North Dakota Teachers' Fund for Retirement

ACTUARIAL EXPERIENCE REVIEW

Analysis of Actuarial Experience During the Period July 1, 2014 through June 30, 2019

March 19, 2020 / Matthew Strom, FSA, MAAA, EA / Tanya Dybal, FSA, MAAA, EA / Kim Nicholl, FSA, MAAA, EA, FCA

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Via Email

March 19, 2020

Board of Trustees
North Dakota Teachers' Fund for Retirement
3442 East Century Avenue
Bismarck, ND 58507-7100

Re: Actuarial Experience Review for the Period July 1, 2014 through June 30, 2019

Dear Trustees:

This report presents the results of the actuarial experience review of the demographic and economic experience of the North Dakota Teachers' Fund for Retirement (TFFR) for the period July 1, 2014 to June 30, 2019.

All current actuarial assumptions were reviewed as part of this study. This study is the basis for our recommendation of the assumptions to be used in the July 1, 2020 valuation.

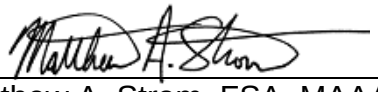
In preparing the results presented in this report, we have relied upon data provided by TFFR regarding the membership census data and financial information. While the scope of our engagement did not call for us to perform an audit or independent verification of this information, we have reviewed it for reasonableness. The accuracy of the results presented in this report is dependent upon the accuracy and completeness of the underlying information.

This review recommends assumptions to be used in the valuation to measure the Fund's financial condition as of a single date. Future actuarial measurements may differ significantly from the current measurements presented in this report due to other assumption sets. This report does not include an analysis of the potential range of such future measurements.

Our analysis was conducted in accordance with generally accepted actuarial principles as prescribed by the Actuarial Standards Board (ASB) and the American Academy of Actuaries. Additionally, the development of all assumptions contained herein is in accordance with ASB Actuarial Standard of Practice (ASOP) No. 27 (*Selection of Economic Assumptions for Measuring Pension Obligations*) and ASOP No. 35 (*Selection of Demographic and Other Non-Economic Assumptions for Measuring Pension Obligations*).

The undersigned are independent. They are Fellows of the Society of Actuaries, Enrolled Actuaries, and members of the American Academy of Actuaries and are experienced in performing experience studies for large public retirement systems. They meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion herein.

Respectively submitted,



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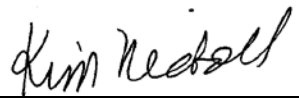

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North Dakota Teachers' Fund for Retirement

Experience Review for the Period July 1, 2014 through June 30, 2019

I. Executive Summary

A. Introduction

Actuarial valuations are prepared annually to determine whether the employer contributions are sufficient to fund the North Dakota Teachers' Fund for Retirement ("TFFR") on an actuarial reserve basis. Each actuarial valuation involves a projection of the benefits expected to be paid in the future to all members of TFFR. The projection of expected future benefit payments is based on the characteristics of members as of the valuation date, the benefit provisions in effect on that date, and assumptions of future events and conditions.

The assumptions used in actuarial valuations can be grouped in two categories: (1) economic assumptions – the assumed long-term rates of investment return, salary increases, and payroll growth, and (2) non-economic or demographic assumptions – the assumed rates of termination, disability, retirement, and mortality. Demographic assumptions are primarily selected on the basis of recent experience (although a change in plan design or the employment environment may suggest otherwise), while economic assumptions rely more on a long-term perspective of expected future trends.

In order to determine the probability of an event occurring, we examine the "decrements" and "exposures" of that event. Using termination from active employment, for example, we compare the number of employees who actually terminate in a certain age and/or service category (i.e., the number of "decrements") with those "who could have terminated" (i.e., the number of "exposures"). For example, if there were 500 active employees in the 20-24 age group at the beginning of the year and 50 of them terminate during the year, we would say the probability of termination in that age group is 50 ÷ 500 or 10%.

When setting the demographic assumptions (other than mortality), we typically develop proposed assumption rates by taking the midpoint of the current assumption rate and the rate that the experience shows for that particular decrement. For example, if the probability of termination in the 20-24 age group is currently 8%, and the experience during the study period shows that 10% of eligible members actually terminated, we would propose adjusting the termination rate to 9%. We choose the midpoint in order to smooth any changes in actual experience in case the experience during the study period is an anomaly.

For the demographic assumptions, we have reviewed the experience during the study period on both a headcount basis and on a benefit-weighted basis in order to determine the appropriate recommendation. For example, a member who is eligible to retire at any retirement age with a large pension may be more likely to retire than a member of the same age with a smaller benefit. Based on our analysis, we have determined that the benefit-weighted approach is the better approach.

If actual experience exactly matches the expected experience, the actual annual cost of TFFR will equal the annual cost determined by the actuarial valuation. However, this result is virtually never achieved, due to the long-term nature of the benefit projections and the numerous assumptions used in actuarial valuations. TFFR recognizes actuarial gains or actuarial losses

each year, reflecting the net difference between actual experience and anticipated experience. Determination of the funded status is updated in connection with each actuarial valuation to reflect the net gain or loss. A pattern of gains or losses with respect to one or more assumptions is the basis for recommended changes to the assumptions. Each valuation measures the effectiveness of each assumption and allows for the monitoring of the assumptions.

Actuarial experience studies are undertaken periodically and serve as the basis for recommended changes in actuarial assumptions and methods. A change in assumptions is recommended when it is demonstrated that the current assumptions do not accurately reflect the current trend determined from analysis of the data or anticipated future trends based upon reasonable expectations. The data analyzed include actual experience for demographic assumptions and economic forecasts for economic assumptions. The Actuarial Standards Board (ASB) provides actuaries with standards of practice that provide guidance and recommendations on acceptable methods and techniques to be used in developing both economic and demographic assumptions. Specifically, these are the ASB Actuarial Standard of Practice (ASOP) No. 27 (*Selection of Economic Assumptions for Measuring Pension Obligations*) and ASOP No. 35 (*Selection of Demographic and Other Non-Economic Assumptions for Measuring Pension Obligations*).

This study reviews the actuarial experience of TFFR for the five-year period beginning July 1, 2014 and ending June 30, 2019, compares this experience to the current actuarial assumptions, and recommends changes to the assumptions as necessary. Economic assumption recommendations were primarily developed based on inputs related to economic forecasts and capital market expectations.

A summary of the key points of our review and our recommendations follows.

B. Recommendations

The experience review provides an opportunity for the Board, staff, and actuary to consider how specific assumptions or methods affect the funding of TFFR, including the funded status and the adequacy of contributions made by members and employers (as compared to the actuarially determined contribution). We have reviewed both economic and demographic experience of the Fund as it relates to the expected actuarial experience based on the current plan assumptions. Included are recommendations for changes in assumptions that we believe will more accurately reflect the future experience of TFFR.

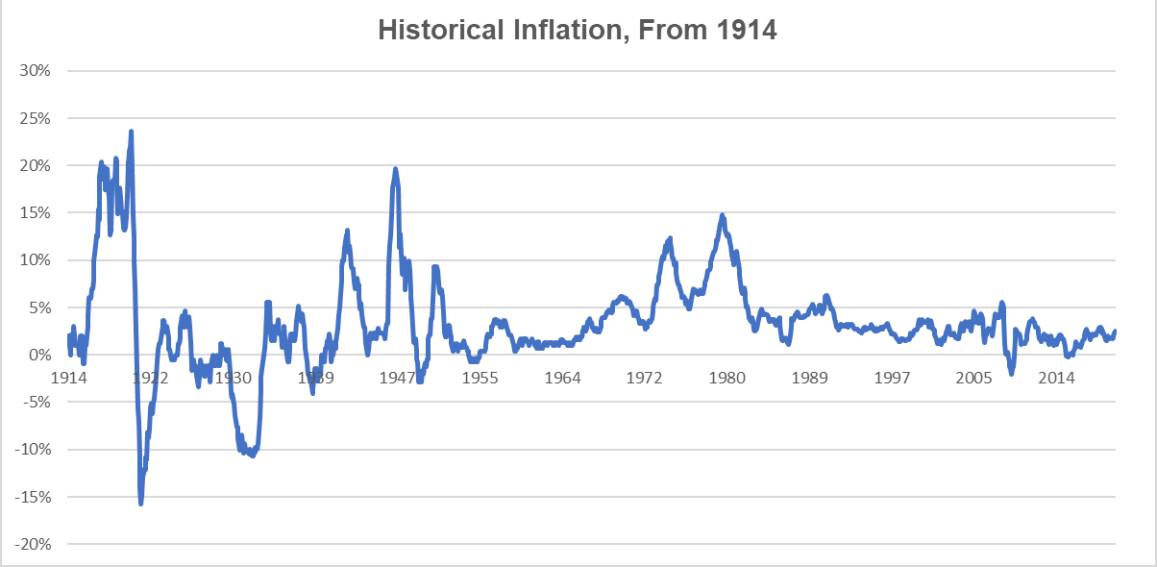
The detailed analysis of each individual assumption is discussed later in this report.

Economic Assumptions

Economic assumptions include inflation, investment rate of return (or discount rate), rate of individual salary increases, and payroll growth.

Inflation

Inflation continues at relatively low levels from a historical perspective, as shown in the graph below.



The current inflation assumption is 2.75% per annum. The outlook for inflation remains slightly less than 2.3%, over a 20 year time horizon according to the Horizon Survey of Capital Market Assumptions (2019 Edition) and other professional forecasters. In light of all sources of inflation expectations reviewed in our study, we recommend lowering the inflation assumption from 2.75% to 2.30%.

The other economic assumptions have an underlying inflation component. The investment return assumption is comprised of inflation and the real rate of return for each asset class. The assumed rates of individual salary increases are comprised of inflation, productivity, and merit and seniority increases. The payroll growth assumption is comprised of inflation and productivity.

Investment Return

The Fund has averaged investment returns of 9.4% and 5.6% over the last 10 years and 20 years, respectfully. The current assumption is 7.75%.

Based on the Fund's target allocation and the 20-year Capital Market Assumptions (CMA) provided in the Horizon Survey of Capital Market Assumptions (2019 Edition), the net expected real rate of investment return (net of investment expenses) is 5.18%, compared to the current assumption of 5.11%. Since we recommend that the inflation assumption be reduced to 2.30%, and the investment return assumption is the combination of expected inflation plus expected real rate of return, the 50th percentile expected return over the next 20 years is 7.48%. We recommend lowering the investment return assumption from 7.75% to 7.25%, which represents a 53% likelihood of achieving 7.25% over the long term.

