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Teachers Retirement System of Georgia

Teachers Retirement System of Georgia
Experience Investigation for the
Five-Year Period Ending June 30, 2018

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May 13, 2020

Board of Trustees
Teachers Retirement System of Georgia
Suite 100, Two Northside 75
Atlanta, GA 30318

Members of the Board:

We are pleased to submit the results of an investigation of the economic and demographic experience for the Teachers Retirement System of Georgia. The investigation has been made in accordance with Section 47-3-23(b) of the retirement law which provides that at least once in every five-year period, the actuary shall make an actuarial investigation into the mortality, service and compensation experience of the members and beneficiaries of the Retirement System. The purpose of the investigation is to assess the reasonability of the actuarial assumptions and methods currently used by the Retirement System. This investigation covers the five-year period from July 1, 2013 to June 30, 2018. As a result of this investigation, it is recommended that revised economic assumptions and demographic tables be adopted by the Board for future use.

The investigation of the demographic experience of members of the System includes all active and retired members as well as beneficiaries of deceased members. The experience was investigated separately for males and females where gender is a basis for material differences in experience.

The number of members expected to separate from active service, the expected rates of salary increase and the expected number of post-retirement deaths were obtained by use of the rates determined in the last experience investigation and adopted by the Board of Trustees. The results of the investigation indicate that the assumed rates of separation from active service due to withdrawal, disability, death and retirement and rates of post-retirement mortality need revision in order to provide a better fit between the actual and anticipated experience of the Retirement System. As a result of the investigation, new withdrawal, disability, retirement and mortality tables have been developed which reflect more closely the actual experience of the membership.

All new assumptions are shown in the attached tables in Appendix D of this report. In the actuary's judgment, the recommended assumptions are suitable for use until further experience indicates that modifications are desirable.

The experience investigation was performed by, and under the supervision of, independent actuaries who are members of the American Academy of Actuaries with experience in performing valuations for public retirement systems. John Garrett and Edward Koebel meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Respectfully submitted,

John Garrett, ASA, FCA, MAAA
Principal and Consulting Actuary

Cathy Turcot
Principal and Managing Director

Edward J. Koebel, FCA, EA, MAAA
Chief Executive Officer

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June 10, 2020

Dr. L. C. Evans
Executive Director
Teachers Retirement System of Georgia
Two Northside 75, Suite 100
Atlanta, GA 30318-7701

Selection of Mortality Assumption in the Latest Experience Study

Dear Dr. Evans:

In the course of presenting the Experience Investigation Report for the Five-Year Period Ending July 1, 2018, a Board Member (Mr. Griffin) raised a question concerning our use of the headcount-weighted rates versus the amount-weighted rates as the base mortality table in the assumption. We are writing to provide our reasoning for the mortality table selection.

There are two primary reasons we feel the headcount weighted table is appropriate for the selection of a reasonable mortality assumption to be used in the future valuations for the Teachers Retirement System (TRS). First, in our experience, large statewide teacher plans are homogenous groups and there are minor differences in amount-weighted experience. The Society of Actuaries (SOA) *Pub-2010 Public Retirement Plans Mortality Table Report* discusses the analysis utilized in developing both the amount-weighted and headcount-weighted mortality rates, and includes the following finding:

> *Broadly speaking, the difference between headcount-weighted and corresponding amount-weighted annuity values represents a measure of the dispersion of individual amounts within the population being studied and the sensitivity of mortality to differences in income. More specifically, the larger the dispersion in underlying amounts, the greater (positive) differential between the amount-weighted annuity values relative to their headcount-weighted counterparts. Therefore, the final columns in the three tables above indicate that*
>
> - *The salary/benefit amount dispersion within the Teacher population (especially females) was considerably less than that for Safety and General and*
>
> - *The salary/benefit amount dispersion for males is greater than that for females within all three job categories.*

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As the TRS retired population is predominately female, we do not expect a material difference in the mortality experience based on amount weighting versus headcount weighting.

Second, the annual valuations determine the actuarial gains and losses on a benefit (or liability)-weighted basis. Historically, the headcount-weighted tables which have been utilized in the past have consistently demonstrated a very close fit to experience. Future valuations will continue to assess the fit of the new mortality assumption on a benefit weighted measure though the annual actuarial gain/loss determinations.

The selection of a post-retirement mortality assumption is very material to the valuation results as it establishes the expected duration of all current and future annuity benefits provided by the Plan. The goal of the actuary is to recommend assumptions which minimize the future differences between actual and expected experience (on a liability basis) and results in the best estimate of the actuarial measures and funding requirements in the annual valuations. There is no advantage to favoring assumptions more conservative than experience. Conservative assumptions may lessen the potential of future losses but increase the potential for future gains resulting in the over-stating the true cost of the Plan and are at variance with the desire for long-term contribution stability.

The undersigned independent consulting actuary is a member of the American Academy of Actuaries. He has experience performing valuations and experience studies for large public retirement systems and is qualified to provide the opinions contained in this letter.

Please let me know if you have any questions.

Sincerely,

John J. Garrett, ASA, FCA, MAAA
Principal and Consulting Actuary

Attachment

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Section I
Executive Summary

The following table summarizes the findings and recommendations with regard to the assumptions utilized for the Teachers Retirement System of Georgia. Detailed explanations for the recommendations are found in the sections that follow.

Summary of Recommended Economic and Demographic Assumptions	
Economic Assumptions	
Inflation	Recommend no change in current assumption of 2.50%
Investment Rate of Return	Composed of inflation assumption and real rate of return assumption. We recommend no change in the current assumption of 7.25%.
Real Rate of Wage Increase	Recommend no change in the current assumption of 0.50% annual rate of real wage increases.
Payroll Growth Rate	Recommend no change in the current assumption of 3.00%.
Demographic Assumptions	
Withdrawal	Recommend changes to current assumed rates of withdrawal that overall increase the number of expected withdrawals.
Retirement	Recommend changes to current assumed rates of retirement that overall increase the number of expected retirements.
Mortality	Recommend adoption of the Pub 2010 Teachers Headcount Weighted Below Median mortality tables with ages set forward one year and increased 6%. Future improvement in mortality rates is assumed using the adjusted MP-2019 projection scale generationally.
Disability	Recommend lowering rates of expected disability retirement.
Salary Increase Above Wage Inflation	Recommend no change in current assumption.

Recommended Other Assumption and Method Changes

The table below lists the other assumptions and methods that are considered in our valuations that should be reviewed during the experience study.

