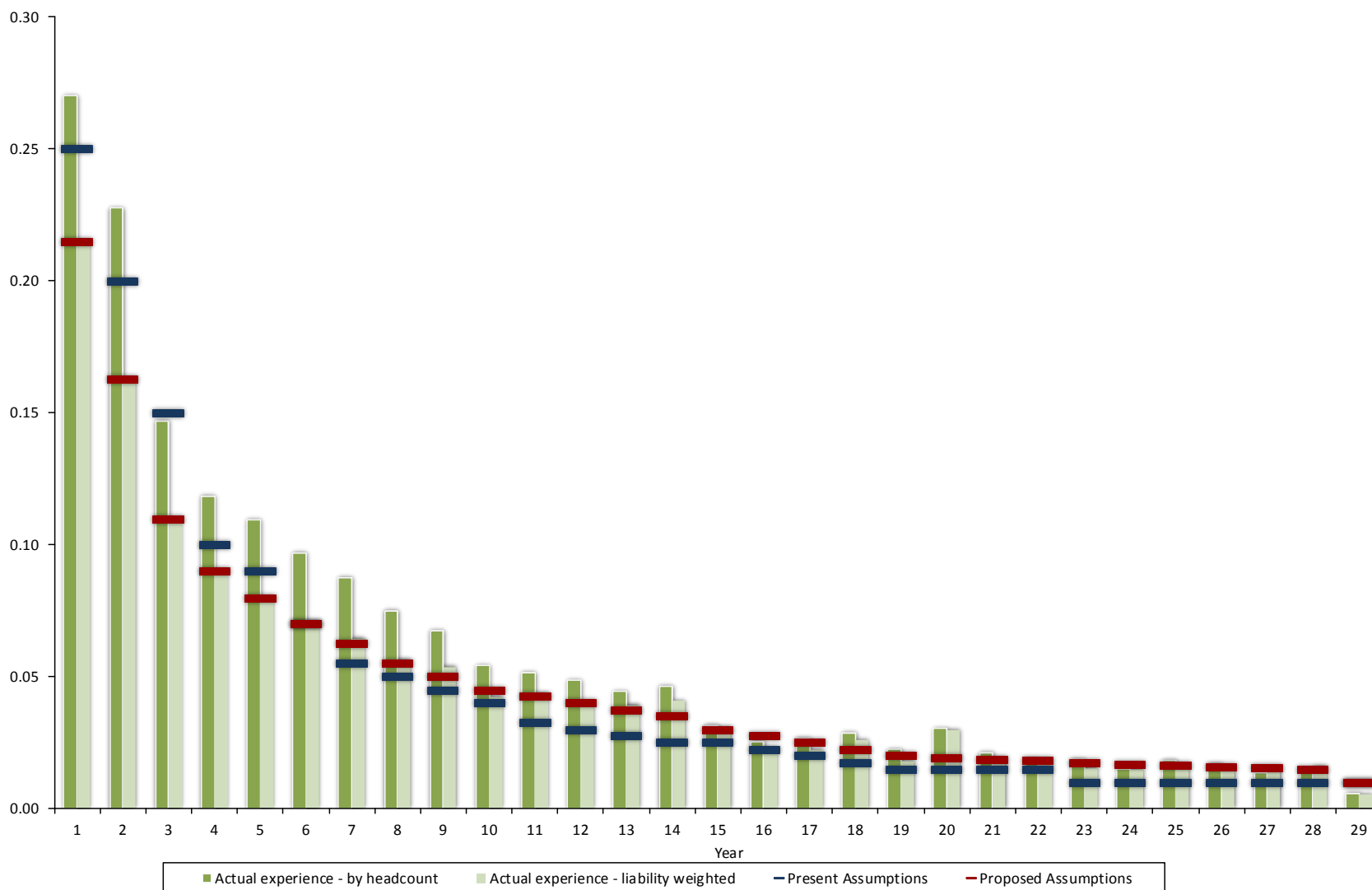
## Recommendation

*We have recommended proposed rates which are slightly lower than current rates during the first several years of employment and slightly higher in later years.*

## Withdrawal Experience Males

							Liability Weighted (\$ 000s)			
Year	Liability Weighted (\$ 000s)		Crude Rates		Sample Rates		Expected		Ratio of	
	Withdrawal	Exposure	Liability Weighted	Population Weighted			Withdrawals		Actuals/Expecteds	
					Present	Proposed	Present	Proposed	Present	Proposed
1	31,833	148,364	0.2146	0.2702	0.2500	0.2150	37,091	31,898	85.8%	99.8%
2	83,648	514,498	0.1626	0.2276	0.2000	0.1625	102,900	83,606	81.3%	100.1%
3	59,505	548,538	0.1085	0.1470	0.1500	0.1100	82,281	60,339	72.3%	98.6%
4	46,347	515,182	0.0900	0.1186	0.1000	0.0900	51,518	46,366	90.0%	100.0%
5	33,182	417,665	0.0794	0.1095	0.0900	0.0800	37,590	33,413	88.3%	99.3%
6	23,379	331,541	0.0705	0.0970	0.0700	0.0700	23,208	23,208	100.7%	100.7%
7	20,794	322,317	0.0645	0.0877	0.0550	0.0625	17,727	20,145	117.3%	103.2%
8	19,230	341,632	0.0563	0.0751	0.0500	0.0550	17,082	18,790	112.6%	102.3%
9	20,477	380,324	0.0538	0.0676	0.0450	0.0500	17,115	19,016	119.6%	107.7%
10	17,942	422,997	0.0424	0.0542	0.0400	0.0450	16,920	19,035	106.0%	94.3%
11	18,532	425,808	0.0435	0.0517	0.0325	0.0425	13,839	18,097	133.9%	102.4%
12	15,410	388,589	0.0397	0.0488	0.0300	0.0400	11,658	15,544	132.2%	99.1%
13	14,684	373,032	0.0394	0.0444	0.0275	0.0375	10,258	13,989	143.1%	105.0%
14	15,169	371,616	0.0408	0.0465	0.0250	0.0350	9,290	13,007	163.3%	116.6%
15	11,769	387,804	0.0303	0.0317	0.0250	0.0300	9,695	11,634	121.4%	101.2%
16	9,396	422,082	0.0223	0.0256	0.0225	0.0275	9,497	11,607	98.9%	80.9%
17	9,470	426,561	0.0222	0.0266	0.0200	0.0250	8,531	10,664	111.0%	88.8%
18	10,794	414,951	0.0260	0.0289	0.0175	0.0225	7,262	9,336	148.6%	115.6%
19	6,906	383,337	0.0180	0.0224	0.0150	0.0200	5,750	7,667	120.1%	90.1%
20	10,646	356,920	0.0298	0.0304	0.0150	0.0190	5,354	6,781	198.8%	157.0%
21	6,169	332,448	0.0186	0.0214	0.0150	0.0185	4,987	6,150	123.7%	100.3%
22	5,316	302,153	0.0176	0.0186	0.0150	0.0180	4,532	5,439	117.3%	97.7%
23	4,193	271,259	0.0155	0.0187	0.0100	0.0175	2,713	4,747	154.5%	88.3%
24	3,625	245,139	0.0148	0.0151	0.0100	0.0170	2,451	4,167	147.9%	87.0%
25	3,827	236,652	0.0162	0.0184	0.0100	0.0165	2,367	3,905	161.7%	98.0%
26	3,413	232,346	0.0147	0.0171	0.0100	0.0160	2,323	3,718	146.9%	91.8%
27	3,548	238,130	0.0149	0.0136	0.0100	0.0155	2,381	3,691	149.0%	96.1%
28	3,584	225,330	0.0159	0.0142	0.0100	0.0150	2,253	3,380	159.1%	106.0%
29	1,125	212,645	0.0053	0.0059	0.0100	0.0100	2,126	2,126	52.9%	52.9%
30 +	8,445	609,559	0.0139	0.0131	0.0100	0.0100	6,096	6,096	138.5%	138.5%
Totals	522,358	10,799,420	0.0484	0.1209	0.0488	0.0479	526,795	517,561	99.2%	100.9%

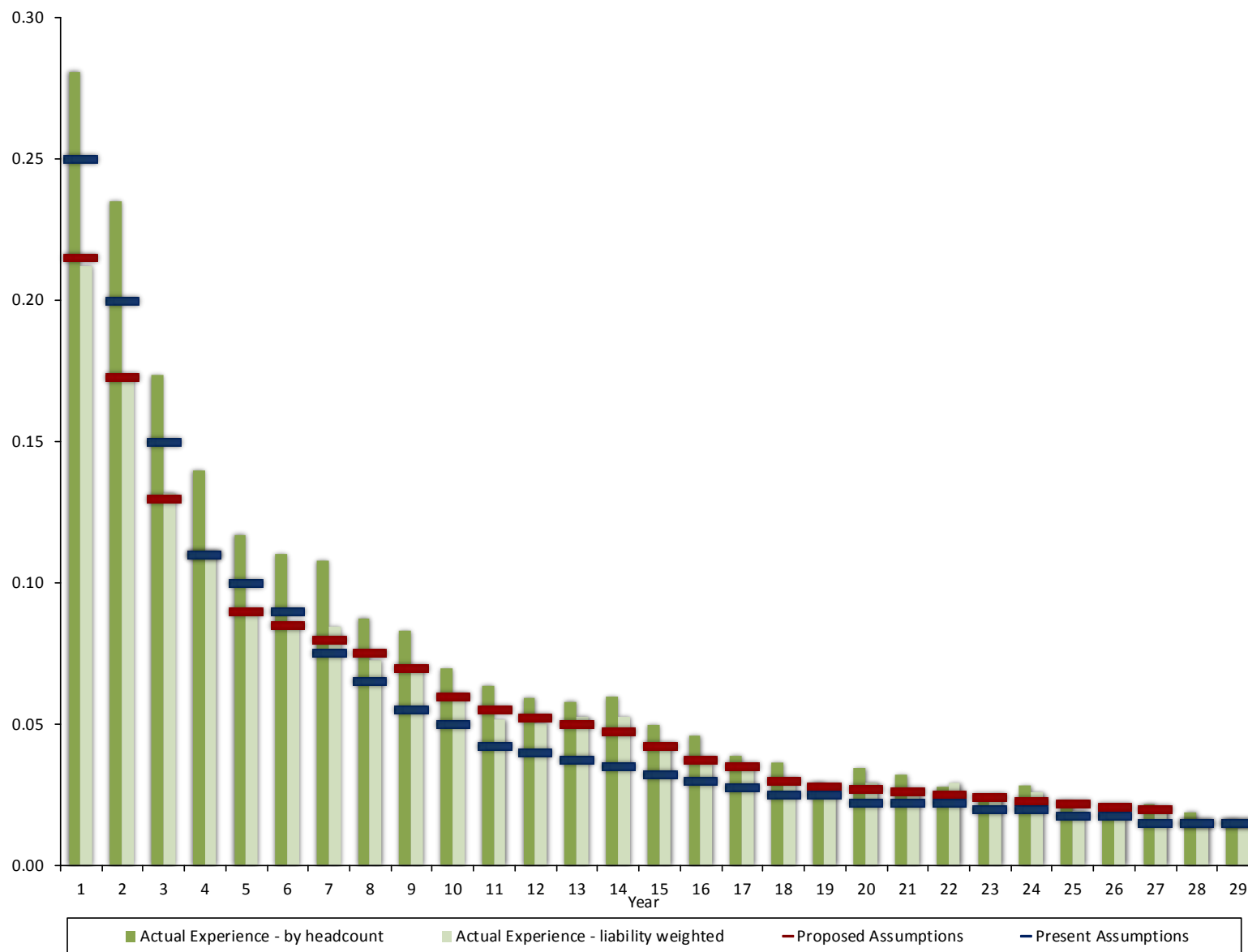
## Withdrawal Experience Males



# Withdrawal Experience Females

							Liability Weighted (\$ 000s)			
Year	Liability Weighted (\$ 000s)		Crude Rates		Sample Rates		Expected		Ratio of	
	Withdrawals	Exposure	Liability Weighted	Population Weighted			Withdrawals	Actuals/Expecteds		
					Present	Proposed	Present	Proposed	Present	Proposed
1	42,972	202,952	0.2117	0.2806	0.2500	0.2150	50,738	43,635	84.7%	98.5%
2	140,332	813,618	0.1725	0.2347	0.2000	0.1725	162,724	140,349	86.2%	100.0%
3	112,341	854,265	0.1315	0.1732	0.1500	0.1300	128,140	111,054	87.7%	101.2%
4	86,383	781,343	0.1106	0.1396	0.1100	0.1100	85,948	85,948	100.5%	100.5%
5	57,473	650,283	0.0884	0.1169	0.1000	0.0900	65,028	58,525	88.4%	98.2%
6	44,979	528,184	0.0852	0.1099	0.0900	0.0850	47,537	44,896	94.6%	100.2%
7	43,211	512,696	0.0843	0.1076	0.0750	0.0800	38,452	41,016	112.4%	105.4%
8	39,356	544,612	0.0723	0.0875	0.0650	0.0750	35,400	40,846	111.2%	96.4%
9	42,537	613,566	0.0693	0.0828	0.0550	0.0700	33,746	42,950	126.0%	99.0%
10	40,876	677,501	0.0603	0.0695	0.0500	0.0600	33,875	40,650	120.7%	100.6%
11	33,783	656,040	0.0515	0.0635	0.0425	0.0550	27,882	36,082	121.2%	93.6%
12	30,229	600,985	0.0503	0.0592	0.0400	0.0525	24,039	31,552	125.7%	95.8%
13	31,226	593,984	0.0526	0.0579	0.0375	0.0500	22,274	29,699	140.2%	105.1%
14	31,107	593,263	0.0524	0.0595	0.0350	0.0475	20,764	28,180	149.8%	110.4%
15	26,332	622,908	0.0423	0.0496	0.0325	0.0425	20,245	26,474	130.1%	99.5%
16	24,351	675,706	0.0360	0.0457	0.0300	0.0375	20,271	25,339	120.1%	96.1%
17	22,770	663,172	0.0343	0.0388	0.0275	0.0350	18,237	23,211	124.9%	98.1%
18	18,518	619,375	0.0299	0.0362	0.0250	0.0300	15,484	18,581	119.6%	99.7%
19	14,225	556,504	0.0256	0.0292	0.0250	0.0280	13,913	15,582	102.2%	91.3%
20	14,831	509,688	0.0291	0.0342	0.0225	0.0270	11,468	13,762	129.3%	107.8%
21	11,552	465,826	0.0248	0.0318	0.0225	0.0260	10,481	12,111	110.2%	95.4%
22	12,350	426,537	0.0290	0.0277	0.0225	0.0250	9,597	10,663	128.7%	115.8%
23	9,585	389,915	0.0246	0.0237	0.0200	0.0240	7,798	9,358	122.9%	102.4%
24	9,015	350,191	0.0257	0.0281	0.0200	0.0230	7,004	8,054	128.7%	111.9%
25	6,277	329,656	0.0190	0.0223	0.0175	0.0220	5,769	7,252	108.8%	86.6%
26	5,784	329,171	0.0176	0.0181	0.0175	0.0210	5,760	6,913	100.4%	83.7%
27	6,644	330,878	0.0201	0.0217	0.0150	0.0200	4,963	6,618	133.9%	100.4%
28	4,873	317,869	0.0153	0.0188	0.0150	0.0150	4,768	4,768	102.2%	102.2%
29	3,948	301,990	0.0131	0.0161	0.0150	0.0150	4,530	4,530	87.2%	87.2%
30 and over	13,981	961,083	0.0145	0.0177	0.0150	0.0150	14,416	14,416	97.0%	97.0%
Totals	981,840	16,473,762	0.0596	0.1344	0.0577	0.0597	951,251	983,014	103.2%	99.9%

## Withdrawal Experience Females



## SECTION F

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### DISABILITY EXPERIENCE

## Disability Experience

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.

### Findings

We reviewed the disability experience during the four-year period. The results are shown on the following pages. Overall, the actual number of disability retirements (417) is about 53 percent of the number projected by the present assumption (794 – see charts on the following pages).

The process of qualifying for a disability benefit requires some burden of proof. This process may result in a member being reported as a termination or withdrawal while the disability application is being reviewed. In fact, over the course of the four-year period, there were approximately 240 members who were reclassified as a disability retirement after first being reported as a termination. In recognition of this process, we recommend lowering the assumed rates of disability, but not as low as reported by the actual experience.