Rates of Individual Salary Increases

We study the merit and seniority increases (plus productivity) separately from inflation. Analysis of the distribution of merit and seniority increases by years since date of hire during the study period shows that these increases were less than expected for members with less than 10 years since hire date and more than expected for those between 26 and 30 years since hire date. Based on experience, we recommend minor changes to the merit and seniority (and productivity) portion of individual salary increases (full rates in the appendix).

Payroll Growth Rate

The payroll growth rate is used for determining the effective amortization period and to determine the amortization payment of the unfunded actuarial accrued liability when the actuarially determined contribution rate is determined as a level percent-of-payroll. Based upon our analysis, we recommend no change to the current payroll growth assumption of 3.25%.

Demographic Assumptions

The demographic assumptions include mortality, retirement, termination, disability incidence, percent married, and spouse age difference.

Mortality

The current mortality table for the healthy annuitant lives is the RP-2014 Healthy Annuitant Mortality Table (sex distinct) set back one year, multiplied by 50% for ages under 75 and grading up to 100% by age 80, projected generationally using MP-2014 for both males and females. The actual rate of mortality for both males and females was more than expected.

In 2019, the Society of Actuaries published a series of mortality tables derived from public plan experience, called Pub-2010. The published mortality tables are based on three broad categories: teachers, public safety, and general employees. In addition, contingent annuitant tables were published. For purposes of comparing actual experience to expected, the PubT-2010 (the teacher table) have been projected to 2016, the mid-point of the experience study.

We recommend updating the base tables to the appropriate Pub-2010 mortality tables, with adjustments for TFFR-specific experience where credible data exists. In order to reflect future improvements in mortality, we recommend updating the mortality projection scale to MP-2019.

The current mortality table for disabled lives is the RP-2014 Disabled Mortality Table set forward four years. This table was intended to have sufficient margin for future improvements in mortality. Experience for disabled annuitants has been consistent with the current assumptions. However, we recommend updating the base table to the non-safety version of the Pub-2010 mortality table for disabled retirees. In order to reflect future improvements in mortality, we recommend using the MP-2019 mortality projection scale.

The current mortality table for beneficiary lives is the same as the current healthy annuitant lives mortality table. We recommend updating the base tables to the Pub-2010 Contingent Survivor Table and updating the mortality projection scale to MP-2019.

The current mortality table for active members is the RP-2014 Employee Mortality Table, projected generationally using Scale MP-2014. Very few members die in active service and the liability associated with active deaths is a small percentage of the total liability. Since plan experience is insufficient to set the assumption, we recommend using the PubT-2010 Employee Table for active members and applying a generational projection using Scale MP-2019.

Retirement

The eligibility criteria for retirement differs by Tier. Tier 1 members are those hired prior to July 1, 2008. Grandfathered Tier 1 members are those who either were at least age 55 with at least years of service or whose age plus service was at least 65 as of June 30, 2013. Non-grandfathered Tier 1 members are those who do not meet these criteria as of June 30, 2013. Tier 2 members are those hired after June 30, 2008.

Eligibility for unreduced retirement benefits is as follows:

- Tier 1 members are eligible at the earlier of:
  - Age 65 with three years of service
  - If grandfathered, age plus service is at least 85
  - If non-grandfathered, age plus service is at least 90 with a minimum age of 60

- Tier 2 members are eligible at the earlier of:
  - Age 65 with five years of service
  - Age plus service is at least 90 with a minimum of age 60

Eligibility for reduced benefits is as follows:

- For all Tier 1 members, age 55 with three years of service
- For Tier 2 members, age 55 with five years of service.

The current retirement rates vary based on a member's age and gender as well as whether the member is eligible for a reduced or unreduced benefit. In the first year that the member becomes eligible for an unreduced benefit, the unreduced retirement rate is increased by 10%.

We have analyzed retirement experience for the following groups:

- Eligible for a reduced benefit.
- Eligible for an unreduced benefit in the first year only
- Eligible for an unreduced benefit in all other years

There is little Tier 2 retirement experience and grandfathered versus non-grandfathered experience to analyze. However, the retirement rates take into account each member's eligibility requirements.

For reduced benefits, there were slightly more retirements than expected. We recommend minor modifications to rates at a few ages. In addition, because the number of retirements were insufficient to justify gender distinct retirement rates, we recommend use of unisex rates of retirement for reduced benefits.

For unreduced benefits in the first year of eligibility, members retired at an average rate of 35%. After the first year of being eligible for unreduced benefits, members retired at an average rate of 20%. Therefore, we recommend changing the current assumption of a 10% increase in retirement rates for the first year of eligibility for unreduced benefits to 12.5%.

For unreduced benefits after the first year of eligibility, there were fewer retirements than expected. The lower-than-expected actual retirement experience was more prominent for female members than for male members. Therefore, we recommend minor (primarily downward) revisions to the retirement rates.

For inactive vested retirements, the current assumption is that 5% will retire at each early retirement age prior to normal retirement and that 100% of the remaining inactive vested members will retire at normal retirement age. During the experience period, an average of 6.5% of those retired at each early retirement age prior to normal retirement. Therefore, we recommend maintaining the current 5% assumption at each early retirement age prior to normal retirement age.

Termination

The current termination assumptions are gender distinct and based on years since date of hire. Similar to the prior experience review, fewer active members are terminating prior to retirement than expected. For male members, the experience is closer to expected than it is for female members. We recommend that the termination rates be modified (primarily downward) to move towards recent actual experience.

Disability Retirement

The current disability incidence rates are based on age and are unisex. The experience for the period July 1, 2014 to June 30, 2019 shows that approximately one-third of those expected retired with a disability benefit. The prior two experience studies showed that actual disability retirements were close to the expected number. Over the last 15-year period, 80% of those expected retired with a disability benefit. Therefore, we recommend a 20% decrease to the current disability retirement rates.

Spouse Information

Spouse information assumptions affect the valuation and include the percentage of members married and the age difference of spouses. The current assumptions are:

- 75% of members are married
- Male spouses are three years older than female spouses
- 100% of spouses are of the opposite gender

We have limited data on spouse information. However, the current assumptions are reasonable and consistent with assumptions used for similar plans. In addition, all optional forms of payment are actuarially equivalent, so these assumptions do not have a material effect on the valuation results. Therefore, we recommend no change to the current assumptions.

Summary of Actuarial Experience

For the five-year period under review, the Fund has experienced actuarial gains and actuarial losses. Investment returns on the market value of assets has averaged 9.4% and 5.6% over the last 10 and 20 years, respectfully. During the five-year study period, the imputed return on the actuarial value of assets has averaged 7.9%. Experience for all other assumptions has varied between producing gains and losses on a year-by-year basis over the study period, but net experience over the entire period has generally produced actuarial gains. A summary of the historical gains and losses is shown below.

Valuation Date Beginning	Actuarial Accrued Liability (AAL)	Total Actuarial Gain/(Loss)		Investment Gain/(Loss)		Non-Investment Gain/(Loss)	
		Amount	% of AAL	Amount	% of AAL	Amount	% of AAL
July 1, 2019	$3,993,424,160	($10,741,695)	-0.27%	($34,821,389)	-0.87%	$24,079,694	0.60%
July 1, 2018	3,863,515,726	33,266,442	0.86%	4,586,416	0.12%	$28,680,026	0.74%
July 1, 2017	3,734,016,828	20,560,351	0.55%	9,464,023	0.25%	$11,096,328	0.30%
July 1, 2016	3,589,393,851	(41,196,887)	-1.15%	(33,588,108)	-0.94%	(7,608,779)	-0.21%
July 1, 2015	3,449,775,982	48,249,394	1.40%	51,873,093	1.50%	(3,623,699)	-0.11%

Summary of Assumptions and Recommended Changes

The following table summarizes the actuarial assumptions and methods used in the valuation and the changes recommended in this report.

Description	Current	Proposed
Economic Assumptions		
Inflation	2.75%	2.30%
Investment Return	7.75%	7.25%
Salary Scale	Merit/seniority rates (including productivity) based on years since date of hire plus inflation	Minor changes to the merit and seniority (and productivity) portion of individual salary increases for less than 10 years since hire and for between 26 and 30 years since hire
Payroll Growth	3.25%	No change
Demographic Assumptions		
Healthy Mortality	RP-2014 Healthy Annuitant Table, set back one year, multiplied by 50% for ages under 75 and grading up to 100% by age 80 with generational mortality improvement using MP-2014	104% of the PubT-2010 Retiree Table and 95% of the Pub-2010 Contingent Survivor Table with generational mortality improvement using MP-2019
Disabled Mortality	RP-2014 Disabled Mortality Table set forward four years	PubNS-2010 Non-Safety Disabled Mortality Table with generational mortality improvement using MP-2019
Active Mortality	RP-2014 Employee Mortality Table with generational mortality improvement using scale MP-2014	PubT-2010 Employee Table with generational mortality improvement using MP-2019
Active Retirement	For reduced retirement, unisex rates based on age that range from 2% at age 55 to 12% at age 54. For unreduced retirement, gender distinct rates that range from 15% at age 50 to 100% at age 75. In the first year that members become eligible for unreduced benefits, the unreduced retirement benefit is increased 10%.	For reduced retirement, minor changes to the unisex rates. For unreduced retirement, retirement rates are lowered. In the first year that members become eligible for unreduced benefits, the unreduced retirement benefit is increased from 10% to 12.5%.
Inactive Vested Retirement	5% at each early retirement age prior to normal retirement and 100% at normal retirement age.	No change
Termination	Gender distinct rates based on years of service	Minor modifications resulting in generally lower termination rates
Disability Retirement	Age based rates	Decrease current rates by 20%
Spouse Information	75% of members are assumed to be married, male spouses are three years younger than female spouses, and 100% of spouses are the opposite gender	No change

Impact of Assumption and Method Changes on Valuation Results

The following tables detail the impact of recommended assumption changes, using the July 1, 2019 actuarial valuation results for illustrative purposes.

