St. Paul Teachers' Retirement Fund Association

5-Year Experience Study
July 1, 2011 Through June 30, 2016

GRS

March 1, 2018

St. Paul Teachers' Retirement Fund Association

Dear Board of Directors:

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

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

The investigation covered the five-year period from *July 1, 2011 to June 30, 2016*, and was carried out using generally accepted actuarial principles and techniques. This report was originally issued in draft form on June 30, 2017.

We believe that the actuarial assumptions recommended in this experience study report represent individually and in the aggregate reasonable estimates of future experience of the St. Paul Teachers' Retirement Fund Association.

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

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

Bonita J. Wurst and James D. Anderson 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. Anderson meets the requirements of "approved actuary" under Minnesota Statutes Section 356.215, Subdivision 1, Paragraph (c).

Respectfully submitted,

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James D. Anderson, FSA, EA, MAAA

BJW/JDA:sc

Actuarial Experience Study

2011 - 2016

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SECTION A

OVERVIEW AND SUMMARY OF BENEFITS

Introduction

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

- Rates of **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 SPTRFA Board of Directors.

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, 2012 and 2013 actuarial valuations based on the results of the most recent experience study. In addition, the amortization period was revised for the June 30, 2014 actuarial valuation and the investment return assumption was revised for the June 30, 2015 actuarial valuation (assumed salary increases and payroll growth assumption were lowered in conjunction with the change in investment return). Assumptions in effect prior to June 30, 2016 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 Findings

The five-year period (July 1, 2011 to June 30, 2016) covered by this experience study provided sufficient data to form a basis for recommending changes in some of the assumptions and/or methods used in actuarial valuations of the St. Paul Teachers' Retirement Fund Association (SPTRFA). The recommended changes in actuarial assumptions and methods resulting from this experience study are summarized below:

- Decrease the current 8.0% investment return assumption to an investment return assumption in the range of 7.12% to 7.95%. Selection of an investment return assumption at the upper end of this range results in a higher risk of increased actuarial contributions in the future.
- Decrease the price inflation assumption from 3.00% to 2.50%.
- Decrease the wage inflation (i.e., payroll growth) assumption from 4.00% to 3.00%, and study future population expectations.
- Adjust rates of merit and seniority, resulting in an overall decrease to the assumed rates of merit and seniority increases:
    - Proposed rates are approximately 2.3% and 0.8% greater than the current rates in the first two years of employment; minor adjustments to the current rates after the second year of employment.
    - Average proposed rate averages approximately 0.1% higher than current rate.
    - When combined with the proposed reduction in wage inflation, proposed salary increase rates average approximately 0.9% lower than the current rates.
- Adjust assumed retirement rates:
    - Slight adjustments to the assumed unreduced retirements (i.e., Normal Retirement).
    - Lower the assumed Rule of 90 retirements at all ages except age 62 for males.
    - Increase the assumed early retirement rates:
        - Slight adjustments to rates at ages less than 62.
        - More significant changes at ages 62 and later, recognizing the enhanced early retirement benefits for members age 62 with 30 years of service.
- Change the assumed rates of withdrawal (termination of membership before eligible to retire):
    - Generally, proposed rates are higher than current rates.
- Decrease the assumed rates of disability by 16%.
- Change the base mortality table to the RP-2014 mortality table, white collar adjustment, with rates age adjusted for some tables in order to better fit observed plan experience and with future improvement projected using scale MP-2017; generally results in a decrease in assumed mortality rates at most ages.

A general impact of these recommended changes is summarized below:

Assumption / Method	General Recommendation	Financial Impact on Contributions
Investment return	Decrease rate	Increase
Price inflation	Decrease rate	No direct impact
Wage inflation	Decrease rate	Increase
Gross pay increases	Decrease rates	Decrease
Rule of 90 retirement rates	Decrease rates	Decrease
Non-Rule of 90 retirement rates	Increase rates	To be determined
Withdrawal rates	Increase rates	Decrease
Disability rates	Decrease rates	Decrease
Mortality rates	Decrease rates	Increase

Summary of Decrement Experience
2011 - 2016

Decrement Risk Area		Actual Number	Expected		
			Present Assumptions	Proposed Assumptions	Change
Retirement					
Normal Retirement*	- Male	25	27.2	27.2	-
	- Female	99	91.7	94.3	2.6
Rule of 90 Retirements	- Male	26	35.4	29.9	(5.5)
	- Female	108	149.0	121.4	(27.6)
Early Retirements	- Male	95	88.1	94.4	6.3
	- Female	300	271.7	300.0	28.3
Withdrawal					
Males		492	353.7	418.8	65.1
Females		1,226	978.6	1,167.7	189.1
Disability (males and females)		9	16.5	14.1	(2.4)
Mortality					
Healthy Retired Lives	- Male	143	160.8	143.8	(17.0)
	- Female	180	181.9	171.0	(10.9)
Active Lives	- Male	3	7.0	5.4	(1.6)
	- Female	8	15.9	12.5	(3.4)

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

SECTION B

ECONOMIC ASSUMPTIONS

Economic Assumptions – Introduction

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

Current economic assumptions for SPTRFA are as follows:

Investment Return	8.00%
Inflation	3.00%
Payroll Growth	4.00%

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

Sources considered in the analysis of the economic assumptions included:

- Future expectations of independent investment consultants
- 2016 Social Security Trustees Report
- Historical observations of inflation statistics and investment returns
- U.S. Department of the Treasury yield curve rates (www.treasury.gov)
- National Average Wage Index

Economic Assumptions – ASOP No. 27

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

The recently adopted revision of ASOP No. 27 (applicable to valuation dates on or after September 30, 2014) defines a reasonable economic assumption as an assumption that has the following characteristics:

(a) It is appropriate for the purpose of the measurement;

(b) It reflects the actuary's professional judgment;

(c) It takes into account historical and current economic data that is relevant as of the valuation date;

(d) It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and

(e) It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included 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%.

Calendar Year Period	Inflation (CPI)
1950-1959	2.2%
1960-1969	2.5%
1970-1979	7.4%
1980-1989	5.1%
1990-1999	2.9%
2000-2009	2.5%
2010	1.5%
2011	3.0%
2012	1.7%
2013	1.5%
2014	0.8%
2015	0.7%
2016	2.1%
Last 5 Years	**1.4%**
Last 10 Years	**1.8%**
Last 20 Years	**2.1%**
Last 30 Years	**2.6%**
Last 40 Years	**3.6%**
Last 50 Years	**4.1%**
Last 60 Years	**3.7%**

The SPTRFA currently uses a 3.0% price inflation assumption in the development of its capital market assumptions.

Most of the investment consulting firms, in setting their capital market assumptions, currently assume that inflation will be less than 3.00%. We examined the capital market assumption sets for eight investment consulting firms. The average assumption for inflation was 2.24%, with a range of 2.00% to 2.75%. 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

The 2016 Social Security Trustees report uses 2.6% as the long-range intermediate price inflation assumption. The low-cost assumption is 3.2%, and the high-cost assumption is 2.0%. (The Social Security program benefits from high inflation through faster earnings and revenue growth). The long-term intermediate assumption has decreased slightly since 2013, from 2.8% to 2.6%.

Treasury Inflation Protected Securities (TIPS) are government bonds which are adjusted upward or downward for actual changes in inflation. Real yields on TIPS at "constant maturity" are interpolated by the U.S. Treasury from Treasury's daily real yield curve. The spread between yield curve rates and real yield curve rates gives insight into market expectations for inflation. As of June 30, 2016, the spread on a 30-year basis was 1.60%. As of the date of this report, the spread on a 30-year basis was approximately 1.90%.

It is difficult to ignore the downward trend in inflation statistics over the last 30 years. We believe that it is appropriate to recognize this trend in future inflation assumptions. **Based upon the reviewed data, we recommend the inflation assumption be reduced from 3.00% to 2.50%.** (Remember that the selected payroll growth and investment return assumptions should be consistent with the final selected inflation assumption.)

Economic Assumptions – Payroll Growth

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

The current payroll growth assumption is 4.00%, which is comprised of a 3.00% price inflation assumption plus a real wage growth assumption of 1.00%. 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 2.9% over the period from 2010-2015 (the latest data available is 2015), while general inflation averaged 1.5% during this same period. This would imply a real growth rate of 1.4% (i.e., 2.9% - 1.5%). The past decade saw a real growth rate of wages of 0.8%. The 2016 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.

SPTRFA salary increases observed in the study level off after about twenty years of service which is consistent with the salary schedules provided to us from the Collective Bargaining Agreements. For members with more than 20 years of service, the observed average salary increase during the five-year period was 1.8%. Inflation during this five-year period averaged 1.4%. Therefore, long-service employees received an average salary increase of 0.4% above inflation.

Based upon the data reviewed, **we recommend reducing the current real wage growth assumption from 1.00% to 0.50%.** When combined with the recommended 2.50% price inflation, the recommended payroll growth assumption is 3.00%.

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

Economic Assumptions – Investment Return

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

Estimated Annual Investment Return

Fiscal Year Ending	Actuarial Value of Assets	Market Value of Assets
June 30, 2012	0.4%	-0.2%
June 30, 2013	4.3%	13.5%
June 30, 2014	13.7%	18.4%
June 30, 2015	11.7%	2.7%
June 30, 2016	6.6%	0.3%
Average annual investment return		
July 1, 2011 to June 30, 2016	**7.2%**	**6.7%**

For purposes of budgeting contributions as a level percentage of payroll, the assumed rate of investment return is used as the discount rate to determine the present value of the system's pension obligations. It is important to note that 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 review of the investment return assumption in this report are 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 SPTRFA's investment policy with the capital market assumptions from eight 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 its own capital market expectations, we request and monitor forward-looking expectations developed by several major investment consulting firms. We update our CMAM on an annual basis.

Economic Assumptions – Investment Return

Many of the investment consultants forecast relatively low returns for the next 10 or so years, followed by higher returns. Keep in mind that the short-term does matter. Any decision made today will be judged in the context of the current environment for many future years. Investment returns realized in the short term have a significant bearing on the long-term average return. A significant portion of liabilities will actually be paid out over the next ten years. 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 capital market assumptions in the 2017 CMAM are from the following investment consultants (in alphabetical order) BNY Mellon, JPMorgan, Marquette Associates, Mercer, NEPC, PCA, RVK, and Voya. It is important to understand that in general no two investment consultants will consider the same asset classes. Moreover, there are differences in investment horizons, price inflation, treatment of investment expenses, excess manager performance (i.e., alpha), geometric vs. arithmetic averages, and other technical issues. We have attempted to align the various assumption sets from the different investment consultants to be as consistent as possible.

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

Asset Classes	
Cash	0.00%
US Stock - Large Cap	20.00%
US Stock - Small Cap	15.00%
Intermational Equity	21.00%
Emerging Markets Equity	4.00%
US Corporate Bonds	10.00%
Government Bonds	3.00%
TIPS	1.00%
High Yield	3.00%
Real Estate	9.00%
Private Equity	9.00%
Hedge Funds	0.00%
Other Alternatives	5.00%
	100.00%

Note from SPTRFA: Certain SPTRFA allocations are not reflected in the asset class categories. In such instances, allocations were placed in categories that most closely reflect the underlying characteristics.

Economic Assumptions – Investment Return

The arithmetic expected return developed from this 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 2.50% (column 5) to get the adjusted nominal return (column 6). Since administrative expenses paid out of trust assets are reflected in the employer contributions and active management fees are assumed to equal excess manager performance (alpha), no expenses (column 7) are netted out of the return. The final arithmetic expected return is shown in column 8. Note that this return has not yet been adjusted for risk or "volatility drag." We have shown the standard deviation of returns as the investment risk in column 9.

ASOP No. 27 acknowledges that for any given economic assumption, there is a reasonable range of opinions on that assumption. This 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	6.21%	2.20%	4.01%	2.50%	6.51%	0.00%	6.51%		13.69%
2	7.24%	2.50%	4.74%	2.50%	7.24%	0.00%	7.24%		14.40%
3	6.76%	2.00%	4.76%	2.50%	7.26%	0.00%	7.26%		12.63%
4	7.40%	2.50%	4.90%	2.50%	7.40%	0.00%	7.40%		14.04%
5	7.17%	2.26%	4.91%	2.50%	7.41%	0.00%	7.41%		11.97%
6	7.76%	2.21%	5.55%	2.50%	8.05%	0.00%	8.05%		14.98%
7	7.81%	2.25%	5.56%	2.50%	8.06%	0.00%	8.06%		15.41%
8	8.36%	2.25%	6.11%	2.50%	8.61%	0.00%	8.61%		12.77%
Average	7.34%	2.27%	5.07%	2.50%	7.57%	0.00%	7.57%		13.74%

The average expected nominal return from column 8 is 7.57% before adjustment for volatility drag. Note that the expected rate of return shown in the table above 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 the average accumulated assets are expected to grow at this rate. However, in any given year it is less than 50% likely that this return will be achieved. From the perspective of the Actuarial Standards of Practice, this may be considered a reasonable assumption. Adjusting for volatility (as we do below) is also reasonable, and provides recognition of the effect of volatility on the longer-term returns.

Economic Assumptions – Investment Return

Next we compare the probabilities of achieving returns over a 20-year horizon. We compute the 40th, 50th, and 60th percentiles of returns as well as the probability of achieving the current assumption of 8.0% over a 20-year horizon. For comparison purposes, we have also shown the probability of achieving a 7.5% and a 7.0% investment return over a 20-year horizon. Note that the investment horizon for many of the capital market assumption sets is between 5 and 10 years.

Investment Consultant	Distribution of 20-Year Average Geometric Net Nominal Return			Probability of Exceeding 8.00%	Probability of Exceeding 7.50%	Probability of Exceeding 7.00%
	40th	50th	60th			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	4.88%	5.64%	6.41%	22.02%	27.11%	32.76%
2	5.48%	6.28%	7.09%	29.58%	35.15%	41.09%
3	5.82%	6.52%	7.23%	30.00%	36.41%	43.26%
4	5.71%	6.49%	7.28%	31.46%	37.32%	43.51%
5	6.08%	6.75%	7.42%	31.90%	38.84%	46.18%
6	6.19%	7.02%	7.86%	38.40%	44.25%	50.26%
7	6.13%	6.98%	7.85%	38.27%	43.95%	49.79%
8	7.16%	7.87%	8.59%	48.17%	55.21%	62.13%
Average	**5.93%**	**6.69%**	**7.47%**	**33.73%**	**39.78%**	**46.12%**

The 50th percentile return is also the geometric average return. This is the expected return adjusted for volatility drag and is a reasonable rate of return for purposes of the valuation. The average of 50th percentile returns for all eight investment consultants is 6.69% per year.

The tables shown above are from GRS' standard model. Next, we developed a revised model that is based on additional capital market assumptions provided to GRS. We adjusted the standard model to exclude assumptions applying to time horizons of less than 10 years. We used Mercer's 20-year capital market assumption set instead of the 10-year set of assumptions. We also included Principal's 20 to 30-year capital market assumptions. The capital market assumptions in this revised model are from the following investment consultants (in alphabetical order) BNY Mellon, JPMorgan, Marquette Associates, Mercer, Principal, and PCA.

In the revised model, the average expected nominal return increases from 7.57% to 7.95%, and the average of 50th percentile returns for the six investment consultants in the revised model increases from 6.69% to 7.12% per year. The probabilities of exceeding 8.00%, 7.50%, and 7.00% are 38%, 45%, and 51%, respectively.

We recommend that SPTRFA consider an investment return assumption in the range of 7.12% to 7.95%. SPTRFA should note that the selection of an investment return assumption at the upper end of this range results in a higher risk of increased actuarial contributions in the future.

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

SECTION C

PAY INCREASES

Pay Increases Due to Merit and Seniority

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

- An across-the-board, economic type of increase granted to most or all members of the group. This increase is typically tied to inflation or cost of living changes, and
- An increase as a result of merit and seniority. This increase is typically related to the performance of an individual and includes promotions and increased years of experience.

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

We reviewed the merit and seniority pay increases during the five-year period. For each year, we excluded individual pay increases that were more than 30% and also excluded individual pay increases that were less than -30%. While this was a relatively small number of records, the experience distorted the experience of the overall group.

In order to study the merit and seniority portion of the salary increase assumption, it is necessary to separate out the portion attributable to wage inflation. General inflation, as measured by the change in the Consumer Price Index, has averaged about 1.4% over the five-year period ending June 30, 2016. Wage inflation (as measured by increases in the National Average Earnings) has averaged 2.9% over the period from 2010-2015, while general inflation averaged 1.5% during this same period. This would imply a real growth rate of 1.4% (i.e., 2.9% - 1.5%). The past decade saw a real growth rate of wages of 0.8%. The 2016 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%.

Based on our review of salary experience for SPTRFA members for the period July 1, 2011 through June 30, 2016, we observed that members with longer periods of service (i.e. 20 years or more) averaged about 1.8% for this period, which is less than the national average. Members with less service received increases that were higher than 1.8% in general. For our analysis of the merit and seniority portion of total salary increase, we assumed that the salary increase amount in excess of the total salary increase for the longer-service members (i.e., those with 20 or more years of service) was attributable to wage inflation only. This assumes that once members reach a certain length of service, merit and seniority increases are no longer provided.

Pay Increases Due to Merit and Seniority

Findings

The current salary increase assumption is a select and ultimate format. Assumed gross increases in salaries are age-based, ranging from 5.9% at age 22 to 4.0% for ages 60 and older. An additional salary increase is assumed for teachers with less than 15 years of service, ranging from 3.0% for new teachers to 0% at 15 years of service. The Expected Increases in our analysis and shown in this section take into account both the select (service based) and ultimate (age based) component of the current salary increase assumption.

The assumed wage inflation was 4.00% for the period of the study. However, due to low price inflation and real wage growth during the period (as described in Section B), we estimated that during the five years of the study, the average actual wage inflation component of pay increases was around 1.8% for members of the SPTRFA. This estimated actual increase was subtracted from the actual pay increases to obtain the estimated merit/seniority portion of the pay increases. It should be noted that the results of the analysis are very sensitive to the estimated wage inflation component.

Gross actual salary increases averaged 3.66% over the five-year period, ranging from 2.93% in 2013 to 4.50% in 2015. After adjusting for the 1.8% average wage inflation for this period, the average net salary increase (i.e., merit and seniority) averaged 1.86%, ranging from 1.13% to 2.70%.