Assumption or Method	Recommended Change
Administrative Expenses	Recommend change to current assumption from 0.25% to 0.20% of payroll
Amortization Method	No change to current method of level percent of payroll amortization with annual layers of changes to UAAL
Asset Smoothing	No change to current method of smoothing market gains and losses over 5 year period
Option Factors	Recommend change in current option factors to reflect change in mortality rate
Percent Married	Recommend no change to current assumption
Unused Sick Leave	Recommend changes to our loads on service for allowing members to convert forfeited sick leave to service at retirement
Valuation Cost Method	No change in Entry Age Normal Cost Method
Vested Termination Benefit	Recommend change to current assumption

Section II
Financial Impact

The following table highlights the impact of the recommended changes on the principal valuation results. This table is for illustrative purposes only and not intended to modify the contribution rates set forth in the June 30, 2018 valuation report.

Impact on Principal Valuation Results ($1,000's)		
	Valuation Results 2018	**Recommended Assumptions**
Unfunded Accrued Liability	$21,880,889	$22,962,411
Funding Ratio	77.4%	76.6%
Employer Annual Required Contribution		
Normal Rate*	7.25%	7.40%
Unfunded Accrued Liability Rate	11.81%	12.35%
Total Rate	19.06%	19.75%
Amortization Period (in years)	25.6	25.8

*Includes administrative expenses

Section III
Economic Assumptions

There are three economic assumptions used in the actuarial valuations performed for the System. They are:

- Price Inflation
- Investment Return
- Wage Inflation

Actuarial Standard of Practice (ASOP) No. 27, *"Selection of Economic Assumptions for Measuring Pension Obligations"*, provides guidance to actuaries in selecting economic assumptions for measuring obligations under defined benefit plans and was revised in September 2013. The revised standard now requires that each economic assumption selected by the actuary should be reasonable which means it has the following characteristics:

- It is appropriate for the purpose of the measurement;
- It reflects the actuary's professional judgment;
- It takes into account historical and current economic data that is relevant as of the measurement date;
- It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and
- It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included and disclosed, or when alternative assumptions are used for the assessment of risk.

Each economic assumption should individually satisfy this standard. Furthermore, with respect to any particular valuation, each economic assumption should be consistent with every other economic assumption over the measurement period.

In conjunction with the June 30, 2018 valuation we reviewed the System's economic assumptions and recommended changes. Those changes were adopted by the Board on May 15, 2019. We have updated our analysis of the System's economic assumptions but recommend no further revisions at this time.

In our opinion, the economic assumptions recommended in this report have been developed in accordance with ASOP No. 27, as revised in September, 2013. The following table shows our recommendation followed by detailed discussions of each assumption.

Item	Current	Proposed
Price Inflation	2.50%	2.50%
Real Rate of Return	4.75	4.75
Investment Return	7.25%	7.25%
Price Inflation	2.50%	2.50%
Real Wage Growth	0.50%	0.50%
Wage Inflation	3.00%	3.00%

Price Inflation

Background: Assumed price inflation is used as the basis for both the investment return assumption and the wage inflation assumption. These latter two assumptions will be discussed in detail in the following sections.

It is important that the price inflation assumption be consistently applied throughout the economic assumptions utilized in an actuarial valuation. This is called for in ASOP No. 27 and is also required to meet the parameters for determining pension liabilities and expenses under Governmental Accounting Standards Board (GASB) Statements No. 67 and 68.

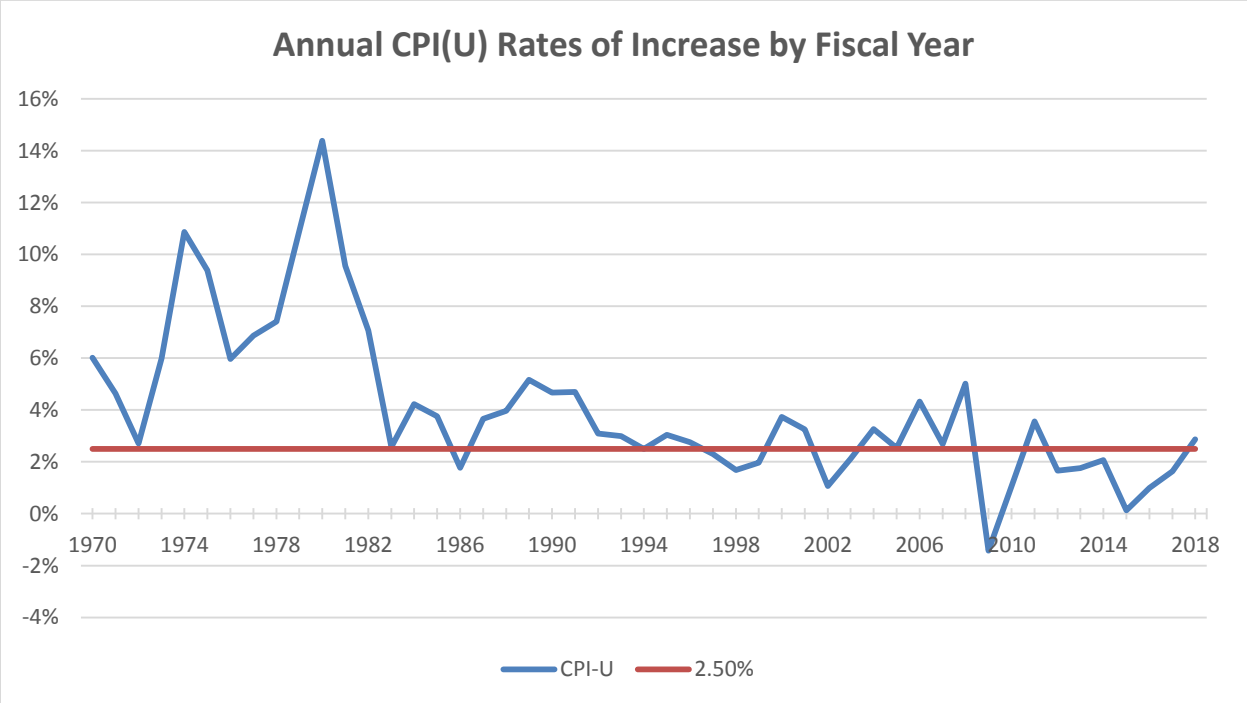
The current price inflation assumption is 2.50% per year.