Description ($ in millions)	Current Assumptions	Proposed Mortality Assumptions	Proposed Mortality and Retirement Assumptions	Proposed Mortality, Retirement, Termination and Disability Assumptions
Actuarial Accrued Liability	$3,993.4	$3,882.0	$3,868.6	$3,870.2
Actuarial Value of Assets	2,635.5	2,635.5	2,635.5	2,635.5
Unfunded Actuarial Accrued Liability	1,357.9	1,246.4	1,233.1	1,234.7
Funded Percentage	66.0%	67.9%	68.1%	68.1%
Normal Cost	$86.0	$84.5	$83.9	$84.1
Actuarially Determined Contribution Rate	12.84%	11.60%	11.38%	11.43%
Margin / (Deficit)	(0.09%)	1.15%	1.37%	1.32%
Effective Amortization Period	24 years	21 years	20 years	20 years

Description ($ in millions)	Proposed Demographic and Current Economic Assumptions	Proposed Demographic Assumptions and 7.25% Investment Return	Proposed Demographic Assumptions, 7.25% Investment Return, Salary Increase, and Inflation
Actuarial Accrued Liability	$3,870.2	$4,087.5	$4,046.9
Actuarial Value of Assets	2,635.5	2,635.5	2,635.5
Unfunded Actuarial Accrued Liability	1,234.7	1,451.9	1,411.4
Funded Percentage	68.1%	64.5%	65.1%
Normal Cost	$84.1	$93.8	$88.7
Actuarially Determined Contribution Rate	11.43%	14.17%	13.24%
Margin / (Deficit)	1.32%	(1.42%)	(0.49%)
Effective Amortization Period	20 years	29 years	26 years

The net effect of the recommended demographic assumption changes, using the July 1, 2019 actuarial valuation for illustrative purposes, would have decreased the actuarial accrued liability by approximately $123 million, or 3.1%. The primary driver of the decrease in the actuarial accrued liability is modifying the mortality tables and projection scale, which generally project less improvement in future mortality than MP-2014.

The net effect of the recommended economic assumption changes would have increased the actuarial accrued liability by approximately $177 million, or 4.6%. The primary driver of the increase in the actuarial accrued liability is the lowering of the investment return assumption from 7.75% to 7.25%.

Overall, the recommended demographic and economic changes would increase the actuarial accrued liability by $54 million, or 1.3%, increase the normal cost by $2.7 million, or 3.1%, increase the actuarially determined contribution rate by 0.40% and increase the effective amortization period by two years.

II. Economic Assumptions

The economic assumptions have a significant impact on the development of plan liabilities. Changes to these assumptions can substantially alter the results determined by the actuary. The goal of an experience study is to produce a consistent set of economic assumptions that appropriately reflect expected future economic trends.

The primary economic assumptions that affect TFFR's funding are:

- Inflation;
- Investment Rate of Return;
- Individual Salary Increases; and
- Payroll Growth

The Actuarial Standards Board (ASB) has adopted Actuarial Standard of Practice No. 27 (ASOP 27 - *Selection of Economic Assumptions for Measuring Pension Obligations*) to provide actuaries guidance in developing economic assumptions.

The inflation component is included in all economic assumptions, and therefore is key to developing a consistent set of actuarial assumptions. The investment rate of return assumption includes an inflation component and a real rate of return component. The components of the salary increase assumption are inflation, productivity, and merit and seniority increases. The components of the payroll growth assumption include inflation and productivity.

A. Inflation

In developing the recommendation for the assumed inflation component, actuarial standards of practice suggest the actuary review appropriate inflation data. This data may include consumer price indexes, the implicit price deflator, forecasts of inflation, and yields on government securities of various maturities. For this study, we referred to commonly referenced historical measures of inflation via the National Consumer Price Index for all urban consumers (CPI-U).

The table below shows that recent inflation experience continues at a low rate.

Historical Consumer Price Index – Averages
(U.S. City Average - All Urban Consumers)

Average Annual Change as of June 30, 2019	CPI-U
5-Year Average	1.45%
10-Year Average	1.73%
20-Year Average	2.19%
30-Year Average	2.44%

As can be seen in the table on the prior page, the average annual inflation rates have gradually declined over the last 30 years due to a relatively low inflationary period over the past two decades. Historical trend is a less important consideration for the assumed rate of inflation, but assists in determining the reasonable bounds of expected inflation.

Since 2012, Horizon Actuarial Services, LLC has published survey results that summarize the capital market assumptions of various investment firms. Based on the survey results from the 2019 Edition of the Survey of Capital Market Assumptions, the average 10-year inflation assumption across 34 survey respondents was 2.21% and the average 20-year inflation assumption across a subset of 16 survey respondents was 2.29%.

The table below compares the 2019 Horizon Survey results to other sources.

Source	10-Year	20-Year
Federal Reserve Bank of Philadelphia Fourth Quarter 2019 Survey of Professional Forecasters	2.20%	
Callan	2.25%	
Segal Marco Advisors	2.00%	2.00%
2019 Horizon Survey of Capital Market Assumptions	2.21%	2.29%

Next, we consider the measure of future inflation expectation. An indication of future expectation is a market-based forecast. Treasury Inflation Protection Securities (TIPS) are government bonds, which, in addition to a fixed yield, add the actual percentage change in CPI to the principal value. Therefore, the spread between the TIPS and the Conventional Treasury note/bond of the same maturity is an indication of the market's forecast for inflation.

The following table compares the yields on US Treasury Bonds as of June 30, 2019, with and without inflation indexing.

US Treasury Bonds as of June 30, 2019	10-Year Yield	20-Year Yield	30-Year Yield
Non-Inflation Indexed	2.07%	2.36%	2.57%
Inflation Indexed	0.37%	0.59%	0.79%
Difference	1.70%	1.77%	1.78%

Because of the inflation protection, TIPS' yields are considerably lower than those of regular Treasury securities of similar maturities. As of June 30, 2019, 30-year Treasuries yielded 2.57% while 30-year TIPS yielded 0.79%. In order for 30-year TIPS to match the return of the conventional 30-year Treasury for a buy-and-hold income investor, inflation would have to measure 1.78% per year over the next 30 years. The market's expectation of inflation alone is not a definitive basis for an inflation assumption, but is useful as one indicator of future trend. In addition, it is also important to note that the market's view of inflation over 20 years is essentially the same as over 30 years.

Lastly, we referred to the 2019 report on the financial status of the Social Security program[1]. The projected average increase in price inflation over the next 75 years under the intermediate cost assumptions used in that report was 2.60%. The price inflation measure used in this report is the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W)[2]. Besides projecting the results under the intermediate cost assumptions using an inflation assumption of 2.60%, alternative projections were also made using a lower and a higher inflation assumption of 2.00% and 3.20%, respectively.

The Philadelphia Federal Reserve Bank Survey of Professional Forecasters indicates inflation expectations of a 10-year period of 2.20%. This is consistent with the 10-year projections contained in the Horizon Survey. The 20-year projections in the Horizon Survey indicate inflation of 2.29%. In addition, the market's expectation of inflation over 30 years is consistent with expectations over 20 years. Considering all of this information, we recommend that the assumption be lowered to 2.30%.

[1] Source: Social Security Administration – The 2019 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds

[2] The CPI-W is a more specialized index relative to CPI-U and seeks to track retail prices as they affect urban hourly wage earners and clerical workers. It encompasses about 32 percent of the United States' population and is a subset of the CPI-U group. The CPI-W places a slightly higher weight on food, apparel, transportation, and other goods and services. It places a slightly lower weight on housing, medical care, and recreation. The CPI-U is a more general index and seeks to track retail prices as they affect all urban consumers. It encompasses about 87 percent of the United States' population.

B. Investment Rate of Return

The investment rate of return is used to determine the present value of expected future plan payments. The selection of an investment return assumption considers capital market outlook, the Fund's portfolio mix, and, to a lesser extent, historical returns.

The current investment return assumption is 7.75%, which is comprised of the following components:

- Inflation: 2.75%
- Real rate of return: 5.61%, net of 0.50% for investment expenses
- Adjustment for conservatism: 0.11%

The table below shows the Fund's actual investment returns on a market value basis as well as an actuarial value basis.

Average Annual Return as of June 30, 2019	Market Value of Assets	Actuarial Value of Assets
Past 10 Years	9.4%	5.3%
Past 15 Years	6.6%	6.1%
Past 20 Years	5.6%	5.9%
Past 30 Years	7.5%	7.1%

Investment returns have been less than the 7.75% return assumption on an actuarial value of assets basis. The investment return on the market value of assets basis has been above the current assumption for the past 10 years, but lower than the assumption for other periods. Historical trend is a less important consideration for the assumed rate of investment return, but assists in determining the reasonable bounds of expected investment return,

We based our analysis of the expected real rate of return on the Horizon Survey of Capital Market Assumptions (2019 Edition). This survey compiles and averages the capital market assumptions of 34 investment consultants (including Callan and Segal Marco Advisors). All investment consultants provided assumptions for a 10-year period and 16 respondents provided assumptions for 20-year periods. The expected arithmetic returns are used to determine the expected return by asset class. The 20-year expected geometric real rate of return was generated from the 50th percentile of 5,000 simulated portfolio return trials.

The real return assumptions for the asset classes and the portfolio's expected real return are shown below.

Horizon Study Asset Classes	Horizon Study 20-Year Annual Arithmetic Real Return	Target Allocation	Weighted Real Return
US Core	2.17%	16%	0.35%
Real Estate	5.65%	10%	0.57%
High Yield	4.09%	7%	0.29%
Commodities/Timber	4.00%	2%	0.08%
Infrastructure	6.17%	6%	0.37%
Cash	0.78%	1%	0.01%
US Large Cap	6.05%	24%	1.45%
US Small Cap	7.23%	7%	0.50%
International Developed	7.01%	17%	1.19%
Emerging Markets	9.38%	4%	0.37%
Private Equity	10.53%	6%	0.63%
Total		**100%**	**5.81%**
Adjustment to Geometric			(0.63%)
Geometric Real Rate of Return			**5.18%**

Using the Fund's target asset allocation and the capital market assumptions provided in the 2019 Horizon Survey, the expected real return is 5.18%. This means that over a 20-year period, the Fund is expected to earn an annual rate of return of at least 5.18% half of the time. An expected real rate of return of 4.95% will increase the likelihood of meeting the expectation over a 20-year period to 53%. The following table summarizes the components of the current and proposed investment return assumption.

Assumption Component	Current Assumption	Proposed Assumption
Inflation	2.75%	2.30%
Real Rate of Return	5.11%	5.18%
Adjustment for Adverse Deviation	(0.11%)	(0.23%)
Total Expected Rate of Return	**7.75%**	**7.25%**
Confidence Level	N/A	53.2%

The purpose of the adjustment for adverse deviation is to increase the likelihood of achieving the expected investment return. For example, the 23 basis point reduction in the recommended assumption increases the likelihood of meeting the expectation to 53.2%.