Fiscal Year Ending	Count	Gross		Net*	
		Expected	Actual	Expected	Actual
2012	3,107	5.75%	3.60%	1.75%	1.80%
2013	3,191	5.79%	2.93%	1.79%	1.13%
2014	3,143	5.83%	3.86%	1.83%	2.06%
2015	3,106	5.85%	4.50%	1.85%	2.70%
2016	3,000	5.88%	3.39%	1.88%	1.59%
Total	**15,547**	**5.82%**	**3.66%**	**1.82%**	**1.86%**

* *Net Expected increases are equal to Gross Expected increases minus assumed wage inflation of 4.0%. Net Actual increases are equal to Gross Actual increases minus the estimated actual wage inflation for the period of 1.8%.*

Pay Increases Due to Merit and Seniority

SPTRFA salary increases observed in the study level off after about 20 years of service which is consistent with the salary schedules provided in the Collective Bargaining Agreements. The results of our analysis are shown on the following page. Using the techniques described above, observed merit and seniority pay increases were generally higher than the presently assumed increases by about 4 basis points.

Recommendation

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

- *Since St. Paul teachers' salaries are governed by Collective Bargaining Agreements that are primarily based on years of service and education level, we recommend a salary increase assumption that is strictly service-based (rather than age and service based).*
- *The proposed merit and seniority increase rates, on average, are 14 basis points higher than the current assumption.*
- *When combined with the proposed 100 basis point reduction in wage inflation assumption, gross salary increase rates are approximately 86 basis points lower than the current assumption.*
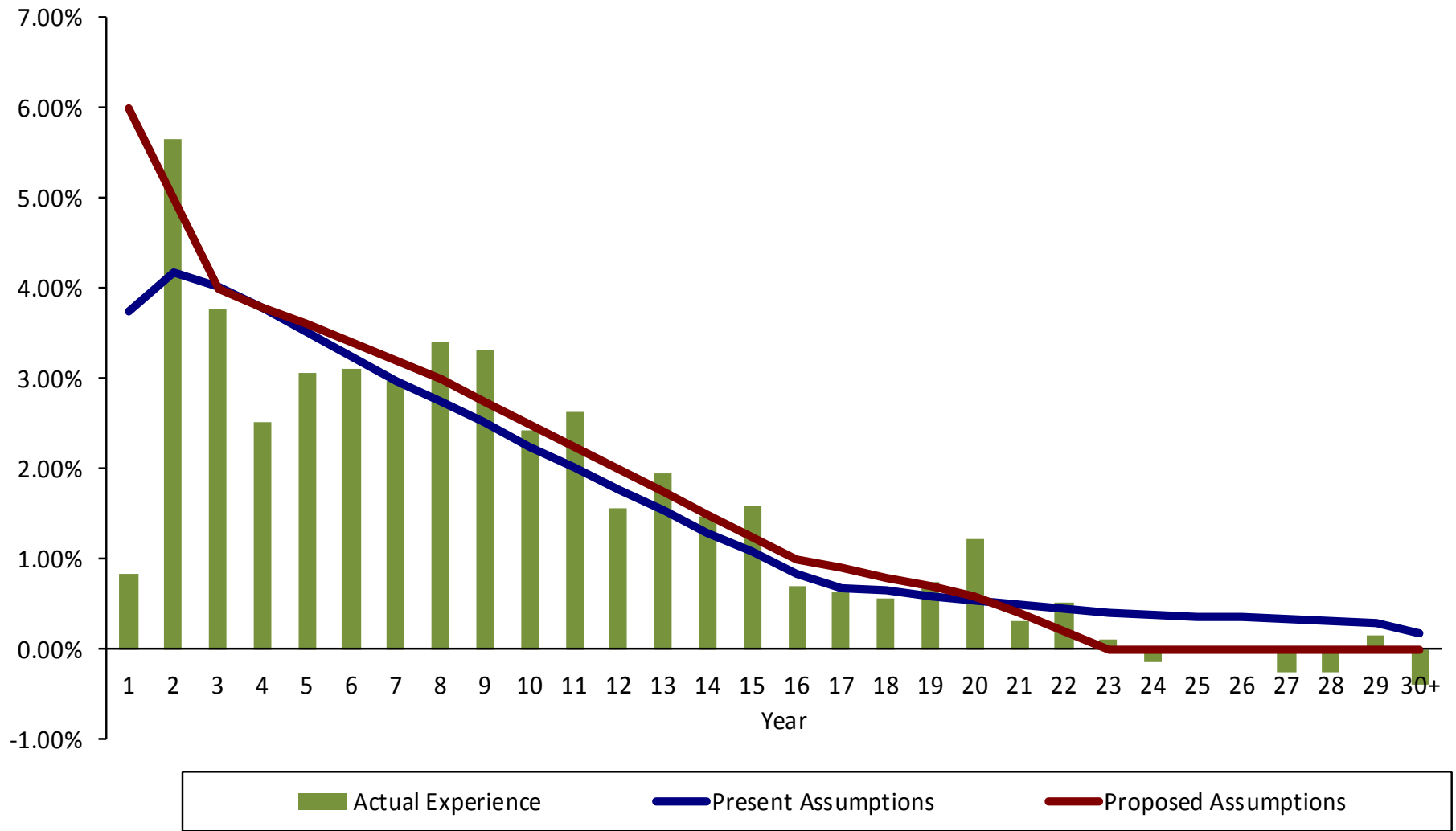
Pay Increases Due to Merit and Seniority

Year	Exposures	Total Salary % Increase			Net* % Increase		
		Actual	Current	Proposed	Actual	Current	Proposed
1	189	2.63%	7.75%	9.00%	0.83%	3.75%	6.00%
2	998	7.45%	8.18%	8.00%	5.65%	4.18%	5.00%
3	807	5.57%	8.01%	7.00%	3.77%	4.01%	4.00%
4	658	4.32%	7.78%	6.80%	2.52%	3.78%	3.80%
5	548	4.85%	7.51%	6.60%	3.05%	3.51%	3.60%
6	492	4.91%	7.25%	6.40%	3.11%	3.25%	3.40%
7	515	4.78%	6.97%	6.20%	2.98%	2.97%	3.20%
8	538	5.21%	6.76%	6.00%	3.41%	2.76%	3.00%
9	528	5.10%	6.52%	5.75%	3.30%	2.52%	2.75%
10	569	4.23%	6.25%	5.50%	2.43%	2.25%	2.50%
11	647	4.43%	6.01%	5.25%	2.63%	2.01%	2.25%
12	677	3.37%	5.77%	5.00%	1.57%	1.77%	2.00%
13	664	3.75%	5.53%	4.75%	1.95%	1.53%	1.75%
14	750	3.28%	5.30%	4.50%	1.48%	1.30%	1.50%
15	766	3.39%	5.10%	4.25%	1.59%	1.10%	1.25%
16	713	2.51%	4.85%	4.00%	0.71%	0.85%	1.00%
17	662	2.43%	4.69%	3.90%	0.63%	0.69%	0.90%
18	645	2.37%	4.65%	3.80%	0.57%	0.65%	0.80%
19	570	2.54%	4.59%	3.70%	0.74%	0.59%	0.70%
20	472	3.02%	4.54%	3.60%	1.22%	0.54%	0.60%
21	431	2.11%	4.50%	3.40%	0.31%	0.50%	0.40%
22	369	2.33%	4.45%	3.20%	0.53%	0.45%	0.20%
23	310	1.91%	4.40%	3.00%	0.11%	0.40%	0.00%
24	269	1.66%	4.38%	3.00%	-0.14%	0.38%	0.00%
25	242	1.83%	4.35%	3.00%	0.03%	0.35%	0.00%
26	253	1.82%	4.35%	3.00%	0.02%	0.35%	0.00%
27	251	1.55%	4.33%	3.00%	-0.25%	0.33%	0.00%
28	222	1.54%	4.31%	3.00%	-0.26%	0.31%	0.00%
29	183	1.96%	4.29%	3.00%	0.16%	0.29%	0.00%
30+	609	1.42%	4.18%	3.00%	-0.38%	0.18%	0.00%
Total	**15,547**	**3.66%**	**5.82%**	**4.96%**	**1.86%**	**1.82%**	**1.96%**

*   *Net Expected increases are equal to Gross Expected increases minus assumed wage inflation of 4.0%. Net Actual increases are equal to Gross Actual increases minus the estimated actual wage inflation for the period of 1.8%.*

Even though we utilized annualized salary in our analysis, most of the first year experience reflected a salary increase that was greater than 30% and was therefore not included in our analysis (707 of 896 occurrences were excluded).

Pay Increases Due to Merit and Seniority

Legend: Actual Experience · Present Assumptions · Proposed Assumptions

GRS Retirement Consulting

SECTION D

RETIREMENT EXPERIENCE

Retirement Analysis

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

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

Liability-weighted results are discussed on page E-1. For the retirement analysis, we reviewed the salary for active members at various retirement ages to determine if the group was homogenous. At age 60, we found that 57% of active members earned between $75,000 and $85,000. We found similar results at ages 58 and 62. The participant group appears to be sufficiently homogenous, meaning most members of a similar age earn a similar salary. As such, we did not include liability-weighted retirement results in our analysis. We would expect liability-weighted results to be similar to headcount results.

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

We did not analyze the retirement assumption for Basic members. As of July 1, 2016, there were only three remaining Basic members that were active in the plan. Over the five year period, there were 27 retirements of Basic members that are excluded from the analysis in this section. We recommend continued use of the current retirement assumption for Basic members.

Age and Service Unreduced (Normal) Retirement

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

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

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

The current assumption includes 35% probability of retirement for females and males (31% for males at age 65) until Rule of 90 eligibility. For members hired before July 1, 1989, once age plus service is equal to or greater than 90 years, the assumed probability of retirement increases to 50% for females at all ages and 35% for males at age 65. The Present Rates on the table on the following page reflect blended actual experience over the period of the study.

Findings

Overall, the plan experienced fewer Normal Retirements than projected by the present assumptions (215 expected versus 157 actual – see totals on the following page). If only retirements prior to age 70 are considered, the plan experienced more normal retirements than projected (119 expected versus 124 actual).

The current assumption ends at age 70; in other words, we assume all members currently under the age of 70 will retire by the age of 70. During the five year period, there were 33 actual retirements at ages 70 or older, including eight actual retirements at age 70 and nine actual retirements at age 71. We believe assuming 100% retirement at age 70 is an appropriately conservative approach.

Recommendations

We recommend minor changes to the retirement rates as indicated on the following pages.
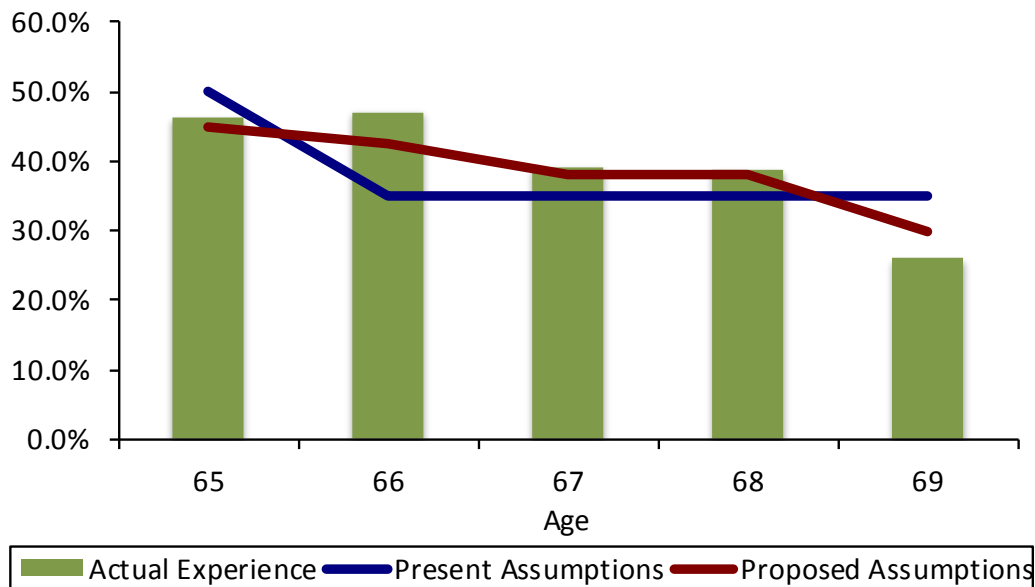
Age and Service Unreduced (Normal) Retirement
Males

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Present	Proposed	Present	Proposed	Present	Proposed
65	3	12	25.0%	34.33%	30.00%	4.12	3.60	72.8%	83.3%
66	6	25	24.0%	35.00%	30.00%	8.75	7.50	68.6%	80.0%
67	5	17	29.4%	35.00%	35.00%	5.95	5.95	84.0%	84.0%
68	6	14	42.9%	35.00%	40.00%	4.90	5.60	122.4%	107.1%
69	5	10	50.0%	35.00%	45.00%	3.50	4.50	142.9%	111.1%
Subtotal	**25**	**78**				**27.22**	**27.15**	**91.8%**	**92.1%**
70+	5	12	41.7%	100.00%	100.00%	12.00	12.00	41.7%	41.7%
Totals	**30**	**90**				**39.22**	**39.15**	**76.5%**	**76.6%**
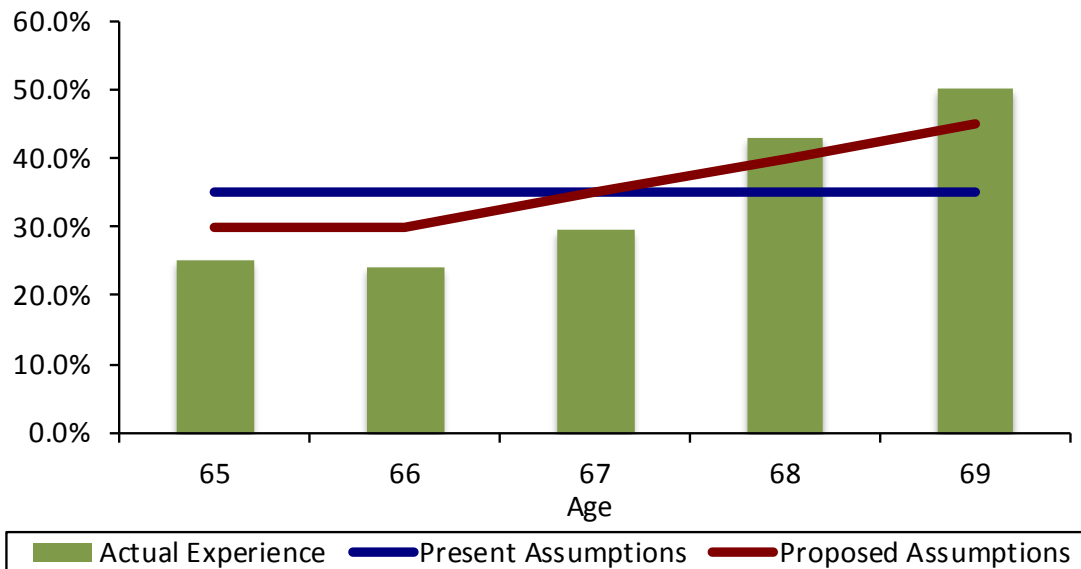
Age and Service Unreduced (Normal) Retirement Females

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Present	Proposed	Present	Proposed	Present	Proposed
65	19	41	46.3%	46.71%	45.00%	19.15	18.45	99.2%	103.0%
66	42	89	47.2%	38.03%	42.50%	33.85	37.83	124.1%	111.0%
67	20	51	39.2%	37.06%	38.00%	18.90	19.38	105.8%	103.2%
68	12	31	38.7%	36.45%	38.00%	11.30	11.78	106.2%	101.9%
69	6	23	26.1%	36.96%	30.00%	8.50	6.90	70.6%	87.0%
Subtotal	**99**	**235**				**91.70**	**94.34**	**108.0%**	**104.9%**
70+	28	84	33.3%	100.00%	100.00%	84.00	84.00	33.3%	33.3%
Totals	**127**	**319**				**175.70**	**178.34**	**72.3%**	**71.2%**

Legend: Actual Experience, Present Assumptions, Proposed Assumptions

GRS Retirement Consulting

Rule of 90 (Unreduced) Early Retirement

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

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

Findings

We reviewed the experience during the study period. Overall, the plan experienced fewer Rule of 90 early retirements than projected by the present assumptions (184 expected versus 134 actual – see totals on the following page).