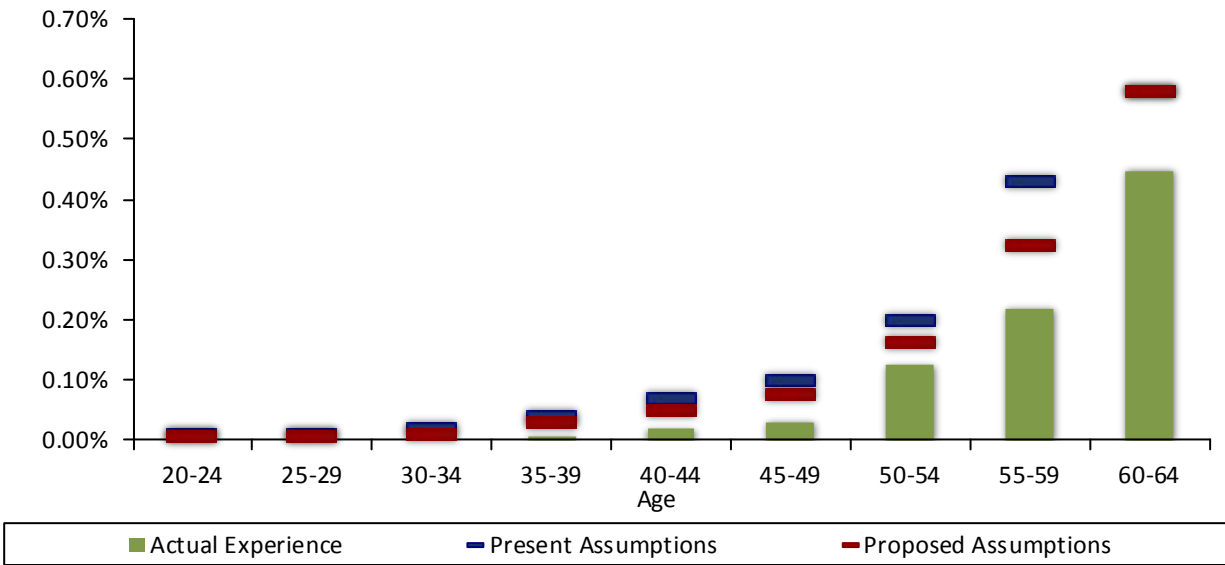
### Recommendation

*We recommend adopting lower rates of disability.*

# Disability Experience Males

Male Disability Table

Age	Disabilities	Exposure	Crude Rates	Sample Rates		Expected Disabilities		Ratio of Actuals/Expecteds	
				Present	Proposed	Present	Proposed	Present	Proposed
Under 20	-	-	N/A	0.0000	0.0001	-	-	0.0%	0.0%
20-24	-	6,449	0.0000	0.0001	0.0001	0.64	0.48	0.0%	0.0%
25-29	-	15,800	0.0000	0.0001	0.0001	1.58	1.19	0.0%	0.0%
30-34	-	18,213	0.0000	0.0002	0.0001	2.93	2.20	0.0%	0.0%
35-39	1	18,827	0.0001	0.0004	0.0003	7.51	5.64	13.3%	17.7%
40-44	3	18,060	0.0002	0.0007	0.0005	11.93	8.94	25.1%	33.6%
45-49	6	20,663	0.0003	0.0010	0.0008	21.58	16.19	27.8%	37.1%
50-54	30	24,506	0.0012	0.0020	0.0016	53.41	40.05	56.2%	74.9%
55-59	63	29,097	0.0022	0.0043	0.0033	126.22	94.66	49.9%	66.6%
60-64	104	23,341	0.0045	0.0058	0.0058	134.34	134.34	77.4%	77.4%
<b>Totals</b>	<b>207</b>	<b>174,956</b>	<b>0.0012</b>	<b>0.0021</b>	<b>0.0017</b>	<b>360.14</b>	<b>303.69</b>	<b>57.5%</b>	<b>68.2%</b>

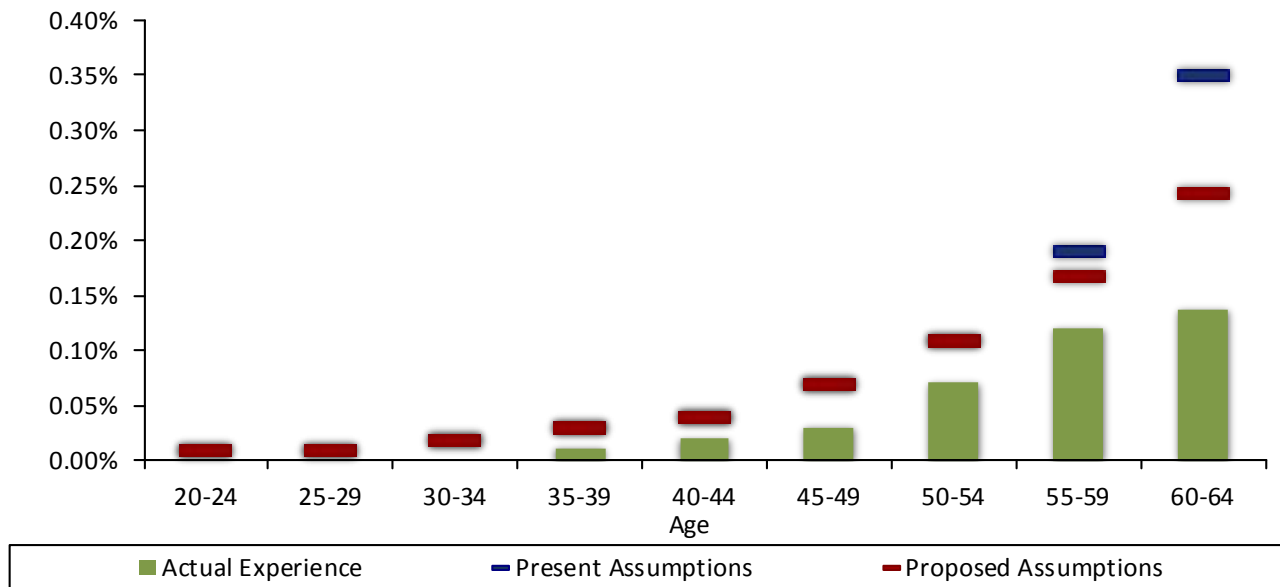




# Disability Experience Females

## Female Disability Table

Age	Disabilities	Exposure	Crude Rates	Sample Rates		Expected Disabilities		Ratio of Actuals/Expecteds	
				Present	Proposed	Present	Proposed	Present	Proposed
Under 20	-	-	N/A	0.0000	0.0001	-	-	0.0%	0.0%
20-24	-	12,215	0.0000	0.0001	0.0001	1.22	1.22	0.0%	0.0%
25-29	-	30,371	0.0000	0.0001	0.0001	3.04	3.04	0.0%	0.0%
30-34	-	34,711	0.0000	0.0002	0.0002	5.60	5.60	0.0%	0.0%
35-39	4	38,199	0.0001	0.0003	0.0003	9.97	9.97	40.1%	40.1%
40-44	8	41,588	0.0002	0.0004	0.0004	17.54	17.54	45.6%	45.6%
45-49	15	51,131	0.0003	0.0007	0.0007	35.00	35.00	42.9%	42.9%
50-54	42	60,616	0.0007	0.0011	0.0011	72.07	72.07	58.3%	58.3%
55-59	77	65,041	0.0012	0.0019	0.0017	128.14	109.45	60.1%	70.4%
60-64	64	47,290	0.0014	0.0035	0.0024	161.56	115.03	39.6%	55.6%
<b>Totals</b>	<b>210</b>	<b>381,162</b>	<b>0.0006</b>	<b>0.0011</b>	<b>0.0010</b>	<b>434.14</b>	<b>368.92</b>	<b>48.4%</b>	<b>56.9%</b>



## SECTION G

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### MORTALITY EXPERIENCE

# Mortality Experience

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

## Actuarial Standards of Practice

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

## The New Mortality Tables and Projection Scale

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

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 GERP retiree and disability mortality on a ‘benefit weighted’ basis and have shown the results on pages G-4 through G-7 of this report. Consistent with the SOA study, GERP members with higher benefits generally appear to experience longer lifespans, resulting in lower mortality rates.

## Projection Scale

Fully generational tables, which are utilized for the PERA valuations, help take into account future improvements in mortality that are expected to occur. The Society of Actuaries updates the projection scale annually and the latest published table is called the MP-2018 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 1,000 deaths are required of each gender in the experience period for full credibility. When less than 1,000 deaths occur during the experience study period, partial credibility can be given to the plan's experience based on the actual number of deaths that occurred.

During the four-year period, there were 3,500 male retiree deaths and 5,000 female retiree deaths. Therefore, the experience is considered fully credible and there is no credibility constraint when fitting the standard mortality tables to the plan's experience.

During the four-year period, there were 300 male disabled retiree deaths and 350 female disabled retiree deaths. Similarly, there were 312 male active deaths and 325 female active deaths. The disabled retiree mortality experience and active 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.

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

### **Healthy Retirees**

Due to potential anti-selection bias as well as data needs which are outside the scope of the annual valuation process, we did not include beneficiary and survivor mortality experience in our study. In total, on a benefit weighted basis, the plan experienced slightly fewer male deaths than expected (\$83,065,000 actual versus \$85,484,000 expected). While this seems like a good fit, the fit varies by age groups. The actual number of deaths on a benefit weighted basis among retired females (\$58,863,000) was more than the number projected by the present assumptions (\$52,490,000). The actual number of female deaths at ages below 80 was far below expected while the actual number of female deaths at ages above 80 was far above expected.

### **Disabled Retirees**

On a benefit weighted basis, the plan experienced approximately the same number of deaths among disabled males (\$5,113,000) as projected by the present assumptions (\$5,109,000). The actual number of deaths on a benefit weighted basis among disabled females (\$3,879,000) was less than the number projected by the present assumptions (\$4,346,000).

### **Active Members**

On a liability-weighted basis, the actual number of male deaths among active members (\$45,383,000) was approximately the same as the number projected by the present assumption (\$44,799,000). The plan experienced fewer deaths on a liability weighted basis among females (\$32,332,000) than projected by the present assumptions (\$37,851,000).

# Mortality Experience

## Recommendations

*We did not find a published standard table that fit the observed experience at all ages. We focused on cohorts of members that represented a large percentage of counts and liability for each group. As such, we recommend adoption of the Pub-2010 mortality tables, with adjustments in order to produce a better fit to observed experience when possible. In some cases, even after adjustments, the fit was not uniform and we put more credibility on the rates in the published table than the plan's experience over the past four years. All recommended tables are Benefit Weighted.*

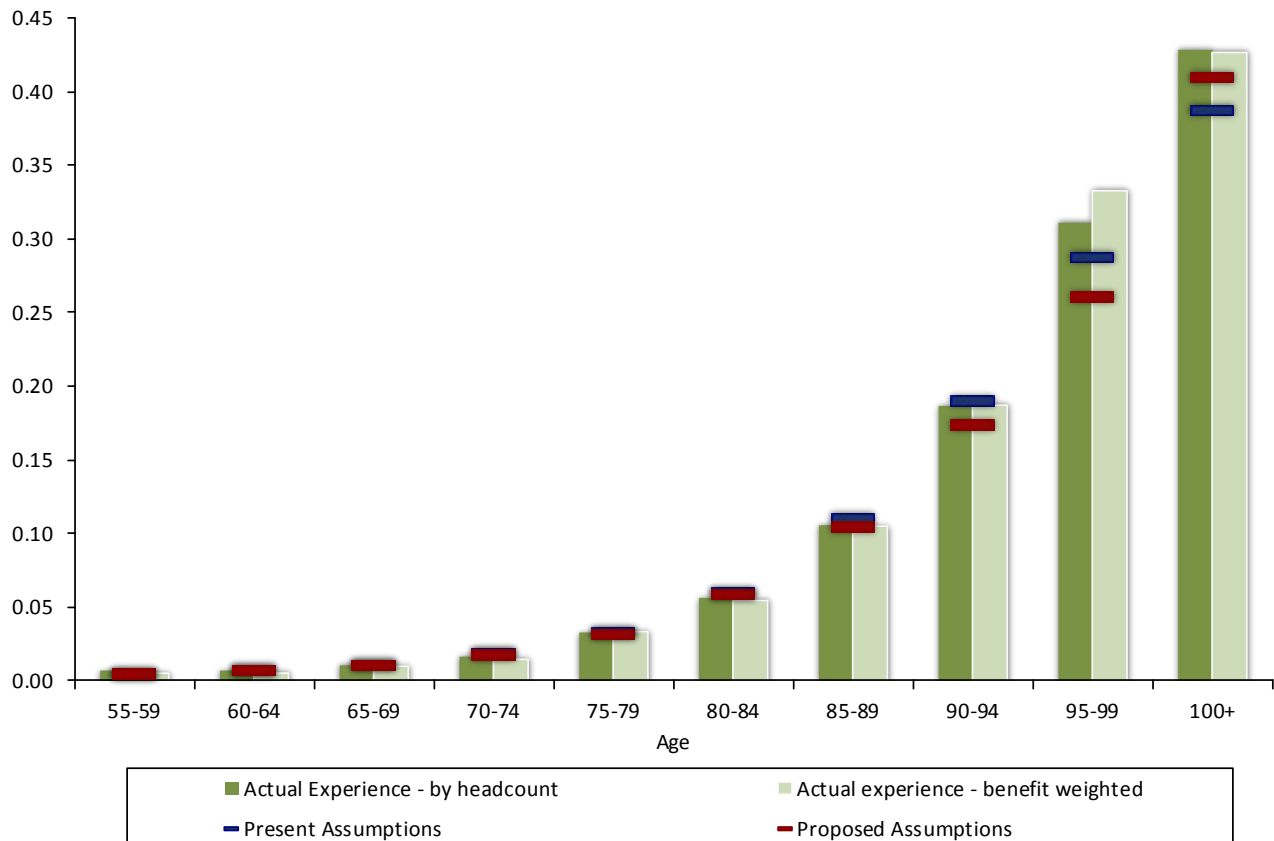
*We recommend adoption of the following mortality tables:*

Healthy Male Retirees:	Pub-2010 Male Healthy Retired General Mortality Table adjusted for mortality improvements using projection scale MP-2018. Rates are multiplied by a factor of 1.02.
Healthy Female Retirees:	Pub-2010 Female Healthy Retired General Mortality Table, adjusted for mortality improvements using projection scale MP-2018. Rates are multiplied by a factor of 0.90.
Disabled Male Retirees:	Pub-2010 Male General/Teacher Disabled Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2018. Rates are set forward two years.
Disabled Female Retirees:	Pub-2010 Female General/Teacher Disabled Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2018. Rates are set forward four years.
Male Active Members:	Pub-2010 Male General Employee Mortality Table adjusted for mortality improvements using projection scale MP-2018. Rates are multiplied by a factor of 1.07.
Female Active Members:	Pub-2010 Female General Employee Mortality Table adjusted for mortality improvements using projection scale MP-2018. Rates are multiplied by a factor of 0.98.

## Post-Retirement Mortality Experience Healthy Males

	Benefit Weighted (\$ 000s)		Crude Rates				Benefit Weighted (\$ 000s)		Ratio of	
Age	Deaths	Exposure	Benefit Weighted	Population Weighted	Sample Rates		Expected Deaths		Actuals/Expecteds	
					Present	Proposed*	Present	Proposed*	Present	Proposed*
55-59	296	55,017	0.0054	0.0070	0.0049	0.0052	287.41	304.93	103.0%	97.1%
60-64	1,798	291,768	0.0062	0.0070	0.0071	0.0075	2,161.49	2,275.12	83.2%	79.0%
65-69	5,811	569,261	0.0102	0.0113	0.0113	0.0112	6,429.26	6,400.22	90.4%	90.8%
70-74	6,169	411,641	0.0150	0.0170	0.0189	0.0185	7,635.94	7,485.99	80.8%	82.4%
75-79	10,262	305,345	0.0336	0.0327	0.0329	0.0326	9,999.02	9,898.18	102.6%	103.7%
80-84	15,059	272,204	0.0553	0.0565	0.0601	0.0591	16,277.92	15,999.41	92.5%	94.1%
85-89	20,595	195,914	0.1051	0.1059	0.1112	0.1052	21,329.65	20,226.34	96.6%	101.8%
90-94	16,752	89,142	0.1879	0.1870	0.1904	0.1737	16,196.80	14,816.82	103.4%	113.1%
95-99	5,951	17,850	0.3334	0.3119	0.2878	0.2609	4,852.27	4,392.33	122.6%	135.5%
100+	372	870	0.4276	0.4286	0.3883	0.4097	314.03	290.65	118.5%	128.0%
Totals	83,065	2,209,012	0.0376	0.0328	0.0387	0.0372	85,483.79	82,089.99	97.2%	101.2%

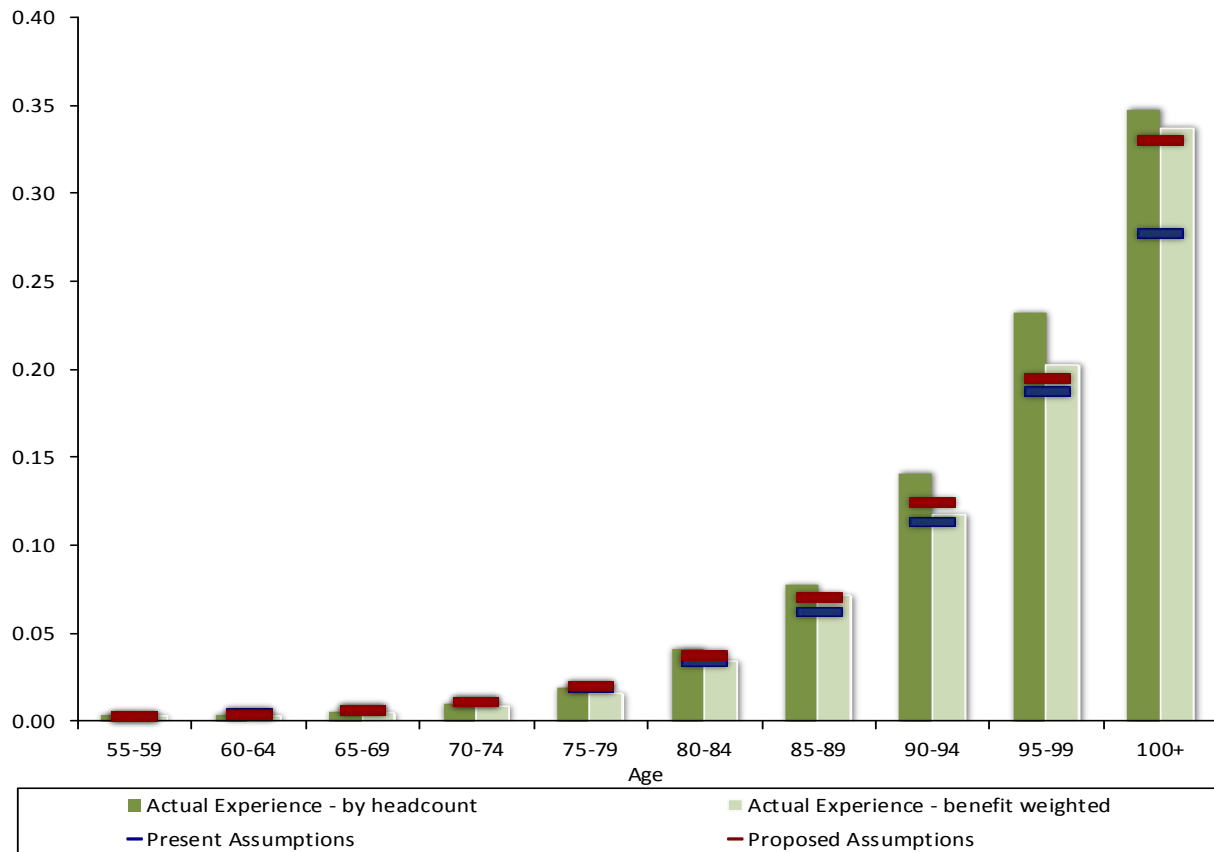
\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2018.