Based on this analysis, we recommend lowering the investment return assumption from 7.75% to 7.25%.

C. Salary Scale

The rate of individual salary increase scale is used to determine members' benefits provided by the Fund. Generally, a member's salary will change over the long term in accordance with inflation, productivity, and merit and seniority scale. The actuary should review available compensation data when selecting this assumption, including the school districts' current compensation practices and any anticipated changes, historical compensation increases and practices of the school districts and other employers in the same industry or geographic area, and historical national wage and productivity growth.

The estimated rate of individual salary increases consists of the following components:

- Inflation
- Productivity
- Merit and seniority increases

The inflation and productivity components are combined to produce the assumed rate of wage inflation. The productivity assumption is currently 1.5%. As described in the next section, we recommend a decrease in the productivity assumption to 1.3%. The inflation and productivity components represents the "across the board" average annual increase in salaries shown in the experience data. The merit component includes the additional increases in salary due to performance, seniority, promotions, etc.

Since merit and seniority increases are unique to each retirement system, it is appropriate to base this assumption on recent experience. We study the merit and seniority increases separately from inflation.

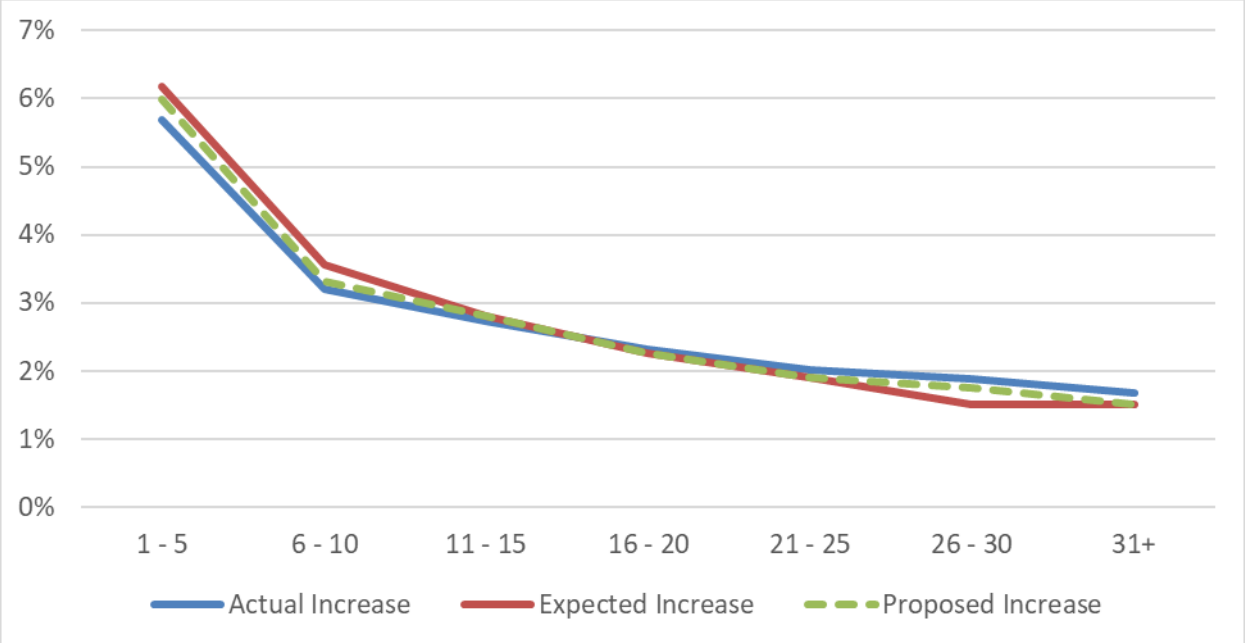
The current salary scale assumption is a table based on years since date of hire. The individual salary increase assumption (including inflation and productivity) ranges from 14.5% during the first year to 4.25% at 26 or more years of service. The historical compensation data, adjusted by approximately 1.5% to account for actual inflation during the study period, was evaluated based on age and years since date of hire age. The strongest relationship continues to be based on members' years since date of hire.

The actual historical compensation data for the experience period (shown in the tables that follow) have been adjusted by approximately 1.5% to account for actual inflation during the study period. The expected salary increase rates have been adjusted by 2.75% to account for our prior assumed rate of inflation. The proposed increase rates are based on ages as of the valuation date and do not reflect any underlying assumptions for inflation, while the proposed increase rates plus inflation reflect our newly proposed assumption for inflation of 2.30%.

The following table and graph shows the actual salary increase experience compared to the current and proposed assumptions. Experience has been adjusted to remove actual inflation over the experience period, which averaged approximately 1.5%.

Years from Hire	Prior Year Salaries (in $000s)	Actual Salaries[3] (in $000s)	Actual Salary Increase	Expected Salary Increases (in $000s)	Expected Salary Increase Rate	Proposed Salary Increase Rate
1 – 5	731,565	773,141	5.68%	776,824	6.19%	6.00%
6 – 10	519,638	536,265	3.20%	538,166	3.57%	3.31%
11 – 15	413,223	424,490	2.73%	424,824	2.81%	2.81%
16 – 20	404,524	413,927	2.32%	413,639	2.25%	2.25%
21 – 25	307,546	313,747	2.02%	313,407	1.91%	1.91%
26 – 30	244,914	249,546	1.89%	248,588	1.50%	1.75%
31+	226,542	230,358	1.68%	229,940	1.50%	1.50%
Total	**2,847,953**	**2,941,473**	**3.28%**	**2,946,389**	**3.42%**	**3.35%**

Graph 1
Salary Increase Experience



[3] Adjusted for actual average inflation of approximately 1.5% during the experience period.

D. Payroll Growth

The payroll growth assumption represents the expected annual increase in total covered payroll from one year to the next. This assumption is used to determine the amortization of unfunded actuarial accrued liability (in the actuarially determined contribution) as a level percentage of payroll. The current assumption for payroll growth is 3.25% per year and consists of the following components:

Component	Current Assumption
Inflation	2.75%
Productivity	1.50%
Adjustment for conservatism	-1.00%
Total	3.25%

Productivity can be measured as the excess of the increase in the National Average Wage over inflation. As of June 2019:

- The 20-year average of the National Average Wage is 3.0%
- The 20-year average inflation is 2.2%

The 0.8% difference between these figures represents the average productivity over the last 20 years. We expect productivity in North Dakota to continue to be greater than the national average, due to its overall strong economy. Therefore, we recommend decreasing the productivity component from 1.5% to 1.3%, which is consistent with the change in national productivity since the prior study (1.0% versus 0.8%)

A lower payroll growth assumption is more conservative. To the extent that actual payroll increases were more than 3.25%, more dollars have gone toward paying off the unfunded liability than anticipated and future amortization payments are lower.

The following table summarizes the Fund's historical payroll and active population growth:

Year Ended June 30	Total Payroll ($ in millions)	Number of Active Members
2019	$680.5	11,175
2014	557.2	10,305
2009	440.0	9,707
2004	376.5	9,826
1999	314.6	10,046

The average increase in covered payroll and active members is shown below:

Period	Increase in Total Payroll	Increase in Active Members
5-year average	4.1%	1.6%
10-year average	4.5%	1.4%
15-year average	4.0%	0.9%
20-year average	3.9%	0.5%

Based on a 30-year open group projection, assuming a level active population and that all recommended demographic assumptions herein are adopted, projected total payroll is expected to increase by 3.0% year, on average, over the long-term and 3.25% over the first ten years.

The following table summarizes the components of the current and recommended payroll growth assumption:

Component	Current	Recommended
Inflation	2.75%	2.30%
Productivity	1.50%	1.30%
Adjustment for Conservatism	-1.00%	-0.35%
Total	3.25%	3.25%

III. Demographic Assumptions

The demographic assumptions used to value TFFR reflect the expected occurrences of various events among members of the Plan. The assumptions should reflect specific characteristics of the Plan and produce reasonable results. A reasonable assumption is one that is expected to model the contingency being measured and not expected to produce significant gains and losses. The types of demographic assumptions used to measure pension obligations include, but are not limited to the following:

- Mortality;
- Retirement;
- Termination;
- Disability incidence; and
- Other assumptions such as percent married and age difference between spouses

The Actuarial Standards Board (ASB) has adopted Actuarial Standard of Practice No. 35 (ASOP 35 – *Selection of Demographic and Other Non-economic Assumptions for Measuring Pension Obligations*) to provide actuaries guidance in developing demographic assumptions. The standard recommends the actuary follow a general process for selecting demographic assumptions. The first step of the general procedure is to identify the types of assumptions to use. The actuary should consider relevant plan provisions that will affect timing and value of any potential benefit payments, all contingencies that give rise to benefits or loss of benefits and the characteristics of the covered group. The next step is to identify the relevant assumption universe. The assumption universe may include prior experience studies or general studies of trends relevant to the type of demographic assumption in addition to plan experience to the extent that it is credible. The third step is to consider the assumption format. The format may include different tables for different segments of the covered population (i.e., different termination rate tables for males/females). The final step is the select the specific assumption and evaluate the reasonableness of each assumption. The specific experience of the Plan should be incorporated but not given undue weight to past experience if recent experience is attributable to a phenomenon that is unlikely to continue. For example, if recent rates of termination were due to a one-time reduction in workforce it may be unreasonable to assume that such rates will continue.

A. Mortality Rates

One of the most significant actuarial assumptions is the probability of death. The mortality assumption takes the form of a mortality table that contains for each age in the table a probability of a person dying between that age and the next. TFFR currently uses three different mortality tables for its members: post-retirement mortality, disabled mortality and pre-retirement mortality.

In 2019, the Society of Actuaries published a series of mortality tables derived from public plan experience, called Pub-2010. The published mortality tables are based on three broad categories: teachers, public safety, and general employees. In addition, the study concluded that surviving annuitants demonstrated worse mortality than the primary annuitants. As a result, separate contingent survivor tables were developed. For purposes of comparing actual experience to expected, the PubT-2010 (the teacher table) have been projected to 2016, the mid-point of the experience study.

We analyzed the experience two ways: one way is solely by number of annuitants while the other way is by weighting the probability of death with each annuitant's pension benefit amount. This methodology takes into consideration the correlation between the annuitant mortality and the level of benefit.

In 2008, the SOA published an article recommending that mortality assumptions include an adjustment for credibility. Under this approach, the number of deaths in a sub-group needed for full credibility for a headcount-weighted mortality table is 1,082. Full credibility in this context means 90% confidence that the actual experience will be within 5% of the expected value.