Recommendation

We recommend lowering the assumed Rule of 90 retirement rates to reflect the lower utilization observed over the last five years.
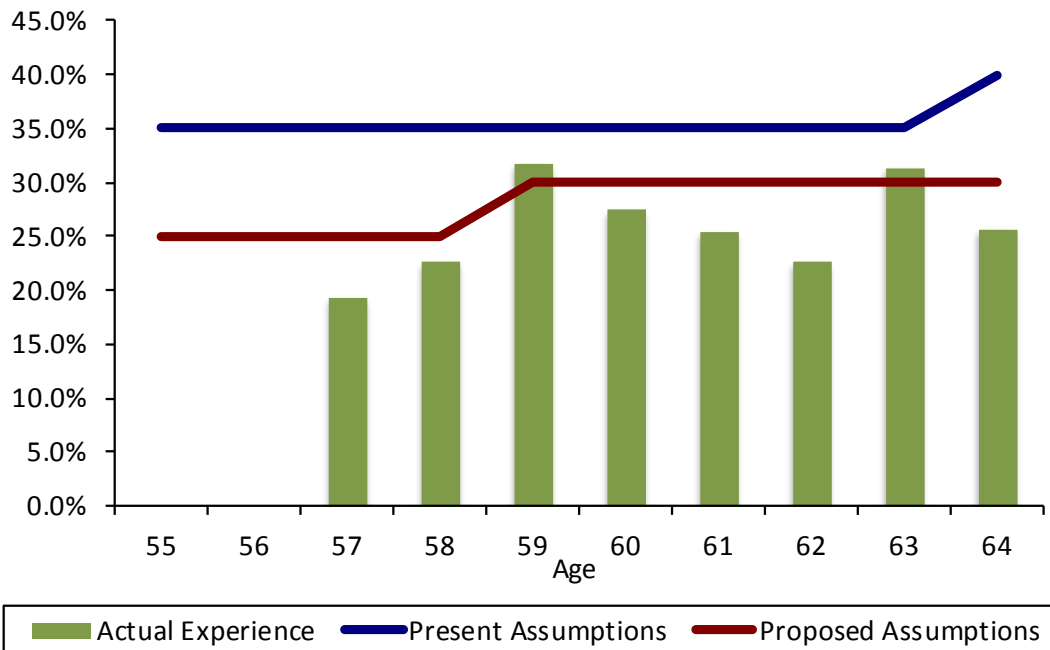
Rule of 90 (Unreduced) Early Retirement
Males

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Present	Proposed	Present	Proposed	Present	Proposed
55	-	-	N/A	35.00%	25.00%	-	-	N/A	N/A
56	-	1	0.0%	35.00%	25.00%	0.35	0.25	0.0%	0.0%
57	1	7	14.3%	35.00%	25.00%	2.45	1.75	40.8%	57.1%
58	3	13	23.1%	35.00%	25.00%	4.55	3.25	65.9%	92.3%
59	2	12	16.7%	35.00%	25.00%	4.20	3.00	47.6%	66.7%
60	4	15	26.7%	35.00%	25.00%	5.25	3.75	76.2%	106.7%
61	1	12	8.3%	35.00%	25.00%	4.20	3.00	23.8%	33.3%
62	8	15	53.3%	35.00%	45.00%	5.25	6.75	152.4%	118.5%
63	6	16	37.5%	35.00%	35.00%	5.60	5.60	107.1%	107.1%
64	1	10	10.0%	35.00%	25.00%	3.50	2.50	28.6%	40.0%
Totals	**26**	**101**				**35.35**	**29.85**	**73.6%**	**87.1%**
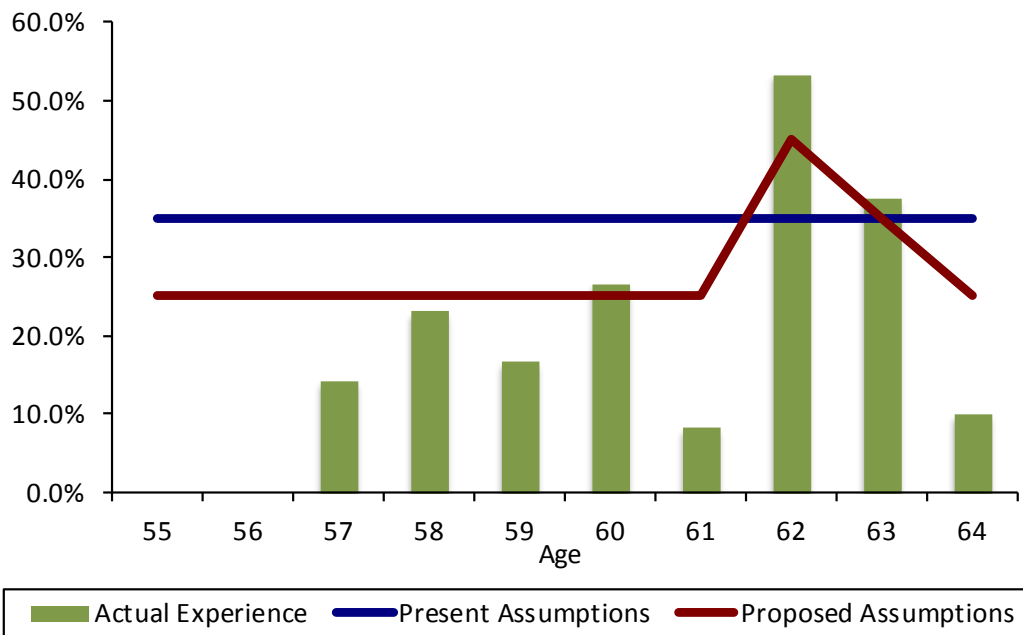
Rule of 90 (Unreduced) Early Retirement
Females

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Present	Proposed	Present	Proposed	Present	Proposed
55	-	1	0.0%	35.00%	25.00%	0.35	0.25	0.0%	0.0%
56	-	8	0.0%	35.00%	25.00%	2.80	2.00	0.0%	0.0%
57	6	31	19.4%	35.00%	25.00%	10.85	7.75	55.3%	77.4%
58	12	53	22.6%	35.00%	25.00%	18.55	13.25	64.7%	90.6%
59	20	63	31.7%	35.00%	30.00%	22.05	18.90	90.7%	105.8%
60	17	62	27.4%	35.00%	30.00%	21.70	18.60	78.3%	91.4%
61	15	59	25.4%	35.00%	30.00%	20.65	17.70	72.6%	84.7%
62	12	53	22.6%	35.00%	30.00%	18.55	15.90	64.7%	75.5%
63	16	51	31.4%	35.00%	30.00%	17.85	15.30	89.6%	104.6%
64	10	39	25.6%	40.00%	30.00%	15.60	11.70	64.1%	85.5%
Totals	**108**	**420**				**148.95**	**121.35**	**72.5%**	**89.0%**

Reduced Early Retirement

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

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

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

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

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

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

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

Findings

Overall, the plan experienced more reduced early retirements than projected by the present assumptions (360 expected versus 395 actual – see totals on the following pages).

Recommendation

We recommend slight adjustments to the early retirement assumptions shown on the following pages. Proposed assumptions for ages 62 and older are slightly higher than past experience due to the new plan provision that provides for enhanced benefits at age 62 with 30 years of service.

Reduced Early Retirement
Males

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Present	Proposed	Present	Proposed	Present	Proposed
55	12	106	11.3%	7.00%	9.00%	7.42	9.54	161.7%	125.8%
56	7	98	7.1%	7.00%	7.00%	6.86	6.86	102.0%	102.0%
57	3	87	3.4%	7.00%	7.00%	6.09	6.09	49.3%	49.3%
58	8	87	9.2%	7.00%	7.00%	6.09	6.09	131.4%	131.4%
59	8	85	9.4%	7.00%	7.00%	5.95	5.95	134.5%	134.5%
60	11	74	14.9%	11.00%	12.00%	8.14	8.88	135.1%	123.9%
61	6	64	9.4%	15.00%	12.00%	9.60	7.68	62.5%	78.1%
62	13	58	22.4%	19.00%	25.00%	11.02	14.50	118.0%	89.7%
63	13	46	28.3%	23.00%	28.00%	10.58	12.88	122.9%	100.9%
64	9	33	27.3%	27.00%	28.00%	8.91	9.24	101.0%	97.4%
65	5	24	20.8%	31.00%	28.00%	7.44	6.72	67.2%	74.4%
Totals	**95**	**762**				**88.10**	**94.43**	**107.8%**	**100.6%**
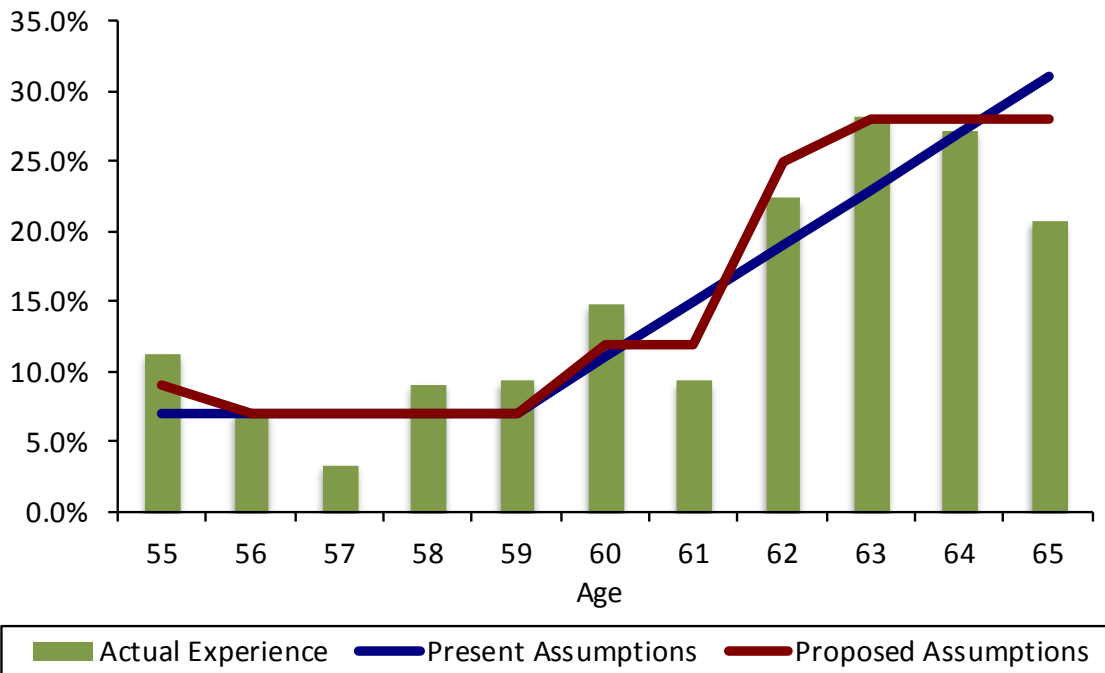
Reduced Early Retirement
Females

Age	Actual Retirements	Exposure	Crude Rates	Rates		Expected Retirements		Actual / Expected	
				Present	Proposed	Present	Proposed	Present	Proposed
55	11	368	3.0%	5.00%	5.00%	18.40	18.40	59.8%	59.8%
56	22	357	6.2%	5.00%	5.00%	17.85	17.85	123.2%	123.2%
57	18	328	5.5%	5.00%	5.00%	16.40	16.40	109.8%	109.8%
58	19	313	6.1%	5.00%	6.00%	15.65	18.78	121.4%	101.2%
59	20	298	6.7%	5.00%	6.00%	14.90	17.88	134.2%	111.9%
60	35	272	12.9%	8.00%	9.00%	21.76	24.48	160.8%	143.0%
61	36	265	13.6%	11.00%	11.00%	29.15	29.15	123.5%	123.5%
62	40	240	16.7%	14.00%	20.00%	33.60	48.00	119.0%	83.3%
63	33	181	18.2%	19.00%	23.00%	34.39	41.63	96.0%	79.3%
64	38	144	26.4%	24.00%	26.00%	34.56	37.44	110.0%	101.5%
65	28	100	28.0%	35.00%	30.00%	35.00	30.00	80.0%	93.3%
Totals	**300**	**2,866**				**271.66**	**300.01**	**110.4%**	**100.0%**
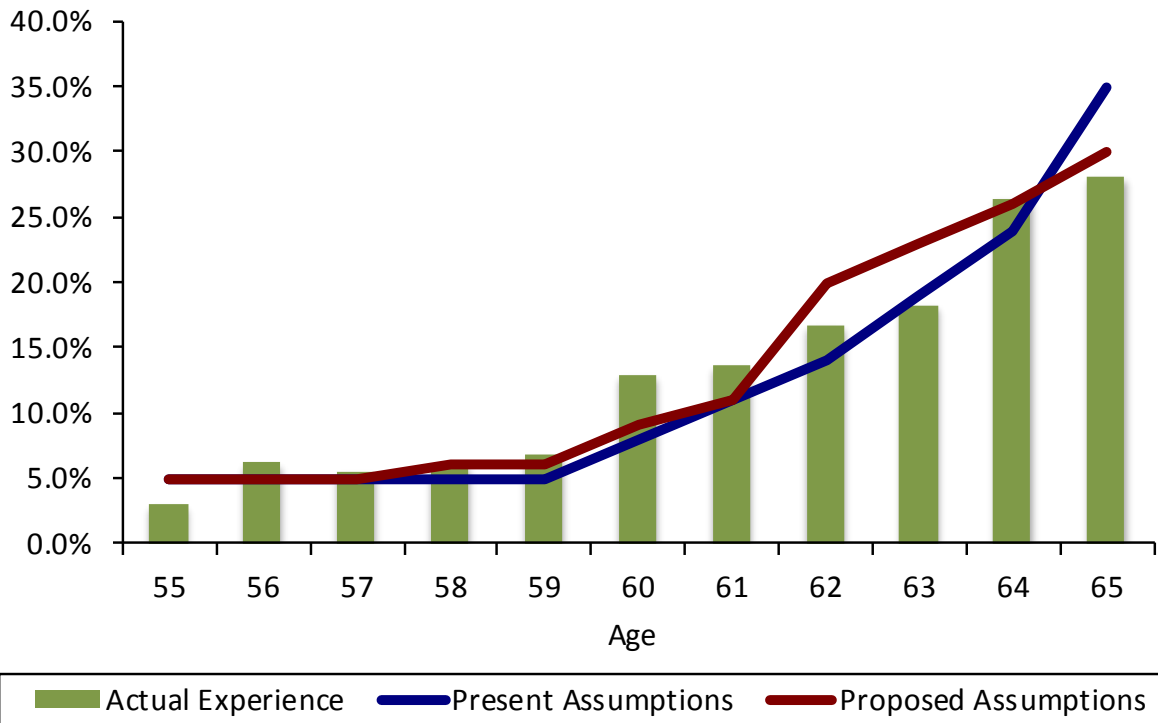
Retirement from Deferred Status

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

Election of Refunds

While some members may elect a refund even if it is less valuable than the deferred annuity, the current valuation assumption is that members will elect a refund only if it is more valuable than the deferred annuity. When a member elects a refund that is less valuable than 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.

Actual employee account balances were not provided by SPTRFA until the 2016 valuation. As such, we are unable to determine the accuracy of the assumption that members will elect an annuity if more valuable.

We recommend no change to this assumption and that it be analyzed with the next experience study when relevant data is available.

Commencement of Benefits – Deferred Members

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

There were 277 actual retirements from deferred status over the five-year period of the study. The largest group of members (13%) were age 65 at retirement. However, an almost equal number of members (12%) were age 62 at retirement. The average retirement age was approximately 63.2 years (61.9 years if we exclude members who retired after age 66).

We recommend no change to the assumption that deferred members retire at age 62 (61 if a Basic member).

SECTION E

WITHDRAWAL EXPERIENCE

Withdrawal Experience

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

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

Deferred retirement benefits are based on the pay and service credit at the time of withdrawal. The benefit is increased with augmentation from termination until commencement 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.

Our experience with similar systems has shown that sometimes the use of assumptions based solely on counts of people terminating employment does not always reduce the size of the gain or loss in a particular decrement. Sometimes this can be due to the relative magnitude of the actuarial accrued liability of the members that decrement, rather than number counts alone. For example, consider a plan with only two members who are both the same age and assume member one has an actuarial accrued liability of $10,000 and member two has an actuarial accrued liability of $90,000. If one of the members leaves and forfeits all of his or her liability, the rate of decrement is one out of two for a rate of 50%. However, the magnitude of the net gain or loss to the system is affected much more if member two leaves employment than if member one leaves employment.

As a result, we have added a column in the following tables that shows the liability-weighted rates. This represents the crude rate of decrement on a liability weighted basis as opposed to strictly a number count basis. The liability weighted rates were found to be more highly correlated with withdrawal than with other decrements. This makes some intuitive sense, since termination decisions are often made based on how much the member has to gain or lose if they change jobs, whereas death and disability is typically not a decision at all, but rather an event that happens to someone.

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

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

Withdrawal Experience

Findings

Overall, the plan experienced more withdrawals than projected by the present assumptions (1,718 actual terminations versus 1,332 expected).

Recommendation

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

Withdrawal Experience
Males

| Year	Withdrawal	Exposure	Crude Rates Population Weighted	Crude Rates Liability Weighted	Sample Rates Old*	Sample Rates New	Expected Withdrawals Old*	Expected Withdrawals New	Ratio of Actuals/Expecteds Old	Ratio of Actuals/Expecteds New
1	157	304	51.64%	9.54%	40.00%	40.00%	121.60	121.60	129.1%	129.1%
2	159	446	35.65%	29.07%	18.00%	26.00%	80.28	115.96	198.1%	137.1%
3	48	268	17.91%	17.39%	14.00%	16.00%	37.52	42.88	127.9%	111.9%
4	26	205	12.68%	13.46%	10.00%	11.00%	20.50	22.55	126.8%	115.3%
5	18	165	10.91%	9.53%	6.00%	8.00%	9.90	13.20	181.8%	136.4%
6	8	153	5.23%	5.08%	5.00%	5.00%	7.65	7.65	104.6%	104.6%
7	6	162	3.70%	4.07%	4.50%	4.75%	7.29	7.70	82.3%	77.9%
8	8	158	5.06%	8.02%	4.10%	4.50%	6.48	7.11	123.5%	112.5%
9	7	157	4.46%	5.52%	3.70%	4.25%	5.81	6.67	120.5%	104.9%
10	7	154	4.55%	7.85%	3.30%	4.00%	5.08	6.16	137.7%	113.6%
11	8	149	5.37%	8.40%	2.90%	3.75%	4.32	5.59	185.1%	143.1%
12	5	156	3.21%	4.68%	2.50%	3.50%	3.90	5.46	128.2%	91.6%
13	5	160	3.13%	5.46%	2.00%	3.25%	3.20	5.20	156.3%	96.2%
14	7	179	3.91%	5.25%	2.00%	3.00%	3.58	5.37	195.5%	130.4%
15+	23	1,829	1.26%	2.92%	2.00%	2.50%	36.58	45.73	62.9%	50.3%
Totals	**492**	**4,645**	**10.59%**	**4.69%**	**7.61%**	**9.02%**	**353.69**	**418.83**	**139.1%**	**117.5%**