## Post-Retirement Mortality Experience Healthy Females

	Benefit Weighted (\$ 000s)		Crude Rates				Benefit Weighted (\$ 000s)		Ratio of	
Age	Deaths	Exposure	Benefit Weighted	Population Weighted			Sample Rates		Expected Deaths	
					Present	Proposed	Present	Proposed*	Present	Proposed*
55-59	169	46,581	0.0036	0.0040	0.0029	0.0030	232.59	242.89	72.7%	69.6%
60-64	1,046	283,957	0.0037	0.0039	0.0044	0.0042	1,669.95	1,549.20	62.6%	67.5%
65-69	3,063	637,534	0.0048	0.0055	0.0071	0.0065	4,636.34	4,302.32	66.1%	71.2%
70-74	4,667	522,626	0.0089	0.0101	0.0114	0.0114	5,362.00	5,334.51	87.0%	87.5%
75-79	5,523	342,054	0.0161	0.0191	0.0195	0.0206	6,074.56	6,409.75	90.9%	86.2%
80-84	8,394	243,388	0.0345	0.0415	0.0345	0.0378	7,848.35	8,592.64	107.0%	97.7%
85-89	13,430	187,016	0.0718	0.0776	0.0628	0.0707	10,650.76	11,970.03	126.1%	112.2%
90-94	12,821	108,842	0.1178	0.1415	0.1134	0.1243	9,927.49	10,939.13	129.1%	117.2%
95-99	7,477	36,816	0.2031	0.2324	0.1878	0.1947	4,951.23	5,164.87	151.0%	144.8%
100+	2,273	6,731	0.3377	0.3481	0.2778	0.3303	1,136.62	1,162.24	200.0%	195.6%
Totals	58,863	2,415,545	0.0244	0.0236	0.0217	0.0230	52,489.89	55,667.58	112.1%	105.7%

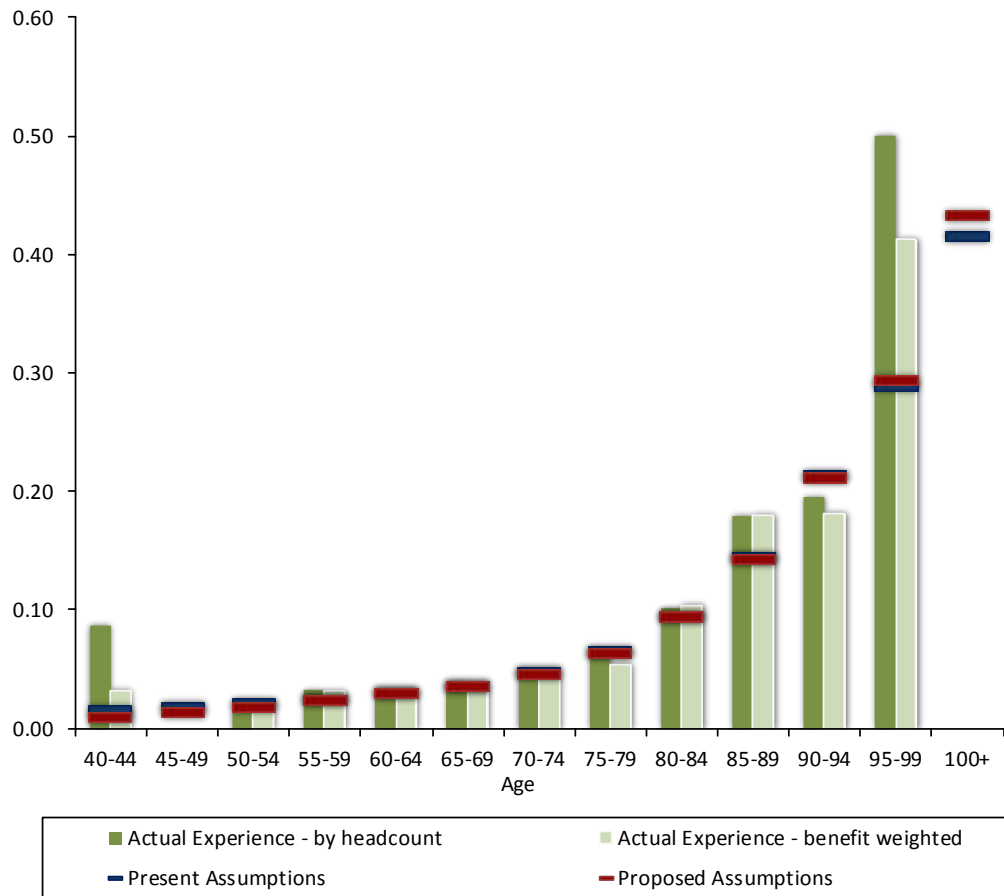
\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2018.



## Post-Retirement Mortality Experience Disabled Males

	Benefit Weighted (\$ 000s)		Crude Rates				Benefit Weighted (\$ 000s)		Ratio of	
Age	Deaths	Exposure	Benefit Weighted	Populatio Weighted			Sample Rates		Expected Deaths	
					Present	Proposed	Present	Proposed*	Present	Proposed*
40-44	4	125	0.03200	0.08696	0.01523	0.00965	2.00	1.23	200.0%	325.2%
45-49	-	657	0.00000	0.00000	0.01849	0.01377	12.40	9.43	0.0%	0.0%
50-54	44	2,964	0.01485	0.01521	0.02165	0.01929	65.21	58.87	67.5%	74.7%
55-59	392	12,445	0.03150	0.03226	0.02515	0.02460	317.08	311.35	123.6%	125.9%
60-64	775	24,939	0.03108	0.03133	0.02970	0.02999	745.92	753.74	103.9%	102.8%
65-69	914	28,238	0.03237	0.03795	0.03639	0.03641	1,025.59	1,026.37	89.1%	89.1%
70-74	699	15,936	0.04386	0.04599	0.04724	0.04631	739.54	725.94	94.5%	96.3%
75-79	633	11,689	0.05415	0.06424	0.06524	0.06445	756.91	747.36	83.6%	84.7%
80-84	729	6,983	0.10440	0.10131	0.09509	0.09503	651.42	651.22	111.9%	111.9%
85-89	621	3,448	0.18010	0.17949	0.14419	0.14291	475.44	471.19	130.6%	131.8%
90-94	245	1,349	0.18162	0.19512	0.21322	0.21155	279.93	277.76	87.5%	88.2%
95-99	57	138	0.41304	0.50000	0.28912	0.29423	37.45	37.60	152.2%	151.6%
100+	-	-	N/A	N/A	0.41642	0.43358	-	-	N/A	N/A
Totals	5,113	108,911	0.04695	0.04555	0.04691	0.04657	5,108.89	5,072.06	100.1%	100.8%

\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2018.

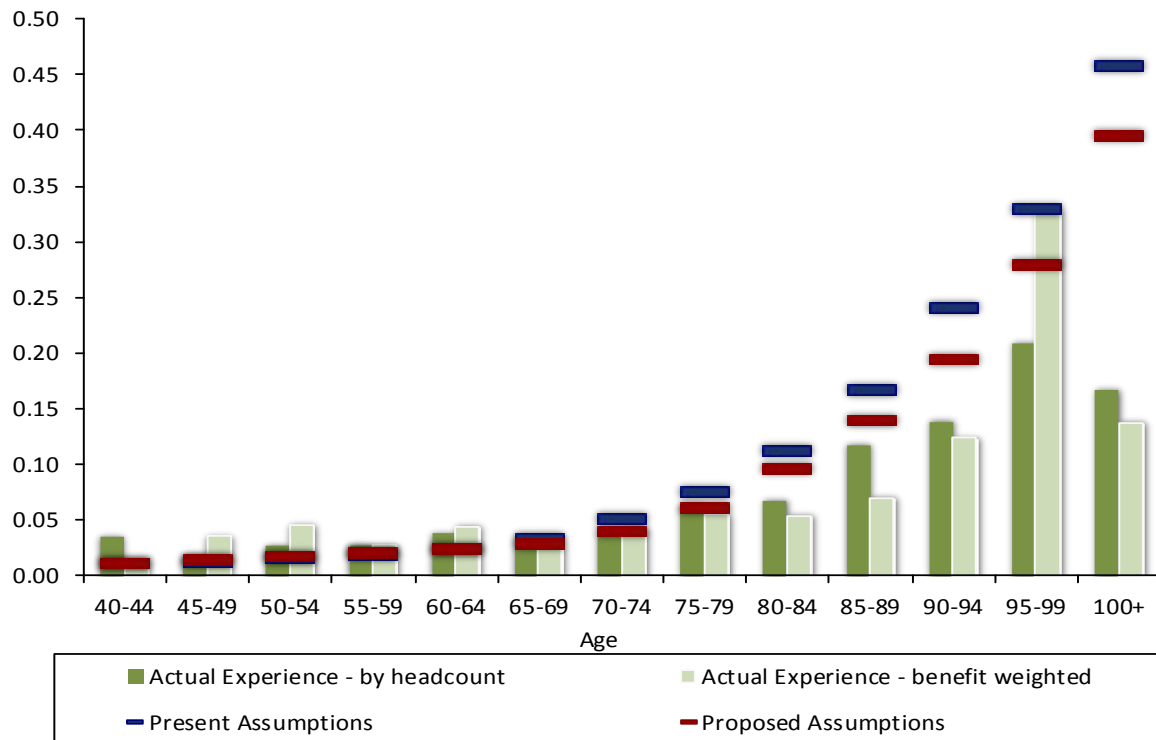




## Post-Retirement Mortality Experience Disabled Females

	Benefit Weighted (\$ 000s)		Crude Rates				Benefit Weighted (\$ 000s)		Ratio of	
Age	Deaths	Exposure	Benefit Weighted	Population Weighted	Sample Rates		Expected Deaths		Actuals/Expecteds	
					Present	Proposed	Present	Proposed*	Present	Proposed*
40-44	3	367	0.0082	0.0351	0.01088	0.0111	4.07	4.09	73.7%	73.3%
45-49	44	1,236	0.0356	0.0171	0.01325	0.0149	16.62	18.38	264.7%	239.4%
50-54	175	3,792	0.0462	0.0270	0.01585	0.0184	61.19	69.59	286.0%	251.5%
55-59	327	11,899	0.0275	0.0278	0.01942	0.0212	234.03	252.55	139.7%	129.5%
60-64	921	20,579	0.0448	0.0380	0.02505	0.0238	520.68	489.04	176.9%	188.3%
65-69	558	19,917	0.0280	0.0303	0.03476	0.0287	686.69	571.96	81.3%	97.6%
70-74	658	15,490	0.0425	0.0372	0.05106	0.0402	778.96	622.34	84.5%	105.7%
75-79	483	8,730	0.0553	0.0632	0.07621	0.0617	654.38	538.70	73.8%	89.7%
80-84	301	5,525	0.0545	0.0677	0.11293	0.0962	610.68	531.26	49.3%	56.7%
85-89	178	2,528	0.0704	0.1176	0.16688	0.1403	415.01	354.78	42.9%	50.2%
90-94	136	1,098	0.1239	0.1389	0.24105	0.1950	255.74	214.09	53.2%	63.5%
95-99	87	266	0.3271	0.2083	0.32984	0.2797	84.49	74.39	103.0%	117.0%
100+	8	58	0.1379	0.1667	0.45801	0.3956	23.59	21.86	33.9%	36.6%
Totals	3,879	91,485	0.0424	0.0407	0.0475	0.0411	4,346.13	3,763.03	89.3%	103.1%

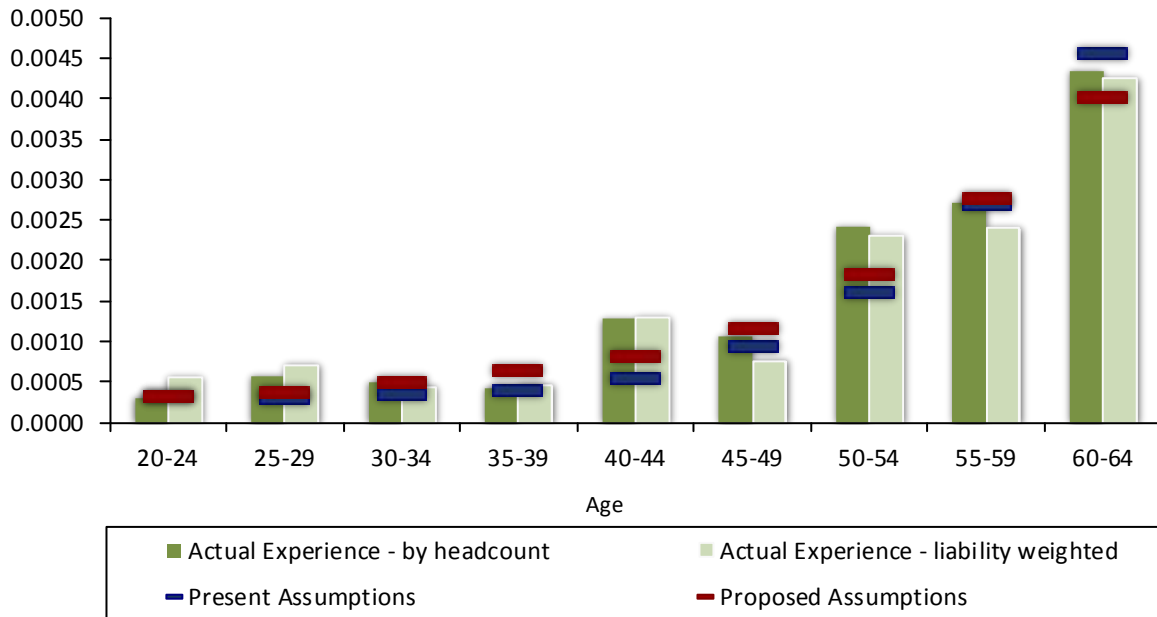
\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2018.



## Pre-Retirement Mortality Experience Healthy Males

Age	Liability Weighted (\$ 000s)		Crude Rates		Sample Rates		Liability Weighted (\$ 000s)		Ratio of Actuals/Expecteds	
	Deaths	Exposure	Liability Weighted	Population Weighted	Expected Deaths		Present	Proposed*	Present	Proposed*
					Present	Proposed*				
Under 20	0	1,167	0.0000	0.0000	0.0003	0.0004	0.31	0.44	0.0%	0.0%
20-24	46	82,764	0.0006	0.0003	0.0003	0.0003	28.77	28.01	159.9%	164.2%
25-29	301	423,219	0.0007	0.0006	0.0003	0.0004	134.13	160.00	224.4%	188.1%
30-34	395	885,208	0.0004	0.0005	0.0004	0.0005	319.84	450.22	123.5%	87.7%
35-39	622	1,345,888	0.0005	0.0004	0.0004	0.0007	566.00	879.03	109.9%	70.8%
40-44	2,211	1,705,808	0.0013	0.0013	0.0006	0.0008	976.01	1,434.71	226.5%	154.1%
45-49	1,857	2,417,215	0.0008	0.0011	0.0009	0.0012	2,289.35	2,867.06	81.1%	64.8%
50-54	8,460	3,679,494	0.0023	0.0024	0.0016	0.0018	5,952.95	6,754.97	142.1%	125.2%
55-59	12,832	5,345,955	0.0024	0.0027	0.0027	0.0028	14,383.11	14,896.94	89.2%	86.1%
60-64	18,659	4,399,486	0.0042	0.0043	0.0046	0.0040	20,148.05	17,718.95	92.6%	105.3%
<b>Totals</b>	<b>45,383</b>	<b>20,286,204</b>	<b>0.0022</b>	<b>0.0018</b>	<b>0.0022</b>	<b>0.0022</b>	<b>44,798.52</b>	<b>45,190.33</b>	<b>101.3%</b>	<b>100.4%</b>

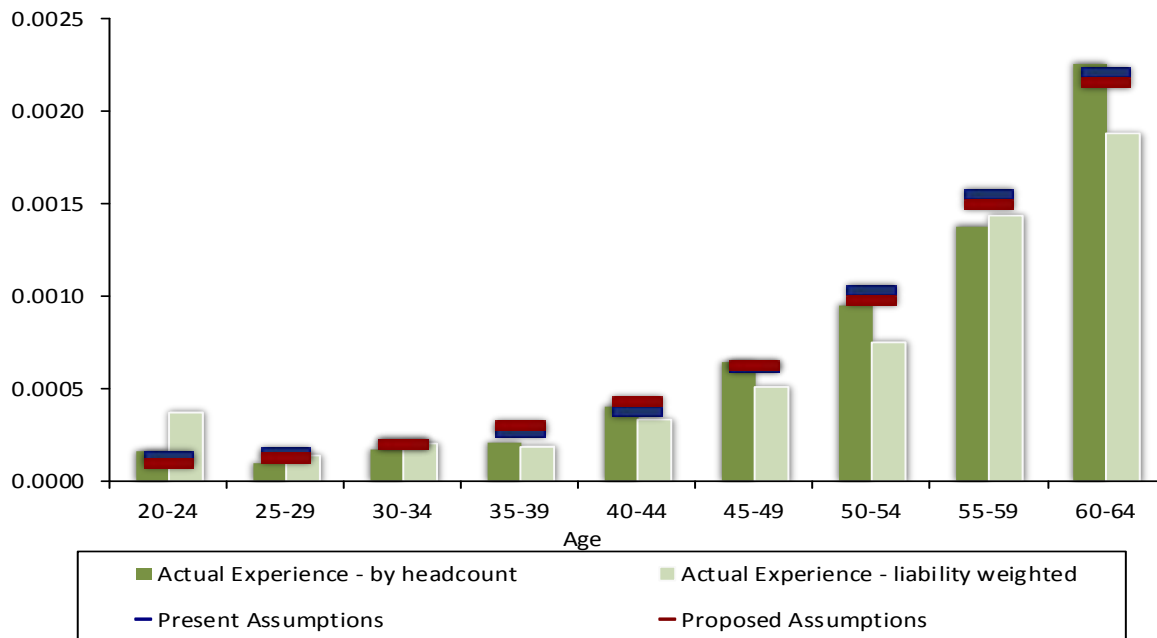
\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2018.