When reviewing the actual experience under each of the three categories below, we compared the actual experience with the current mortality table and with the applicable Pub-2010 mortality table. After thoroughly reviewing the results, we can conclude that the Pub-2010 mortality tables are more consistent with the actual experience than the prior RP-2014 mortality tables. We recommend updating the base tables to the appropriate Pub-2010 mortality tables, with adjustments for TFFR-specific experience where credible data exists. We also recommend the use of the Pub-2010 Contingent Survivor Mortality Table. In order to reflect future improvements in mortality, we recommend updating the mortality projection scale to MP-2019.

Post-Retirement Healthy Mortality

The mortality experience among retirees and beneficiaries determines the durations over which retirement benefits are paid. Lower mortality rates mean longer benefit payment periods and, therefore, higher benefit costs.

Currently, TFFR uses healthy post-retirement mortality rates based on the RP-2014 Healthy Annuitant Mortality Table (sex distinct) set back one year, multiplied by 50% for ages under 75 and grading up to 100% by age 80, projected generationally using MP-2014 for both males and females.

The experience during the study period shows that, in total, more members in pay status have died than expected. On a benefit-weighted basis, the actual number of deaths was 21% greater than expected. The actual rate of death for females was 16% greater than expected. For males, the actual rate of death was 28% greater than expected. During the experience study period,

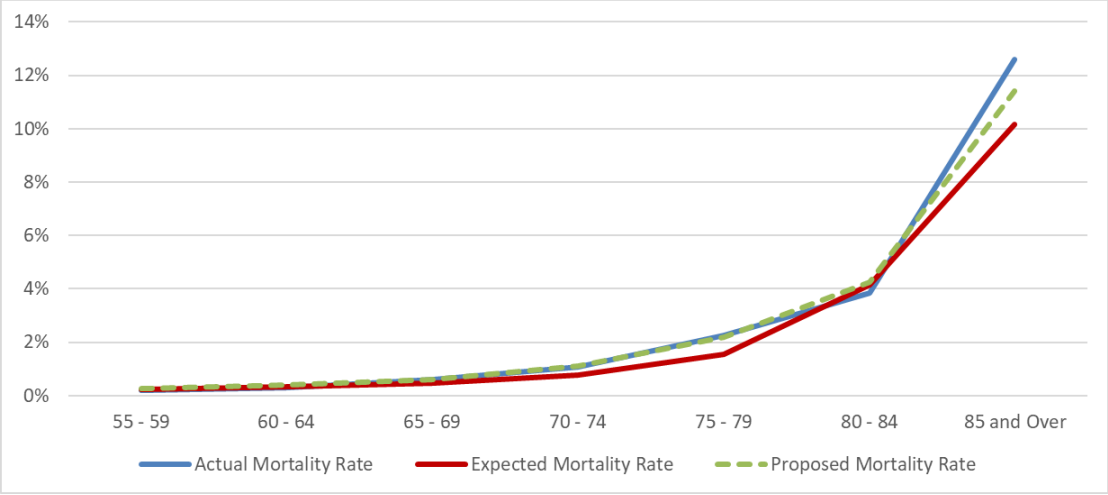
there were 849 actual deaths, resulting in partial credibility of 89%. We used the 89% credibility adjustment to develop the recommended mortality assumptions.

The following table provides a summary of mortality experience for annuitants by basis and gender for the study period:

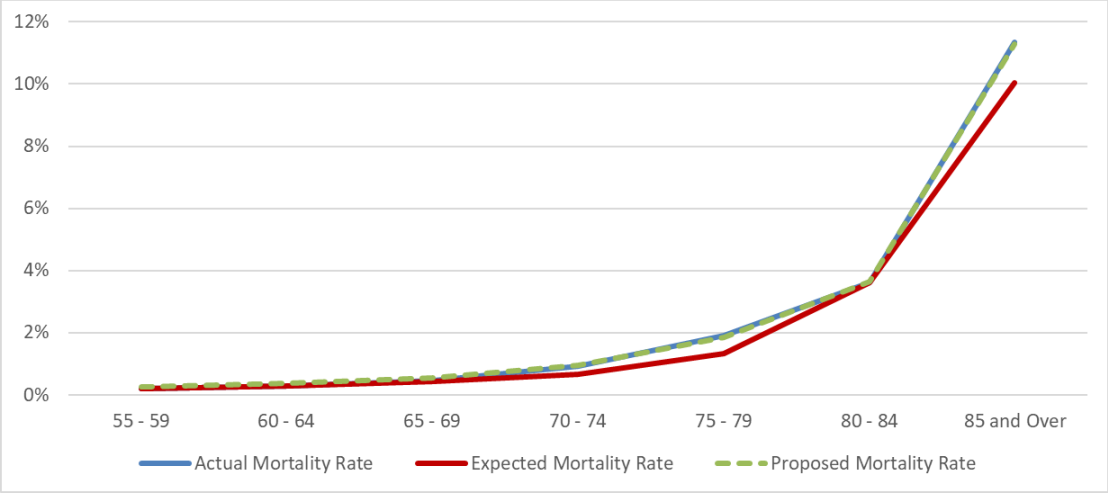
Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected
Basis – Counts				
Female	24,894	521	451	115%
Male	12,319	328	243	135%
Total	**37,213**	**849**	**694**	**122%**
Basis – Benefits (in 000's)				
Female	555,846	6,882	5,939	116%
Male	326,378	6,267	4,905	128%
Total	**882,244**	**13,149**	**10,844**	**121%**

The total number of deaths on a benefit-weighted basis was 13,149. Applying the TFFR exposures to the unadjusted PubT-2010 Retiree Table would result in 12,601 proposed deaths. Applying the credibility-weighted adjustment of 89% would result in 13,048 proposed deaths (a blend of actual experience and unadjusted PubT-2010). Therefore, we recommend that the mortality table be updated to 104% of the PubT-2010 Retiree Table, which would result in 13,105 deaths and is close to the number of credibility-weighted deaths during the study period. The following graphs show the actual mortality rate, expected mortality rate, and proposed mortality rate by total, female, and male.

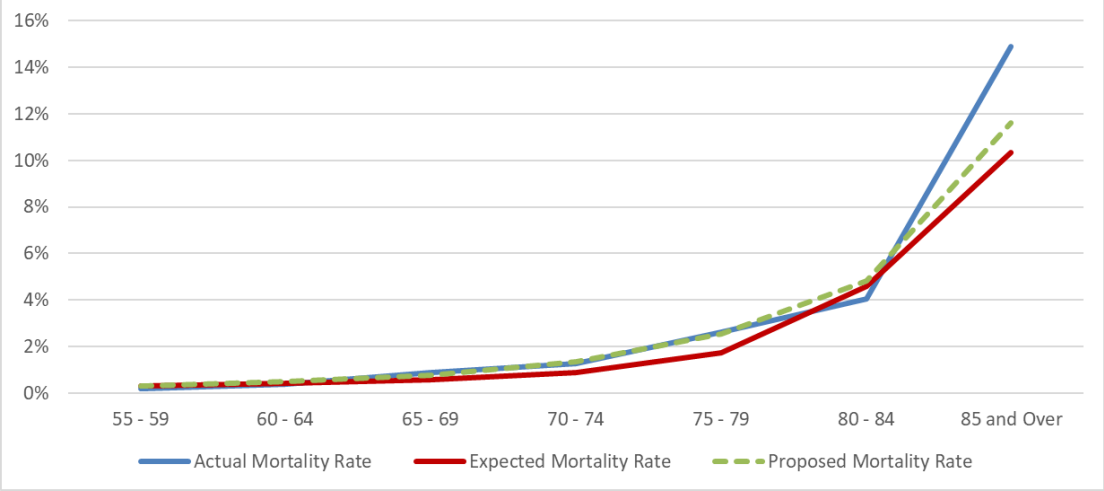
Graph 2
Actual Versus Proposed Experience, Benefit-Weighted Basis
Healthy Retiree Mortality – **Total**



Graph 3
Actual Versus Proposed Experience, Benefit-Weighted Basis
Healthy Retiree Mortality – **Female**



Graph 4
Actual Versus Proposed Experience, Benefit-Weighted Basis
Healthy Retiree Mortality – **Male**



The following table compares the experience during the study period of the actual annuitant deaths to the current assumption and the proposed assumption.

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected	Proposed Deaths	Ratio of Actual to Proposed
Basis – Benefits (in 000's)						
Female	555,846	6,882	5,939	116%	7,093	97%
Male	326,378	6,267	4,905	128%	6,012	104%
Total	**882,244**	**13,149**	**10,844**	**121%**	**13,105**	**100%**

Beneficiary Mortality

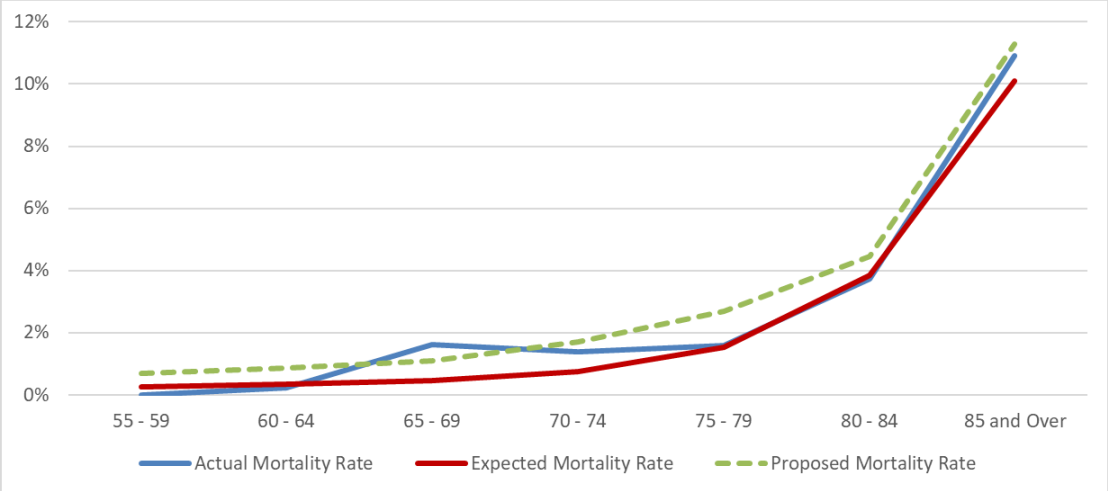
Currently, TFFR uses the same mortality table for beneficiaries that is used for healthy annuitants. The beneficiary experience during the study period shows that, in total, more beneficiaries have died than expected. On a benefit-weighted basis, the rate of death in total was 15% greater than expected. The actual rate of death for females was 11% greater than expected. For males, the actual rate of death was 32% greater than expected. During the experience study period, there were 130 actual deaths, resulting in partial credibility of 35%. We used the 35% credibility adjustment to develop the recommended mortality assumptions.