Past Experience: The Consumer Price Index, US City Average, All Urban Consumers, CPI (U), has been used as the basis for reviewing historical levels of price inflation. The level of that index in June of each of the last 50 years is provided in Appendix A.

In analyzing this data, annual rates of inflation have been determined by measuring the compound growth rate of the CPI (U) over various time periods. The results are as follows:

Period (Fiscal Years Ending)	Number of Years	Inflation	Annual Standard Deviation
2009-2018	10	1.42%	1.39%
1999-2008	10	2.99	1.17
1989-1998	10	3.28	1.16
1979-1988	10	6.11	4.15
1969-1978	10	6.51	2.31
1999-2018	20	2.20%	1.49%
1989-2018	30	2.56	1.46
1979-2018	40	3.44	2.84
1969-2018	50	4.04	2.99
1927-2018	92	2.91	4.08

The graph below shows the annual increases in the CPI (U) over the 50-year period (1969-2018) compared to the 2.50% currently assumed.



Over shorter historical periods, the average annual rate of increase in the CPI-U has been below 3.00%. The period of high inflation from 1973 to 1982 has a significant impact on the averages over periods which include these rates. Further, the average rate of 2.91% over the entire 92-year period is higher than the average rate of 2.56% for the prior 30 years (1989 to 2018) but, more importantly, the volatility of the annual rates in the more recent years has been markedly lower as indicated by the significantly lower annual standard deviations. Many experts attribute the lower average annual rates and lower volatility to the increased efforts of the Federal Reserve since the early 1980's to stabilize price inflation. In our judgement, the post-1981 period of inflation is a more meaningful representation of historical price inflation than longer-term measures. The severe recession of 2007-2009 resulted in a short period of deflation followed by low levels of inflation. Although the quantitative easing program has ended, the Federal Reserve has disclosed an inflation target of 2.0% which has been higher than the post-recession average rate of inflation of 1.74% as measured from the CPI-U by fiscal years.

The bond market's measure of expected inflation is shown by the spread between the nominal yield on U.S. government bonds and Treasury Inflation Protected Securities (TIPS) of the same maturity. As of June 30, 2018, the spread at 10, 20 and 30 year maturities were all around 2.10% which is called the breakeven rate of inflation.

Recommendation: Although the 10-year average price inflation rate of 1.42% is significantly lower than the System's assumed rate of 2.50%, the longer 30-year average rate of 2.56% is slightly higher than the System's assumed rate. We rely more heavily on longer-term historical data and note that both the Fed's inflation target and the Bond market's expectation are higher than the short-term historical rates.

An additional reliable source of expected rates of inflation, the 2019 OASDI Trustees Report, the Chief Actuary for Social Security bases the 75-year cost projections on an intermediate inflation assumption of 2.6% with a range from 2.0% to 3.2%. We consider that range to be reasonable and recommend that TRS maintains the current price inflation rate assumption of 2.50%.

Rate of Price Inflation Assumption	
Current Assumption	2.50%
Recommended Assumption	2.50%

Investment Rate of Return

Background: The assumed investment return is one of the most significant assumptions in the annual actuarial valuation process as it is used to discount the expected benefit payments for all active, inactive and retired members of the System. Minor changes in this assumption can have a major impact on valuation results. The investment return assumption should reflect the asset allocation target for the funds set by the Board of Trustees.

The current assumption is 7.25%, consisting of a price inflation assumption of 2.50% and a real rate of return assumption of 4.75%. The return is net of investment expenses.

Past Experience: The assets for the System are valued using a widely accepted asset-smoothing methodology (5-year smoothing) that fully recognizes the expected investment income and also recognizes 20% of each year's investment gain or loss (the difference between actual and expected investment income). The asset smoothing methodology from 2010 to 2012 was based on 7-year smoothing and actuarial value was set equal to market value in 2013. The recent experience over the last five years is shown in the table below.

Year Ending 6/30	Actuarial Value	Market Value
2014	9.41	17.17
2015	9.02	3.70
2016	7.30	1.40
2017	7.80	12.50
2018	8.36	8.95
Average	8.40%	8.60%

The impact of the asset smoothing method can be observed in the table. Although the average returns over the five-year period are very close, the return on actuarial value is, as expected, less variable. We also note, as provided by the guidance of the Actuarial Standards of Practice (ASOP), that historical returns over a short time period are not credible for the purpose of setting the long-term assumed future rate of return.

We next include in our analysis information concerning future expectations for the investment return assumption. We prefer to base our investment return assumption largely on the capital market assumptions utilized by the Board in setting investment policy and the System's asset allocation. The investment rate of return assumption has two component parts: the rate of price inflation and the real rate of investment return. This component approach is referred to as the building block method in ASOP No. 27. The price inflation component was discussed previously in this report, therefore, this section will focus on the real rate of investment return component.

Analysis: The current capital market assumptions and asset allocation as provided by the System investment staff are shown in Appendix B. We further assumed that investment returns approximately follow a lognormal distribution with no correlation between years. The results below provide an expected range of real rates of return over up to a 50-year time horizon. Looking at one year results produces an expected real return of 6.4% but also has a high standard deviation or measurement of volatility. By expanding the time horizon, the compound average return approaches the expected median of future real returns and the volatility declines significantly. The following table provides a summary of results. The geometric real rates of return are net of investment expenses.

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	6.4%	13.7%	-14.5%	-3.2%	5.5%	15.0%	30.2%
5	5.7%	6.1%	-4.0%	1.5%	5.5%	9.6%	15.9%
10	5.6%	4.3%	-1.3%	2.7%	5.5%	8.4%	12.8%
20	5.5%	3.0%	0.7%	3.5%	5.5%	7.6%	10.6%
30	5.5%	2.5%	1.5%	3.9%	5.5%	7.2%	9.6%
50	5.5%	1.9%	2.4%	4.2%	5.5%	6.8%	8.7%

Based on this analysis the median (50th percentile) real rate of return over a 50-year period is 5.5%. It can also be anticipated that for the 10-year time span, 50% of the expected compound average real rates of return were between 2.7%% and 8.4%. As the time span increases, this spread begins to narrow. Over a 50-year time span, the analysis indicates there is a 25% likelihood that real returns will average below 4.2% and a 25% likelihood they will be above 6.8%. In other words, 50% of the distribution of expected compound average real returns will be between 4.2% and 6.8 %.

Using the building block approach of ASOP No. 27 and the projection results outlined above, we have determined a range for the investment return assumption of the 25th to 75th percentile real returns over the 50-year time span plus the recommended inflation assumption. The following table details the range.