## Pre-Retirement Mortality Experience Healthy Females

Age	Liability Weighted (\$ 000s)		Crude Rates		Sample Rates		Liability Weighted (\$ 000s)		Ratio of Actuals/Expecteds	
	Deaths	Exposure	Liability Weighted	Population Weighted			Expected Deaths			
					Present	Proposed*	Present	Proposed*	Present	Proposed*
Under 20	7	1,910	0.0037	0.0014	0.0001	0.0001	0.27	0.24	0.0%	0.0%
20-24	45	119,149	0.0004	0.0002	0.0001	0.0001	16.40	12.19	274.3%	369.2%
25-29	93	650,458	0.0001	0.0001	0.0002	0.0001	102.25	81.35	90.9%	114.3%
30-34	258	1,246,763	0.0002	0.0002	0.0002	0.0002	255.13	256.49	101.1%	100.6%
35-39	358	1,858,290	0.0002	0.0002	0.0003	0.0003	494.19	567.12	72.4%	63.1%
40-44	826	2,465,487	0.0003	0.0004	0.0004	0.0004	930.79	1,063.71	88.7%	77.7%
45-49	1,960	3,824,051	0.0005	0.0006	0.0006	0.0006	2,385.12	2,411.63	82.2%	81.3%
50-54	4,521	5,977,302	0.0008	0.0010	0.0010	0.0010	6,191.31	5,884.40	73.0%	76.8%
55-59	11,694	8,125,619	0.0014	0.0014	0.0016	0.0015	12,650.98	12,172.82	92.4%	96.1%
60-64	12,570	6,686,200	0.0019	0.0023	0.0022	0.0022	14,824.96	14,446.78	84.8%	87.0%
Totals	32,332	30,955,229	0.0010	0.0009	0.0012	0.0012	37,851.39	36,896.73	85.4%	87.6%

\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2018.



## SECTION H

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### 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 scheduled 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, 2018 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. PERA 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 General Employees Retirement Plan (GERP). 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, 2018 actuarial valuation amortizes the UAAL over a 30-year period. The amortization period decreases each year by one year (like a typical mortgage).

In 2018, legislation changed the statutory amortization date from June 30, 2033 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, PERA could consider using a shorter maximum period, such as 15, 20 or 25 years. 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 GERP 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 (UAAL), i.e., “negative amortization.” Payments less than the interest only amount will result in the UAAL increasing for an initial period of time. Based on the proposed assumptions of 7.50% interest and 3.00% payroll growth, payments will continue to be less than the interest only amount, with amortization payments exceeding the interest only amount once the period declines to 20 years. This means that the UAAL is expected to increase for approximately 10 years under the current funding policy. Negative amortization, once commonly accepted, is increasingly attracting criticism. We greatly prefer combinations of amortization methods and assumptions that result in the UAAL decreasing each year.

It should be noted that actual growth in GERP payroll over the past four years has exceeded the expected rate of 3.25%. However, over the most recent ten year period, payroll growth has been lower than expected. 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. Some plans address this issue by not permitting the payroll growth assumption to exceed the actual average growth rate over the past 5 years. If payroll growth continues to fall short of expectations, a method change should be considered.

## Recommendation

*We recommend PERA consider layered amortization as an alternative to the current 30-year closed amortization policy, since the current method results in approximately ten years of negative amortization and an increasing unfunded actuarial accrued liability. We also recommend continued use of the level percent of payroll amortization method. Lastly, we recommend closely monitoring actual payroll growth with implementation of a payroll growth assumption equal to recent experience if payroll growth consistently falls short of the recommended 3.0% growth assumption.*



# Funding Policy – Post-Retirement Benefit Increases

## Valuation of Future Post-Retirement Benefit Increases

Effective January 1, 2019, benefit increases after retirement equal 50% of the Social Security Cost-of-Living Adjustment, not less than 1.0%, and not more than 1.5%. The increase as of January 1, 2019 was 1.4%.

For the July 1, 2018 valuation, stochastic modeling (described in detail in the valuation report) was used to determine the assumption that benefit increases will equal 1.25% per year. The assumption is very sensitive to inflation expectations and will be re-determined on a regular basis.

## Recommendation

*We recommend continued use of the methodologies described above.*

## 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% according to the actuarial assumptions. 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.

### Recommendation

*We recommend the Minnesota Standards for Actuarial Practice be amended to be less prescriptive and more principles-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.*

## SECTION I

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### MISCELLANEOUS AND TECHNICAL ASSUMPTIONS

## Marital Status

Married members will frequently make different annuity selections than non-married members. The current valuation assumption is 80% of male members are married and 70% of female members are married. Actual marital status is used for retired members.

### Findings

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

Gender	Married New Retirees	Total New Retirees	Crude Rates	Sample Rates		Expected Married Retirees		Ratio of Actuals/Expecteds	
				Present	Proposed	Present	Proposed	Present	Proposed
Males	3,764	4,682	0.8039	0.8000	0.8000	3,745.60	3,745.60	100.5%	100.5%
Females	6,016	8,211	0.7327	0.7000	0.7000	5,747.70	5,747.70	104.7%	104.7%
<b>Total</b>	<b>9,780</b>	<b>12,893</b>	<b>0.7586</b>			<b>9,493.30</b>	<b>9,493.30</b>	<b>103.0%</b>	<b>103.0%</b>

The experience shows that the number of married new retirees is approximately the same as expected.

### Recommendation

*We recommend no change to the marital status assumption.*

## Age of Survivor

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

### Findings

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

Gender	Married New Retirees	Average Age Difference	Expected Age Difference		Ratio of Actuals/Expecteds	
			Present	Proposed	Present	Proposed
Males	3,764	2.72	3.00	3.00	90.8%	90.8%
Females	6,016	(0.82)	(2.00)	(1.00)	41.1%	82.2%
<b>Total</b>	<b>9,780</b>					

The experience shows that the age difference for females has been trending down. Actual average age differences were -1.65 years in the 2008-2014 study and -0.82 years in this 2014-2018 study.

### Recommendation

*We recommend changing the survivor age difference assumption for new female married retirees from 2 years to 1 year.*

## 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.
- 25% Joint & Survivor – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 25% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.
- 50% Joint & Survivor – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 50% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.
- 75% Joint & Survivor – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 75% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.
- 100% Joint & Survivor – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 100% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.

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

Males:	5% elect 25% Joint & Survivor option
	15% elect 50% Joint & Survivor option
	10% elect 75% Joint & Survivor option
	30% elect 100% Joint & Survivor option
Females:	5% elect 25% Joint & Survivor option
	5% elect 50% Joint & Survivor option
	5% elect 75% Joint & Survivor option
	15% elect 100% Joint & Survivor option

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

## Findings

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

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

## Recommendation

*We recommend increasing the assumed percentage electing the 100% joint and survivor annuity and reducing the assumed percentage electing the single life annuity accordingly.*

# Form of Payment

## Male Experience

Form of Payment	Actual Electing Annuity	Married New Retirees	Crude Rates	Sample Rates		Expected Electing Annuity		Ratio of Actuals/Expecteds	
				Present	Proposed	Present	Proposed	Present	Proposed
Single-life annuity	683	3,764	0.1815	0.3000	0.2000	1,129.20	752.80	60.5%	90.7%
25% joint & survivor	223	3,764	0.0592	0.1000	0.1000	376.40	376.40	59.2%	59.2%
50% joint & survivor	470	3,764	0.1249	0.1500	0.1500	564.60	564.60	83.2%	83.2%
75% joint & survivor	299	3,764	0.0794	0.1000	0.1000	376.40	376.40	79.4%	79.4%
100% joint & survivor	2,089	3,764	0.5550	0.3500	0.4500	1,317.40	1,693.80	158.6%	123.3%
<b>Total</b>	<b>3,764</b>	<b>3,764</b>	<b>1.0000</b>	<b>1.0000</b>	<b>1.0000</b>	<b>3,764.00</b>	<b>3,764.00</b>		

## Female Experience

Form of Payment	Actual Electing Annuity	Married New Retirees	Crude Rates	Sample Rates		Expected Electing Annuity		Ratio of Actuals/Expecteds	
				Old	New	Old	New	Old	New
Life annuity	2,697	6,016	0.4483	0.6000	0.4500	3,609.60	2,707.20	74.7%	99.6%
25% joint & survivor	494	6,016	0.0821	0.1000	0.1000	601.60	601.60	82.1%	82.1%
50% joint & survivor	671	6,016	0.1115	0.1000	0.1000	601.60	601.60	111.5%	111.5%
75% joint & survivor	248	6,016	0.0412	0.0500	0.0500	300.80	300.80	82.4%	82.4%
100% joint & survivor	1,906	6,016	0.3168	0.1500	0.3000	902.40	1,804.80	211.2%	105.6%
<b>Total</b>	<b>6,016</b>	<b>6,016</b>	<b>1.0000</b>	<b>1.0000</b>	<b>1.0000</b>	<b>6,016.00</b>	<b>6,016.00</b>		

## Actuarial Equivalent Factors

Early retirement and Joint and Survivor benefits are actuarially equivalent to the Single-life annuity. Effective July 1, 2019, actuarial equivalent factors are based on the RP-2014 mortality table for healthy annuitants for a member turning age 62 in 2021, reflecting projected mortality improvements using Scale MP-2017, white collar adjustment, male rates set forward two years, female rates multiplied by 0.90, blended 40% males, 6.17% post-retirement interest and 7.5% pre-retirement interest. Reflecting statutory requirements, joint and survivor factors are based on an interest assumption of 6.5%.

### Recommendation

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



# Proposed Miscellaneous and Technical Assumptions

## Background

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

The Allowance for Combined Service Annuity assumptions are based on an analysis completed by the LCPR actuary and documented in a report dated October 2016.

## Recommendation

*Miscellaneous and Technical Assumptions are listed on page I-7. We recommend continued use of the other Miscellaneous and Technical Assumptions.*

## Miscellaneous and Technical Assumptions

<b><i>Benefit Service</i></b>	Exact fractional service is used to determine the amount of benefit payable.
<b><i>Decrement Operation</i></b>	Withdrawal decrements do not operate during retirement eligibility.
<b><i>Decrement Timing</i></b>	Decrements of all types are assumed to occur mid-year.
<b><i>Eligibility Testing</i></b>	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.
<b><i>Forfeitures</i></b>	For vested separations from service, it is assumed that members separating will withdraw their contributions and forfeit an employer financed benefit when the value of member contributions is greater than the value of the employer financed benefit.
<b><i>Incidence of Contributions</i></b>	Contributions are assumed to be received on a monthly basis, per the Standards of Actuarial Work.
<b><i>Liability Adjustments</i></b>	Liabilities for former members are increased by 15% for vested members and 3% for non-vested members to account for the effect of some participants having eligibility for a Combined Service Annuity.
<b><i>Pay Increase Timing</i></b>	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.
<b><i>Service Credit Accruals</i></b>	Members were assumed to accrue one year of service credit per year.

## SECTION J

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### PROPOSED ASSUMPTION LISTING

# Proposed Actuarial Assumptions Based on 2014 - 2018 Experience Study

## Merit and Seniority Pay Increases

% Merit & Seniority Increases in Salaries Next Year	
Year	Rate
1	7.25%
2	4.25%
3	3.00%
4	2.50%
5	2.00%
6	1.70%
7	1.50%
8	1.40%
9	1.30%
10	1.20%
11	1.00%
12	0.90%
13	0.80%
14	0.70%
15	0.65%
16	0.60%
17	0.50%
18	0.40%
19	0.40%
20	0.40%
21	0.30%
22	0.30%
23	0.30%
24	0.20%
25	0.20%
26	0.10%
27	0.00%
28	0.00%
29	0.00%
30+	0.00%

## Proposed Actuarial Assumptions Based on 2014 - 2018 Experience Study

### Age & Service Retirement Pattern Unreduced (Normal) Retirement

Age	% Retiring
65	40.0%
66	35.0%
67	25.0%
68	25.0%
69	25.0%
70	25.0%
71+*	100.0%

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

## **Proposed Actuarial Assumptions Based on 2014 - 2018 Experience Study**

### **Rule of 90 Retirement Pattern**

<b>Age</b>	<b>% Retiring</b>
55	20.0%
56	15.0%
57	15.0%
58	15.0%
59	15.0%
60	15.0%
61	15.0%
62	30.0%
63	25.0%
64	25.0%

## **Proposed Actuarial Assumptions Based on 2014 - 2018 Experience Study**

### **Age & Service Retirement Pattern Tier 1 Reduced (Early) Retirement**

<b>Age</b>	<b>% Retiring</b>
55	4.0%
56	4.0%
57	5.0%
58	5.0%
59	6.0%
60	8.0%
61	10.0%
62	20.0%
63	20.0%
64	20.0%

## **Proposed Actuarial Assumptions Based on 2014 - 2018 Experience Study**

### **Age & Service Retirement Pattern Tier 2 Reduced (Early) Retirement**

<b>Age</b>	<b>% Retiring</b>
55	4.0%
56	4.0%
57	4.0%
58	5.0%
59	5.0%
60	6.0%
61	8.0%
62	15.0%
63	15.0%
64	15.0%
65	25.0%



# Proposed Actuarial Assumptions Based on 2014 - 2018 Experience Study

## Withdrawal

Year	% Withdrawals	
	Male	Female
1	0.2150	0.2150
2	0.1625	0.1725
3	0.1100	0.1300
4	0.0900	0.1100
5	0.0800	0.0900
6	0.0700	0.0850
7	0.0625	0.0800
8	0.0550	0.0750
9	0.0500	0.0700
10	0.0450	0.0600
11	0.0425	0.0550
12	0.0400	0.0525
13	0.0375	0.0500
14	0.0350	0.0475
15	0.0300	0.0425
16	0.0275	0.0375
17	0.0250	0.0350
18	0.0225	0.0300
19	0.0200	0.0280
20	0.0190	0.0270
21	0.0185	0.0260
22	0.0180	0.0250
23	0.0175	0.0240
24	0.0170	0.0230
25	0.0165	0.0220
26	0.0160	0.0210
27	0.0155	0.0200
28	0.0150	0.0150
29	0.0100	0.0150
30+	0.0100	0.0150

# Proposed Actuarial Assumptions Based on 2014 - 2018 Experience Study

## Disability Rates

Age	% Becoming Disabled	
	Male	Female
20	0.0075%	0.0100%
21	0.0075%	0.0100%
22	0.0075%	0.0100%
23	0.0075%	0.0100%
24	0.0075%	0.0100%
25	0.0075%	0.0100%
26	0.0075%	0.0100%
27	0.0075%	0.0100%
28	0.0075%	0.0100%
29	0.0075%	0.0100%
30	0.0075%	0.0100%
31	0.0075%	0.0100%
32	0.0150%	0.0200%
33	0.0150%	0.0200%
34	0.0150%	0.0200%
35	0.0225%	0.0200%
36	0.0300%	0.0200%
37	0.0300%	0.0300%
38	0.0300%	0.0300%
39	0.0375%	0.0300%
40	0.0375%	0.0400%
41	0.0450%	0.0400%
42	0.0525%	0.0400%
43	0.0525%	0.0400%
44	0.0600%	0.0500%
45	0.0600%	0.0500%
46	0.0750%	0.0600%
47	0.0750%	0.0700%
48	0.0825%	0.0800%
49	0.0975%	0.0800%
50	0.1125%	0.1000%
51	0.1350%	0.1100%
52	0.1500%	0.1100%
53	0.1875%	0.1300%
54	0.2175%	0.1400%
55	0.2550%	0.1400%
56	0.2925%	0.1445%
57	0.3225%	0.1615%
58	0.3600%	0.1870%
59	0.3975%	0.2125%
60	0.5300%	0.2125%
61	0.5300%	0.2170%
62	0.5800%	0.2450%
63	0.6200%	0.2730%
64	0.6600%	0.3010%

# Proposed Actuarial Assumptions Based on 2014 - 2018 Experience Study

## Healthy Post-Retirement Mortality Rates

Age in 2018	% Dying Next Year*		Age in 2018	% Dying Next Year*	
	Male	Female		Male	Female
50	0.2807%	0.1938%	81	5.0794%	3.2451%
51	0.3047%	0.2065%	82	5.7324%	3.6760%
52	0.3320%	0.2219%	83	6.4657%	4.1661%
53	0.3616%	0.2380%	84	7.2847%	4.7263%
54	0.3955%	0.2542%	85	8.1925%	5.3644%
55	0.4315%	0.2710%	86	9.1921%	6.0902%
56	0.4705%	0.2881%	87	10.2827%	6.9098%
57	0.5121%	0.3058%	88	11.4678%	7.8244%
58	0.5560%	0.3228%	89	12.7475%	8.8347%
59	0.6036%	0.3417%	90	14.1205%	9.9229%
60	0.6520%	0.3625%	91	15.5732%	11.0756%
61	0.7024%	0.3869%	92	17.0901%	12.2755%
62	0.7562%	0.4149%	93	18.6613%	13.5163%
63	0.8115%	0.4484%	94	20.2810%	14.8016%
64	0.8725%	0.4857%	95	21.9458%	16.1445%
65	0.9410%	0.5299%	96	23.7848%	17.6260%
66	1.0193%	0.5804%	97	25.6925%	19.1964%
67	1.1098%	0.6387%	98	27.6645%	20.8550%
68	1.2137%	0.7069%	99	29.6894%	22.6097%
69	1.3344%	0.7862%	100	31.7488%	24.4409%
70	1.4724%	0.8768%	101	33.8311%	26.3313%
71	1.6290%	0.9816%	102	35.8966%	28.2440%
72	1.8092%	1.1017%	103	37.9426%	30.1526%
73	2.0131%	1.2386%	104	39.9380%	32.0637%
74	2.2469%	1.3942%	105	41.8863%	33.9301%
75	2.5126%	1.5700%	106	43.7683%	35.7661%
76	2.8154%	1.7684%	107	45.5651%	37.5385%
77	3.1594%	1.9931%	108	47.2823%	39.2374%
78	3.5515%	2.2480%	109	48.9105%	40.8629%
79	3.9971%	2.5375%	110	50.2199%	42.4086%
80	4.5036%	2.8677%			

\* The rates shown are PUB-2010 mortality for healthy annuitants, General table, with adjustments, if applicable (see Section G). Recommended rates include mortality improvements using projection scale MP-2018.