Withdrawal Experience
Males
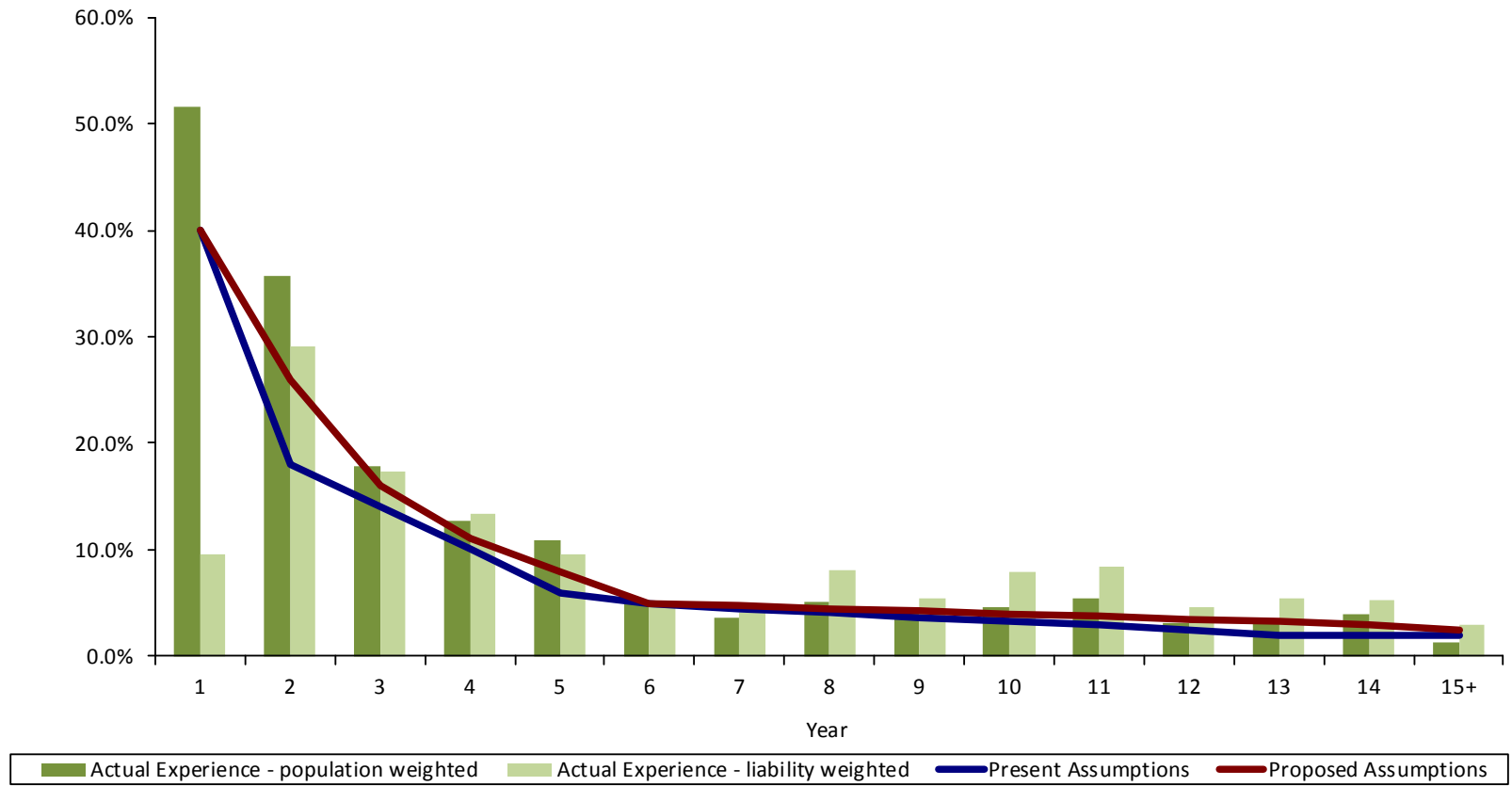
Withdrawal Experience
Females

Year	Withdrawal	Exposure	Crude Rates		Sample Rates		Expected Withdrawals		Ratio of Actuals/Expecteds	
			Population Weighted	Liability Weighted	Old*	New	Old*	New	Old	New
1	390	775	50.32%	5.94%	40.00%	40.00%	310.00	310.00	125.8%	125.8%
2	335	1,297	25.83%	21.65%	18.00%	22.00%	233.46	285.34	143.5%	117.4%
3	128	835	15.33%	14.35%	14.00%	15.00%	116.90	125.25	109.5%	102.2%
4	69	649	10.63%	13.22%	10.00%	12.00%	64.90	77.88	106.3%	88.6%
5	51	507	10.06%	11.19%	6.70%	10.00%	33.97	50.70	150.1%	100.6%
6	36	431	8.35%	8.40%	5.90%	8.50%	25.43	36.64	141.6%	98.3%
7	27	404	6.68%	9.16%	5.10%	7.00%	20.60	28.28	131.0%	95.5%
8	26	454	5.73%	8.21%	4.30%	5.50%	19.52	24.97	133.2%	104.1%
9	17	434	3.92%	5.06%	3.50%	4.50%	15.19	19.53	111.9%	87.0%
10	19	455	4.18%	4.65%	3.10%	4.00%	14.11	18.20	134.7%	104.4%
11	23	516	4.46%	5.74%	2.70%	3.75%	13.93	19.35	165.1%	118.9%
12	13	558	2.33%	4.16%	2.30%	3.50%	12.83	19.53	101.3%	66.6%
13	16	567	2.82%	3.86%	1.90%	3.00%	10.77	17.01	148.5%	94.1%
14	15	599	2.50%	3.97%	1.50%	2.50%	8.99	14.98	166.9%	100.1%
15+	61	6,001	1.02%	2.96%	1.30%	2.00%	78.01	120.02	78.2%	50.8%
Totals	**1,226**	**14,482**	**8.47%**	**4.47%**	**6.76%**	**8.06%**	**978.62**	**1,167.68**	**125.3%**	**105.0%**

Withdrawal Experience
Females
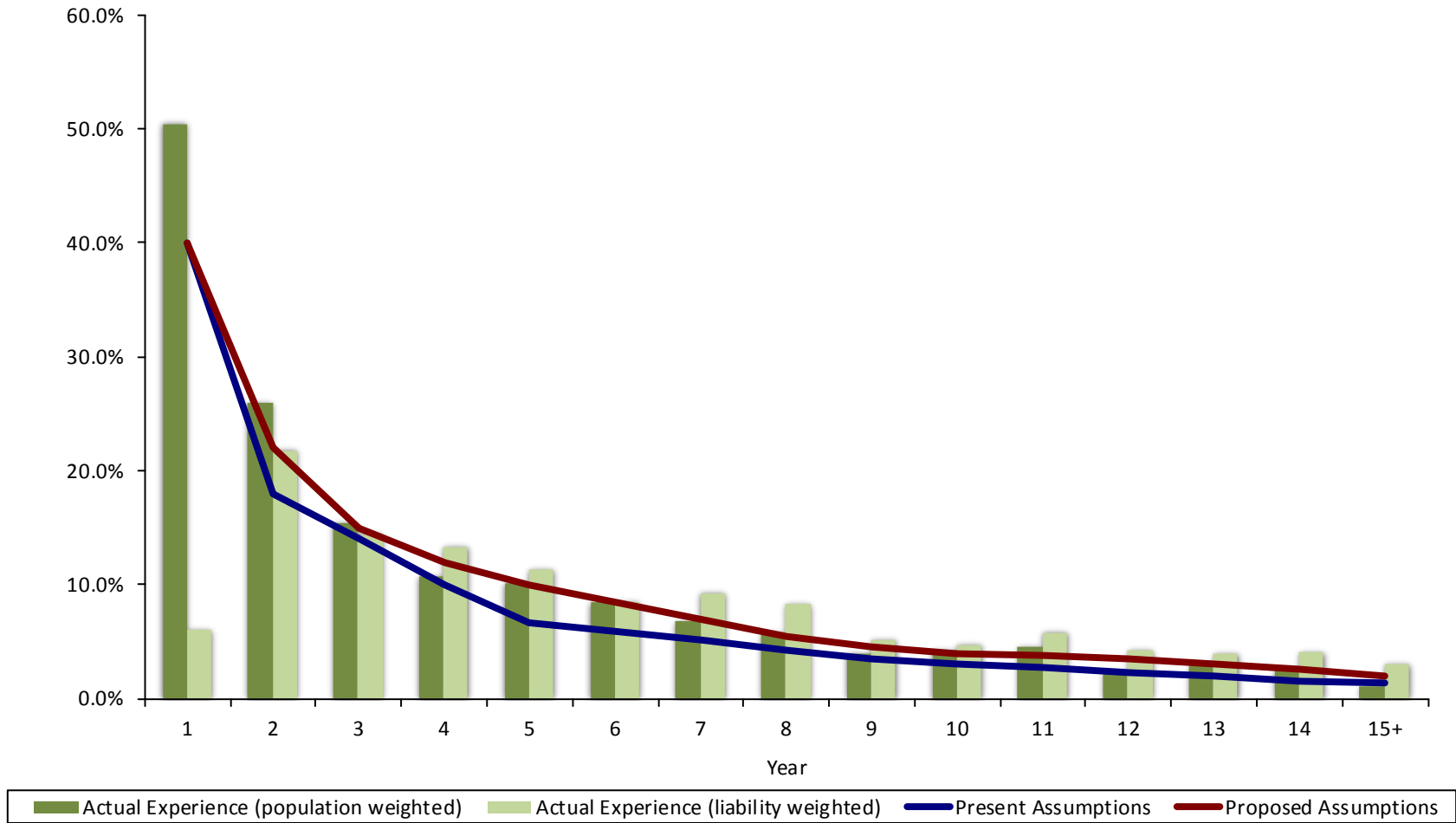
SECTION F

DISABILITY EXPERIENCE

Disability Experience

Findings

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

We reviewed the disability experience during the five year period. The results are shown on the following page. Overall, the actual number of disability retirements is less than predicted by the current assumption (9 actual versus 16 expected, see chart on the following page). The reverse was true in the 2006-2011 experience study; there were more disability retirements than expected, resulting in a 40% increase in disability retirement rates.

Recommendation

We recommend reducing the rates of disability incidence by 16%.

Disability Experience
Males & Females

Age	Disabilities	Exposure	Crude Rates	Sample Rates		Expected Disabilities		Ratio of Actuals/Expecteds	
				Old	New	Old	New	Old	New
20-24	-	2	0.0000%	0.0168%	0.0144%	-	0.00	N/A	0.0%
25-29	-	656	0.0000%	0.0168%	0.0144%	0.11	0.09	0.0%	0.0%
30-34	-	1,617	0.0000%	0.0252%	0.0216%	0.41	0.35	0.0%	0.0%
35-39	-	2,159	0.0000%	0.0252%	0.0216%	0.54	0.47	0.0%	0.0%
40-44	1	2,539	0.0394%	0.0336%	0.0288%	0.86	0.73	116.3%	136.8%
45-49	1	2,433	0.0411%	0.0504%	0.0432%	1.23	1.05	81.3%	95.1%
50-54	3	2,338	0.1283%	0.1008%	0.0864%	2.35	2.02	127.7%	148.5%
55-59	-	2,276	0.0000%	0.2016%	0.1728%	4.58	3.93	0.0%	0.0%
60-64	4	1,581	0.2530%	0.4032%	0.3456%	6.37	5.46	62.8%	73.2%
Totals	**9**	**15,601**	**0.0577%**	**0.0955%**	**0.0818%**	**16.45**	**14.11**	**54.7%**	**63.8%**
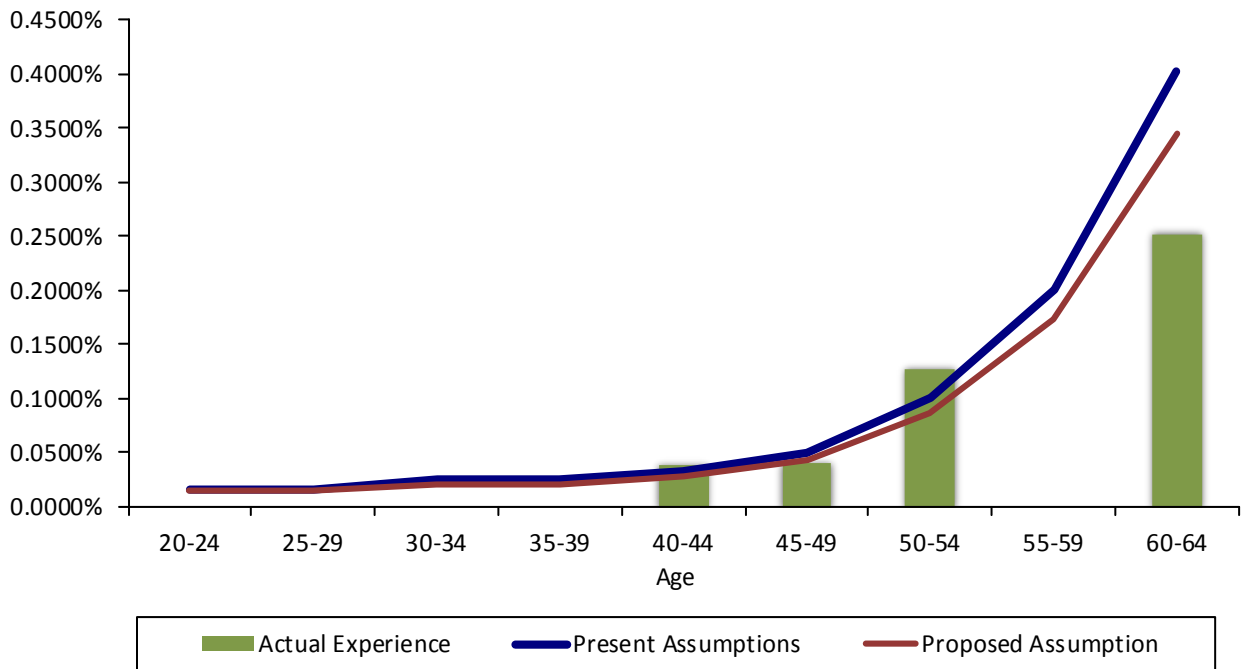
SECTION G

MORTALITY EXPERIENCE

Mortality Experience

Post-retirement mortality is an important component in cost calculations and should be updated from time to time to reflect current and expected future longevity improvements. Pre-retirement mortality is a relatively minor component in cost calculations. 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

The Society of Actuaries (SOA) released updated mortality tables late in 2014 which reflect the improvement in longevity of the studied group of private pension plan participants, and which also reflects projected future improvements for current and future generations of participants. The new mortality table is called the RP-2014 table. The mortality improvement scale is called the MP-2014 improvement scale. The mortality improvement scale is applied to the RP-2014 table to show the improvements in mortality that are expected to occur. The SOA has released annual updates to the mortality improvement scale, called MP-2015, MP-2016, and MP-2017.

The SOA has developed combined experience tables and collar-specific experience versions of the RP-2014 tables. The Blue Collar tables have higher mortality rates than the combined tables and the White Collar tables have lower mortality than the combined tables.

Mortality Improvement Observations at a National Level

The updated mortality and mortality improvement tables show that among males age 65, overall longevity rose 2.0 years, from 84.6 in 2000 to 86.6 in 2014. Saying it another way, men age 65 in the year 2000 were expected to live to be 84.6 years old. Men age 65 in the year 2014 were expected to live to be 86.6 years old. For women age 65, overall longevity rose 2.4 years, from age 86.4 in 2000 to age 88.8 in 2014. The annual mortality improvement scale updates have adjusted these life expectancies down gradually, to age 85.6 for males and age 87.6 for females.

Mortality Experience

Findings

Healthy Retirees
We reviewed the mortality experience of healthy retirees during the five year period. Due to potential anti-selection bias as well as data needs which are outside the scope of the annual valuation process, we did not include beneficiary and survivor mortality experience in our study. The results are shown on the following pages.

The plan experienced fewer deaths among males (143) than projected by the present assumption (161). The actual number of deaths among retired females (180) was approximately equal to the number projected by the present assumption (182). While this seems like a fairly good fit, the fit at some age groups is not ideal.

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

Active Members
We reviewed the mortality experience among active members during the five-year period. The results are shown on the following pages.

The actual number of deaths among active members (11) was much lower than the number projected by the present assumption (23).

Mortality Experience

Recommendations

The experience of the St. Paul Teachers' Retirement Fund Association is not large enough to be considered credible for purposes of setting mortality assumptions. As such, we recommend adoption of standard mortality tables. In addition, since the data does not distinguish disabled retirees from healthy retirees after Normal Retirement Age, we recommend utilizing the same mortality for disabled members as healthy members.

We recommend adoption of the following mortality tables:

Healthy Male Retirees: RP-2014 Male Healthy Annuitant Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2017 from 2006.

Healthy Female Retirees: RP-2014 Female Healthy Annuitant Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2017 from 2006. Rates are set back two years.

Disabled Male Retirees: RP-2014 Male Healthy Annuitant Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2017 from 2006.

Disabled Female Retirees: RP-2014 Female Healthy Annuitant Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2017 from 2006. Rates are set back two years.

Male Active Members: RP-2014 Male Employee Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2017 from 2006.

Female Active Members: RP-2014 Female Employee Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2017 from 2006.
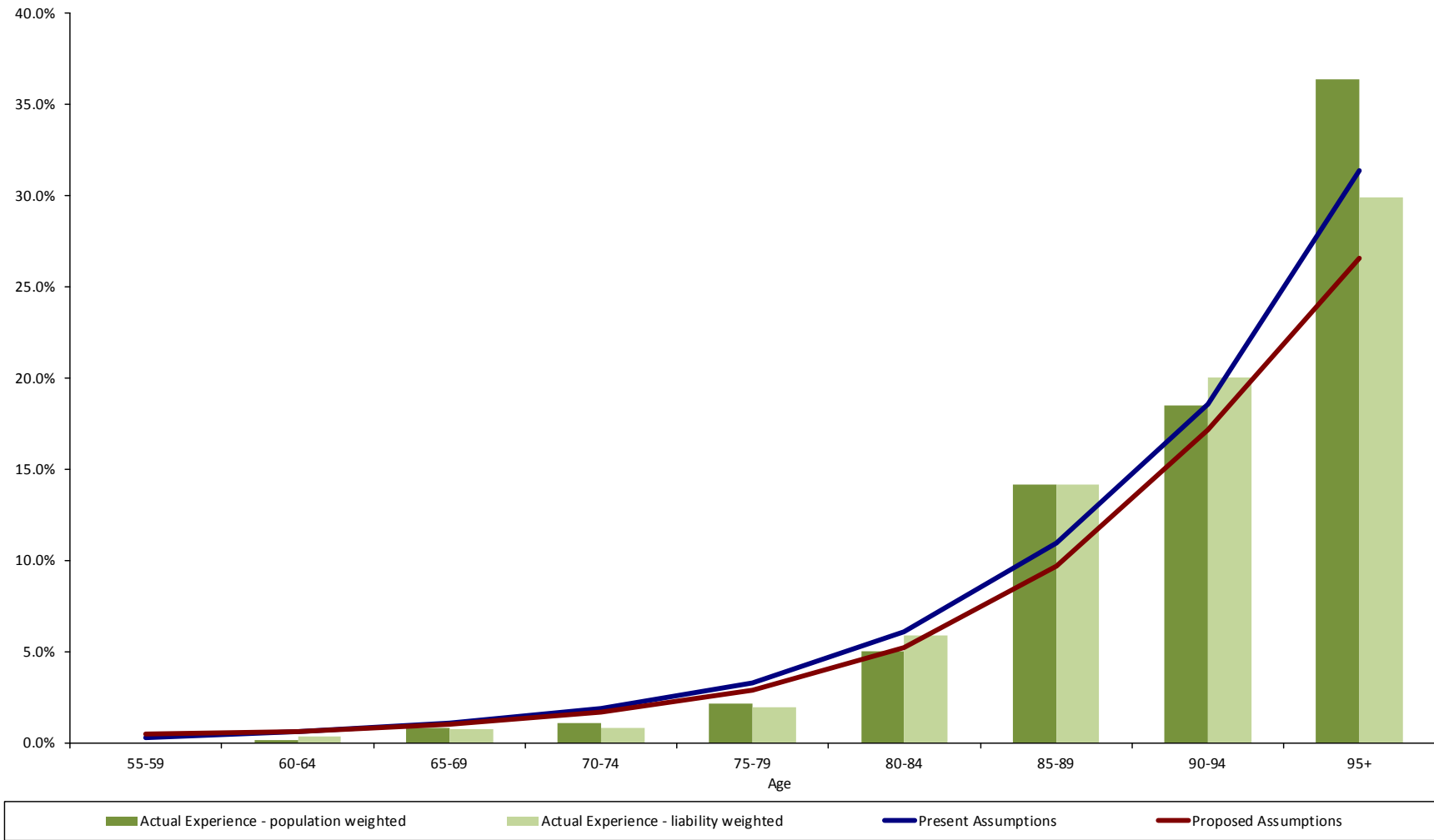
Post-Retirement Mortality Experience
Healthy Males

Age	Deaths	Exposure	Crude Rates Population Weighted	Crude Rates Liability Weighted	Sample Rates Old	Sample Rates New*	Expected Deaths Old	Expected Deaths New*	Ratio of Actuals/Expecteds Old	Ratio of Actuals/Expecteds New*
55-59	-	111	0.0000%	0.0000%	0.2935%	0.4545%	0.38	0.53	0.0%	0.0%
60-64	1	654	0.1529%	0.3152%	0.5778%	0.6342%	4.07	4.32	24.6%	23.1%
65-69	10	1,269	0.7880%	0.7620%	1.1012%	0.9764%	14.08	12.47	71.0%	80.2%
70-74	12	1,133	1.0591%	0.8275%	1.8427%	1.6560%	20.56	18.46	58.4%	65.0%
75-79	18	854	2.1077%	1.9451%	3.2490%	2.9003%	27.35	24.44	65.8%	73.6%
80-84	33	658	5.0152%	5.8734%	6.0830%	5.2385%	39.34	33.89	83.9%	97.4%
85-89	45	318	14.1509%	14.1667%	10.9297%	9.7054%	33.36	29.51	134.9%	152.5%
90-94	20	108	18.5185%	20.0204%	18.5643%	17.1589%	18.68	17.17	107.1%	116.5%
95+	4	11	36.3636%	29.8724%	31.3771%	26.5349%	3.01	2.96	132.9%	135.1%
Totals	**143**	**5,116**	**2.7952%**	**2.4572%**	**3.1437%**	**2.8098%**	**160.83**	**143.75**	**88.9%**	**99.5%**

*   *In order to show the fit for the five-year period of the study, New Sample Rates and New Expected Deaths were determined using the proposed mortality rates projected to the mid-point of the study (2014) using projection scale MP-2017.*

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.