Item	25th Percentile	50th Percentile	75th Percentile
Real Rate of Return*	4.20%	5.50%	6.80%
Inflation	2.50	2.50	2.50
Net Investment Return	6.70%	8.00%	9.30%

* net of investment expenses

Based on the capital market assumptions provided by the System's investment experts, the median expected compound average return is 8.0% over a 50-year period. The current 7.25% assumed rate of return is approximately the 35th percentile of the distribution of expected average rate of returns over a 50-year period. Although not in the center of the recommended range, in our opinion a return of 7.25% is a reasonable expectation with a sufficient margin to account for adverse experience. It should be noted that the capital market assumptions of investment professionals will vary from year to year and can differ substantially from investment professional to investment professional. Different market expectations could impact the development of a recommended assumptions.

For a broader view of expected returns, we also reviewed the 2018 Survey of Capital Market Assumptions produced by Horizon Actuarial Services, LLC to see what other investment professionals are currently using for capital market assumptions. The Horizon survey includes both 10-year horizon and 20-year horizon capital market assumptions of several investment consultants. Using the Board's current target asset allocation, we applied the same statistical analysis to these survey results as we did the capital market assumption of the investment staff with the following results for the 20-year horizon:

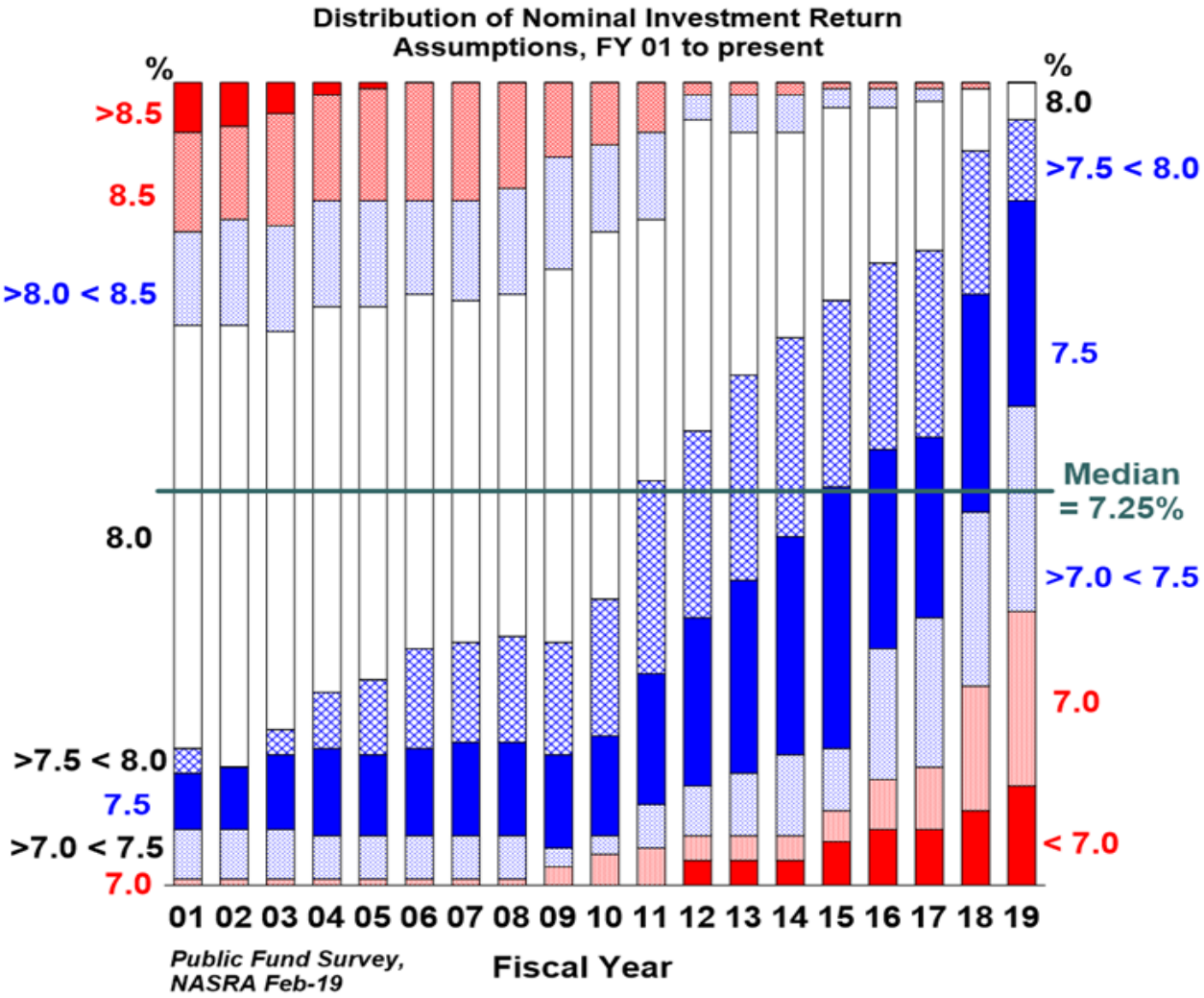
Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	5.2%	12.0%	-13.3%	-3.2%	4.5%	12.8%	25.9%
5	4.6%	5.3%	-3.9%	1.0%	4.5%	8.1%	13.6%
10	4.5%	3.8%	-1.5%	2.0%	4.5%	7.0%	10.8%
20	4.5%	2.7%	0.2%	2.7%	4.5%	6.3%	8.9%
30	4.5%	2.2%	1.0%	3.0%	4.5%	5.9%	8.1%
50	4.5%	1.7%	1.8%	3.4%	4.5%	5.6%	7.3%

Again, using the building block approach and the Horizon projection results, the following shows the range for the investment return assumptions.

Item	25th Percentile	50th Percentile	75th Percentile
Real Rate of Return	3.35%	4.47%	5.61%
Inflation	2.50	2.50	2.50
Net Investment Return	5.85%	6.97%	8.11%

Using this basis, the 7.25% is slightly above the median expected return over a 50-year period. We prefer the use of the capital market assumptions of the Board's investment professionals over the assumptions from a survey of several consultants which do not serve the Board since the survey assumptions were not the basis for the asset allocation decisions of the Board. By the guidance of the actuarial standards, we maintain a long-term perspective in setting all assumptions, especially the investment return assumption.