The following table provides a summary of mortality experience for beneficiaries by basis and gender for the study period:

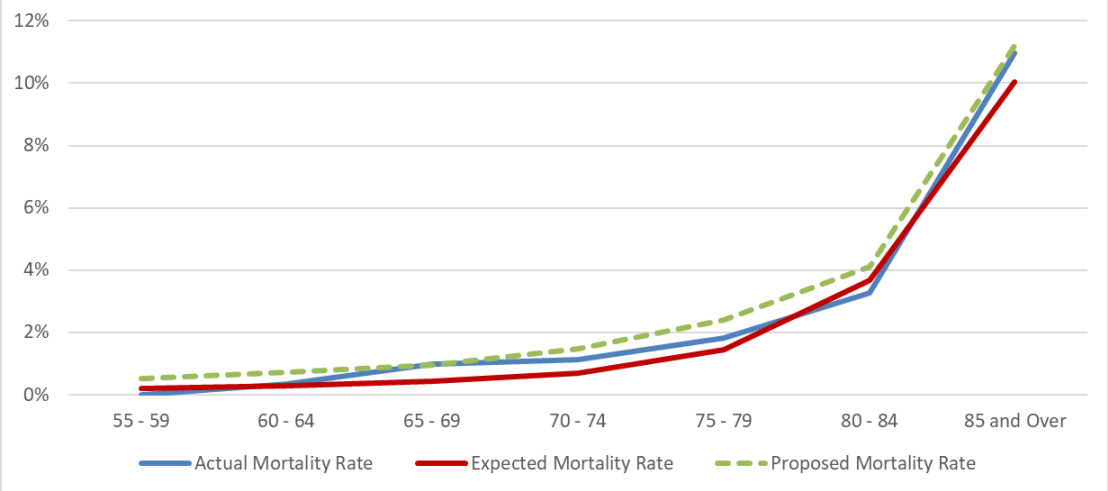
Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected
Basis – Counts				
Female	2,458	104	92	113%
Male	868	26	19	135%
Total	**3,326**	**130**	**112**	**116%**
Basis – Benefits (in 000's)				
Female	36,201	1,326	1,192	111%
Male	11,799	304	230	132%
Total	**48,000**	**1,630**	**1,423**	**115%**

The total number of beneficiary deaths on a benefit-weighted basis was 1,630. Applying the TFFR exposures to the unadjusted Pub-2010 Contingent Survivor Table would result in 1,928 proposed deaths. Applying the credibility-weighted adjustment of 35% would result in 1,828 proposed deaths (a blend of actual experience and unadjusted Pub-2010 Contingent Survivor). Therefore, we recommend that the mortality table be updated to 95% of the Pub-2010 Contingent Survivor Table, which would result in 1,832 deaths and is close to the number of credibility-weighted deaths during the study period. The following graphs show the actual mortality rate, expected mortality rate, and proposed mortality rate by total, female, and male.

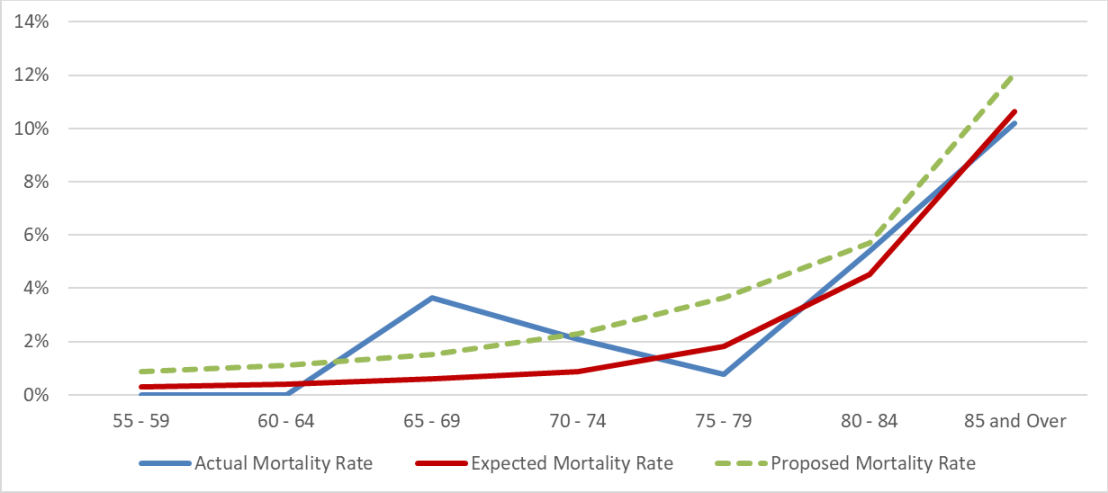
Graph 5
Actual Versus Proposed Experience, Benefit-Weighted Basis
Beneficiary Mortality – **Total**



Graph 6
Actual Versus Proposed Experience, Benefit-Weighted Basis
Beneficiary Mortality – **Female**



Graph 7
Actual Versus Proposed Experience, Benefit-Weighted Basis
Beneficiary Mortality – **Male**



The following table compares the experience during the study period of the actual beneficiary deaths to the current assumption and the proposed assumption.

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected	Proposed Deaths	Ratio of Actual to Proposed
Basis – Benefits (in 000's)						
Female	36,201	1,326	1,192	111%	1,468	90%
Male	11,799	304	230	132%	364	83%
Total	**48,000**	**1,630**	**1,423**	**115%**	**1,832**	**89%**

Disabled Mortality

The current mortality table for disabled lives is the RP-2014 Disabled Mortality Table set forward four years. Experience for disabled annuitants has been consistent with the current assumptions as the ratio of actual to expected deaths on a benefits weighted basis is 92%. However, we recommend updating the base table to the Pub-2010 Non-Safety Disabled Retiree Table. The limited number of actual deaths is insufficient to warrant making an adjustment to the published table. In order to reflect future improvements in mortality, rather than using a static table with margin, we recommend applying generational improvement using Scale MP-2019.

The following table provides a summary of disabled mortality experience by basis in total for the study period:

Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected	Proposed Deaths	Ratio of Actual to Proposed
Basis – Counts					
638	18	20	90%		
Basis – Benefits (in 000's)					
9,373	250	272	92%	229	109%

Pre-Retirement Mortality

First, in combination with withdrawal and disability rates, the pre-retirement mortality table enables the actuary to estimate the number of individuals who will eventually be eligible for a service retirement benefit, and thereby estimate the liability for those individuals. In addition, the death of a member before retirement may result in a benefit payable to a beneficiary, and the liability for these benefits must be taken into account in the valuation.

The current mortality table for active members is the RP-2014 Employee Mortality Table, projected generationally using Scale MP-2014. Very few members die in active service and the liability associated with active deaths is a small percentage of the total liability. Since plan experience is insufficient to set the assumption, we recommend using the PubT-2010 Employee Table for active members and applying a generational projection using Scale MP-2019. The mortality experience of active and terminated vested members is important for several reasons.

B. Retirement Rates

Active Retirement

The eligibility criteria for retirement differs by Tier. Tier 1 members are those hired prior to July 1, 2008. Grandfathered Tier 1 members are those who either were at least age 55 with at least three years of service or whose age plus service was at least 65 as of June 30, 2013. Non-grandfathered Tier 1 members are those who do not meet these criteria as of June 30, 2013. Tier 2 members are those hired after June 30, 2008.

Eligibility for unreduced retirement benefits is as follows:

- Tier 1 members are eligible at the earlier of:
  - Age 65 with three years of service
  - If grandfathered, age plus service is at least 85
  - If non-grandfathered, age plus service is at least 90 with a minimum age of 60
- Tier 2 members are eligible at the earlier of:
  - Age 65 with five years of service
  - Age plus service is at least 90 with a minimum of age 60

Eligibility for reduced benefits is as follows:

- For all Tier 1 members, age 55 with three years of service
- For Tier 2 members, age 55 with five years of service.

The current retirement rates vary based on a member's age and gender as well as whether the member is eligible for a reduced or unreduced benefit. In the first year that the member becomes eligible for an unreduced benefit, the unreduced retirement rate is increased by 10%.

We have analyzed retirement experience on a benefit-weighted basis for the following groups:

- Eligible for a reduced benefit.
- Eligible for an unreduced benefit in the first year only
- Eligible for an unreduced benefit in all other years

There is little Tier 2 retirement experience and grandfathered versus non-grandfathered experience to analyze. However, the retirement rates take into account each member's eligibility requirements.

Reduced Retirement Benefit

The experience showed that there were slightly more retirements than expected. We recommend minor modifications at a few ages. In addition, because the number of retirements were insufficient to justify gender distinct retirement rates, we recommend continued use of unisex rates of retirement for reduced benefits.

The following table compares the experience during the study period of the rate of reduced retirements to the current assumption and the proposed assumption.

Gender	Exposures	Actual Retirements	Expected Retirements	Ratio of Actual to Expected	Proposed Retirements	Ratio of Actual to Proposed
Basis – Benefits (in 000's)						
Total	87,178	4,173	3,278	127%	3,738	112%

The following table and graph shows the actual reduced retirement experience compared to the current and proposed assumptions.

Age	Exposures	Actual Retirements	Actual Retirement Rate	Expected Retirements	Assumed Retirement Rate	Ratio of Actual Rate to Expected Rate	Proposed Retirement Rate
Basis – Benefits (in 000's)							
55	17,281	293	1.70%	346	2.00%	85%	2.00%
56	14,057	330	2.34%	281	2.00%	117%	2.00%
57	12,723	576	4.53%	254	2.00%	226%	3.00%
58	10,256	386	3.76%	308	3.00%	125%	3.50%
59	9,161	408	4.45%	321	3.50%	127%	4.00%
60	7,748	398	5.14%	310	4.00%	128%	5.00%
61	6,014	722	12.01%	391	6.50%	185%	9.00%
62	4,173	448	10.73%	376	9.00%	119%	10.00%
63	3,326	262	7.88%	399	12.00%	66%	11.00%
64	2,440	350	14.36%	293	12.00%	120%	12.00%
Total	**87,178**	**4,173**	**4.79%**	**3,278**	**3.76%**	**127%**	**4.29%**

Graph 8
Actual Versus Proposed Experience, Benefit-Weighted Basis
Reduced Retirement – **Total**

Unreduced Retirement Benefit in the First Year of Eligibility

The experience shows that male and female members who retired in the first year of eligibility for an unreduced benefit retired an average rate of 35%. After the first year of being eligible for unreduced benefits, members retired at an average rate of 20%. Therefore, we recommend changing the current assumption of a 10% increase in retirement rates for the first year of eligibility for unreduced benefits to 12.5%.