Post-Retirement Mortality Experience
Healthy Males

Legend:
- Actual Experience - population weighted
- Actual Experience - liability weighted
- Present Assumptions
- Proposed Assumptions
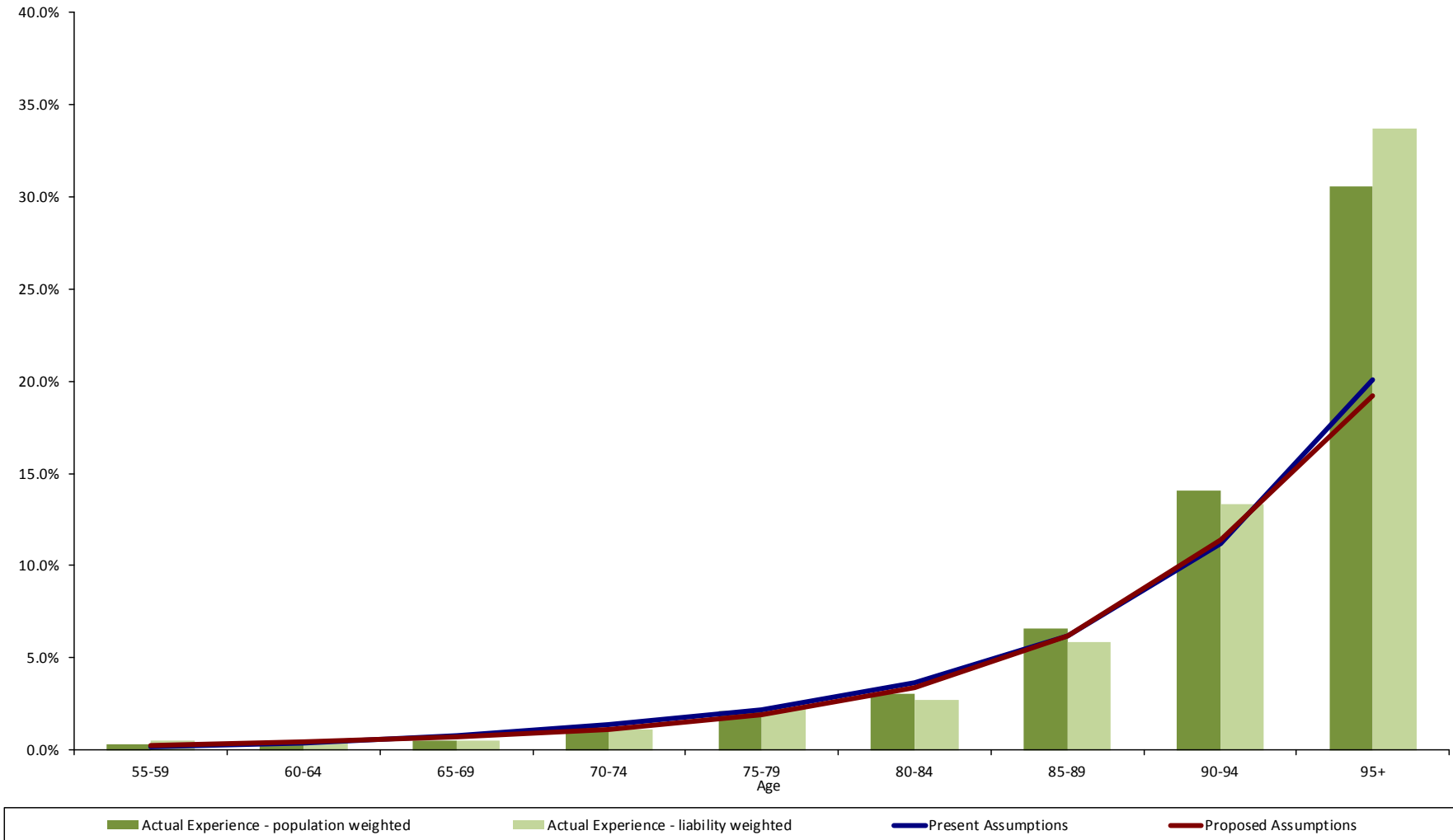
GRS Retirement Consulting

Post-Retirement Mortality Experience
Healthy Females

Age	Deaths	Exposure	Crude Rates		Sample Rates		Expected Deaths		Ratio of Actuals/Expecteds	
			Population Weighted	Liability Weighted	Old	New*	Old	New*	Old	New*
55-59	1	345	0.2899%	0.5055%	0.2059%	0.2836%	0.81	1.03	123.5%	97.1%
60-64	7	1,878	0.3727%	0.5106%	0.4109%	0.4195%	8.17	8.24	85.7%	85.0%
65-69	16	3,050	0.5246%	0.5026%	0.7885%	0.6992%	23.86	21.20	67.1%	75.5%
70-74	19	1,941	0.9789%	1.1075%	1.3645%	1.1423%	25.91	21.70	73.3%	87.6%
75-79	28	1,328	2.1084%	2.3416%	2.2142%	1.9268%	28.97	25.14	96.7%	111.4%
80-84	25	812	3.0788%	2.7077%	3.6472%	3.3858%	29.02	26.85	86.1%	93.1%
85-89	33	502	6.5737%	5.8310%	6.2087%	6.1904%	30.56	30.46	108.0%	108.3%
90-94	29	206	14.0777%	13.3175%	11.2066%	11.3695%	21.62	21.79	134.1%	133.1%
95+	22	72	30.5556%	33.6991%	20.0687%	19.2405%	12.93	14.61	170.1%	150.6%
Totals	**180**	**10,134**	**1.7762%**	**1.3021%**	**1.7945%**	**1.6876%**	**181.85**	**171.02**	**99.0%**	**105.3%**

* *In order to show the fit for the five-year period of the study, New Sample Rates and New Expected Deaths were determined using the proposed mortality rates projected to the mid-point of the study (2014) using projection scale MP-2017.*

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.
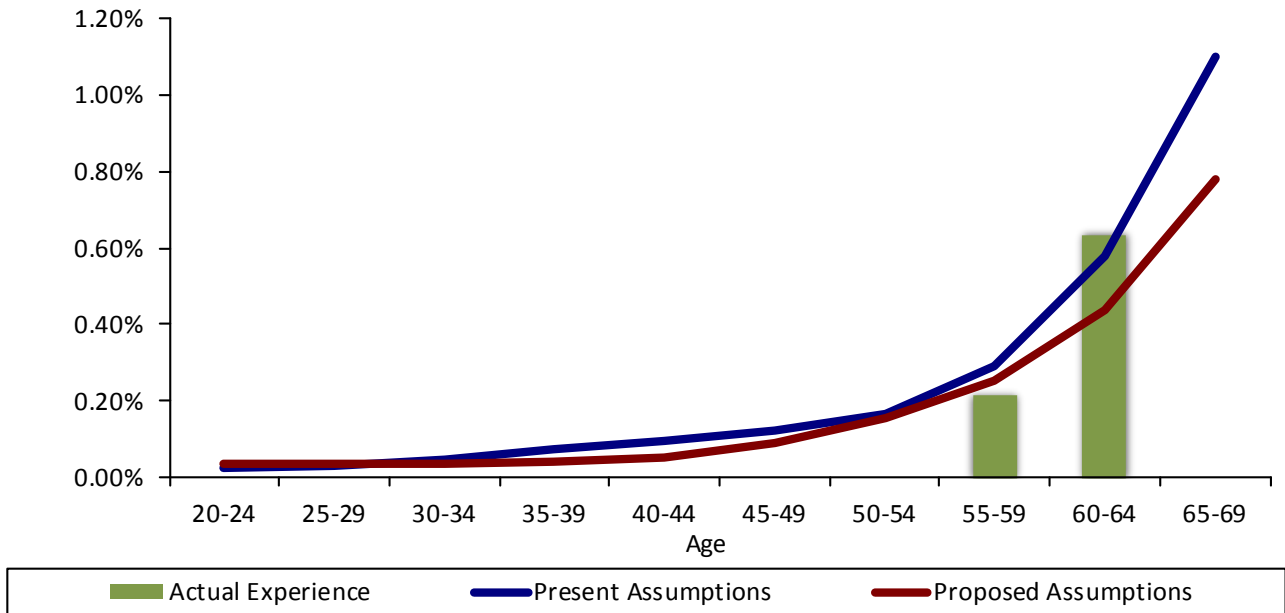
Post-Retirement Mortality Experience
Healthy Females

Legend: Actual Experience - population weighted | Actual Experience - liability weighted | Present Assumptions | Proposed Assumptions

Pre-Retirement Mortality Experience
Healthy Males

| Age	Deaths	Exposure	Crude Rates	Sample Rates Old	Sample Rates New	Expected Deaths Old	Expected Deaths New	Ratio of Actuals/Expecteds Old	Ratio of Actuals/Expecteds New
20-24	-	-	N/A	0.0249%	0.0338%	-	-	N/A	N/A
25-29	-	146	0.0000%	0.0327%	0.0340%	0.05	0.05	0.0%	0.0%
30-34	-	344	0.0000%	0.0461%	0.0366%	0.16	0.13	0.0%	0.0%
35-39	-	543	0.0000%	0.0754%	0.0421%	0.41	0.23	0.0%	0.0%
40-44	-	697	0.0000%	0.0959%	0.0550%	0.67	0.39	0.0%	0.0%
45-49	-	673	0.0000%	0.1221%	0.0904%	0.82	0.60	0.0%	0.0%
50-54	-	542	0.0000%	0.1660%	0.1537%	0.90	0.83	0.0%	0.0%
55-59	1	467	0.2141%	0.2935%	0.2511%	1.37	1.17	73.2%	85.5%
60-64	2	316	0.6329%	0.5778%	0.4382%	1.74	1.33	114.6%	150.4%
65-69	-	89	0.0000%	1.1012%	0.7809%	0.90	0.64	0.0%	0.0%
Totals	**3**	**3,817**	**0.0786%**	**0.1839%**	**0.1407%**	**7.02**	**5.37**	**42.7%**	**55.9%**

* *In order to show the fit for the five-year period of the study, New Sample Rates and New Expected Deaths were determined using the proposed mortality rates projected to the mid-point of the study (2014) using projection scale MP-2017.*

Pre-Retirement Mortality Experience
Healthy Females

Age	Deaths	Exposure	Crude Rates	Sample Rates Old	Sample Rates New*	Expected Deaths Old	Expected Deaths New*	Ratio of Actuals/Expecteds Old	Ratio of Actuals/Expecteds New*
20-24	-	2	0.0000%	0.0139%	0.0145%	0.00	-	0.0%	N/A
25-29	-	510	0.0000%	0.0151%	0.0165%	0.08	0.09	0.0%	0.0%
30-34	-	1,273	0.0000%	0.0206%	0.0217%	0.27	0.28	0.0%	0.0%
35-39	-	1,616	0.0000%	0.0354%	0.0299%	0.57	0.48	0.0%	0.0%
40-44	-	1,842	0.0000%	0.0490%	0.0441%	0.91	0.82	0.0%	0.0%
45-49	1	1,760	0.0568%	0.0753%	0.0712%	1.32	1.25	75.8%	80.0%
50-54	2	1,796	0.1114%	0.1105%	0.1144%	1.99	2.06	100.6%	97.1%
55-59	3	1,809	0.1658%	0.2059%	0.1769%	3.71	3.20	80.8%	93.8%
60-64	2	1,302	0.1536%	0.4109%	0.2631%	5.11	3.33	39.2%	60.1%
65-69	-	270	0.0000%	0.7885%	0.4196%	1.90	1.03	0.0%	0.0%
Totals	**8**	**12,180**	**0.0657%**	**0.1302%**	**0.1030%**	**15.86**	**12.54**	**50.5%**	**63.8%**

*   *In order to show the fit for the five-year period of the study, New Sample Rates and New Expected Deaths were determined using the proposed mortality rates projected to the mid-point of the study (2014) using projection scale MP-2017.*
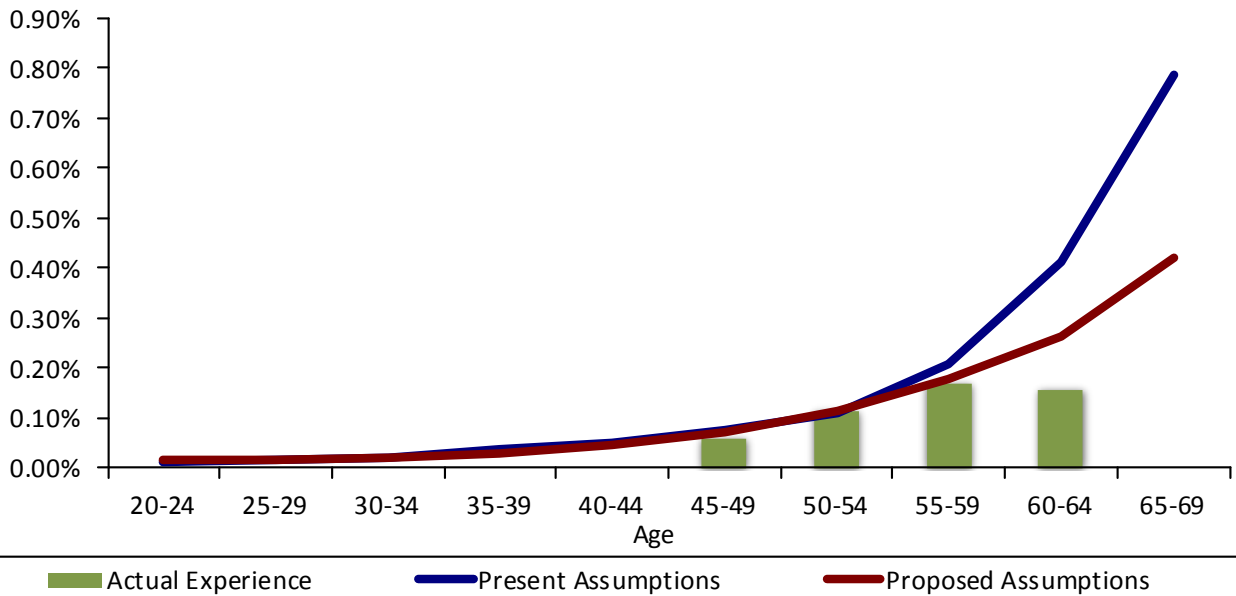
SECTION H

ACTUARIAL METHODS

Asset Valuation Method

Background

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

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

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

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

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

In 2007, the Actuarial Standards Board issued a standard on asset valuation methods which requires that the asset valuation method bear a reasonable relationship to current market value. There may be some concern that if the deviation between the funding value of assets and the market value of assets becomes too large, it could be considered unreasonable. The alternative to allowing large deviations usually involves setting upper and lower bounds (corridors) for the relationship between funding value and market value. Once a corridor limit is reached, any further market experience in the same direction is recognized immediately, which can introduce substantial fluctuations in the results of the actuarial valuation. If a 20% corridor were applied to the June 30, 2016 actuarial value of assets, it would not change the numerical result (the asset value would be unchanged).

Recommendation

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

Funding Policy – Actuarial Funding Method

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

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

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

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

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

Recommendations

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

Funding Policy – Amortization

Amortization Period

Minnesota Statute 356.215, Subdivision 11 specifies the established date for full funding of the St. Paul Teachers' Retirement Fund Association (SPTRFA). The amortization period was statutorily changed in 2014 from a 25-year rolling amortization to a fixed amortization date of June 30, 2042.

The June 30, 2016 actuarial valuation amortizes the UAAL over a 26-year period. We suggest that the present practice of decreasing the amortization period each year by one year (like a typical mortgage) be continued.

Some plans will occasionally reset the amortization period in order to minimize volatility and manage cost requirements. This practice shifts costs to the future. Actuarial practice, including Governmental Accounting Standards Board policy, is moving toward shorter amortization periods than in the past. SPTRFA could consider using a shorter maximum period, such as 15, 20 or 25 years. 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, but mitigates the volatility caused by gains and losses. We would be happy to provide more information and analysis on this topic.