In the course of constructing an investment return assumption, while we don't develop the recommended investment rate of return based on those used by your peers, we also consider the range of assumptions used by other large public retirement systems. The graph below is from a recent Public Fund Survey, note that the current median return assumptions for the approximately 125 large public plans in the survey is 7.25%. Further, note that the trend in the return assumptions of these large plans is toward lower assumed rates of return.



Recommendation: We are recommending that the long-term investment return assumption remain at 7.25%.

Investment Return Assumption		
	Current	**Recommended**
Real Rate of Return*	4.75%	4.75%
Inflation	2.50	2.50
Net Investment Return	7.25%	7.25%

* net of investment expenses

Wage Inflation

Background: The assumed future increases in salaries consist of a wage inflation component and a component for promotion and longevity, often called merit increases. Wage inflation normally consists of price inflation and a component for real wage growth which reflects the overall return on labor in the economy. Merit increases are generally age and or service related, and will be discussed in the demographic assumption section of the report.

The current wage inflation assumption is 3.00% and is composed of a 2.50% rate of inflation assumption and a 0.50% real rate of wage inflation.

Past Experience: The Social Security Administration publishes data on wage growth in the United States. Appendix C shows the last 50 calendar years' data. We provide the rates of wage inflation and a comparison with the rates of price inflation over various calendar year time periods in the table below. We remove the rate of price inflation for each calendar year for the data to result in the historical real rate of wage inflation.

Period (Calendar Years Ending)	Number of Years	Wage Inflation	Price Inflation	Real Wage Growth
2009-2018	10	2.35%	1.80%	0.55%
1999-2008	10	3.66	2.52	0.84
1989-1998	10	4.09	3.12	0.97
1979-1988	10	6.24	5.94	0.30
1969-1978	10	6.60	6.67	(0.07)
1999-2018	20	3.00%	2.16%	0.84%
1989-2018	30	3.36	2.48	0.88
1979-2018	40	4.07	3.33	0.74
1969-2018	50	4.57	3.99	0.58

As the analysis of the national wage growth data shows, the shorter-term historical average real rate of wage inflation (0.55% for latest 10 year period) is slightly less than the longer-term average real rate (0.58% over 50 years). The rate of real wage inflation over the prior 20 and 30 year periods is 0.84% and 0.88% respectively.

The apparent annual real wage growth rate experience of TRS during the experience study period averaged a 1.07% above inflation compared to the real growth in the national average wages of 1.53%. The 5-year historical period is not materially relevant for setting this assumption but it is important that the System's experienced lower rates of increase than reflected nationally.

Recommendation: Based on the apparent real wage growth from the actual wage data and consistent with the longer term real growth in the national average wage data, we recommend no change to the current assumed rate of real wage growth of 0.50% per year.

Wage Inflation Assumption		
	Current	**Recommended**
Price Inflation	2.50%	2.50%
Real Wage Growth	0.50	0.50
Wage Inflation	3.00%	3.00%

Payroll Growth Assumption: The current amortization method is level percent of payroll which requires the use of an assumed rate of annual payroll growth. This assumption typically ranges from the rate of inflation (2.50%) to the rate of wage inflation (3.00%). We recommend continued use of the current 3.00% payroll growth assumption.

Section IV
Demographic Assumptions

There are several demographic assumptions used in the actuarial valuations performed for the Teachers Retirement System of Georgia. They are:

- Rates of Withdrawal
- Rates of Disability Retirement
- Rates of Service Retirement
- Rate of Mortality
- Rates of Salary Increase

The Actuarial Standards Board has issued Actuarial Standard of Practice (ASOP) No. 35, *"Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations"*, which provides guidance to actuaries in selecting demographic assumptions for measuring obligations under defined benefit plans. In our opinion, the demographic assumptions recommended in this report have been developed in accordance with ASOP No. 35.

The purpose of a study of demographic experience is to compare what actually happened to the membership during the study period (July 1, 2013, through June 30, 2018) with what was expected to happen based on the assumptions used in the last five actuarial valuations.

Detailed tabulations by age, service and/or gender are performed over the entire study period. These tabulations look at all active and retired members during the period as well as separately annotating those who experience a demographic event, also referred to as a decrement. In addition the tabulation of all members together with the current assumptions permits the calculation of the number of expected decrements during the study period.

If the actual experience differs significantly from the overall expected results, or if the pattern of actual decrements, or rates of decrement, by age, gender, or service does not follow the expected pattern, new assumptions are recommended. Recommended changes usually do not follow the exact actual experience during the observation period. Judgment is required to extrapolate future experience from past trends and current member behavior.

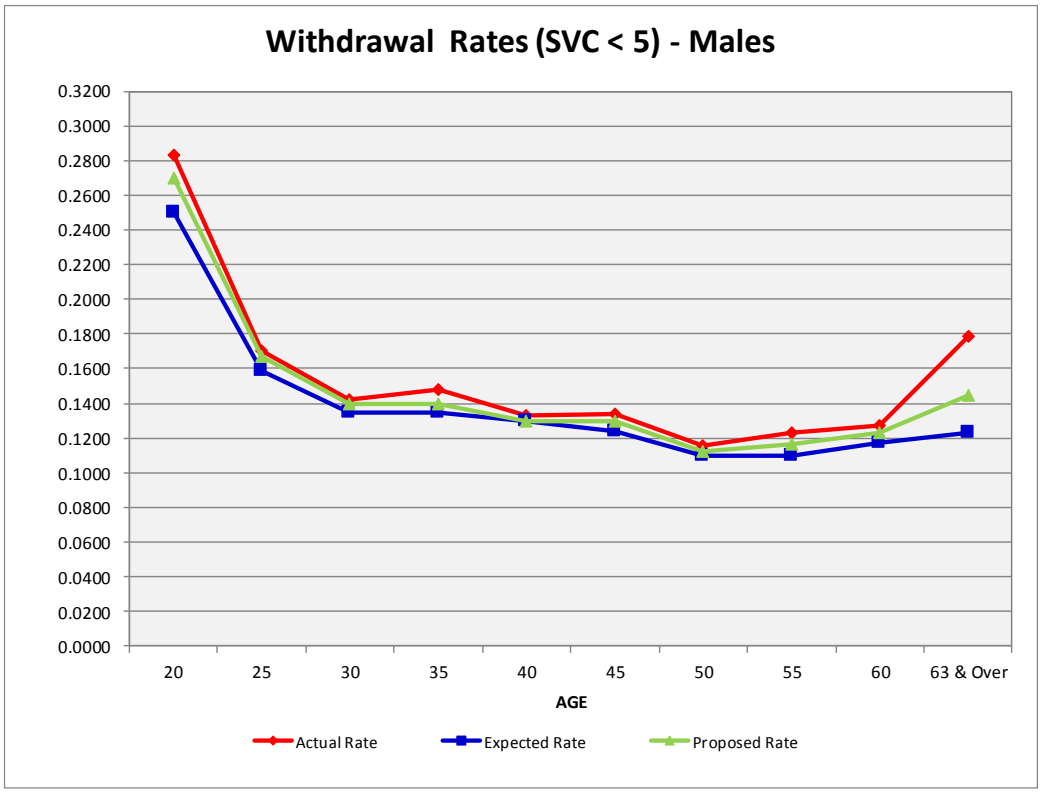
The remainder of this section presents the results of the demographic study. We have prepared tables that show a comparison of the actual and expected decrements and the overall ratio of actual to expected results (A/E Ratios) under the current assumptions. If a change is being proposed, the revised A/E Ratios are shown as well. Salary adjustments, other than the economic assumption for wage inflation discussed in the previous section, are treated as demographic assumptions.