# Proposed Actuarial Assumptions Based on 2014 - 2018 Experience Study

## Disabled Post-Retirement Mortality Rates

Age in 2018	% Dying Next Year*		Age in 2018	% Dying Next Year*	
	Male	Female		Male	Female
20	0.3428%	0.1676%	56	2.3463%	2.0799%
21	0.3132%	0.1676%	57	2.4528%	2.1370%
22	0.2923%	0.1676%	58	2.5598%	2.1893%
23	0.2876%	0.1676%	59	2.6686%	2.2380%
24	0.2876%	0.1676%	60	2.7823%	2.2848%
25	0.2876%	0.2626%	61	2.9014%	2.3312%
26	0.3588%	0.2925%	62	3.0238%	2.3823%
27	0.3864%	0.3254%	63	3.1451%	2.4414%
28	0.4156%	0.3613%	64	3.2669%	2.5117%
29	0.4460%	0.4011%	65	3.3881%	2.5991%
30	0.4774%	0.4433%	66	3.5110%	2.7065%
31	0.5090%	0.4888%	67	3.6391%	2.8379%
32	0.5428%	0.5366%	68	3.7768%	2.9965%
33	0.5756%	0.5875%	69	3.9332%	3.1850%
34	0.6103%	0.6405%	70	4.1092%	3.4075%
35	0.6464%	0.6955%	71	4.3129%	3.6658%
36	0.6842%	0.7519%	72	4.5461%	3.9631%
37	0.7230%	0.8086%	73	4.8130%	4.3004%
38	0.7632%	0.8651%	74	5.1163%	4.6824%
39	0.8058%	0.9223%	75	5.4606%	5.1113%
40	0.8515%	0.9806%	76	5.8494%	5.5912%
41	0.9008%	1.0404%	77	6.2871%	6.1256%
42	0.9576%	1.1026%	78	6.7774%	6.7191%
43	1.0198%	1.1693%	79	7.3229%	7.3751%
44	1.0910%	1.2424%	80	7.9215%	8.0947%
45	1.1721%	1.3242%	81	8.5798%	8.8842%
46	1.2633%	1.4147%	82	9.2954%	9.7076%
47	1.3653%	1.4575%	83	10.0653%	10.5469%
48	1.4795%	1.5093%	84	10.8938%	11.3949%
49	1.5757%	1.5708%	85	11.7846%	12.2542%
50	1.6790%	1.6406%	86	12.7498%	13.1330%
51	1.7877%	1.7153%	87	13.9584%	14.0507%
52	1.9006%	1.7933%	88	15.2952%	15.0263%
53	2.0148%	1.8712%	89	16.6642%	16.0850%
54	2.1281%	1.9456%	90	18.0461%	17.2335%
55	2.2379%	2.0154%			

\* The rates shown are PUB-2010 mortality for disabled annuitants, General/Teachers table, with adjustments, if applicable (see Section G). Recommended rates include mortality improvements using projection scale MP-2018.

# Proposed Actuarial Assumptions Based on 2014 - 2018 Experience Study

## Healthy Pre-Retirement Mortality Rates

Age in 2018	% Dying Next Year*		Age in 2018	% Dying Next Year*	
	Male	Female		Male	Female
20	0.0385%	0.0130%	46	0.1077%	0.0570%
21	0.0382%	0.0122%	47	0.1152%	0.0614%
22	0.0357%	0.0114%	48	0.1253%	0.0662%
23	0.0343%	0.0106%	49	0.1359%	0.0723%
24	0.0330%	0.0097%	50	0.1472%	0.0789%
25	0.0326%	0.0099%	51	0.1614%	0.0868%
26	0.0358%	0.0112%	52	0.1762%	0.0953%
27	0.0380%	0.0124%	53	0.1927%	0.1051%
28	0.0414%	0.0138%	54	0.2100%	0.1150%
29	0.0437%	0.0152%	55	0.2300%	0.1269%
30	0.0471%	0.0177%	56	0.2516%	0.1386%
31	0.0504%	0.0191%	57	0.2756%	0.1508%
32	0.0535%	0.0217%	58	0.3009%	0.1632%
33	0.0565%	0.0228%	59	0.3271%	0.1767%
34	0.0592%	0.0252%	60	0.3547%	0.1912%
35	0.0628%	0.0273%	61	0.3835%	0.2056%
36	0.0659%	0.0293%	62	0.4128%	0.2209%
37	0.0687%	0.0322%	63	0.4433%	0.2382%
38	0.0721%	0.0337%	64	0.4740%	0.2577%
39	0.0751%	0.0362%	65	0.5060%	0.2786%
40	0.0789%	0.0383%	66	0.5394%	0.3030%
41	0.0821%	0.0415%	67	0.5758%	0.3312%
42	0.0861%	0.0433%	68	0.6154%	0.3626%
43	0.0900%	0.0462%	69	0.6610%	0.3983%
44	0.0947%	0.0490%	70	0.7116%	0.4392%
45	0.1007%	0.0529%			

\* The rates shown are PUB-2010 mortality for employees, General table, with adjustments, if applicable (see Section G). Recommended rates include mortality improvements using projection scale MP-2018.

## SECTION K

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### GLOSSARY

## Glossary

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

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

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

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

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

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

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

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

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

## Glossary

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

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



**SECTION L**

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**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

### 2014-2018 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	25,475	10.14%	11.25%
2	36,345	7.06%	8.25%
3	30,945	5.78%	6.75%
4	25,070	5.43%	5.75%
5	19,982	5.00%	5.25%
6	16,916	4.72%	4.95%
7	16,202	4.43%	4.65%
8	16,573	4.51%	4.55%
9	17,394	4.41%	4.45%
10	17,136	4.27%	4.25%
11	15,339	4.23%	4.00%
12	14,051	4.10%	3.85%
13	13,224	3.72%	3.75%
14	13,491	3.69%	3.65%
15	13,874	3.76%	3.65%
16	13,870	3.70%	3.60%
17	13,279	3.54%	3.55%
18	12,053	3.35%	3.50%
19	10,808	3.33%	3.50%
20	9,791	3.43%	3.50%
21	8,964	3.33%	3.50%
22	8,172	3.25%	3.45%
23	7,447	3.30%	3.35%
24	6,943	3.15%	3.35%
25	6,503	3.22%	3.35%
26	6,224	3.06%	3.25%
27	5,958	2.97%	3.25%
28	5,405	3.05%	3.25%
29	4,838	2.92%	3.25%
30+	24,546	2.93%	3.25%
<b>Totals</b>	<b>436,818</b>	<b>4.70%</b>	<b>5.01%</b>

## Appendix – Detailed Experience Analysis Salary Increases

### 2014-2015 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	5,553	11.52%	11.25%
2	7,627	7.17%	8.25%
3	6,495	5.69%	6.75%
4	4,821	5.49%	5.75%
5	3,850	5.34%	5.25%
6	4,045	4.75%	4.95%
7	5,179	4.37%	4.65%
8	4,913	4.70%	4.55%
9	4,776	4.61%	4.45%
10	4,004	4.39%	4.25%
11	3,311	4.58%	4.00%
12	3,386	4.39%	3.85%
13	3,706	3.88%	3.75%
14	4,201	3.61%	3.65%
15	3,758	4.03%	3.65%
16	3,544	3.94%	3.60%
17	3,171	3.80%	3.55%
18	2,807	3.63%	3.50%
19	2,399	3.59%	3.50%
20	2,424	3.64%	3.50%
21	2,289	3.64%	3.50%
22	1,963	3.47%	3.45%
23	1,748	3.51%	3.35%
24	1,894	3.11%	3.35%
25	1,803	3.23%	3.35%
26	1,715	3.11%	3.25%
27	1,510	2.98%	3.25%
28	1,355	2.98%	3.25%
29	1,228	2.90%	3.25%
30+	6,124	2.74%	3.25%
<b>Totals</b>	<b>105,599</b>	<b>4.76%</b>	<b>4.86%</b>

## Appendix – Detailed Experience Analysis Salary Increases

### 2015-2016 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	6,325	9.82%	11.25%
2	8,904	7.25%	8.25%
3	7,108	6.00%	6.75%
4	6,002	5.53%	5.75%
5	4,468	5.02%	5.25%
6	3,604	4.89%	4.95%
7	3,749	4.65%	4.65%
8	4,894	4.57%	4.55%
9	4,628	4.61%	4.45%
10	4,496	4.40%	4.25%
11	3,792	3.99%	4.00%
12	3,132	3.82%	3.85%
13	3,233	3.49%	3.75%
14	3,537	3.67%	3.65%
15	3,953	3.75%	3.65%
16	3,560	3.56%	3.60%
17	3,309	3.41%	3.55%
18	3,025	3.09%	3.50%
19	2,635	3.19%	3.50%
20	2,265	3.28%	3.50%
21	2,270	3.25%	3.50%
22	2,113	3.12%	3.45%
23	1,799	3.09%	3.35%
24	1,619	3.24%	3.35%
25	1,737	3.38%	3.35%
26	1,615	3.17%	3.25%
27	1,545	2.96%	3.25%
28	1,348	3.13%	3.25%
29	1,193	2.94%	3.25%
30+	6,135	3.12%	3.25%
<b>Totals</b>	<b>107,993</b>	<b>4.69%</b>	<b>4.98%</b>

## Appendix – Detailed Experience Analysis Salary Increases

### 2016-2017 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	7,125	10.36%	11.25%
2	9,688	7.14%	8.25%
3	8,364	5.88%	6.75%
4	6,602	5.38%	5.75%
5	5,572	4.89%	5.25%
6	4,208	4.73%	4.95%
7	3,434	4.52%	4.65%
8	3,589	4.28%	4.55%
9	4,610	4.29%	4.45%
10	4,340	4.13%	4.25%
11	4,193	4.37%	4.00%
12	3,571	4.15%	3.85%
13	2,933	3.72%	3.75%
14	3,042	3.72%	3.65%
15	3,281	3.69%	3.65%
16	3,683	3.68%	3.60%
17	3,352	3.48%	3.55%
18	3,101	3.42%	3.50%
19	2,862	3.29%	3.50%
20	2,455	3.65%	3.50%
21	2,132	3.16%	3.50%
22	2,136	3.21%	3.45%
23	1,961	3.26%	3.35%
24	1,651	3.24%	3.35%
25	1,472	3.16%	3.35%
26	1,567	2.87%	3.25%
27	1,499	2.87%	3.25%
28	1,380	3.06%	3.25%
29	1,184	3.08%	3.25%
30+	6,199	2.82%	3.25%
<b>Totals</b>	<b>111,186</b>	<b>4.76%</b>	<b>5.08%</b>

## Appendix – Detailed Experience Analysis Salary Increases

### 2017-2018 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	6,472	9.04%	11.25%
2	10,126	6.72%	8.25%
3	8,978	5.58%	6.75%
4	7,645	5.37%	5.75%
5	6,092	4.87%	5.25%
6	5,059	4.57%	4.95%
7	3,840	4.21%	4.65%
8	3,177	4.40%	4.55%
9	3,380	4.02%	4.45%
10	4,296	4.17%	4.25%
11	4,043	4.01%	4.00%
12	3,962	4.02%	3.85%
13	3,352	3.77%	3.75%
14	2,711	3.80%	3.65%
15	2,882	3.51%	3.65%
16	3,083	3.61%	3.60%
17	3,447	3.49%	3.55%
18	3,120	3.29%	3.50%
19	2,912	3.29%	3.50%
20	2,647	3.17%	3.50%
21	2,273	3.27%	3.50%
22	1,960	3.20%	3.45%
23	1,939	3.36%	3.35%
24	1,779	3.02%	3.35%
25	1,491	3.07%	3.35%
26	1,327	3.11%	3.25%
27	1,404	3.07%	3.25%
28	1,322	3.03%	3.25%
29	1,233	2.76%	3.25%
30+	6,088	3.03%	3.25%
<b>Totals</b>	<b>112,040</b>	<b>4.58%</b>	<b>5.09%</b>

## Appendix – Detailed Experience Analysis

### Rule of 90 Retirement

#### 2014-2018 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	34,785	162,764	32,552.80	106.9%
56	48,348	322,901	48,435.15	99.8%
57	70,400	544,223	81,633.45	86.2%
58	92,602	702,389	105,358.35	87.9%
59	126,315	861,216	129,182.40	97.8%
60	140,054	989,364	148,404.60	94.4%
61	173,357	1,107,677	199,381.86	86.9%
62	344,323	1,133,265	396,642.75	86.8%
63	200,103	910,031	227,507.75	88.0%
64	180,267	776,985	194,246.25	92.8%
<b>Totals</b>	<b>1,410,554</b>	<b>7,510,815</b>	<b>1,563,345.36</b>	<b>90.2%</b>



## Appendix – Detailed Experience Analysis

### Rule of 90 Retirement

#### 2014-2015 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	13,267	53,003	10,600.60	125.2%
56	17,119	92,521	13,878.15	123.4%
57	13,084	147,588	22,138.20	59.1%
58	20,514	180,034	27,005.10	76.0%
59	37,640	217,121	32,568.15	115.6%
60	30,945	229,378	34,406.70	89.9%
61	46,149	283,138	50,964.84	90.6%
62	90,037	291,362	101,976.70	88.3%
63	50,994	230,135	57,533.75	88.6%
64	48,225	175,456	43,864.00	109.9%
<b>Totals</b>	<b>367,974</b>	<b>1,899,736</b>	<b>394,936.19</b>	<b>93.2%</b>

#### 2015-2016 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	7,684	49,382	9,876.40	77.8%
56	9,858	82,240	12,336.00	79.9%
57	14,568	120,326	18,048.90	80.7%
58	26,508	181,244	27,186.60	97.5%
59	26,827	221,253	33,187.95	80.8%
60	34,756	238,264	35,739.60	97.2%
61	38,727	251,949	45,350.82	85.4%
62	101,900	289,747	101,411.45	100.5%
63	56,568	248,709	62,177.25	91.0%
64	50,206	201,577	50,394.25	99.6%
<b>Totals</b>	<b>367,602</b>	<b>1,884,691</b>	<b>395,709.22</b>	<b>92.9%</b>

## Appendix – Detailed Experience Analysis

### Rule of 90 Retirement

#### 2016-2017 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	8,105	35,722	7,144.40	113.4%
56	10,695	80,402	12,060.30	88.7%
57	16,141	122,804	18,420.60	87.6%
58	20,147	162,431	24,364.65	82.7%
59	29,940	216,394	32,459.10	92.2%
60	33,108	262,256	39,338.40	84.2%
61	37,386	265,231	47,741.58	78.3%
62	75,294	267,766	93,718.10	80.3%
63	45,164	216,513	54,128.25	83.4%
64	42,474	209,049	52,262.25	81.3%
<b>Totals</b>	<b>318,454</b>	<b>1,838,568</b>	<b>381,637.63</b>	<b>83.4%</b>

#### 2017-2018 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	5,729	24,657	4,931.40	116.2%
56	10,676	67,738	10,160.70	105.1%
57	26,607	153,505	23,025.75	115.6%
58	25,433	178,680	26,802.00	94.9%
59	31,908	206,448	30,967.20	103.0%
60	41,245	259,466	38,919.90	106.0%
61	51,095	307,359	55,324.62	92.4%
62	77,092	284,390	99,536.50	77.5%
63	47,377	214,674	53,668.50	88.3%
64	39,362	190,903	47,725.75	82.5%
<b>Totals</b>	<b>356,524</b>	<b>1,887,820</b>	<b>391,062.32</b>	<b>91.2%</b>

## Appendix – Detailed Experience Analysis Non-Rule of 90 Retirement – Tier 1 Members

2014-2018 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	32,836	1,000,477	50,023.85	65.6%
56	36,789	977,184	48,859.20	75.3%
57	44,154	846,301	42,315.05	104.3%
58	35,774	750,092	45,005.52	79.5%
59	39,648	654,083	45,785.81	86.6%
60	38,292	504,772	40,381.76	94.8%
61	38,751	380,648	38,064.80	101.8%
62	53,804	279,414	55,882.80	96.3%
63	35,905	191,790	38,358.00	93.6%
64	26,167	138,666	34,666.50	75.5%
65	317,787	747,638	242,982.35	130.8%
66	191,363	421,538	105,384.50	181.6%
67	74,570	232,152	46,430.40	160.6%
68	55,250	174,734	30,578.45	180.7%
69	33,882	126,876	19,031.40	178.0%
70	28,622	85,384	14,942.20	191.6%
<b>Totals</b>	<b>1,083,594</b>	<b>7,511,749</b>	<b>898,692.59</b>	<b>120.6%</b>