Amortization Method

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

Longer amortization periods combined with the level percent of pay methodology results in initial payments that are less than the "interest only" payment on the unfunded actuarial accrued liability, i.e., "negative amortization." Payments less than the interest only amount will result in the UAAL increasing for an initial period of time. With 26 years remaining as of June 30, 2016, calculated SPTRFA amortization payments are expected to be less than the interest only amount.

It should be noted that actual growth in SPTRFA payroll over the past five years has fallen short of the expected rate of 4.0% (proposed payroll growth rate is 3.0%). When payroll grows slower than expected, contributions collected will also be less than expected, and insufficient to eliminate the UAAL by the statutory amortization date.

Funding Policy – Amortization

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

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

5-year average:	1.5%
10-year average:	1.3%
15-year average:	1.6%

Funding Policy – Payroll Growth

Actual payroll growth has averaged approximately 1.5% for the prior five years (0.1% more than price inflation) and 1.3% for the past decade (0.5% <u>less</u> than price inflation). The low rate of total payroll growth fell far short of the assumption that it would grow 4% per year (proposed payroll growth assumption is 3%).

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

One way to address this would be to adopt a level dollar funding policy rather than a level percent of payroll methodology. This would increase initial costs, but future contributions would not be dependent on assumed future payroll growth. An alternate approach would be to require that the payroll growth assumption used to determine the contribution toward the unfunded actuarial accrued liability not be greater than the actual plan average for the last ten years.

For example, based on the above data, actual ten-year payroll growth was 1.3%. Instead of using the payroll growth appropriate for a stable population of 3.0% to determine the amortization contribution, a payroll growth assumption of 1.3% would be used in the current valuation. This would be tested annually and the rate adjusted as necessary. After initial implementation, this method change will recognize a lower rate of payroll growth gradually and prevent actuarial losses.

We suggest that SPTRFA study this issue carefully before the next scheduled experience study. If the trend continues, the funding policy should be adjusted as suggested to prevent further actuarial losses due to less than expected payroll growth.

Recommendation

We recommend continued use of the current amortization policy of reducing the amortization period each year by one year until the next study, at which point the method should be re-evaluated. We also recommend SPTRFA evaluate the appropriateness of the current level percent of payroll amortization method, and consider alternate methods.

Funding Policy – Post-Retirement Benefit Increases

Valuation of Future Post-Retirement Benefit Increases

If the plan has reached the funding ratio threshold required to pay a 2.0% or 2.5% benefit increase, Minnesota Statutes require the higher benefit increase rate to be reflected in the liability calculations. If the plan has not yet reached the threshold required to pay a 2.0% or 2.5% benefit increase, Minnesota Statutes require a projection to be performed to determine the expected attainment of the funding ratio threshold, and the expected reversion to a higher benefit increase rate must be reflected in the liability calculations. As of June 30, 2016, based on projection methodology described in the SPTRFA valuation report, the benefit increase rate was assumed to increase to 2.0% on January 1, 2055 and to 2.5% on January 1, 2066. The date will be re-determined as of each valuation date.

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 4.0% according to the actuarial assumptions. (This experience study is proposing a change to this assumption, from 4.0% to 3.0%.) The total payroll, increased at the assumed payroll growth rate (currently 4.0%) 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 that the Minnesota Standards for Actuarial Work be amended to be less prescriptive and more principle-based, so that the actuaries for the Systems may use their best judgment to calculate contribution rates and liabilities in a mathematically consistent manner and in accordance with actuarial standards of practice.

SECTION I

MISCELLANEOUS AND TECHNICAL ASSUMPTIONS

Retirement Statistics

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

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

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

- **Single Life Annuity** – the benefit is paid for the lifetime of the member. No benefit is payable to a beneficiary upon the member's death.
- **Guaranteed Refund** – the benefit is paid for the lifetime of the member with the guarantee that an amount equal to any remaining balance of accumulated contributions is paid to a beneficiary upon the member's death.
- **15-Year Certain and Life** – a reduced benefit is paid for the lifetime of the member. If the member dies before 180 payments have been made, the benefit continues to be paid to a beneficiary until 180 payments have been made.
- **50% Joint & Survivor** – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 50% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.
- **100% Joint & Survivor** – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 100% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.

There is no actuarial reduction for the bounce-back feature (i.e., this is subsidized by the plan).

Married members retiring from active status are currently assumed to elect a Single life annuity.

Findings

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

Recommendation

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

Actuarial Equivalent Optional Form Factors

Joint and Survivor and Certain and Life benefits are actuarially equivalent to the Single-life annuity. Current actuarial equivalent factors are based on the RP-2000 combined mortality table, projected to 2020, set back one year for males and three years for females, blended 25% males, 7.43% interest.

Recommendation

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

Proposed Miscellaneous and Technical Assumptions

Background

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

Recommendation

We recommend continued use of the other Miscellaneous and Technical Assumptions.

Miscellaneous and Technical Assumptions

Benefit Service
Exact fractional service is used to determine the amount of benefit payable.

Decrement Operation
Withdrawal decrements do not operate during retirement eligibility.

Decrement Timing
Retirement and withdrawal decrements of all types are assumed to occur at the end of the valuation year (consistent with the end of the school year). All other decrements are assumed to occur mid-year.

Eligibility Testing
Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur.

Forfeitures
For vested separations from service, it is assumed that members separating will withdraw their contributions and forfeit an employer financed benefit when the value of member contributions is greater than the value of the employer financed benefit.

Incidence of Contributions
Contributions are assumed to be received on a monthly basis, per the Standards of Actuarial Work.

Liability Adjustments
Effective with the July 1, 2017 valuation, liabilities for active members are increased by 0%, liabilities for former vested members are increased by 20% and liabilities for former non-vested members are increased by 9% to account for the effect of some participants having eligibility for a Combined Service Annuity. These rates were modified as a result of a recent study completed by Deloitte.

Pay Increase Timing
Pay increases were assumed to be at the beginning of the fiscal year. This is equivalent to assuming that reported pays represent amounts paid to members during the year ended on the valuation date.

Service Credit Accruals
Members were assumed to accrue one year of service credit per year.

Projected Annual Payroll Calculation
The valuation census data reflects retirements and terminations occurring during the months of May and June; however, it does not necessarily reflect the replacements hired to fill these positions who may have hire dates in August or September. For valuation purposes, the projected annual payroll for the upcoming fiscal year contains an additional projected salary component for these assumed replacement teachers equal to the B.A. entry level salary level as defined in the current Collective Bargaining Agreement.

SECTION J

PROPOSED ASSUMPTION LISTING

Proposed Actuarial Assumptions
Based on 2011-2016 Experience Study

Merit and Seniority Pay Increases

% Merit & Seniority Increases in Salaries Next Year	
Year	Rate
1	6.00%
2	5.00%
3	4.00%
4	3.80%
5	3.60%
6	3.40%
7	3.20%
8	3.00%
9	2.75%
10	2.50%
11	2.25%
12	2.00%
13	1.75%
14	1.50%
15	1.25%
16	1.00%
17	0.90%
18	0.80%
19	0.70%
20	0.60%
21	0.40%
22	0.20%
23+	0.00%

Proposed Actuarial Assumptions
Based on 2011-2016 Experience Study

Age & Service Retirement Pattern
Unreduced (Normal) Retirement

	% Retiring	
Age	**Male**	**Female**
65	30%	45%
66	30%	43%
67	35%	38%
68	40%	38%
69	45%	30%
70+	100%	100%

Proposed Actuarial Assumptions
Based on 2011-2016 Experience Study

Rule of 90 Retirement Pattern

	% Retiring	
Age	Male	Female
55	25%	25%
56	25%	25%
57	25%	25%
58	25%	25%
59	25%	30%
60	25%	30%
61	25%	30%
62	45%	30%
63	35%	30%
64	25%	30%

Proposed Actuarial Assumptions
Based on 2011-2016 Experience Study

Age & Service Retirement Pattern
Reduced (Early) Retirement

	% Retiring	
Age	Male	Female
55	9%	5%
56	7%	5%
57	7%	5%
58	7%	6%
59	7%	6%
60	12%	9%
61	12%	11%
62	25%	20%
63	28%	23%
64	28%	26%
65	28%	30%

Proposed Actuarial Assumptions
Based on 2011-2016 Experience Study

Withdrawal

Year	% Withdrawals	
	Male	Female
1	40.00%	40.00%
2	26.00%	22.00%
3	16.00%	15.00%
4	11.00%	12.00%
5	8.00%	10.00%
6	5.00%	8.50%
7	4.75%	7.00%
8	4.50%	5.50%
9	4.25%	4.50%
10	4.00%	4.00%
11	3.75%	3.75%
12	3.50%	3.50%
13	3.25%	3.00%
14	3.00%	2.50%
15+	2.50%	2.00%

Proposed Actuarial Assumptions
Based on 2011-2016 Experience Study

Disability Rates

Age	% Becoming Disabled	
	Male	**Female**
20	0.0144%	0.0144%
21	0.0144%	0.0144%
22	0.0144%	0.0144%
23	0.0144%	0.0144%
24	0.0144%	0.0144%
25	0.0144%	0.0144%
26	0.0144%	0.0144%
27	0.0144%	0.0144%
28	0.0144%	0.0144%
29	0.0144%	0.0144%
30	0.0216%	0.0216%
31	0.0216%	0.0216%
32	0.0216%	0.0216%
33	0.0216%	0.0216%
34	0.0216%	0.0216%
35	0.0216%	0.0216%
36	0.0216%	0.0216%
37	0.0216%	0.0216%
38	0.0216%	0.0216%
39	0.0216%	0.0216%
40	0.0288%	0.0288%
41	0.0288%	0.0288%
42	0.0288%	0.0288%
43	0.0288%	0.0288%
44	0.0288%	0.0288%
45	0.0432%	0.0432%
46	0.0432%	0.0432%
47	0.0432%	0.0432%
48	0.0432%	0.0432%
49	0.0432%	0.0432%
50	0.0864%	0.0864%
51	0.0864%	0.0864%
52	0.0864%	0.0864%
53	0.0864%	0.0864%
54	0.0864%	0.0864%
55	0.1728%	0.1728%
56	0.1728%	0.1728%
57	0.1728%	0.1728%
58	0.1728%	0.1728%
59	0.1728%	0.1728%
60+	0.3456%	0.3456%

Proposed Actuarial Assumptions
Based on 2011-2016 Experience Study

Healthy Post-Retirement Mortality Rates

Age in 2014	% Dying Next Year* Male	% Dying Next Year* Female	Age in 2014	% Dying Next Year* Male	% Dying Next Year* Female
50	0.2901%	0.1983%	81	4.5649%	2.9698%
51	0.3132%	0.2076%	82	5.1526%	3.3342%
52	0.3372%	0.2173%	83	5.8264%	3.7508%
53	0.3597%	0.2270%	84	6.5981%	4.2244%
54	0.3823%	0.2380%	85	7.4705%	4.7673%
55	0.4062%	0.2507%	86	8.4575%	5.3881%
56	0.4271%	0.2649%	87	9.5718%	6.0931%
57	0.4511%	0.2811%	88	10.8173%	6.8978%
58	0.4785%	0.2999%	89	12.2100%	7.8059%
59	0.5097%	0.3213%	90	13.7579%	8.8273%
60	0.5449%	0.3460%	91	15.4043%	9.9693%
61	0.5842%	0.3745%	92	17.1167%	11.2514%
62	0.6284%	0.4069%	93	18.8694%	12.6497%
63	0.6784%	0.4581%	94	20.6464%	14.1496%
64	0.7352%	0.5121%	95	22.4337%	15.7376%
65	0.8004%	0.5689%	96	24.4141%	17.4016%
66	0.8756%	0.6292%	97	26.4553%	19.1320%
67	0.9626%	0.6936%	98	28.5895%	20.9906%
68	1.0635%	0.7637%	99	30.7819%	22.9409%
69	1.1800%	0.8407%	100	32.7946%	24.9822%
70	1.3130%	0.9263%	101	34.8165%	27.1056%
71	1.4640%	1.0217%	102	36.8146%	29.1512%
72	1.6348%	1.1292%	103	38.7729%	31.1799%
73	1.8265%	1.2499%	104	40.6757%	33.2133%
74	2.0416%	1.3846%	105	42.4925%	35.2368%
75	2.2822%	1.5368%	106	44.2360%	37.2249%
76	2.5533%	1.7082%	107	45.8753%	39.1637%
77	2.8592%	1.9014%	108	47.4112%	41.0451%
78	3.2065%	2.1197%	109	48.8394%	42.8258%
79	3.6005%	2.3679%	110	50.1568%	44.5311%
80	4.0503%	2.6497%			

* *The rates shown are RP-2014 mortality for healthy annuitants, with adjustments, if applicable (see Section G). Recommended rates include adjustments for white collar and mortality improvements using projection scale MP-2016.*

Proposed Actuarial Assumptions
Based on 2011-2016 Experience Study

Healthy Pre-Retirement Mortality Rates

Age in 2014	% Dying Next Year* Male	% Dying Next Year* Female	Age in 2014	% Dying Next Year* Male	% Dying Next Year* Female
20	0.0286%	0.0145%	46	0.0799%	0.0638%
21	0.0318%	0.0145%	47	0.0893%	0.0707%
22	0.0349%	0.0145%	48	0.0998%	0.0779%
23	0.0368%	0.0145%	49	0.1114%	0.0858%
24	0.0368%	0.0145%	50	0.1240%	0.0944%
25	0.0355%	0.0145%	51	0.1379%	0.1036%
26	0.0343%	0.0162%	52	0.1531%	0.1136%
27	0.0335%	0.0167%	53	0.1684%	0.1245%
28	0.0333%	0.0171%	54	0.1850%	0.1361%
29	0.0333%	0.0180%	55	0.2032%	0.1487%
30	0.0344%	0.0190%	56	0.2237%	0.1620%
31	0.0354%	0.0203%	57	0.2474%	0.1761%
32	0.0367%	0.0216%	58	0.2747%	0.1909%
33	0.0379%	0.0231%	59	0.3064%	0.2067%
34	0.0388%	0.0247%	60	0.3429%	0.2234%
35	0.0399%	0.0261%	61	0.3846%	0.2415%
36	0.0408%	0.0277%	62	0.4320%	0.2612%
37	0.0417%	0.0296%	63	0.4856%	0.2829%
38	0.0431%	0.0318%	64	0.5457%	0.3067%
39	0.0448%	0.0342%	65	0.6130%	0.3335%
40	0.0472%	0.0370%	66	0.6874%	0.3715%
41	0.0502%	0.0400%	67	0.7705%	0.4142%
42	0.0539%	0.0435%	68	0.8641%	0.4623%
43	0.0588%	0.0476%	69	0.9695%	0.5164%
44	0.0647%	0.0524%	70	1.0883%	0.5771%
45	0.0716%	0.0578%			

* *The rates shown are RP-2014 mortality for employees, with adjustments, if applicable (see Section G). Recommended rates include adjustments for white collar and mortality improvements using projection scale MP-2016.*

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SECTION K

GLOSSARY

Glossary

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

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

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

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

Decrements. The decrements are the means by which a member ceases to be a member. For active members, the decrements are death, 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.

Glossary

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.

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

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

2011-2016 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	189	2.63%	7.75%
2	998	7.45%	8.18%
3	807	5.57%	8.01%
4	658	4.32%	7.78%
5	548	4.85%	7.51%
6	492	4.91%	7.25%
7	515	4.78%	6.97%
8	538	5.21%	6.76%
9	528	5.10%	6.52%
10	569	4.23%	6.25%
11	647	4.43%	6.01%
12	677	3.37%	5.77%
13	664	3.75%	5.53%
14	750	3.28%	5.30%
15	766	3.39%	5.10%
16	713	2.51%	4.85%
17	662	2.43%	4.69%
18	645	2.37%	4.65%
19	570	2.54%	4.59%
20	472	3.02%	4.54%
21	431	2.11%	4.50%
22	369	2.33%	4.45%
23	310	1.91%	4.40%
24	269	1.66%	4.38%
25	242	1.83%	4.35%
26	253	1.82%	4.35%
27	251	1.55%	4.33%
28	222	1.54%	4.31%
29	183	1.96%	4.29%
30+	609	1.42%	4.18%
Totals	**15,547**	**3.66%**	**5.82%**

Appendix – Detailed Experience Analysis
Salary Increases

2011-2012 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	26	0.01%	7.78%
2	116	7.85%	8.22%
3	125	6.10%	8.05%
4	97	3.91%	7.80%
5	127	5.20%	7.47%
6	95	4.65%	7.20%
7	127	4.11%	6.92%
8	149	5.30%	6.84%
9	116	4.87%	6.55%
10	127	4.29%	6.23%
11	163	5.17%	6.05%
12	153	4.32%	5.78%
13	175	4.10%	5.55%
14	193	3.30%	5.30%
15	167	3.63%	5.07%
16	113	2.22%	4.80%
17	110	2.09%	4.66%
18	138	2.13%	4.60%
19	97	1.75%	4.50%
20	94	3.19%	4.50%
21	61	1.84%	4.46%
22	53	1.75%	4.39%
23	70	1.63%	4.40%
24	55	1.95%	4.33%
25	52	2.22%	4.37%
26	66	1.30%	4.39%
27	50	1.64%	4.34%
28	36	1.04%	4.29%
29	25	2.01%	4.21%
30+	131	0.89%	4.17%
Totals	**3,107**	**3.60%**	**5.75%**

Appendix – Detailed Experience Analysis
Salary Increases

2012-2013 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	48	2.60%	7.90%
2	183	7.37%	8.25%
3	116	4.73%	7.98%
4	127	3.49%	7.78%
5	104	3.79%	7.54%
6	127	3.58%	7.26%
7	89	3.91%	6.96%
8	123	4.48%	6.70%
9	141	4.59%	6.58%
10	127	4.09%	6.32%
11	109	3.81%	5.98%
12	166	2.86%	5.81%
13	142	3.52%	5.59%
14	170	2.19%	5.32%
15	184	2.74%	5.08%
16	165	1.67%	4.85%
17	106	2.01%	4.66%
18	110	1.34%	4.62%
19	128	2.10%	4.57%
20	89	1.73%	4.50%
21	90	1.09%	4.46%
22	57	2.03%	4.45%
23	50	-0.01%	4.35%
24	66	1.16%	4.39%
25	52	1.01%	4.31%
26	52	1.51%	4.33%
27	61	-0.01%	4.35%
28	49	1.36%	4.30%
29	30	1.80%	4.28%
30+	130	0.86%	4.15%
Totals	**3,191**	**2.93%**	**5.79%**