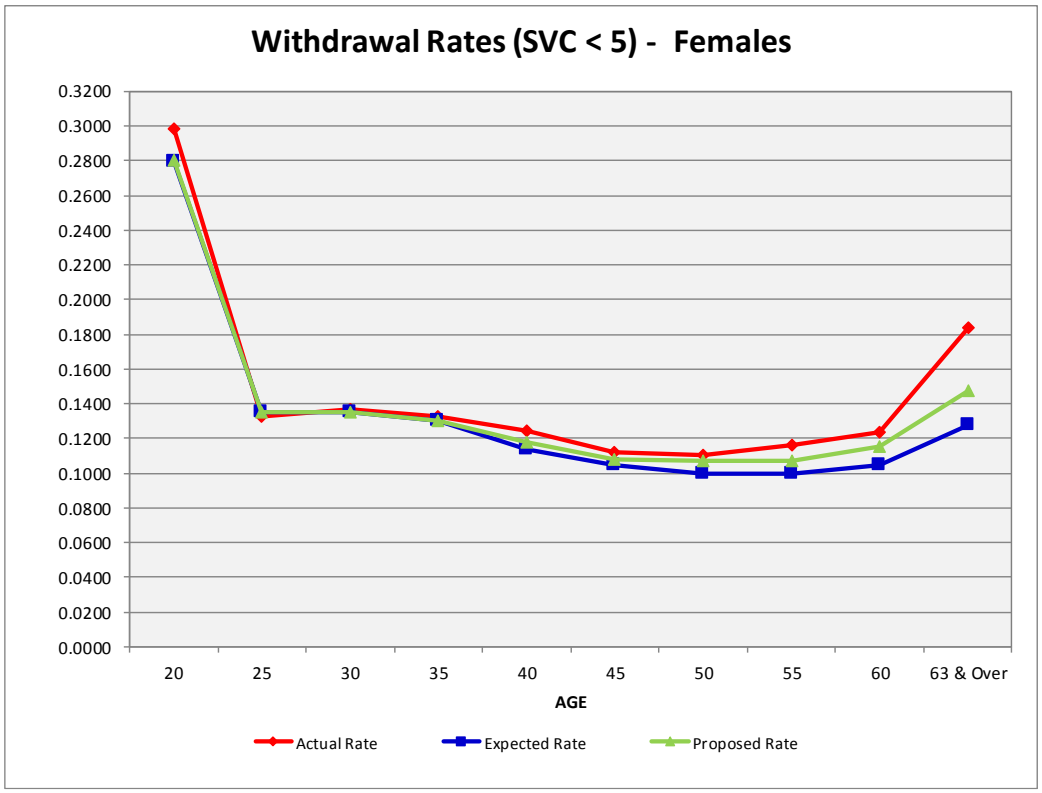
RATES OF WITHDRAWAL

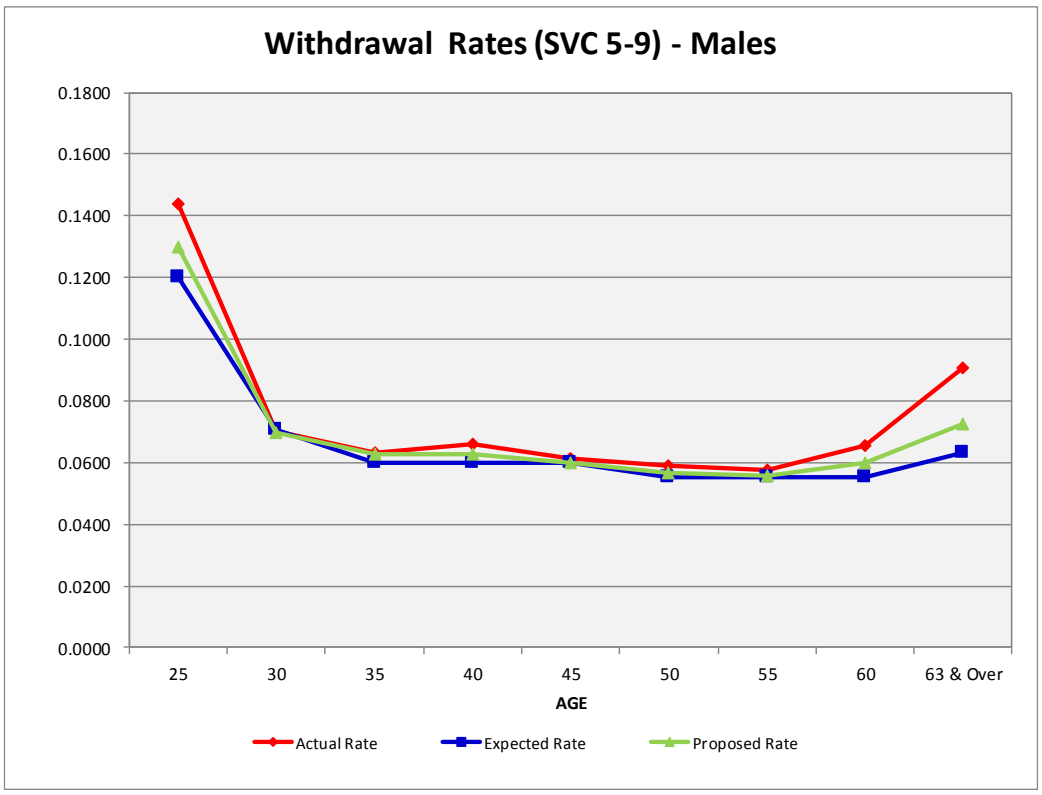
COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS FROM ACTIVE SERVICE