## Appendix – Detailed Experience Analysis

### Non-Rule of 90 Retirement – Tier 1 Members

#### 2014-2015 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	14,088	284,197	14,209.85	99.1%
56	11,111	266,638	13,331.90	83.3%
57	9,194	239,134	11,956.70	76.9%
58	13,868	246,179	14,770.74	93.9%
59	9,787	199,264	13,948.48	70.2%
60	10,165	153,924	12,313.92	82.5%
61	12,886	130,894	13,089.40	98.4%
62	16,949	105,942	21,188.40	80.0%
63	15,015	65,037	13,007.40	115.4%
64	8,011	34,954	8,738.50	91.7%
65	80,916	182,529	59,321.93	136.4%
66	45,167	111,409	27,852.25	162.2%
67	18,773	56,412	11,282.40	166.4%
68	15,352	50,452	8,829.10	173.9%
69	6,015	27,208	4,081.20	147.4%
70	5,061	13,526	2,367.05	213.8%
<b>Totals</b>	<b>292,358</b>	<b>2,167,699</b>	<b>250,289.22</b>	<b>116.8%</b>

#### 2015-2016 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	6,329	276,826	13,841.30	45.7%
56	7,364	236,019	11,800.95	62.4%
57	11,477	222,460	11,123.00	103.2%
58	7,009	192,543	11,552.58	60.7%
59	11,871	183,231	12,826.17	92.6%
60	9,505	137,845	11,027.60	86.2%
61	9,744	100,736	10,073.60	96.7%
62	17,722	74,272	14,854.40	119.3%
63	7,756	48,961	9,792.20	79.2%
64	6,161	35,561	8,890.25	69.3%
65	65,765	159,611	51,873.58	126.8%
66	50,905	102,358	25,589.50	198.9%
67	22,670	66,894	13,378.80	169.4%
68	10,959	38,391	6,718.43	163.1%
69	7,089	35,470	5,320.50	133.2%
70	9,682	21,859	3,825.33	253.1%
<b>Totals</b>	<b>262,008</b>	<b>1,933,037</b>	<b>222,488.18</b>	<b>117.8%</b>

## Appendix – Detailed Experience Analysis

### Non-Rule of 90 Retirement – Tier 1 Members

#### 2016-2017 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/Expected
55	5,471	239,376	11,968.80	45.7%
56	7,597	245,217	12,260.85	62.0%
57	10,563	191,258	9,562.90	110.5%
58	8,194	169,319	10,159.14	80.7%
59	7,999	138,740	9,711.80	82.4%
60	8,666	122,299	9,783.92	88.6%
61	7,241	81,145	8,114.50	89.2%
62	10,144	51,645	10,329.00	98.2%
63	6,741	39,183	7,836.60	86.0%
64	6,746	37,384	9,346.00	72.2%
65	84,749	189,605	61,621.63	137.5%
66	42,103	95,358	23,839.50	176.6%
67	16,135	51,794	10,358.80	155.8%
68	14,911	46,003	8,050.53	185.2%
69	9,751	29,004	4,350.60	224.1%
70	9,242	28,904	5,058.20	182.7%
<b>Totals</b>	<b>256,253</b>	<b>1,756,234</b>	<b>212,352.76</b>	<b>120.7%</b>

#### 2017-2018 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/Expected
55	6,948	200,078	10,003.90	69.5%
56	10,717	229,310	11,465.50	93.5%
57	12,920	193,449	9,672.45	133.6%
58	6,703	142,051	8,523.06	78.6%
59	9,991	132,848	9,299.36	107.4%
60	9,956	90,704	7,256.32	137.2%
61	8,880	67,873	6,787.30	130.8%
62	8,989	47,555	9,511.00	94.5%
63	6,393	38,609	7,721.80	82.8%
64	5,249	30,767	7,691.75	68.2%
65	86,357	215,893	70,165.23	123.1%
66	53,188	112,413	28,103.25	189.3%
67	16,992	57,052	11,410.40	148.9%
68	14,028	39,888	6,980.40	201.0%
69	11,027	35,194	5,279.10	208.9%
70	4,637	21,095	3,691.63	125.6%
<b>Totals</b>	<b>272,975</b>	<b>1,654,779</b>	<b>213,562.44</b>	<b>127.8%</b>

## Appendix – Detailed Experience Analysis

### Non-Rule of 90 Retirement – Tier 2 Members

2014-2018 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	51,840	1,323,956	66,197.80	78.3%
56	49,252	1,300,779	65,038.95	75.7%
57	52,390	1,276,395	63,819.75	82.1%
58	56,031	1,231,133	61,556.65	91.0%
59	56,707	1,177,385	70,643.10	80.3%
60	68,128	1,122,297	78,560.79	86.7%
61	75,456	1,034,224	93,080.16	81.1%
62	149,911	926,699	139,004.85	107.8%
63	99,784	768,743	115,311.45	86.5%
64	100,885	637,526	95,628.90	105.5%
65	141,709	499,630	124,907.50	113.5%
66	127,853	331,807	82,951.75	154.1%
67	56,573	189,118	37,823.60	149.6%
68	34,636	125,815	22,017.63	157.3%
69	20,212	89,395	13,409.25	150.7%
70	19,500	65,806	11,516.05	169.3%
<b>Totals</b>	<b>1,160,867</b>	<b>12,100,708</b>	<b>1,141,468.18</b>	<b>101.7%</b>

## Appendix – Detailed Experience Analysis

### Non-Rule of 90 Retirement – Tier 2 Members

#### 2014-2015 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	9,507	298,153	14,907.65	63.8%
56	9,191	300,966	15,048.30	61.1%
57	12,525	295,271	14,763.55	84.8%
58	11,414	274,775	13,738.75	83.1%
59	12,307	256,898	15,413.88	79.8%
60	16,146	256,322	17,942.54	90.0%
61	15,385	225,087	20,257.83	75.9%
62	30,818	192,035	28,805.25	107.0%
63	20,736	164,537	24,680.55	84.0%
64	23,763	130,118	19,517.70	121.8%
65	29,795	97,066	24,266.50	122.8%
66	25,575	65,442	16,360.50	156.3%
67	13,070	43,697	8,739.40	149.6%
68	8,452	27,427	4,799.73	176.1%
69	4,363	17,879	2,681.85	162.7%
70	4,247	12,760	2,233.00	190.2%
<b>Totals</b>	<b>247,294</b>	<b>2,658,433</b>	<b>244,156.98</b>	<b>101.3%</b>

#### 2015-2016 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	13,632	321,588	16,079.40	84.8%
56	11,073	305,251	15,262.55	72.6%
57	12,767	304,374	15,218.70	83.9%
58	13,544	297,738	14,886.90	91.0%
59	14,654	274,030	16,441.80	89.1%
60	17,172	255,122	17,858.54	96.2%
61	21,412	251,396	22,625.64	94.6%
62	36,264	218,160	32,724.00	110.8%
63	19,468	168,847	25,327.05	76.9%
64	22,559	149,986	22,497.90	100.3%
65	31,277	111,425	27,856.25	112.3%
66	26,491	69,689	17,422.25	152.1%
67	11,835	41,040	8,208.00	144.2%
68	8,135	31,893	5,581.28	145.8%
69	4,678	19,639	2,945.85	158.8%
70	4,878	14,120	2,471.00	197.4%
<b>Totals</b>	<b>269,839</b>	<b>2,834,298</b>	<b>263,407.11</b>	<b>102.4%</b>

## Appendix – Detailed Experience Analysis Non-Rule of 90 Retirement – Tier 2 Members

### 2016-2017 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	11,926	323,564	16,178.20	73.7%
56	13,145	326,133	16,306.65	80.6%
57	11,098	312,782	15,639.10	71.0%
58	12,333	309,558	15,477.90	79.7%
59	12,604	302,369	18,142.14	69.5%
60	12,267	278,026	19,461.82	63.0%
61	15,284	254,474	22,902.66	66.7%
62	35,958	245,368	36,805.20	97.7%
63	25,048	197,462	29,619.30	84.6%
64	22,245	162,537	24,380.55	91.2%
65	36,769	137,493	34,373.25	107.0%
66	33,253	86,026	21,506.50	154.6%
67	13,668	46,596	9,319.20	146.7%
68	7,735	31,233	5,465.78	141.5%
69	5,512	25,811	3,871.65	142.4%
70	5,012	16,782	2,936.85	170.7%
<b>Totals</b>	<b>273,857</b>	<b>3,056,214</b>	<b>292,386.75</b>	<b>93.7%</b>

### 2017-2018 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	16,775	380,651	19,032.55	88.1%
56	15,843	368,429	18,421.45	86.0%
57	16,000	363,968	18,198.40	87.9%
58	18,740	349,062	17,453.10	107.4%
59	17,142	344,088	20,645.28	83.0%
60	22,543	332,827	23,297.89	96.8%
61	23,375	303,267	27,294.03	85.6%
62	46,871	271,136	40,670.40	115.2%
63	34,532	237,897	35,684.55	96.8%
64	32,318	194,885	29,232.75	110.6%
65	43,868	153,646	38,411.50	114.2%
66	42,534	110,650	27,662.50	153.8%
67	18,000	57,785	11,557.00	155.7%
68	10,314	35,262	6,170.85	167.1%
69	5,659	26,066	3,909.90	144.7%
70	5,363	22,144	3,875.20	138.4%
<b>Totals</b>	<b>369,877</b>	<b>3,551,763</b>	<b>341,517.35</b>	<b>108.3%</b>



## Appendix – Detailed Experience Analysis Terminations

2014-2018 Experience (\$000s)

Males					Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected
1	31,832	148,364	37,090.99	85.8%	1	42,972	202,952	50,738.08	84.7%
2	83,648	514,498	102,899.58	81.3%	2	140,332	813,619	162,723.71	86.2%
3	59,505	548,538	82,280.75	72.3%	3	112,340	854,265	128,139.73	87.7%
4	46,347	515,182	51,518.23	90.0%	4	86,382	781,343	85,947.66	100.5%
5	33,182	417,665	37,589.85	88.3%	5	57,473	650,283	65,028.33	88.4%
6	23,378	331,540	23,207.86	100.7%	6	44,978	528,184	47,536.55	94.6%
7	20,794	322,317	17,727.44	117.3%	7	43,211	512,697	38,452.23	112.4%
8	19,231	341,633	17,081.60	112.6%	8	39,356	544,612	35,399.81	111.2%
9	20,477	380,325	17,114.58	119.6%	9	42,536	613,566	33,746.12	126.0%
10	17,941	422,997	16,919.87	106.0%	10	40,876	677,502	33,875.05	120.7%
11	18,532	425,809	13,838.77	133.9%	11	33,784	656,039	27,881.68	121.2%
12	15,409	388,590	11,657.68	132.2%	12	30,230	600,985	24,039.40	125.8%
13	14,684	373,032	10,258.39	143.1%	13	31,226	593,984	22,274.39	140.2%
14	15,169	371,616	9,290.40	163.3%	14	31,107	593,263	20,764.19	149.8%
15	11,769	387,803	9,695.10	121.4%	15	26,333	622,908	20,244.51	130.1%
16	9,396	422,083	9,496.85	98.9%	16	24,352	675,706	20,271.16	120.1%
17	9,470	426,561	8,531.22	111.0%	17	22,771	663,173	18,237.22	124.9%
18	10,793	414,952	7,261.64	148.6%	18	18,518	619,374	15,484.35	119.6%
19	6,906	383,337	5,750.06	120.1%	19	14,226	556,504	13,912.60	102.3%
20	10,647	356,921	5,353.80	198.9%	20	14,830	509,688	11,467.98	129.3%
21	6,169	332,448	4,986.72	123.7%	21	11,551	465,826	10,481.09	110.2%
22	5,316	302,153	4,532.29	117.3%	22	12,350	426,537	9,597.09	128.7%
23	4,193	271,259	2,712.59	154.6%	23	9,585	389,915	7,798.31	122.9%
24	3,624	245,140	2,451.40	147.8%	24	9,015	350,190	7,003.82	128.7%
25	3,827	236,652	2,366.52	161.7%	25	6,277	329,655	5,768.98	108.8%
26	3,413	232,346	2,323.46	146.9%	26	5,784	329,171	5,760.49	100.4%
27	3,548	238,130	2,381.30	149.0%	27	6,644	330,878	4,963.18	133.9%
28	3,583	225,329	2,253.30	159.0%	28	4,872	317,868	4,768.04	102.2%
29	1,124	212,644	2,126.45	52.9%	29	3,948	301,990	4,529.86	87.2%
30+	8,445	609,559	6,095.59	138.5%	30	13,980	961,084	14,416.30	97.0%
<b>Totals</b>	<b>522,352</b>	<b>10,799,423</b>	<b>526,794.24</b>	<b>99.2%</b>	<b>Totals</b>	<b>981,839</b>	<b>16,473,761</b>	<b>951,251.87</b>	<b>103.2%</b>

## Appendix – Detailed Experience Analysis Terminations

2014-2015 Experience (\$000s)

Males					Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected
1	7,403	31,890	7,972.52	92.9%	1	9,576	42,198	10,549.51	90.8%
2	19,509	112,474	22,494.77	86.7%	2	31,069	172,401	34,480.20	90.1%
3	12,723	111,720	16,758.03	75.9%	3	24,771	183,683	27,552.49	89.9%
4	10,207	96,750	9,675.03	105.5%	4	18,792	153,301	16,863.08	111.4%
5	7,628	75,681	6,811.29	112.0%	5	12,758	115,208	11,520.79	110.7%
6	5,241	65,001	4,550.08	115.2%	6	9,693	100,560	9,050.39	107.1%
7	6,646	96,761	5,321.85	124.9%	7	12,919	153,912	11,543.40	111.9%
8	5,752	108,086	5,404.28	106.4%	8	12,234	174,005	11,310.34	108.2%
9	7,079	111,507	5,017.80	141.1%	9	11,415	176,187	9,690.31	117.8%
10	5,494	109,448	4,377.90	125.5%	10	11,478	175,012	8,750.58	131.2%
11	4,056	95,958	3,118.64	130.1%	11	7,387	139,625	5,934.08	124.5%
12	3,958	74,931	2,247.93	176.1%	12	4,772	121,769	4,870.77	98.0%
13	4,466	97,247	2,674.29	167.0%	13	8,272	170,432	6,391.23	129.4%
14	4,886	111,035	2,775.88	176.0%	14	9,272	181,861	6,365.14	145.7%
15	3,471	118,130	2,953.25	117.5%	15	7,401	185,592	6,031.75	122.7%
16	3,612	108,614	2,443.81	147.8%	16	6,849	174,599	5,237.97	130.8%
17	3,008	106,549	2,130.99	141.2%	17	4,003	166,199	4,570.47	87.6%
18	2,131	101,380	1,774.14	120.1%	18	4,335	144,718	3,617.96	119.8%
19	2,248	91,032	1,365.48	164.6%	19	3,860	133,554	3,338.87	115.6%
20	3,268	86,461	1,296.91	252.0%	20	3,553	121,095	2,724.65	130.4%
21	1,837	81,735	1,226.03	149.8%	21	3,293	122,665	2,759.97	119.3%
22	1,429	72,822	1,092.34	130.8%	22	3,009	107,549	2,419.87	124.3%
23	962	62,968	629.68	152.8%	23	689	91,379	1,827.58	37.7%
24	1,597	64,086	640.86	249.2%	24	1,789	89,839	1,796.79	99.6%
25	1,045	70,768	707.68	147.7%	25	2,010	97,995	1,714.93	117.2%
26	1,069	76,279	762.79	140.1%	26	2,998	108,162	1,892.84	158.4%
27	1,193	75,430	754.30	158.2%	27	1,220	98,138	1,472.08	82.9%
28	2,046	68,079	680.79	300.5%	28	1,276	87,139	1,307.10	97.6%
29	868	66,422	664.23	130.7%	29	826	83,044	1,245.67	66.3%
30+	3,342	184,953	1,849.52	180.7%	30+	3,887	277,242	4,158.70	93.5%
<b>Totals</b>	<b>138,174</b>	<b>2,734,197</b>	<b>120,173.07</b>	<b>115.0%</b>	<b>Totals</b>	<b>235,406</b>	<b>4,149,063</b>	<b>220,989.47</b>	<b>106.5%</b>

## Appendix – Detailed Experience Analysis Terminations

2015-2016 Experience (\$000s)