Appendix – Detailed Experience Analysis
Salary Increases

2013-2014 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	48	1.03%	7.86%
2	245	7.25%	8.27%
3	153	5.35%	8.00%
4	107	4.67%	7.76%
5	106	4.80%	7.56%
6	100	6.13%	7.27%
7	107	5.11%	7.03%
8	84	4.88%	6.73%
9	110	5.76%	6.47%
10	136	4.17%	6.34%
11	117	4.19%	6.05%
12	109	3.38%	5.72%
13	148	3.42%	5.58%
14	142	3.92%	5.33%
15	148	3.43%	5.11%
16	174	3.40%	4.81%
17	160	2.42%	4.67%
18	94	3.02%	4.64%
19	105	2.57%	4.57%
20	116	3.29%	4.55%
21	84	3.03%	4.47%
22	84	2.94%	4.43%
23	53	2.63%	4.42%
24	46	2.49%	4.32%
25	62	1.30%	4.36%
26	48	1.41%	4.28%
27	47	1.85%	4.31%
28	55	1.09%	4.34%
29	44	1.76%	4.29%
30+	111	2.08%	4.16%
Totals	**3,143**	**3.86%**	**5.83%**

Appendix – Detailed Experience Analysis
Salary Increases

2014-2015 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	44	2.74%	7.51%
2	255	7.28%	7.97%
3	222	5.90%	8.03%
4	134	5.64%	7.74%
5	91	5.41%	7.44%
6	97	6.43%	7.24%
7	104	5.28%	6.90%
8	101	6.46%	6.68%
9	75	5.62%	6.30%
10	108	4.71%	6.06%
11	160	4.49%	5.91%
12	128	3.57%	5.59%
13	109	4.23%	5.27%
14	155	4.22%	5.21%
15	133	4.15%	5.03%
16	140	2.92%	4.81%
17	155	3.21%	4.64%
18	153	3.73%	4.65%
19	90	4.11%	4.60%
20	85	3.95%	4.58%
21	104	2.98%	4.51%
22	64	3.37%	4.42%
23	66	3.01%	4.35%
24	34	1.71%	4.41%
25	28	3.30%	4.27%
26	52	3.25%	4.35%
27	39	2.88%	4.29%
28	43	3.14%	4.29%
29	41	3.13%	4.31%
30+	96	2.57%	4.17%
Totals	**3,106**	**4.50%**	**5.85%**

Appendix – Detailed Experience Analysis
Salary Increases

2015-2016 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	23	8.81%	7.59%
2	199	7.74%	8.23%
3	191	5.51%	8.00%
4	193	3.97%	7.81%
5	120	5.03%	7.54%
6	73	3.90%	7.31%
7	88	5.61%	7.08%
8	81	4.95%	6.81%
9	86	4.97%	6.61%
10	71	3.75%	6.31%
11	98	4.07%	6.11%
12	121	2.62%	5.93%
13	90	3.36%	5.66%
14	90	2.63%	5.35%
15	134	3.18%	5.21%
16	121	2.16%	4.99%
17	131	2.12%	4.80%
18	150	1.54%	4.72%
19	150	2.46%	4.68%
20	88	2.87%	4.60%
21	92	1.48%	4.58%
22	111	1.69%	4.52%
23	71	1.97%	4.48%
24	68	1.32%	4.43%
25	48	2.12%	4.41%
26	35	1.71%	4.43%
27	54	2.02%	4.36%
28	39	1.09%	4.31%
29	43	1.14%	4.34%
30+	141	1.13%	4.24%
Totals	**3,000**	**3.39%**	**5.88%**

Appendix – Detailed Experience Analysis
Rule of 90 Retirement

2011-2016 Experience

Age Group	Males				Females			
	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	-	1	0.35	0.0%
56	-	1	0.35	0.0%	-	8	2.80	0.0%
57	1	7	2.45	40.8%	6	31	10.85	55.3%
58	3	13	4.55	65.9%	12	53	18.55	64.7%
59	2	12	4.20	47.6%	20	63	22.05	90.7%
60	4	15	5.25	76.2%	17	62	21.70	78.3%
61	1	12	4.20	23.8%	15	59	20.65	72.6%
62	8	15	5.25	152.4%	12	53	18.55	64.7%
63	6	16	5.60	107.1%	16	51	17.85	89.6%
64	1	10	3.50	28.6%	10	39	15.60	64.1%
Totals	**26**	**101**	**35.35**	**73.6%**	**108**	**420**	**148.95**	**72.5%**

Appendix – Detailed Experience Analysis
Rule of 90 Retirement

2011-2012 Experience

	Males				Females			
Age Group	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	-	-	-	N/A
56	-	-	-	N/A	-	3	1.05	0.0%
57	-	3	1.05	0.0%	-	5	1.75	0.0%
58	2	4	1.40	142.9%	3	11	3.85	77.9%
59	1	3	1.05	95.2%	2	7	2.45	81.6%
60	1	1	0.35	285.7%	3	8	2.80	107.1%
61	-	5	1.75	0.0%	3	12	4.20	71.4%
62	-	1	0.35	0.0%	-	3	1.05	0.0%
63	1	6	2.10	47.6%	2	10	3.50	57.1%
64	-	1	0.35	0.0%	-	2	0.80	0.0%
Totals	**5**	**24**	**8.40**	**59.5%**	**13**	**61**	**21.45**	**60.6%**

2012-2013 Experience

	Males				Females			
Age Group	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	-	-	-	N/A
56	-	1	0.35	0.0%	-	3	1.05	0.0%
57	1	1	0.35	285.7%	2	9	3.15	63.5%
58	-	4	1.40	0.0%	3	10	3.50	85.7%
59	-	2	0.70	0.0%	2	13	4.55	44.0%
60	1	2	0.70	142.9%	2	10	3.50	57.1%
61	-	-	-	N/A	4	7	2.45	163.3%
62	2	5	1.75	114.3%	5	12	4.20	119.0%
63	1	2	0.70	142.9%	-	7	2.45	0.0%
64	1	5	1.75	57.1%	2	8	3.20	62.5%
Totals	**6**	**22**	**7.70**	**77.9%**	**20**	**79**	**28.05**	**71.3%**

2013-2014 Experience

	Males				Females			
Age Group	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	-	-	-	N/A
56	-	-	-	N/A	-	1	0.35	0.0%
57	-	1	0.35	0.0%	3	12	4.20	71.4%
58	-	1	0.35	0.0%	1	9	3.15	31.7%
59	1	4	1.40	71.4%	9	15	5.25	171.4%
60	-	5	1.75	0.0%	2	16	5.60	35.7%
61	-	1	0.35	0.0%	3	12	4.20	71.4%
62	-	-	-	N/A	2	8	2.80	71.4%
63	2	5	1.75	114.3%	4	10	3.50	114.3%
64	-	1	0.35	0.0%	5	11	4.40	113.6%
Totals	**3**	**18**	**6.30**	**47.6%**	**29**	**94**	**33.45**	**86.7%**

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Appendix – Detailed Experience Analysis
Rule of 90 Retirement

2014-2015 Experience

Age Group	Males Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Females Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	-	1	0.35	0.0%
56	-	-	-	N/A	-	-	-	N/A
57	-	1	0.35	0.0%	1	4	1.40	71.4%
58	-	1	0.35	0.0%	4	12	4.20	95.2%
59	-	1	0.35	0.0%	3	14	4.90	61.2%
60	1	4	1.40	71.4%	3	10	3.50	85.7%
61	1	4	1.40	71.4%	3	18	6.30	47.6%
62	3	3	1.05	285.7%	2	12	4.20	47.6%
63	1	1	0.35	285.7%	2	7	2.45	81.6%
64	-	3	1.05	0.0%	2	9	3.60	55.6%
Totals	**6**	**18**	**6.30**	**95.2%**	**20**	**87**	**30.90**	**64.7%**

2015-2016 Experience

Age Group	Males Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Females Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	-	-	N/A	-	-	-	N/A
56	-	-	-	N/A	-	1	0.35	0.0%
57	-	1	0.35	0.0%	-	1	0.35	0.0%
58	1	3	1.05	95.2%	1	11	3.85	26.0%
59	-	2	0.70	0.0%	4	14	4.90	81.6%
60	1	3	1.05	95.2%	7	18	6.30	111.1%
61	-	2	0.70	0.0%	2	10	3.50	57.1%
62	3	6	2.10	142.9%	3	18	6.30	47.6%
63	1	2	0.70	142.9%	8	17	5.95	134.5%
64	-	-	-	N/A	1	9	3.60	27.8%
Totals	**6**	**19**	**6.65**	**90.2%**	**26**	**99**	**35.10**	**74.1%**

Appendix – Detailed Experience Analysis
Non-Rule of 90 Retirement

2011-2016 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	12	106	7.42	161.7%	11	368	18.40	59.8%
56	7	98	6.86	102.0%	22	357	17.85	123.2%
57	3	87	6.09	49.3%	18	328	16.40	109.8%
58	8	87	6.09	131.4%	19	313	15.65	121.4%
59	8	85	5.95	134.5%	20	298	14.90	134.2%
60	11	74	8.14	135.1%	35	272	21.76	160.8%
61	6	64	9.60	62.5%	36	265	29.15	123.5%
62	13	58	11.02	118.0%	40	240	33.60	119.0%
63	13	46	10.58	122.9%	33	181	34.39	96.0%
64	9	33	8.91	101.0%	38	144	34.56	110.0%
65	8	36	11.56	69.2%	47	141	54.15	86.8%
66	6	25	8.75	68.6%	42	89	33.85	124.1%
67	5	17	5.95	84.0%	20	51	18.90	105.8%
68	6	14	4.90	122.4%	12	31	11.30	106.2%
69	5	10	3.50	142.9%	6	23	8.50	70.6%
70+	5	12	12.00	41.7%	28	84	84.00	33.3%
Totals	**125**	**852**	**127.32**	**98.2%**	**427**	**3,185**	**447.36**	**95.4%**

Appendix – Detailed Experience Analysis
Non-Rule of 90 Retirement

2011-2012 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	-	17	1.19	0.0%	1	83	4.15	24.1%
56	1	21	1.47	68.0%	1	71	3.55	28.2%
57	1	17	1.19	84.0%	1	66	3.30	30.3%
58	-	20	1.40	0.0%	3	70	3.50	85.7%
59	1	19	1.33	75.2%	1	68	3.40	29.4%
60	3	13	1.43	209.8%	2	60	4.80	41.7%
61	1	16	2.40	41.7%	6	69	7.59	79.1%
62	2	14	2.66	75.2%	3	47	6.58	45.6%
63	5	10	2.30	217.4%	3	32	6.08	49.3%
64	2	4	1.08	185.2%	5	26	6.24	80.1%
65	-	6	1.94	0.0%	6	28	10.70	56.1%
66	1	3	1.05	95.2%	6	16	6.05	99.2%
67	-	2	0.70	0.0%	5	11	4.00	125.0%
68	2	4	1.40	142.9%	-	4	1.40	0.0%
69	2	2	0.70	285.7%	1	3	1.05	95.2%
70+	1	1	1.00	100.0%	3	17	17.00	17.6%
Totals	**22**	**169**	**23.24**	**94.7%**	**47**	**671**	**89.39**	**52.6%**

2012-2013 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	1	21	1.47	68.0%	1	70	3.50	28.6%
56	1	17	1.19	84.0%	4	79	3.95	101.3%
57	-	19	1.33	0.0%	2	65	3.25	61.5%
58	1	16	1.12	89.3%	4	61	3.05	131.1%
59	3	20	1.40	214.3%	3	62	3.10	96.8%
60	3	18	1.98	151.5%	4	62	4.96	80.6%
61	1	10	1.50	66.7%	9	58	6.38	141.1%
62	1	15	2.85	35.1%	11	61	8.54	128.8%
63	1	12	2.76	36.2%	7	40	7.60	92.1%
64	-	5	1.35	0.0%	4	31	7.44	53.8%
65	-	3	0.97	0.0%	11	23	8.65	127.2%
66	-	7	2.45	0.0%	10	23	8.35	119.8%
67	-	2	0.70	0.0%	3	10	3.80	78.9%
68	1	2	0.70	142.9%	3	6	2.25	133.3%
69	-	2	0.70	0.0%	1	5	1.75	57.1%
70+	-	1	1.00	0.0%	2	17	17.00	11.8%
Totals	**13**	**170**	**23.47**	**55.4%**	**79**	**673**	**93.57**	**84.4%**

2013-2014 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	3	22	1.54	194.8%	4	67	3.35	119.4%
56	-	20	1.40	0.0%	3	67	3.35	89.6%
57	-	17	1.19	0.0%	6	70	3.50	171.4%
58	1	19	1.33	75.2%	1	66	3.30	30.3%
59	2	16	1.12	178.6%	7	53	2.65	264.2%
60	2	14	1.54	129.9%	6	55	4.40	136.4%
61	2	15	2.25	88.9%	8	55	6.05	132.2%
62	2	10	1.90	105.3%	9	44	6.16	146.1%
63	4	13	2.99	133.8%	6	46	8.74	68.6%
64	4	11	2.97	134.7%	6	29	6.96	86.2%
65	2	9	2.95	67.8%	11	34	12.95	84.9%
66	1	3	1.05	95.2%	5	12	4.50	111.1%
67	2	7	2.45	81.6%	3	13	4.70	63.8%
68	-	2	0.70	0.0%	3	7	2.60	115.4%
69	-	1	0.35	0.0%	-	5	1.90	0.0%
70+	1	3	3.00	33.3%	7	21	21.00	33.3%
Totals	**26**	**182**	**28.73**	**90.5%**	**85**	**644**	**96.11**	**88.4%**

Appendix – Detailed Experience Analysis
Non-Rule of 90 Retirement

2014-2015 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	4	24	1.68	238.1%	2	72	3.60	55.6%
56	3	19	1.33	225.6%	7	70	3.50	200.0%
57	1	19	1.33	75.2%	4	63	3.15	127.0%
58	4	17	1.19	336.1%	4	62	3.10	129.0%
59	2	18	1.26	158.7%	4	60	3.00	133.3%
60	2	14	1.54	129.9%	11	44	3.52	312.5%
61	1	12	1.80	55.6%	6	48	5.28	113.6%
62	6	11	2.09	287.1%	8	45	6.30	127.0%
63	3	7	1.61	186.3%	10	33	6.27	159.5%
64	3	9	2.43	123.5%	17	38	9.12	186.4%
65	3	8	2.48	121.0%	12	27	10.35	115.9%
66	3	7	2.45	122.4%	15	23	8.95	167.6%
67	2	2	0.70	285.7%	5	9	3.15	158.7%
68	3	6	2.10	142.9%	4	10	3.50	114.3%
69	1	2	0.70	142.9%	3	4	1.55	193.5%
70+	1	3	3.00	33.3%	11	19	19.00	57.9%
Totals	**42**	**178**	**27.69**	**151.7%**	**123**	**627**	**93.34**	**131.8%**

2015-2016 Experience

	Males				Females			
Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
55	4	22	1.54	259.7%	3	76	3.80	78.9%
56	2	21	1.47	136.1%	7	70	3.50	200.0%
57	1	15	1.05	95.2%	5	64	3.20	156.3%
58	2	15	1.05	190.5%	7	54	2.70	259.3%
59	-	12	0.84	0.0%	5	55	2.75	181.8%
60	1	15	1.65	60.6%	12	51	4.08	294.1%
61	1	11	1.65	60.6%	7	35	3.85	181.8%
62	2	8	1.52	131.6%	9	43	6.02	149.5%
63	-	4	0.92	0.0%	7	30	5.70	122.8%
64	-	4	1.08	0.0%	6	20	4.80	125.0%
65	3	10	3.22	93.2%	7	29	11.50	60.9%
66	1	5	1.75	57.1%	6	15	6.00	100.0%
67	1	4	1.40	71.4%	4	8	3.25	123.1%
68	-	-	-	N/A	2	4	1.55	129.0%
69	2	3	1.05	190.5%	1	6	2.25	44.4%
70+	2	4	4.00	50.0%	5	10	10.00	50.0%
Totals	**22**	**153**	**24.19**	**90.9%**	**93**	**570**	**74.95**	**124.1%**

Appendix – Detailed Experience Analysis
Terminations, Service Based

2011-2016 Experience

	Males				Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	157	304	121.60	129.1%	390	775	310.00	125.8%
2	159	446	80.28	198.1%	335	1,297	233.46	143.5%
3	48	268	37.52	127.9%	128	835	116.90	109.5%
4	26	205	20.50	126.8%	69	649	64.90	106.3%
5	18	165	9.90	181.8%	51	507	33.97	150.1%
6	8	153	7.65	104.6%	36	431	25.43	141.6%
7	6	162	7.29	82.3%	27	404	20.60	131.0%
8	8	158	6.48	123.5%	26	454	19.52	133.2%
9	7	157	5.81	120.5%	17	434	15.19	111.9%
10	7	154	5.08	137.7%	19	455	14.11	134.7%
11	8	149	4.32	185.1%	23	516	13.93	165.1%
12	5	156	3.90	128.2%	13	558	12.83	101.3%
13	5	160	3.20	156.3%	16	567	10.77	148.5%
14	7	179	3.58	195.5%	15	599	8.99	166.9%
15 & Over	23	1,829	36.58	62.9%	61	6,001	78.01	78.2%
Totals	**492**	**4,645**	**353.69**	**139.1%**	**1,226**	**14,482**	**978.62**	**125.3%**

Appendix – Detailed Experience Analysis
Terminations, Service Based

2011-2012 Experience

	Males				Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	16	34	13.60	117.6%	31	88	35.20	88.1%
2	13	48	8.64	150.5%	35	161	28.98	120.8%
3	2	49	6.86	29.2%	8	112	15.68	51.0%
4	2	36	3.60	55.6%	3	93	9.30	32.3%
5	1	29	1.74	57.5%	6	101	6.77	88.7%
6	-	23	1.15	0.0%	5	80	4.72	105.9%
7	1	48	2.16	46.3%	1	81	4.13	24.2%
8	1	39	1.60	62.5%	1	117	5.03	19.9%
9	-	28	1.04	0.0%	2	104	3.64	54.9%
10	1	24	0.79	126.3%	1	100	3.10	32.3%
11	1	32	0.93	107.8%	5	136	3.67	136.2%
12	3	44	1.10	272.7%	1	121	2.78	35.9%
13	-	41	0.82	0.0%	2	128	2.43	82.2%
14	1	39	0.78	128.2%	1	140	2.10	47.6%
15 & Over	5	342	6.84	73.1%	8	1,141	14.83	53.9%
Totals	**47**	**856**	**51.65**	**91.0%**	**110**	**2,703**	**142.37**	**77.3%**