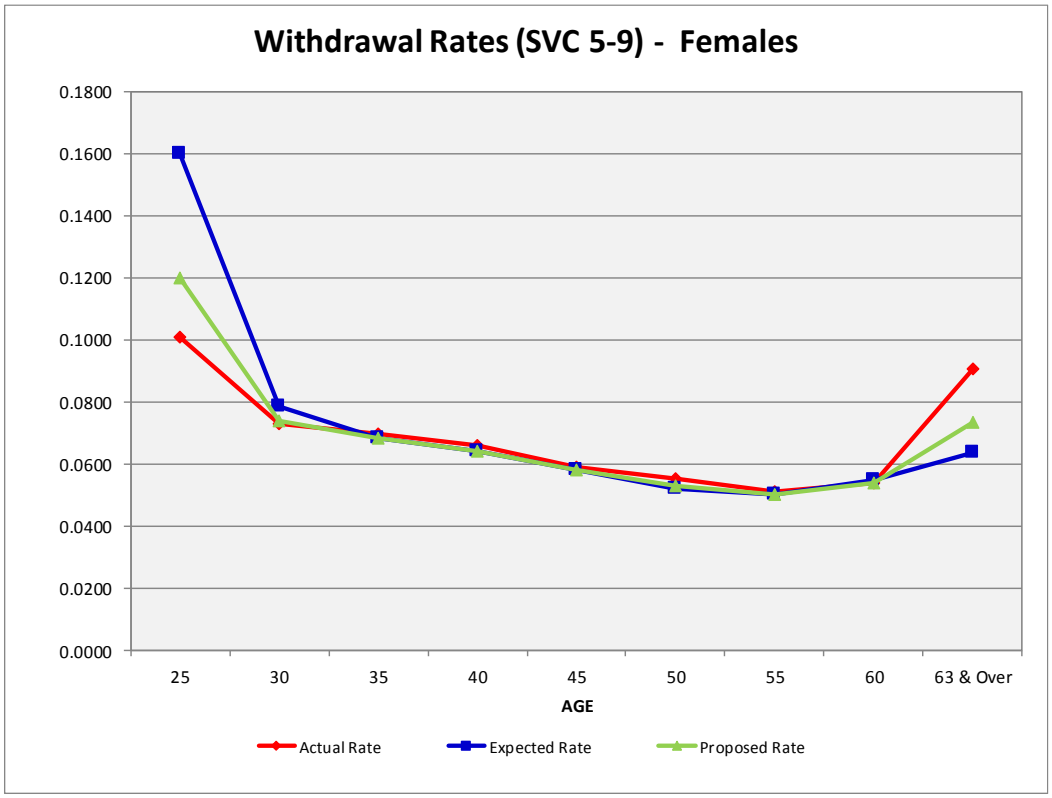
CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	MALE			FEMALE		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	Withdrawals with less than 5 years of service					
20	130	114.8	1.132	219	205.0	1.068
25	2,000	1,868.1	1.071	5,657	5,769.5	0.981
30	2,157	2,047.7	1.053	5,867	5,797.6	1.012
35	1,580	1,437.8	1.099	3,956	3,885.7	1.018
40	1,132	1,107.5	1.022	3,331	3,063.0	1.087
45	1,006	933.1	1.078	2,904	2,724.8	1.066
50	742	703.6	1.055	2,112	1,914.3	1.103
53 & Over	1,331	1,138.3	1.169	2,940	2,437.9	1.206
TOTAL	**10,078**	**9,350.9**	**1.078**	**26,986**	**25,797.8**	**1.046**
	Withdrawals with at least 5 but less than 10 years of service					
25	48	40.1	1.197	92	146.2	0.629
30	664	668.3	0.994	2,673	2,876.4	0.929
35	760	724.6	1.049	2,431	2,383.1	1.020
40	562	510.8	1.100	1,771	1,722.5	1.028
45	454	445.0	1.020	1,648	1,618.6	1.018
50	357	334.3	1.068	1,325	1,247.2	1.062
53 & Over	813	681.2	1.193	2,006	1,849.8	1.084
TOTAL	**3,658**	**3,404.3**	**1.075**	**11,946**	**11,843.8**	**1.009**
	Withdrawals with 10 or greater years of service					
30	18	22.5	0.800	60	63.7	0.942
35	330	275.4	1.198	1,547	1,258.2	1.230
40	541	465.5	1.162	1,931	1,578.4	1.223
45	595	508.6	1.170	2,117	1,814.8	1.167
50	492	418.8	1.175	2,050	1,566.5	1.309
53 & Over	632	537.2	1.176	2,783	2,278.3	1.222
TOTAL	**2,608**	**2,228.0**	**1.171**	**10,488**	**8,559.9**	**1.225**