Males					Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected
1	7,108	38,160	9,539.93	74.5%	1	10,316	50,880	12,720.00	81.1%
2	20,741	128,888	25,777.63	80.5%	2	34,122	191,251	38,250.11	89.2%
3	14,635	129,335	19,400.22	75.4%	3	26,212	195,417	29,312.49	89.4%
4	11,260	118,245	11,824.50	95.2%	4	22,206	190,985	21,008.29	105.7%
5	7,738	92,861	8,357.47	92.6%	5	13,045	146,926	14,692.64	88.8%
6	5,171	69,535	4,867.48	106.2%	6	10,177	108,553	9,769.73	104.2%
7	4,797	65,760	3,616.82	132.6%	7	9,277	104,639	7,847.90	118.2%
8	5,623	95,841	4,792.05	117.3%	8	11,374	156,301	10,159.59	112.0%
9	6,107	108,786	4,895.37	124.8%	9	13,419	175,347	9,644.06	139.1%
10	5,363	109,757	4,390.28	122.2%	10	10,227	176,273	8,813.64	116.0%
11	4,218	109,313	3,552.67	118.7%	11	9,341	171,249	7,278.10	128.3%
12	3,757	93,622	2,808.65	133.8%	12	7,198	138,613	5,544.53	129.8%
13	3,453	72,528	1,994.53	173.1%	13	7,282	121,559	4,558.47	159.7%
14	2,966	96,608	2,415.21	122.8%	14	7,419	164,101	5,743.54	129.2%
15	3,700	107,973	2,699.33	137.1%	15	6,364	174,113	5,658.67	112.5%
16	2,292	116,100	2,612.25	87.7%	16	6,260	183,314	5,499.42	113.8%
17	1,857	104,328	2,086.57	89.0%	17	7,200	164,995	4,537.36	158.7%
18	4,652	103,374	1,809.04	257.2%	18	4,251	153,953	3,848.84	110.4%
19	2,166	95,435	1,431.52	151.3%	19	4,213	137,510	3,437.77	122.6%
20	1,206	85,803	1,287.05	93.7%	20	3,207	121,032	2,723.23	117.8%
21	1,180	79,881	1,198.21	98.5%	21	2,465	111,392	2,506.34	98.4%
22	1,594	74,907	1,123.60	141.9%	22	2,743	111,394	2,506.38	109.4%
23	959	65,391	653.91	146.7%	23	2,585	98,009	1,960.18	131.9%
24	874	54,149	541.49	161.4%	24	2,416	82,734	1,654.68	146.0%
25	358	56,638	566.38	63.2%	25	902	79,946	1,399.06	64.5%
26	758	59,234	592.34	128.0%	26	643	86,234	1,509.10	42.6%
27	181	65,790	657.90	27.5%	27	2,764	94,895	1,423.43	194.2%
28	56	63,030	630.30	8.9%	28	241	83,719	1,255.80	19.2%
29	-	52,660	526.60	0.0%	29	888	73,856	1,107.84	80.2%
30+	1,424	151,219	1,512.19	94.2%	30+	4,504	246,156	3,692.39	122.0%
<b>Totals</b>	<b>126,194</b>	<b>2,665,151</b>	<b>128,161.49</b>	<b>98.5%</b>	<b>Totals</b>	<b>243,261</b>	<b>4,095,346</b>	<b>230,063.58</b>	<b>105.7%</b>

## Appendix – Detailed Experience Analysis Terminations

2016-2017 Experience (\$000s)

Males					Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected
1	8,309	38,178	9,544.53	87.1%	1	10,943	55,009	13,752.31	79.6%
2	19,166	131,381	26,276.17	72.9%	2	33,577	213,662	42,732.47	78.6%
3	13,719	143,701	21,555.17	63.6%	3	26,235	211,782	31,767.24	82.6%
4	11,447	134,612	13,461.19	85.0%	4	18,932	196,446	21,609.08	87.6%
5	7,566	108,173	9,735.60	77.7%	5	13,524	176,352	17,635.20	76.7%
6	4,888	83,275	5,829.28	83.9%	6	10,073	132,411	11,917.01	84.5%
7	3,452	67,437	3,709.03	93.1%	7	7,900	103,860	7,789.49	101.4%
8	2,667	62,062	3,103.09	85.9%	8	6,149	99,609	6,474.57	95.0%
9	3,712	91,310	4,108.94	90.3%	9	10,104	148,394	8,161.68	123.8%
10	3,294	102,267	4,090.69	80.5%	10	9,221	163,287	8,164.36	112.9%
11	5,049	104,273	3,388.86	149.0%	11	7,329	164,820	7,004.85	104.6%
12	2,326	104,357	3,130.71	74.3%	12	6,758	158,251	6,330.03	106.8%
13	3,525	87,929	2,418.05	145.8%	13	6,432	127,647	4,786.73	134.4%
14	2,647	66,417	1,660.43	159.4%	14	5,529	108,652	3,802.82	145.4%
15	2,119	90,430	2,260.76	93.7%	15	6,745	147,256	4,785.80	140.9%
16	1,179	99,996	2,249.91	52.4%	16	4,690	158,002	4,740.05	98.9%
17	2,187	105,855	2,117.09	103.3%	17	4,827	163,833	4,505.39	107.1%
18	1,526	95,984	1,679.71	90.8%	18	4,696	144,191	3,604.76	130.3%
19	1,275	92,197	1,382.95	92.2%	19	2,267	136,554	3,413.83	66.4%
20	2,310	83,814	1,257.21	183.7%	20	3,264	121,360	2,730.58	119.5%
21	1,317	78,745	1,181.18	111.5%	21	2,217	104,778	2,357.49	94.0%
22	936	72,383	1,085.74	86.2%	22	1,742	96,916	2,180.60	79.9%
23	780	66,607	666.07	117.1%	23	1,200	96,511	1,930.22	62.2%
24	298	60,356	603.56	49.4%	24	1,282	79,836	1,596.72	80.3%
25	1,689	47,665	476.65	354.3%	25	1,254	69,569	1,217.46	103.0%
26	433	48,630	486.30	89.0%	26	584	66,099	1,156.72	50.5%
27	1,703	49,014	490.14	347.5%	27	992	71,520	1,072.79	92.5%
28	951	49,170	491.70	193.4%	28	689	79,799	1,196.97	57.6%
29	256	50,036	500.36	51.2%	29	746	66,929	1,003.94	74.3%
30+	1,018	131,746	1,317.47	77.3%	30+	1,369	217,818	3,267.22	41.9%
<b>Totals</b>	<b>111,744</b>	<b>2,548,000</b>	<b>130,258.54</b>	<b>85.8%</b>	<b>Totals</b>	<b>211,270</b>	<b>3,881,153</b>	<b>232,688.38</b>	<b>90.8%</b>

## Appendix – Detailed Experience Analysis Terminations

2017-2018 Experience (\$000s)

Males					Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected
1	9,012	40,136	10,034.00	89.8%	1	12,137	54,865	13,716.26	88.5%
2	24,232	141,755	28,351.01	85.5%	2	41,564	236,305	47,260.94	87.9%
3	18,428	163,782	24,567.32	75.0%	3	35,122	263,383	39,507.51	88.9%
4	13,433	165,575	16,557.51	81.1%	4	26,452	240,611	26,467.21	99.9%
5	10,250	140,950	12,685.48	80.8%	5	18,146	211,797	21,179.70	85.7%
6	8,078	113,729	7,961.02	101.5%	6	15,035	186,660	16,799.42	89.5%
7	5,899	92,359	5,079.73	116.1%	7	13,115	150,286	11,271.44	116.4%
8	5,189	75,644	3,782.18	137.2%	8	9,599	114,697	7,455.31	128.8%
9	3,579	68,722	3,092.47	115.7%	9	7,598	113,638	6,250.06	121.6%
10	3,790	101,525	4,060.99	93.3%	10	9,950	162,930	8,146.47	122.1%
11	5,209	116,265	3,778.61	137.9%	11	9,727	180,345	7,664.65	126.9%
12	5,368	115,680	3,470.39	154.7%	12	11,502	182,352	7,294.08	157.7%
13	3,240	115,328	3,171.53	102.2%	13	9,240	174,346	6,537.97	141.3%
14	4,670	97,556	2,438.89	191.5%	14	8,887	138,649	4,852.69	183.1%
15	2,479	71,270	1,781.76	139.1%	15	5,823	115,947	3,768.29	154.5%
16	2,313	97,373	2,190.89	105.6%	16	6,553	159,791	4,793.72	136.7%
17	2,418	109,829	2,196.57	110.1%	17	6,741	168,146	4,624.00	145.8%
18	2,484	114,214	1,998.74	124.3%	18	5,236	176,512	4,412.79	118.7%
19	1,217	104,673	1,570.10	77.5%	19	3,886	148,886	3,722.14	104.4%
20	3,863	100,843	1,512.64	255.4%	20	4,806	146,201	3,289.52	146.1%
21	1,835	92,087	1,381.30	132.8%	21	3,576	126,991	2,857.29	125.2%
22	1,357	82,041	1,230.62	110.3%	22	4,856	110,678	2,490.24	195.0%
23	1,492	76,293	762.93	195.6%	23	5,111	104,016	2,080.32	245.7%
24	855	66,549	665.49	128.5%	24	3,528	97,781	1,955.63	180.4%
25	735	61,581	615.81	119.4%	25	2,111	82,145	1,437.54	146.8%
26	1,153	48,203	482.03	239.2%	26	1,559	68,676	1,201.83	129.7%
27	471	47,896	478.96	98.3%	27	1,668	66,325	994.87	167.7%
28	530	45,050	450.51	117.6%	28	2,666	67,211	1,008.17	264.4%
29	-	43,526	435.26	0.0%	29	1,488	78,161	1,172.41	126.9%
30+	2,661	141,641	1,416.41	187.9%	30+	4,220	219,868	3,297.99	128.0%
<b>Totals</b>	<b>146,240</b>	<b>2,852,075</b>	<b>148,201.14</b>	<b>98.7%</b>	<b>Totals</b>	<b>291,902</b>	<b>4,348,199</b>	<b>267,510.45</b>	<b>109.1%</b>

## Appendix – Detailed Experience Analysis Disability Retirements

### 2014-2018 Experience

Males					Females				
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected	Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	-	6,449	0.64	0.0%	20-24	-	12,215	1.22	0.0%
25-29	-	15,800	1.58	0.0%	25-29	-	30,371	3.04	0.0%
30-34	-	18,213	2.93	0.0%	30-34	-	34,711	5.60	0.0%
35-39	1	18,827	7.51	13.3%	35-39	4	38,199	9.97	40.1%
40-44	3	18,060	11.93	25.2%	40-44	8	41,588	17.54	45.6%
45-49	6	20,663	21.58	27.8%	45-49	15	51,131	35.00	42.9%
50-54	30	24,506	53.41	56.2%	50-54	42	60,616	72.07	58.3%
55-59	63	29,097	126.22	49.9%	55-59	77	65,041	128.14	60.1%
60-64	104	23,341	134.34	77.4%	60-64	64	47,290	161.56	39.6%
<b>Totals</b>	<b>207</b>	<b>174,956</b>	<b>360.14</b>	<b>57.5%</b>	<b>Totals</b>	<b>210</b>	<b>381,162</b>	<b>434.13</b>	<b>48.4%</b>

## Appendix – Detailed Experience Analysis

### Disability Retirements

#### 2014-2015 Experience

Males					Females				
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected	Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	-	1,334	0.13	0.0%	20-24	-	2,543	0.25	0.0%
25-29	-	3,683	0.37	0.0%	25-29	-	7,121	0.71	0.0%
30-34	-	4,280	0.70	0.0%	30-34	-	7,978	1.28	0.0%
35-39	-	4,282	1.71	0.0%	35-39	-	8,531	2.23	0.0%
40-44	2	4,337	2.88	69.3%	40-44	2	10,256	4.34	46.1%
45-49	2	5,117	5.35	37.4%	45-49	4	13,064	8.95	44.7%
50-54	8	6,497	14.22	56.3%	50-54	17	16,132	19.18	88.6%
55-59	18	7,294	31.61	56.9%	55-59	14	16,038	31.55	44.4%
60-64	21	5,689	32.74	64.1%	60-64	15	11,349	38.59	38.9%
<b>Totals</b>	<b>51</b>	<b>42,513</b>	<b>89.72</b>	<b>56.8%</b>	<b>Totals</b>	<b>52</b>	<b>93,012</b>	<b>107.07</b>	<b>48.6%</b>

#### 2015-2016 Experience

Males					Females				
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected	Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	-	1,516	0.15	0.0%	20-24	-	2,874	0.29	0.0%
25-29	-	3,844	0.38	0.0%	25-29	-	7,369	0.74	0.0%
30-34	-	4,414	0.71	0.0%	30-34	-	8,452	1.36	0.0%
35-39	-	4,600	1.84	0.0%	35-39	3	9,205	2.40	125.0%
40-44	-	4,378	2.90	0.0%	40-44	2	10,197	4.31	46.4%
45-49	1	5,095	5.30	18.9%	45-49	3	12,828	8.76	34.3%
50-54	8	6,226	13.56	59.0%	50-54	8	15,406	18.35	43.6%
55-59	22	7,336	31.76	69.3%	55-59	27	16,233	32.00	84.4%
60-64	25	5,823	33.52	74.6%	60-64	19	11,620	39.76	47.8%
<b>Totals</b>	<b>56</b>	<b>43,232</b>	<b>90.11</b>	<b>62.1%</b>	<b>Totals</b>	<b>62</b>	<b>94,184</b>	<b>107.97</b>	<b>57.4%</b>

## Appendix – Detailed Experience Analysis Disability Retirements

### 2016-2017 Experience

Males					Females				
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected	Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	-	1,735	0.17	0.0%	20-24	-	3,187	0.32	0.0%
25-29	-	4,032	0.40	0.0%	25-29	-	7,678	0.77	0.0%
30-34	-	4,621	0.74	0.0%	30-34	-	8,891	1.44	0.0%
35-39	1	4,801	1.91	52.3%	35-39	-	9,953	2.60	0.0%
40-44	-	4,548	2.98	0.0%	40-44	1	10,322	4.34	23.0%
45-49	1	5,242	5.47	18.3%	45-49	4	12,709	8.69	46.0%
50-54	7	6,003	13.12	53.4%	50-54	6	14,706	17.49	34.3%
55-59	16	7,260	31.50	50.8%	55-59	13	16,388	32.29	40.3%
60-64	33	5,902	33.96	97.2%	60-64	13	11,915	40.75	31.9%
<b>Totals</b>	<b>58</b>	<b>44,144</b>	<b>90.26</b>	<b>64.3%</b>	<b>Totals</b>	<b>37</b>	<b>95,749</b>	<b>108.68</b>	<b>34.0%</b>

### 2017-2018 Experience

Males					Females				
Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected	Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected
Under 20	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	-	1,864	0.19	0.0%	20-24	-	3,611	0.36	0.0%
25-29	-	4,241	0.42	0.0%	25-29	-	8,203	0.82	0.0%
30-34	-	4,898	0.79	0.0%	30-34	-	9,390	1.52	0.0%
35-39	-	5,144	2.05	0.0%	35-39	1	10,510	2.75	36.4%
40-44	1	4,797	3.16	31.7%	40-44	3	10,813	4.54	66.0%
45-49	2	5,209	5.47	36.6%	45-49	4	12,530	8.61	46.5%
50-54	7	5,780	12.51	56.0%	50-54	11	14,372	17.05	64.5%
55-59	7	7,207	31.34	22.3%	55-59	23	16,382	32.30	71.2%
60-64	25	5,927	34.13	73.3%	60-64	17	12,406	42.46	40.0%
<b>Totals</b>	<b>42</b>	<b>45,067</b>	<b>90.05</b>	<b>46.6%</b>	<b>Totals</b>	<b>59</b>	<b>98,217</b>	<b>110.41</b>	<b>53.4%</b>



## Appendix – Detailed Experience Analysis Post-Retirement Mortality

2014-2018 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
55-59	296	55,017	287.41	103.0%	55-59	317	76,628	232.59	136.3%
60-64	1,798	291,768	2,161.49	83.2%	60-64	1,266	359,773	1,669.95	75.8%
65-69	5,811	569,261	6,429.26	90.4%	65-69	3,594	656,847	4,636.34	77.5%
70-74	6,169	411,641	7,635.93	80.8%	70-74	4,838	477,792	5,362.00	90.2%
75-79	10,262	305,345	9,999.01	102.6%	75-79	5,960	317,059	6,074.57	98.1%
80-84	15,059	272,204	16,277.92	92.5%	80-84	9,413	230,288	7,848.35	119.9%
85-89	20,595	195,914	21,329.64	96.6%	85-89	13,172	173,267	10,650.77	123.7%
90-94	16,752	89,142	16,196.81	103.4%	90-94	11,991	91,605	9,927.50	120.8%
95-99	5,951	17,850	4,852.27	122.6%	95-99	6,716	27,984	4,951.24	135.6%
100+	369	867	312.71	118.0%	100+	1,596	4,308	1,139.02	140.1%
<b>Totals</b>	<b>83,062</b>	<b>2,209,009</b>	<b>85,482.45</b>	<b>97.2%</b>	<b>Totals</b>	<b>58,863</b>	<b>2,415,551</b>	<b>52,492.33</b>	<b>112.1%</b>

## Appendix – Detailed Experience Analysis Post-Retirement Mortality

### 2014-2015 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
55-59	46	15,344	79.93	57.6%	55-59	138	20,071	60.46	228.3%
60-64	495	75,136	552.90	89.5%	60-64	359	83,914	386.58	92.9%
65-69	1,290	127,445	1,429.13	90.3%	65-69	562	139,567	989.94	56.8%
70-74	1,316	89,160	1,683.26	78.2%	70-74	1,047	102,414	1,169.76	89.5%
75-79	2,419	75,723	2,517.07	96.1%	75-79	1,217	71,924	1,402.35	86.8%
80-84	4,229	70,449	4,246.97	99.6%	80-84	2,067	55,773	1,934.59	106.8%
85-89	5,065	49,695	5,490.69	92.2%	85-89	3,450	42,875	2,663.02	129.6%
90-94	4,602	20,682	3,822.73	120.4%	90-94	2,352	20,713	2,280.12	103.2%
95-99	1,079	4,297	1,187.56	90.9%	95-99	1,273	6,516	1,160.01	109.7%
100+	53	95	34.77	152.4%	100+	344	1,083	285.46	120.5%
<b>Totals</b>	<b>20,594</b>	<b>528,026</b>	<b>21,045.01</b>	<b>97.9%</b>	<b>Totals</b>	<b>12,809</b>	<b>544,850</b>	<b>12,332.29</b>	<b>103.9%</b>