2012-2013 Experience

	Males				Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	26	78	31.20	83.3%	54	182	72.80	74.2%
2	27	87	15.66	172.4%	39	254	45.72	85.3%
3	8	37	5.18	154.4%	11	116	16.24	67.7%
4	5	51	5.10	98.0%	8	108	10.80	74.1%
5	2	33	1.98	101.0%	5	93	6.23	80.2%
6	2	31	1.55	129.0%	3	98	5.78	51.9%
7	-	20	0.90	0.0%	5	75	3.83	130.7%
8	1	45	1.85	54.2%	1	82	3.53	28.4%
9	1	38	1.41	71.1%	1	113	3.96	25.3%
10	1	28	0.92	108.2%	2	106	3.29	60.9%
11	3	22	0.64	470.2%	3	95	2.57	117.0%
12	-	34	0.85	0.0%	1	133	3.06	32.7%
13	1	39	0.78	128.2%	1	114	2.17	46.2%
14	-	45	0.90	0.0%	1	130	1.95	51.3%
15 & Over	1	353	7.06	14.2%	4	1,221	15.87	25.2%
Totals	**78**	**941**	**75.97**	**102.7%**	**139**	**2,920**	**197.78**	**70.3%**

2013-2014 Experience

	Males				Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	45	90	36.00	125.0%	118	203	81.20	145.3%
2	34	100	18.00	188.9%	90	321	57.78	155.8%
3	12	55	7.70	155.8%	37	196	27.44	134.8%
4	7	36	3.60	194.4%	14	109	10.90	128.4%
5	5	44	2.64	189.4%	14	89	5.96	234.8%
6	-	31	1.55	0.0%	5	90	5.31	94.2%
7	-	27	1.22	0.0%	8	96	4.90	163.4%
8	2	19	0.78	256.7%	5	73	3.14	159.3%
9	2	44	1.63	122.9%	4	74	2.59	154.4%
10	2	38	1.25	159.5%	5	108	3.35	149.3%
11	1	24	0.70	143.7%	8	110	2.97	269.4%
12	-	20	0.50	0.0%	4	92	2.12	189.0%
13	2	34	0.68	294.1%	2	130	2.47	81.0%
14	1	39	0.78	128.2%	4	111	1.67	240.2%
15 & Over	2	377	7.54	26.5%	19	1,253	16.29	116.6%
Totals	**115**	**978**	**84.56**	**136.0%**	**337**	**3,055**	**228.08**	**147.8%**

Appendix – Detailed Experience Analysis
Terminations, Service Based

2014-2015 Experience

	Males				Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	50	71	28.40	176.1%	95	156	62.40	152.2%
2	46	119	21.42	214.8%	98	318	57.24	171.2%
3	11	57	7.98	137.8%	32	210	29.40	108.8%
4	6	42	4.20	142.9%	13	153	15.30	85.0%
5	3	23	1.38	217.4%	12	92	6.16	194.7%
6	4	43	2.15	186.0%	11	80	4.72	233.1%
7	3	32	1.44	208.3%	5	86	4.39	114.0%
8	2	28	1.15	174.2%	8	92	3.96	202.2%
9	2	17	0.63	318.0%	6	65	2.28	263.7%
10	2	44	1.45	137.7%	5	73	2.26	220.9%
11	1	35	1.02	98.5%	7	106	2.86	244.6%
12	-	26	0.65	0.0%	-	100	2.30	0.0%
13	1	19	0.38	263.2%	3	85	1.62	185.8%
14	2	37	0.74	270.3%	6	135	2.03	296.3%
15 & Over	4	384	7.68	52.1%	15	1,207	15.69	95.6%
Totals	**137**	**977**	**80.66**	**169.8%**	**316**	**2,958**	**212.60**	**148.6%**

2015-2016 Experience

	Males				Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	20	31	12.40	161.3%	92	146	58.40	157.5%
2	39	92	16.56	235.5%	73	243	43.74	166.9%
3	15	70	9.80	153.1%	40	201	28.14	142.1%
4	6	40	4.00	150.0%	31	186	18.60	166.7%
5	7	36	2.16	324.1%	14	132	8.84	158.3%
6	2	25	1.25	160.0%	12	83	4.90	245.0%
7	2	35	1.58	127.0%	8	66	3.37	237.7%
8	2	27	1.11	180.7%	11	90	3.87	284.2%
9	2	30	1.11	180.2%	4	78	2.73	146.5%
10	1	20	0.66	151.5%	6	68	2.11	284.6%
11	2	36	1.04	191.6%	-	69	1.86	0.0%
12	2	32	0.80	250.0%	7	112	2.58	271.7%
13	1	27	0.54	185.2%	8	110	2.09	382.8%
14	3	19	0.38	789.5%	3	83	1.25	241.0%
15 & Over	11	373	7.46	147.5%	15	1,179	15.33	97.9%
Totals	**115**	**893**	**60.85**	**189.0%**	**324**	**2,846**	**197.80**	**163.8%**

Appendix – Detailed Experience Analysis
Disability Retirements

2011-2016 Experience

Age Group	Actual Disabilities	Exposure	Total Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	2	-	N/A
25-29	-	656	0.11	0.0%
30-34	-	1,617	0.41	0.0%
35-39	-	2,159	0.54	0.0%
40-44	1	2,539	0.86	116.3%
45-49	1	2,433	1.23	81.3%
50-54	3	2,338	2.35	127.7%
55-59	-	2,276	4.58	0.0%
60-64	4	1,581	6.37	62.8%
Totals	**9**	**15,601**	**16.45**	**54.7%**

Appendix – Detailed Experience Analysis
Disability Retirements

2011-2012 Experience

Age Group	Actual Disabilities	Total Exposure	Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	-	-	N/A
25-29	-	119	0.02	0.0%
30-34	-	309	0.07	0.0%
35-39	-	450	0.11	0.0%
40-44	-	521	0.18	0.0%
45-49	-	446	0.23	0.0%
50-54	-	457	0.46	0.0%
55-59	-	486	0.98	0.0%
60-64	1	320	1.29	77.5%
Totals	**1**	**3,108**	**3.34**	**29.9%**

2012-2013 Experience

Age Group	Actual Disabilities	Total Exposure	Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	-	-	N/A
25-29	-	108	0.01	0.0%
30-34	-	318	0.08	0.0%
35-39	-	436	0.11	0.0%
40-44	1	525	0.18	555.6%
45-49	1	461	0.23	434.8%
50-54	1	467	0.47	212.8%
55-59	-	473	0.95	0.0%
60-64	-	340	1.37	0.0%
Totals	**3**	**3,128**	**3.40**	**88.2%**

2013-2014 Experience

Age Group	Actual Disabilities	Total Exposure	Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	-	-	N/A
25-29	-	125	0.02	0.0%
30-34	-	305	0.08	0.0%
35-39	-	447	0.11	0.0%
40-44	-	514	0.18	0.0%
45-49	-	498	0.25	0.0%
50-54	2	457	0.46	434.8%
55-59	-	459	0.92	0.0%
60-64	1	337	1.36	73.5%
Totals	**3**	**3,142**	**3.38**	**88.8%**

Appendix – Detailed Experience Analysis
Disability Retirements

2014-2015 Experience

Age Group	Actual Disabilities	Exposure	Total Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	-	-	N/A
25-29	-	146	0.03	0.0%
30-34	-	337	0.09	0.0%
35-39	-	411	0.11	0.0%
40-44	-	491	0.16	0.0%
45-49	-	509	0.25	0.0%
50-54	-	479	0.48	0.0%
55-59	-	427	0.86	0.0%
60-64	1	312	1.26	79.4%
Totals	**1**	**3,112**	**3.24**	**30.9%**

2015-2016 Experience

Age Group	Actual Disabilities	Exposure	Total Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	2	-	N/A
25-29	-	158	0.03	0.0%
30-34	-	348	0.09	0.0%
35-39	-	415	0.10	0.0%
40-44	-	488	0.16	0.0%
45-49	-	519	0.27	0.0%
50-54	-	478	0.48	0.0%
55-59	-	431	0.87	0.0%
60-64	1	272	1.09	91.7%
Totals	**1**	**3,111**	**3.09**	**32.4%**

Appendix – Detailed Experience Analysis
Post-Retirement Mortality

2011-2016

Age Group	Males				Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
55-59	-	111	0.38	0.0%	1	345	0.81	123.5%
60-64	1	654	4.07	24.6%	7	1,878	8.17	85.7%
65-69	10	1,269	14.08	71.0%	16	3,050	23.86	67.1%
70-74	12	1,133	20.56	58.4%	19	1,941	25.91	73.3%
75-79	18	854	27.35	65.8%	28	1,328	28.97	96.7%
80-84	33	658	39.34	83.9%	25	812	29.02	86.1%
85-89	45	318	33.36	134.9%	33	502	30.56	108.0%
90-94	20	108	18.68	107.1%	29	206	21.62	134.1%
95+	4	11	3.01	132.9%	22	72	12.93	170.1%
Totals	**143**	**5,116**	**160.83**	**88.9%**	**180**	**10,134**	**181.85**	**99.0%**

Appendix – Detailed Experience Analysis
Post-Retirement Mortality

2011-2012 Experience

Age Group	Males				Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
55-59	-	26	0.08	0.0%	-	78	0.18	0.0%
60-64	-	170	1.06	0.0%	3	430	1.86	161.3%
65-69	3	257	2.87	104.5%	3	517	4.04	74.3%
70-74	4	194	3.52	113.6%	3	310	4.25	70.6%
75-79	2	161	5.07	39.4%	9	233	5.09	176.8%
80-84	4	124	7.15	55.9%	4	136	4.82	83.0%
85-89	11	64	6.84	160.8%	5	91	5.33	93.8%
90-94	3	14	2.41	124.5%	9	37	3.89	231.4%
95+	1	2	0.59	169.5%	4	19	3.35	119.4%
Totals	**28**	**1,012**	**29.59**	**94.6%**	**40**	**1,851**	**32.81**	**121.9%**

2012-2013 Experience

Age Group	Males				Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
55-59	-	27	0.09	0.0%	-	69	0.16	0.0%
60-64	-	136	0.84	0.0%	-	385	1.67	0.0%
65-69	2	261	2.86	69.9%	3	577	4.45	67.4%
70-74	2	220	3.98	50.3%	3	339	4.51	66.5%
75-79	8	166	5.35	149.5%	7	249	5.33	131.3%
80-84	6	128	7.57	79.3%	2	154	5.40	37.0%
85-89	8	58	6.16	129.9%	3	99	5.95	50.4%
90-94	6	21	3.58	167.6%	4	34	3.67	109.0%
95+	-	1	0.27	0.0%	6	18	3.28	182.9%
Totals	**32**	**1,018**	**30.70**	**104.2%**	**28**	**1,924**	**34.42**	**81.3%**

2013-2014 Experience

Age Group	Males				Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
55-59	-	24	0.09	0.0%	-	74	0.18	0.0%
60-64	1	126	0.80	125.0%	-	365	1.60	0.0%
65-69	3	247	2.74	109.5%	5	617	4.79	104.4%
70-74	-	227	4.07	0.0%	4	381	5.03	79.5%
75-79	3	171	5.44	55.1%	4	273	5.91	67.7%
80-84	8	140	8.48	94.3%	6	166	5.97	100.5%
85-89	3	54	5.68	52.8%	7	106	6.65	105.3%
90-94	4	23	3.86	103.6%	9	35	3.79	237.5%
95+	-	2	0.52	0.0%	8	15	2.74	292.0%
Totals	**22**	**1,014**	**31.68**	**69.4%**	**43**	**2,032**	**36.66**	**117.3%**

Appendix – Detailed Experience Analysis
Post-Retirement Mortality

2014-2015 Experience

	Males				Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
55-59	-	17	0.06	0.0%	-	66	0.15	0.0%
60-64	-	114	0.71	0.0%	-	352	1.53	0.0%
65-69	-	252	2.79	0.0%	2	649	5.06	39.5%
70-74	1	241	4.38	22.8%	6	446	5.90	101.7%
75-79	2	176	5.68	35.2%	3	278	6.11	49.1%
80-84	8	136	8.35	95.8%	5	171	6.10	82.0%
85-89	14	68	7.13	196.4%	8	108	6.60	121.2%
90-94	2	23	4.03	49.6%	4	44	4.49	89.1%
95+	1	3	0.80	125.0%	2	10	1.76	113.6%
Totals	**28**	**1,030**	**33.93**	**82.5%**	**30**	**2,124**	**37.70**	**79.6%**

2015-2016

	Males				Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
55-59	-	17	0.06	0.0%	1	58	0.14	714.3%
60-64	-	108	0.66	0.0%	4	346	1.51	264.9%
65-69	2	252	2.82	70.9%	3	690	5.52	54.3%
70-74	5	251	4.61	108.5%	3	465	6.22	48.2%
75-79	3	180	5.81	51.6%	5	295	6.53	76.6%
80-84	7	130	7.79	89.9%	8	185	6.73	118.9%
85-89	9	74	7.55	119.2%	10	98	6.03	165.8%
90-94	5	27	4.80	104.2%	3	56	5.78	51.9%
95+	2	3	0.83	241.0%	2	10	1.80	111.1%
Totals	**33**	**1,042**	**34.93**	**94.5%**	**39**	**2,203**	**40.26**	**96.9%**

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality

2011-2016 Experience

Age Group	Males				Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
20-24	-	-	-	N/A	-	2	0.00	0.0%
25-29	-	146	0.05	0.0%	-	510	0.08	0.0%
30-34	-	344	0.16	0.0%	-	1,273	0.27	0.0%
35-39	-	543	0.41	0.0%	-	1,616	0.57	0.0%
40-44	-	697	0.67	0.0%	-	1,842	0.91	0.0%
45-49	-	673	0.82	0.0%	1	1,760	1.32	75.8%
50-54	-	542	0.90	0.0%	2	1,796	1.99	100.6%
55-59	1	467	1.37	73.2%	3	1,809	3.71	80.8%
60-64	2	316	1.74	114.6%	2	1,302	5.11	39.2%
65-69	-	89	0.90	0.0%	-	270	1.90	0.0%
Totals	**3**	**3,817**	**7.02**	**42.7%**	**8**	**12,180**	**15.86**	**50.5%**

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality

2011-2012 Experience

Age Group	Males				Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
20-24	-	-	-	N/A	-	-	-	N/A
25-29	-	31	0.01	0.0%	-	88	0.01	0.0%
30-34	-	58	0.03	0.0%	-	251	0.05	0.0%
35-39	-	118	0.09	0.0%	-	332	0.12	0.0%
40-44	-	148	0.14	0.0%	-	373	0.18	0.0%
45-49	-	118	0.14	0.0%	-	328	0.25	0.0%
50-54	-	103	0.17	0.0%	1	354	0.39	255.9%
55-59	-	97	0.29	0.0%	2	389	0.80	251.2%
60-64	-	66	0.35	0.0%	1	259	0.99	100.8%
65-69	-	14	0.14	0.0%	-	51	0.36	0.0%
Totals	**-**	**753**	**1.37**	**0.0%**	**4**	**2,425**	**3.15**	**126.9%**

2012-2013 Experience

Age Group	Males				Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
20-24	-	-	-	N/A	-	-	-	N/A
25-29	-	27	0.01	0.0%	-	81	0.01	0.0%
30-34	-	65	0.03	0.0%	-	253	0.05	0.0%
35-39	-	114	0.09	0.0%	-	322	0.12	0.0%
40-44	-	149	0.14	0.0%	-	376	0.19	0.0%
45-49	-	124	0.15	0.0%	-	337	0.25	0.0%
50-54	-	106	0.18	0.0%	1	361	0.40	251.2%
55-59	-	96	0.28	0.0%	-	377	0.78	0.0%
60-64	-	69	0.38	0.0%	-	277	1.08	0.0%
65-69	-	14	0.14	0.0%	-	57	0.39	0.0%
Totals	**-**	**764**	**1.40**	**0.0%**	**1**	**2,441**	**3.27**	**30.6%**

2013-2014 Experience

Age Group	Males				Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
20-24	-	-	-	N/A	-	-	-	N/A
25-29	-	27	0.01	0.0%	-	98	0.02	0.0%
30-34	-	65	0.03	0.0%	-	240	0.05	0.0%
35-39	-	111	0.09	0.0%	-	336	0.12	0.0%
40-44	-	139	0.13	0.0%	-	375	0.19	0.0%
45-49	-	139	0.17	0.0%	-	359	0.27	0.0%
50-54	-	105	0.17	0.0%	-	352	0.39	0.0%
55-59	-	95	0.28	0.0%	-	364	0.75	0.0%
60-64	2	70	0.40	500.5%	-	278	1.09	0.0%
65-69	-	20	0.20	0.0%	-	56	0.39	0.0%
Totals	**2**	**771**	**1.48**	**134.8%**	**-**	**2,458**	**3.26**	**0.0%**

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality

2014-2015 Experience

Age Group	Males				Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
20-24	-	-	-	N/A	-	-	-	N/A
25-29	-	31	0.01	0.0%	-	115	0.02	0.0%
30-34	-	73	0.03	0.0%	-	264	0.06	0.0%
35-39	-	105	0.08	0.0%	-	306	0.11	0.0%
40-44	-	129	0.12	0.0%	-	362	0.18	0.0%
45-49	-	143	0.17	0.0%	-	366	0.27	0.0%
50-54	-	112	0.18	0.0%	-	367	0.41	0.0%
55-59	1	95	0.28	362.8%	-	332	0.68	0.0%
60-64	-	60	0.33	0.0%	-	256	1.02	0.0%
65-69	-	23	0.23	0.0%	-	62	0.45	0.0%
Totals	**1**	**771**	**1.44**	**69.4%**	**-**	**2,430**	**3.18**	**0.0%**

2015-2016 Experience

Age Group	Males				Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
20-24	-	-	-	N/A	-	2	0.00	0.0%
25-29	-	30	0.01	0.0%	-	128	0.02	0.0%
30-34	-	83	0.04	0.0%	-	265	0.06	0.0%
35-39	-	95	0.07	0.0%	-	320	0.11	0.0%
40-44	-	132	0.13	0.0%	-	356	0.17	0.0%
45-49	-	149	0.18	0.0%	1	370	0.27	364.1%
50-54	-	116	0.19	0.0%	-	362	0.40	0.0%
55-59	-	84	0.24	0.0%	1	347	0.71	140.7%
60-64	-	51	0.28	0.0%	1	232	0.93	107.9%
65-69	-	18	0.19	0.0%	-	44	0.31	0.0%
Totals	**-**	**758**	**1.33**	**0.0%**	**3**	**2,426**	**2.99**	**100.4%**