Unreduced Retirement Benefit after the First Year of Eligibility

The experience shows that there were fewer retirements than expected. The reduction in retirements was greater for female members than for male members. Therefore, we recommend minor revisions to the retirement rates.

As shown in the table below, the actual number of retirements that occurred after the first year of eligibility for unreduced benefits was 19% less than expected for females and 11% less than expected for males.

Gender	Exposures	Actual Retirements	Expected Retirements	Ratio of Actual to Expected
Basis – Benefits (in 000's)				
Female	128,576	24,905	30,922	81%
Male	55,138	10,880	12,196	89%
Total	**183,714**	**35,785**	**43,118**	**83%**

The following tables and graphs shows the actual unreduced retirement experience compared to the current and proposed assumptions.

Female

Age	Exposures	Actual Retirements	Actual Retirement Rate	Expected Retirements	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate
Basis – Benefits (in 000's)							
<55	2,145	598	27.88%	322	15.00%	186%	15.00%
55	6,566	1,529	23.29%	985	15.00%	155%	15.00%
56	9,022	1,321	14.64%	1,353	15.00%	98%	15.00%
57	10,169	1,241	12.20%	1,525	15.00%	81%	15.00%
58	11,395	1,986	17.43%	1,709	15.00%	116%	15.00%
59	13,302	2,007	15.09%	1,995	15.00%	101%	15.00%
60	14,628	2,207	15.09%	2,194	15.00%	101%	15.00%
61	13,909	3,356	24.13%	3,477	25.00%	97%	25.00%
62	13,064	4,156	31.81%	4,573	35.00%	91%	30.00%
63	10,237	2,177	21.27%	3,071	30.00%	71%	30.00%
64	8,460	3,257	38.50%	3,384	40.00%	96%	40.00%
65	6,855	624	9.10%	3,427	50.00%	18%	35.00%
66	3,306	146	4.41%	1,322	40.00%	11%	30.00%
67	2,371	216	9.12%	711	30.00%	30%	20.00%
68	924	46	5.03%	277	30.00%	17%	20.00%
69	777	8	0.97%	233	30.00%	3%	20.00%
70-74	1,445	31	2.13%	361	25.00%	9%	20.00%
Total	**128,576**	**24,905**	**19.37%**	**30,922**	**24.05%**	**81%**	**22.11%**

Graph 9
Actual Versus Proposed Experience, Benefit-Weighted Basis
Reduced Retirement – **Female**

Male

Age	Exposures	Actual Retirements	Actual Retirement Rate	Expected Retirements	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate
Basis – Benefits (in 000's)							
<55	649	154	23.74%	97	15.00%	158%	15.00%
55	2,381	393	16.49%	357	15.00%	110%	15.00%
56	4,216	679	16.11%	632	15.00%	107%	15.00%
57	5,265	969	18.40%	790	15.00%	123%	15.00%
58	5,453	669	12.26%	818	15.00%	82%	15.00%
59	5,873	1,130	19.25%	881	15.00%	128%	15.00%
60	5,557	1,021	18.38%	834	15.00%	123%	15.00%
61	5,524	2,033	36.81%	1,381	25.00%	147%	30.00%
62	4,205	1,062	25.24%	1,472	35.00%	72%	30.00%
63	4,128	1,021	24.74%	1,032	25.00%	99%	25.00%
64	3,323	1,197	36.00%	1,163	35.00%	103%	35.00%
65	2,935	159	5.40%	1,174	40.00%	14%	30.00%
66	1,911	216	11.30%	573	30.00%	38%	25.00%
67	1,236	67	5.42%	371	30.00%	18%	25.00%
68	624	47	7.53%	156	25.00%	30%	20.00%
69	642	27	4.18%	161	25.00%	17%	20.00%
70-74	1,215	37	3.05%	304	25.00%	12%	20.00%
Total	**55,138**	**10,880**	**19.73%**	**12,196**	**22.12%**	**89%**	**21.20%**

Graph 10
Actual Versus Proposed Experience, Benefit-Weighted Basis
Reduced Retirement – **Male**

Inactive Vested Retirement

The current assumption is that 5% of inactive members will retire at each early retirement age prior to normal retirement and that 100% of the remaining inactive vested members will retire at normal retirement age. During the experience study period, an average of 6.5% of eligible inactive vested members retired at each early retirement age prior to normal retirement. Therefore, we recommend maintaining the current 5% assumption at each early retirement age prior to normal retirement age.

The following table compares the experience during the study period of the rate of inactive vested retirements to the current assumption and the proposed assumption.

Exposures	Actual Retirements	Expected Retirements	Ratio of Actual to Expected	Proposed Retirements	Ratio of Actual to Proposed
Basis – Counts					
2,373	154	119	130%	119	130%

C. Termination

The termination rates used in annual actuarial valuations project the percentage of employees at each age or service duration that will terminate membership before retirement. These rates take account of possible terminations for all causes other than retirement, death, or disability. They include both voluntary and involuntary withdrawals from service.

Terminations before retirement give rise to some benefit rights, but may also involve the forfeiture of a portion of previously accrued benefits. Forfeitures resulting from turnover are anticipated in advance and help finance benefits that become payable to other members.

The termination experience studied includes all terminations of active employment for members not vested at termination (since such members are not eligible for other benefits, termination of employment will, most likely, result in a withdrawal of employee contributions), and terminations of membership for members who were vested and either withdrew their contributions or are eligible for future benefits. Rehired members offset these terminations in order to determine the net terminations for each year.

As shown in the table below, the total rate of terminations (on a benefit-weighted basis) are about 10% less than expected.

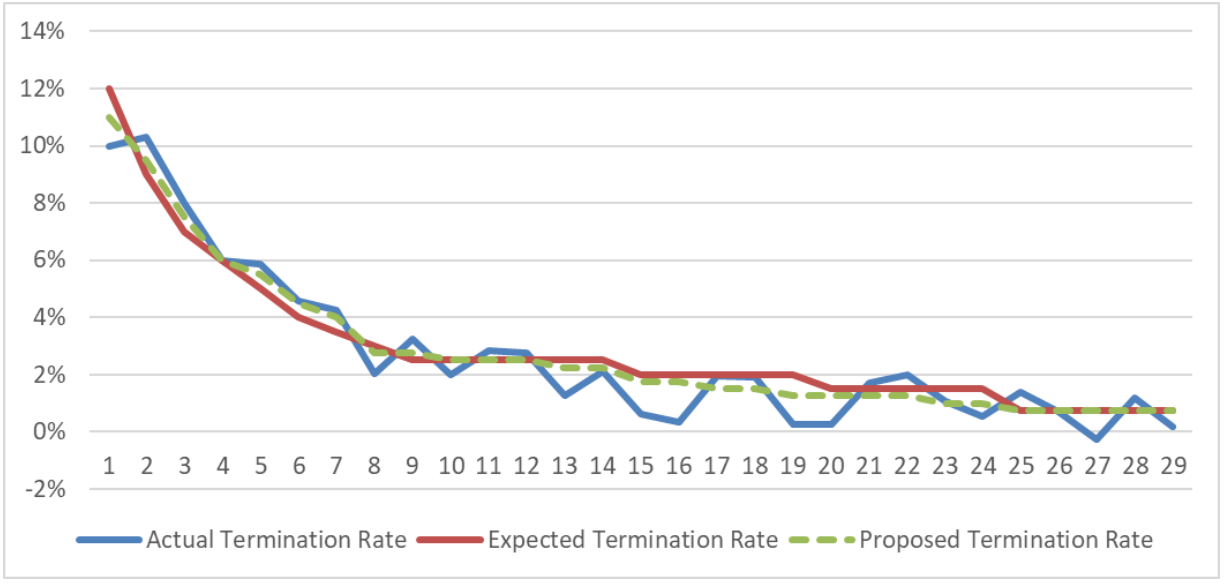
Gender	Exposures	Actual Terminations	Expected Terminations	Ratio of Actual to Expected
Basis – Benefits (in 000's)				
Female	338,406	6,839	7,854	87%
Male	156,525	2,707	2,745	99%
Total	**494,931**	**9,546**	**10,599**	**90%**

The current termination assumptions are sex distinct and based on service. We recommend minor changes (primarily decreases) to the rates of termination. The following tables and graphs show the actual, expected, and proposed termination rates based on years since hire.

Female

Years Since Hire	Exposures	Actual Terminations[4]	Actual Termination Rate	Expected Terminations	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate
Basis – Benefits (in 000's)							
1	2,517	251	9.98%	302	12.00%	83%	11.00%
2	4,914	506	10.29%	442	9.00%	114%	9.50%
3	6,573	527	8.02%	460	7.00%	115%	7.50%
4	7,470	448	6.00%	448	6.00%	100%	6.00%
5	7,643	449	5.88%	382	5.00%	118%	5.50%
6	8,451	387	4.57%	338	4.00%	114%	4.50%
7	9,320	395	4.24%	326	3.50%	121%	4.00%
8	10,201	208	2.04%	306	3.00%	68%	2.75%
9	10,970	356	3.24%	274	2.50%	130%	2.75%
10	11,764	233	1.98%	294	2.50%	79%	2.50%
11	12,296	349	2.84%	307	2.50%	114%	2.50%
12	12,164	337	2.77%	304	2.50%	111%	2.50%
13	12,059	152	1.26%	301	2.50%	50%	2.25%
14	13,280	278	2.09%	332	2.50%	84%	2.25%
15-19	75,251	779	1.04%	1,505	2.00%	52%	1.54%
20-24	70,488	776	1.10%	1,057	1.50%	73%	1.15%
25-29	63,045	407	0.65%	473	0.75%	86%	0.75%
Total	**338,406**	**6,839**	**2.02%**	**7,854**	**2.32%**	**87%**	**2.18%**

Graph 11
Actual Versus Proposed Experience, Benefit-Weighted Basis
Termination Before Retirement – **Female**