### 2015-2016 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
55-59	104	14,235	74.27	140.0%	55-59	22	20,160	61.09	36.0%
60-64	404	74,013	546.94	73.9%	60-64	244	88,239	409.50	59.6%
65-69	1,196	140,229	1,581.50	75.6%	65-69	1,045	157,873	1,120.33	93.3%
70-74	1,513	95,425	1,785.53	84.7%	70-74	1,199	110,437	1,253.80	95.6%
75-79	3,027	76,414	2,526.89	119.8%	75-79	1,179	75,868	1,463.68	80.6%
80-84	3,079	67,699	4,071.95	75.6%	80-84	2,423	57,023	1,957.47	123.8%
85-89	4,576	49,306	5,427.34	84.3%	85-89	3,005	43,035	2,651.16	113.3%
90-94	3,247	21,343	3,907.57	83.1%	90-94	2,541	22,182	2,398.34	105.9%
95-99	1,261	4,078	1,129.03	111.7%	95-99	1,473	7,043	1,237.09	119.1%
100+	44	126	45.59	96.5%	100+	340	1,258	334.10	101.8%
<b>Totals</b>	<b>18,451</b>	<b>542,868</b>	<b>21,096.61</b>	<b>87.5%</b>	<b>Totals</b>	<b>13,471</b>	<b>583,118</b>	<b>12,886.56</b>	<b>104.5%</b>

## Appendix – Detailed Experience Analysis Post-Retirement Mortality

### 2016-2017 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
55-59	102	12,896	67.66	150.8%	55-59	64	18,707	56.98	112.3%
60-64	367	71,673	532.63	68.9%	60-64	379	93,243	433.91	87.3%
65-69	1,502	148,805	1,687.27	89.0%	65-69	865	171,066	1,205.59	71.7%
70-74	1,471	106,455	1,971.09	74.6%	70-74	1,062	125,335	1,401.18	75.8%
75-79	2,176	74,993	2,448.95	88.9%	75-79	1,758	80,933	1,547.54	113.6%
80-84	3,974	68,135	4,080.45	97.4%	80-84	2,601	57,840	1,963.73	132.5%
85-89	5,956	48,270	5,258.34	113.3%	85-89	3,378	43,319	2,657.05	127.1%
90-94	4,209	22,761	4,097.35	102.7%	90-94	3,236	23,743	2,551.57	126.8%
95-99	1,917	4,747	1,274.72	150.4%	95-99	1,878	7,165	1,263.98	148.6%
100+	135	367	129.99	103.9%	100+	540	1,089	288.96	186.9%
<b>Totals</b>	<b>21,809</b>	<b>559,102</b>	<b>21,548.45</b>	<b>101.2%</b>	<b>Totals</b>	<b>15,761</b>	<b>622,440</b>	<b>13,370.49</b>	<b>117.9%</b>

### 2017-2018 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
55-59	44	12,542	65.55	67.1%	55-59	93	17,690	54.06	172.0%
60-64	532	70,946	529.02	100.6%	60-64	284	94,377	439.96	64.6%
65-69	1,823	152,782	1,731.36	105.3%	65-69	1,122	188,341	1,320.48	85.0%
70-74	1,869	120,601	2,196.05	85.1%	70-74	1,530	139,606	1,537.26	99.5%
75-79	2,640	78,215	2,506.10	105.3%	75-79	1,806	88,334	1,661.00	108.7%
80-84	3,777	65,921	3,878.55	97.4%	80-84	2,322	59,652	1,992.56	116.5%
85-89	4,998	48,643	5,153.27	97.0%	85-89	3,339	44,038	2,679.54	124.6%
90-94	4,694	24,356	4,369.16	107.4%	90-94	3,862	24,967	2,697.47	143.2%
95-99	1,694	4,728	1,260.96	134.3%	95-99	2,092	7,260	1,290.16	162.2%
100+	137	279	102.36	133.8%	100+	372	878	230.50	161.4%
<b>Totals</b>	<b>22,208</b>	<b>579,013</b>	<b>21,792.38</b>	<b>101.9%</b>	<b>Totals</b>	<b>16,822</b>	<b>665,143</b>	<b>13,902.99</b>	<b>121.0%</b>

## Appendix – Detailed Experience Analysis Pre-Retirement Mortality

2014-2018 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
Under 20	-	1,167	0.31	0.0%	Under 20	7	1,910	0.27	2622.0%
20-24	46	82,764	28.77	159.9%	20-24	45	119,149	16.40	274.3%
25-29	301	423,219	134.13	224.4%	25-29	93	650,458	102.25	90.9%
30-34	395	885,208	319.84	123.5%	30-34	258	1,246,763	255.13	101.1%
35-39	622	1,345,888	566.00	109.9%	35-39	358	1,858,290	494.19	72.4%
40-44	2,211	1,705,808	976.01	226.5%	40-44	826	2,465,487	930.79	88.7%
45-49	1,857	2,417,215	2,289.35	81.1%	45-49	1,960	3,824,051	2,385.12	82.2%
50-54	8,460	3,679,494	5,952.95	142.1%	50-54	4,521	5,977,302	6,191.31	73.0%
55-59	12,832	5,345,955	14,383.11	89.2%	55-59	11,694	8,125,619	12,650.98	92.4%
60-64	18,659	4,399,486	20,148.05	92.6%	60-64	12,570	6,686,200	14,824.96	84.8%
<b>Totals</b>	<b>45,383</b>	<b>20,286,204</b>	<b>44,798.52</b>	<b>101.3%</b>	<b>Totals</b>	<b>32,332</b>	<b>30,955,229</b>	<b>37,851.39</b>	<b>85.4%</b>

## Appendix – Detailed Experience Analysis Pre-Retirement Mortality

### 2014-2015 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
Under 20	-	183	0.05	0.0%	Under 20	-	234	0.03	0.0%
20-24	-	15,985	5.67	0.0%	20-24	-	23,296	3.23	0.0%
25-29	93	93,731	29.70	313.1%	25-29	-	142,586	22.26	0.0%
30-34	75	206,652	73.33	102.3%	30-34	49	281,811	56.67	86.5%
35-39	-	302,542	124.69	0.0%	35-39	41	418,978	109.41	37.5%
40-44	673	415,421	239.20	281.4%	40-44	152	603,773	228.99	66.4%
45-49	314	610,589	589.05	53.3%	45-49	493	974,620	614.63	80.2%
50-54	1,111	1,036,808	1,707.20	65.1%	50-54	1,484	1,634,221	1,702.76	87.2%
55-59	3,338	1,363,523	3,678.90	90.7%	55-59	4,140	2,061,376	3,188.64	129.8%
60-64	3,804	1,097,939	5,002.71	76.0%	60-64	3,490	1,607,612	3,533.05	98.8%
<b>Totals</b>	<b>9,408</b>	<b>5,143,373</b>	<b>11,450.51</b>	<b>82.2%</b>	<b>Totals</b>	<b>9,849</b>	<b>7,748,507</b>	<b>9,459.66</b>	<b>104.1%</b>

### 2015-2016 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
Under 20	-	272	0.07	0.0%	Under 20	7	507	0.07	9800.2%
20-24	-	19,012	6.65	0.0%	20-24	-	26,729	3.69	0.0%
25-29	116	100,131	31.76	365.2%	25-29	-	152,297	23.92	0.0%
30-34	38	214,602	77.29	49.2%	30-34	7	299,648	61.08	11.5%
35-39	291	329,534	137.85	211.1%	35-39	116	449,130	118.82	97.6%
40-44	801	415,378	237.57	337.2%	40-44	85	609,640	230.20	36.9%
45-49	658	598,030	565.53	116.4%	45-49	398	965,176	602.40	66.1%
50-54	2,340	926,977	1,506.16	155.4%	50-54	1,305	1,515,620	1,576.90	82.8%
55-59	2,226	1,335,500	3,595.77	61.9%	55-59	2,787	2,014,404	3,137.24	88.8%
60-64	3,570	1,078,222	4,956.08	72.0%	60-64	2,725	1,634,817	3,625.06	75.2%
<b>Totals</b>	<b>10,040</b>	<b>5,017,658</b>	<b>11,114.74</b>	<b>90.3%</b>	<b>Totals</b>	<b>7,430</b>	<b>7,667,968</b>	<b>9,379.38</b>	<b>79.2%</b>

## Appendix – Detailed Experience Analysis Pre-Retirement Mortality

### 2016-2017 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
Under 20	-	349	0.09	0.0%	Under 20	-	471	0.07	0.0%
20-24	-	22,969	7.95	0.0%	20-24	2	31,610	4.35	45.9%
25-29	2	109,171	34.66	5.8%	25-29	55	167,668	26.44	208.0%
30-34	231	218,114	79.27	291.4%	30-34	72	313,198	64.37	111.8%
35-39	208	330,032	139.53	149.1%	35-39	-	460,336	123.06	0.0%
40-44	346	396,688	225.86	153.2%	40-44	168	573,149	215.76	77.9%
45-49	608	568,072	534.36	113.8%	45-49	265	885,806	550.13	48.2%
50-54	2,832	835,899	1,345.93	210.4%	50-54	576	1,366,120	1,413.55	40.7%
55-59	3,237	1,297,115	3,488.16	92.8%	55-59	2,604	1,962,735	3,064.29	85.0%
60-64	6,717	1,084,373	4,977.05	135.0%	60-64	2,311	1,653,383	3,678.02	62.8%
<b>Totals</b>	<b>14,181</b>	<b>4,862,782</b>	<b>10,832.87</b>	<b>130.9%</b>	<b>Totals</b>	<b>6,053</b>	<b>7,414,476</b>	<b>9,140.04</b>	<b>66.2%</b>

### 2017-2018 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
Under 20	-	363	0.10	0.0%	Under 20	-	698	0.10	0.0%
20-24	46	24,798	8.49	541.7%	20-24	43	37,514	5.13	838.5%
25-29	90	120,186	38.01	236.8%	25-29	38	187,907	29.63	128.2%
30-34	51	245,840	89.94	56.7%	30-34	130	352,106	73.01	178.1%
35-39	123	383,780	163.93	75.0%	35-39	201	529,846	142.89	140.7%
40-44	391	478,321	273.39	143.0%	40-44	421	678,925	255.84	164.6%
45-49	277	640,524	600.41	46.1%	45-49	804	998,449	617.96	130.1%
50-54	2,177	879,810	1,393.65	156.2%	50-54	1,156	1,461,341	1,498.11	77.2%
55-59	4,031	1,349,817	3,620.28	111.3%	55-59	2,163	2,087,104	3,260.82	66.3%
60-64	4,568	1,138,952	5,212.21	87.6%	60-64	4,044	1,790,388	3,988.83	101.4%
<b>Totals</b>	<b>11,754</b>	<b>5,262,391</b>	<b>11,400.40</b>	<b>103.1%</b>	<b>Totals</b>	<b>9,000</b>	<b>8,124,278</b>	<b>9,872.31</b>	<b>91.2%</b>

## Appendix – Detailed Experience Analysis Disabled Mortality

2014-2018 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
40-44	4	125	1.11	361.8%	41-44	3	367	2.66	112.8%
45-49	-	657	9.15	0.0%	45-49	44	1,236	12.68	346.9%
50-54	32	2,964	47.27	67.7%	50-54	99	3,792	45.25	218.8%
55-59	255	12,445	243.44	104.7%	55-59	338	11,899	190.37	177.6%
60-64	719	30,635	658.66	109.2%	60-64	686	24,914	450.04	152.4%
65-69	972	27,047	1,005.71	96.6%	65-69	833	19,227	675.15	123.4%
70-74	603	13,944	809.43	74.5%	70-74	538	13,978	783.41	68.7%
75-79	708	11,023	745.80	94.9%	75-79	608	7,930	666.91	91.2%
80-84	741	6,138	672.58	110.2%	80-84	300	4,798	633.92	47.3%
85-89	745	2,746	548.59	135.8%	85-89	156	2,254	449.50	34.7%
90-94	270	1,104	296.05	91.2%	90-94	179	880	297.13	60.2%
95-99	64	83	71.10	90.0%	95-99	76	173	105.93	71.7%
>= 100	-	-	-	N/A	>= 100	19	37	33.17	57.3%
<b>Totals</b>	<b>5,113</b>	<b>108,911</b>	<b>5,108.89</b>	<b>100.1%</b>	<b>Totals</b>	<b>3,879</b>	<b>91,485</b>	<b>4,346.14</b>	<b>89.3%</b>

## Appendix – Detailed Experience Analysis Disabled Mortality

### 2014-2015 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
40-44	-	42	0.51	0.0%	41-44	-	59	0.35	0.0%
45-49	-	171	2.92	0.0%	45-49	15	374	3.31	453.8%
50-54	19	866	12.57	151.1%	50-54	39	1,080	13.41	290.8%
55-59	23	3,468	68.50	33.6%	55-59	107	3,202	50.84	210.5%
60-64	191	7,622	171.86	111.1%	60-64	152	6,205	118.80	127.9%
65-69	173	6,200	250.63	69.0%	65-69	238	4,812	157.80	150.8%
70-74	83	3,387	163.55	50.7%	70-74	147	2,986	192.84	76.2%
75-79	78	2,583	193.71	40.3%	75-79	138	1,876	152.05	90.8%
80-84	220	1,561	165.98	132.5%	80-84	64	1,033	134.36	47.6%
85-89	74	580	121.24	61.0%	85-89	45	497	108.82	41.4%
90-94	105	290	82.50	127.3%	90-94	71	247	77.10	92.1%
95-99	-	-	9.37	0.0%	95-99	-	36	19.52	0.0%
>= 100	-	-	-	N/A	>= 100	-	-	3.12	0.0%
<b>Totals</b>	<b>966</b>	<b>26,770</b>	<b>1,243.35</b>	<b>77.7%</b>	<b>Totals</b>	<b>1,016</b>	<b>22,407</b>	<b>1,032.32</b>	<b>98.4%</b>

### 2015-2016 Experience (\$000s)

Males					Females				
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/Expected
40-44	-	51	0.41	0.0%	41-44	2	85	0.59	336.3%
45-49	-	207	2.89	0.0%	45-49	-	264	2.36	0.0%
50-54	-	705	11.72	0.0%	50-54	33	1,056	11.12	296.8%
55-59	98	3,218	62.73	156.2%	55-59	95	2,939	48.10	197.5%
60-64	117	7,504	161.91	72.3%	60-64	172	6,334	111.65	154.1%
65-69	280	6,780	267.47	104.7%	65-69	95	4,485	170.58	55.7%
70-74	90	3,288	176.10	51.1%	70-74	99	3,372	184.11	53.8%
75-79	256	2,804	193.55	132.3%	75-79	152	1,944	162.41	93.6%
80-84	160	1,515	154.66	103.5%	80-84	27	1,134	152.61	17.7%
85-89	185	658	142.10	130.2%	85-89	34	527	108.63	31.3%
90-94	16	250	72.03	22.2%	90-94	35	200	67.75	51.7%
95-99	-	36	14.48	0.0%	95-99	-	55	25.07	0.0%
>= 100	-	-	-	N/A	>= 100	11	8	11.75	93.6%
<b>Totals</b>	<b>1,202</b>	<b>27,016</b>	<b>1,260.05</b>	<b>95.4%</b>	<b>Totals</b>	<b>755</b>	<b>22,403</b>	<b>1,056.73</b>	<b>71.4%</b>



## Appendix – Detailed Experience Analysis Disabled Mortality

### 2016-2017 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
40-44	4	26	0.13	3174.4%	41-44	-	113	0.80	0.0%
45-49	-	178	1.77	0.0%	45-49	14	264	3.35	417.3%
50-54	3	728	11.32	26.5%	50-54	13	839	11.00	118.2%
55-59	126	2,934	60.63	207.8%	55-59	26	3,047	47.62	54.6%
60-64	220	7,891	162.16	135.7%	60-64	189	6,390	112.89	167.4%
65-69	155	6,764	243.06	63.8%	65-69	221	4,705	174.47	126.7%
70-74	202	3,493	222.39	90.8%	70-74	199	3,920	198.94	100.0%
75-79	207	2,809	179.45	115.3%	75-79	88	1,929	172.85	50.9%
80-84	97	1,519	171.33	56.6%	80-84	82	1,234	171.83	47.7%
85-89	225	734	144.64	155.6%	85-89	51	591	102.51	49.8%
90-94	74	285	81.68	90.6%	90-94	49	233	71.19	68.8%
95-99	54	37	17.21	313.8%	95-99	58	53	42.65	136.0%
>= 100	-	-	-	N/A	>= 100	-	8	8.43	0.0%
<b>Totals</b>	<b>1,367</b>	<b>27,398</b>	<b>1,295.76</b>	<b>105.5%</b>	<b>Totals</b>	<b>990</b>	<b>23,326</b>	<b>1,118.53</b>	<b>88.5%</b>

### 2017-2018 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
40-44	-	6	0.06	0.0%	41-44	1	110	0.92	108.7%
45-49	-	101	1.56	0.0%	45-49	15	334	3.66	409.8%
50-54	10	665	11.66	85.8%	50-54	14	817	9.72	144.0%
55-59	8	2,825	51.57	15.5%	55-59	110	2,711	43.80	251.2%
60-64	191	7,618	162.75	117.4%	60-64	173	5,985	106.70	162.1%
65-69	364	7,303	244.56	148.8%	65-69	279	5,225	172.30	161.9%
70-74	228	3,776	247.39	92.2%	70-74	93	3,700	207.52	44.8%
75-79	167	2,827	179.08	93.3%	75-79	230	2,181	179.60	128.1%
80-84	264	1,543	180.62	146.2%	80-84	127	1,397	175.12	72.5%
85-89	261	774	140.62	185.6%	85-89	26	639	129.54	20.1%
90-94	75	279	59.84	125.3%	90-94	24	200	81.09	29.6%
95-99	10	10	30.04	33.3%	95-99	18	29	18.70	96.3%
>= 100	-	-	-	N/A	>= 100	8	21	9.88	81.0%
<b>Totals</b>	<b>1,578</b>	<b>27,727</b>	<b>1,309.74</b>	<b>120.5%</b>	<b>Totals</b>	<b>1,118</b>	<b>23,349</b>	<b>1,138.55</b>	<b>98.2%</b>