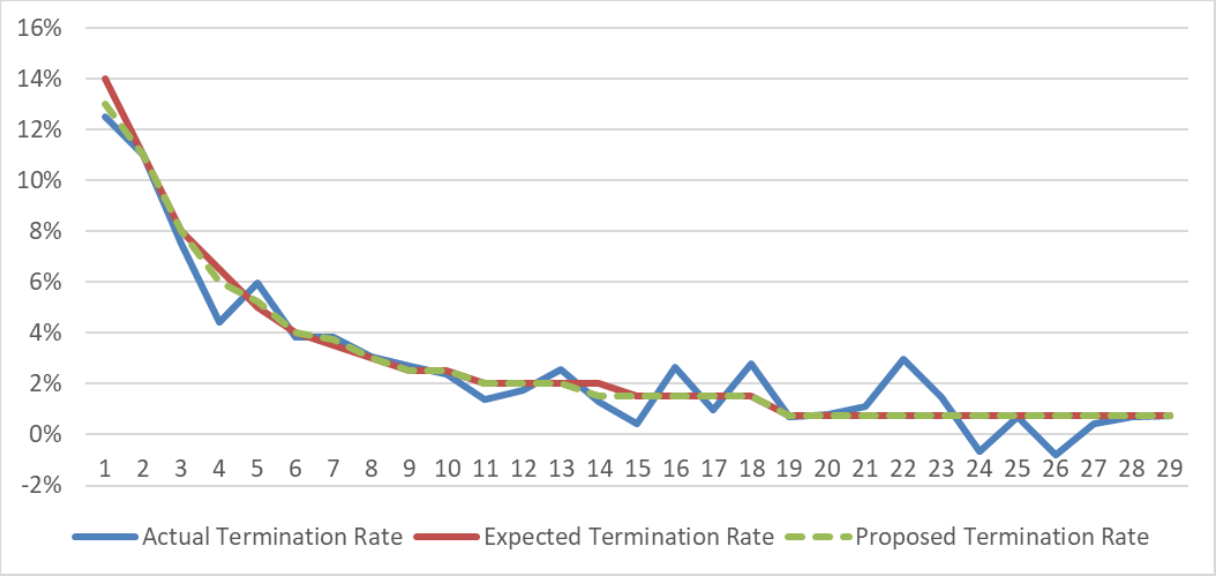


[4] Actual terminations as shown in the table are net of rehired employees.

Male

Years Since Hire	Exposures	Actual Terminations[5]	Actual Termination Rate	Expected Terminations	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate
Basis – Benefits (in 000's)							
1	852	106	12.50%	119	14.00%	89%	13.00%
2	1,639	181	11.03%	180	11.00%	100%	11.00%
3	2,162	163	7.52%	173	8.00%	94%	8.00%
4	2,473	109	4.41%	161	6.50%	68%	6.00%
5	2,529	151	5.97%	126	5.00%	119%	5.25%
6	2,848	109	3.81%	114	4.00%	95%	4.00%
7	3,211	123	3.84%	112	3.50%	110%	3.75%
8	3,963	121	3.06%	119	3.00%	102%	3.00%
9	4,468	120	2.68%	112	2.50%	107%	2.50%
10	4,767	114	2.40%	119	2.50%	96%	2.50%
11	4,995	70	1.40%	100	2.00%	70%	2.00%
12	5,229	90	1.73%	105	2.00%	86%	2.00%
13	5,149	131	2.55%	103	2.00%	128%	2.00%
14	5,275	68	1.28%	105	2.00%	64%	1.50%
15-19	34,028	523	1.54%	450	1.32%	116%	1.32%
20-24	37,129	410	1.11%	278	0.75%	147%	0.75%
25-29	35,809	117	0.33%	269	0.75%	44%	0.75%
Total	**156,525**	**2,707**	**1.73%**	**2,745**	**1.75%**	**99%**	**1.73%**

Graph 12
Actual Versus Proposed Experience, Benefit-Weighted Basis
Termination Before Retirement – **Male**



The schedule of termination rates also include a rate in the first year (i.e., 0 years from hire), which is used in the development of Entry Age Normal cost calculations and is currently 20% for both males and females. Since the census data often does not include members at plan entry, there is insufficient data on which to base this assumption. However, after reviewing the actual experience for members with less than five years since date of hire and extrapolating, we recommend lowering the termination rate in the first year from 20% to 15%.

[5] Actual terminations as shown in the table are net of rehired employees.

D. Disability Retirement

Disability incidence rates function in the same way as retirement rate tables. The rate at each age indicates the probability of becoming disabled before the next age. Disability rates add liability for the value of disability benefits, but lessen the value of retirement benefits ultimately payable, since anyone who becomes disabled is not projected to receive retirement benefits other than the disability benefit.

The current disability rates are based on age and are unisex. The experience for the period July 1, 2014 to June 30, 2019 shows that approximately one-third of those expected retired with a disability benefit. During the study period, there were 15 members who received a disability benefit compared to 41 members who were expected to receive a disability benefit. The prior two experience studies showed that actual disability retirements were close to the expected number. Over the last 15-year period, 80% of those expected retired with a disability benefit. Therefore, we recommend a 20% decrease to the current disability retirement rates.

E. Spouse Information

Spouse information assumptions that affect the valuation include the percentage of members married and the age difference of spouses. The current assumptions are:

- 75% of members are married
- Male spouses are three years older than female spouses
- 100% of spouses are of the opposite gender

We have limited data on spouse information. However, the current assumptions are reasonable and consistent with assumptions used for similar plans. In addition, all optional forms of payment are actuarially equivalent, so these assumptions do not have a material effect on the valuation results. Therefore, we recommend no changes to the current assumptions.

IV. Appendix

Appendix A: Proposed Salary Scale (Service-based Rates, Inclusive of Proposed Inflation)

Years from Hire	Current Total Salary Increase Rate	Proposed Total Salary Increase Rate
1	14.50%	14.80%
2	7.75%	6.80%
3	7.50%	6.55%
4	7.25%	6.30%
5	7.00%	6.30%
6	6.75%	5.80%
7	6.50%	5.80%
8	6.25%	5.55%
9	6.00%	5.55%
10	6.00%	5.30%
11	5.75%	5.30%
12	5.75%	5.30%
13	5.50%	5.05%
14	5.50%	5.05%
15	5.25%	4.80%
16	5.25%	4.80%
17	5.00%	4.55%
18	5.00%	4.55%
19	5.00%	4.55%
20	4.75%	4.30%
21	4.75%	4.30%
22	4.75%	4.30%
23	4.75%	4.30%
24	4.50%	4.05%
25	4.50%	4.05%
26	4.25%	4.05%
27	4.25%	4.05%
28	4.25%	4.05%
29	4.25%	4.05%
30	4.25%	4.05%
31 and over	4.25%	3.80%

Appendix B: Proposed Retirement Rates (Age-based Rates)

Age	Unreduced Retirement[6]				Reduced Retirement	
	Female		Male		Unisex	
	Current Rate	Proposed Rate	Current Rate	Proposed Rate	Current Rate	Proposed Rate
<55	15.0%	15.0%	15.0%	15.0%		
55	15.0%	15.0%	15.0%	15.0%	2.0%	2.0%
56	15.0%	15.0%	15.0%	15.0%	2.0%	2.0%
57	15.0%	15.0%	15.0%	15.0%	2.0%	3.0%
58	15.0%	15.0%	15.0%	15.0%	3.0%	3.5%
59	15.0%	15.0%	15.0%	15.0%	3.5%	4.0%
60	15.0%	15.0%	15.0%	15.0%	4.0%	5.0%
61	25.0%	25.0%	25.0%	30.0%	6.5%	9.0%
62	35.0%	30.0%	35.0%	30.0%	9.0%	10.0%
63	30.0%	30.0%	25.0%	25.0%	12.0%	11.0%
64	40.0%	40.0%	35.0%	35.0%	12.0%	12.0%
65	50.0%	35.0%	40.0%	30.0%		
66	40.0%	30.0%	30.0%	25.0%		
67	30.0%	20.0%	30.0%	25.0%		
68	30.0%	20.0%	25.0%	20.0%		
69	30.0%	20.0%	25.0%	20.0%		
70	25.0%	20.0%	25.0%	20.0%		
71	25.0%	20.0%	25.0%	20.0%		
72	25.0%	20.0%	25.0%	20.0%		
73	25.0%	20.0%	25.0%	20.0%		
74	25.0%	20.0%	25.0%	20.0%		
75	100.0%	100.0%	100.0%	100.0%		

[6] If a member reaches eligibility for unreduced retirement before age 65 under the rule of 85 (Grandfathered Tier 1) or the Rule of 90/Age 60 (Non-grandfathered Tier 1 and Tier 2), [10.0% current / 12.5% proposed] is added to the rate at the age (and only this age) the member becomes first eligible for an unreduced retirement benefit

Appendix C: Proposed Termination Rates (Service-based Rates)

	Female		Male	
Years from Hire	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
0	20.00%	15.00%	20.00%	15.00%
1	12.00%	11.00%	14.00%	13.00%
2	9.00%	9.50%	11.00%	11.00%
3	7.00%	7.50%	8.00%	8.00%
4	6.00%	6.00%	6.50%	6.00%
5	5.00%	5.50%	5.00%	5.25%
6	4.00%	4.50%	4.00%	4.00%
7	3.50%	4.00%	3.50%	3.75%
8	3.00%	2.75%	3.00%	3.00%
9	2.50%	2.75%	2.50%	2.50%
10	2.50%	2.50%	2.50%	2.50%
11	2.50%	2.50%	2.00%	2.00%
12	2.50%	2.50%	2.00%	2.00%
13	2.50%	2.25%	2.00%	2.00%
14	2.50%	2.25%	2.00%	1.50%
15	2.00%	1.75%	1.50%	1.50%
16	2.00%	1.75%	1.50%	1.50%
17	2.00%	1.50%	1.50%	1.50%
18	2.00%	1.50%	1.50%	1.50%
19	2.00%	1.25%	0.75%	0.75%
20	1.50%	1.25%	0.75%	0.75%
21	1.50%	1.25%	0.75%	0.75%
22	1.50%	1.25%	0.75%	0.75%
23	1.50%	1.00%	0.75%	0.75%
24	1.50%	1.00%	0.75%	0.75%
25	0.75%	0.75%	0.75%	0.75%
26	0.75%	0.75%	0.75%	0.75%
27	0.75%	0.75%	0.75%	0.75%
28	0.75%	0.75%	0.75%	0.75%
29	0.75%	0.75%	0.75%	0.75%

END OF REPORT