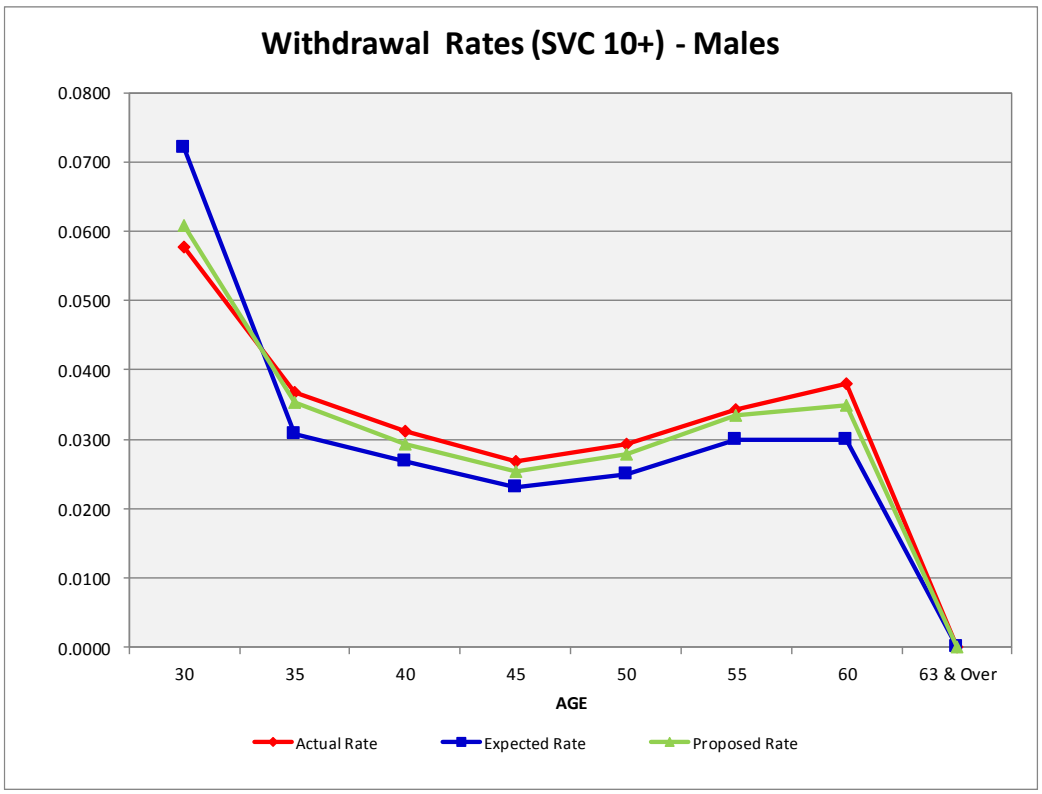
The following graphs show a comparison of the current expected, actual, and proposed rates of withdrawal for actives.

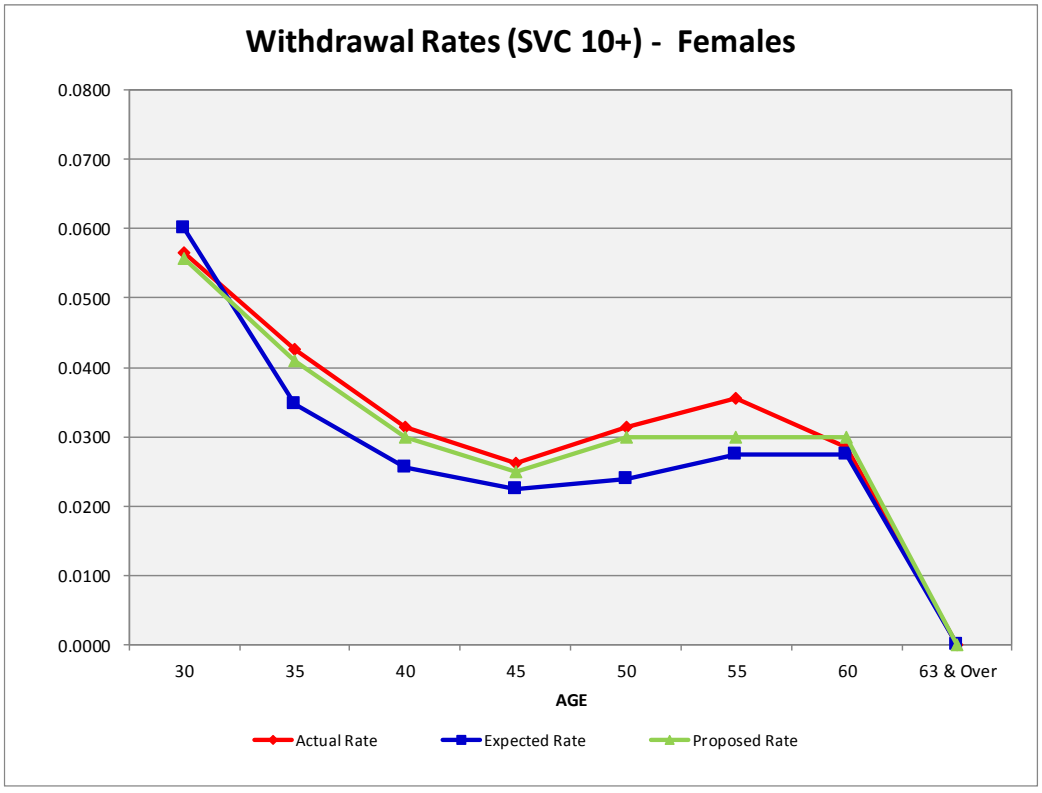





Withdrawal Rates (SVC 5-9) - Males
0.1800
0.1600
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
25
30
35
40
45
50
55
60
63 & Over
AGE
Actual Rate
Expected Rate
Proposed Rate


Withdrawal Rates (SVC 5-9) - Females
0.1800
0.1600
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
25
30
35
40
45
50
55
60
63 & Over
AGE
Actual Rate
Expected Rate
Proposed Rate


Withdrawal Rates (SVC 10+) - Males
0.0800
0.0700
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
30
35
40
45
50
55
60
63 & Over
AGE
Actual Rate
Expected Rate
Proposed Rate


Withdrawal Rates (SVC 10+) - Females
0.0800
0.0700
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
30
35
40
45
50
55
60
63 & Over
AGE
Actual Rate
Expected Rate
Proposed Rate

The rates of withdrawal adopted by the Board are used to determine the expected number of separations from active service which will occur as a result of resignation or dismissal. The preceding results indicate that during the study period more members than expected withdrew in all service categories for both males and females except at some of the younger ages. More withdrawals than expected create gains to the System since fewer members remain in service to accrue additional benefits. We recommend that the rates of withdrawal be revised at this time to more closely reflect the experience of the System.

COMPARATIVE RATES OF WITHDRAWAL
FROM ACTIVE SERVICE

AGE	RATES OF WITHDRAWAL					
	Present			Proposed		
	Years Of Service			Years Of Service		
	0 - 4	5 - 9	10 +	0 - 4	5 - 9	10 +
	Male					
20	25.00%			27.00%		
25	17.00%	12.00%		17.00%	13.00%	
30	13.50%	7.00%	8.00%	14.00%	6.50%	6.00%
35	13.50%	6.00%	3.00%	14.00%	6.25%	3.50%
40	13.00%	6.00%	2.50%	13.00%	6.25%	2.75%
45	12.00%	6.00%	2.30%	13.00%	6.00%	2.50%
50	11.00%	5.50%	2.50%	11.25%	5.75%	2.75%
55	11.00%	5.50%	3.00%	11.75%	5.50%	3.25%
60	12.00%	5.50%	0.00%	12.00%	6.00%	0.00%
64	13.00%	6.50%	0.00%	15.00%	7.50%	0.00%
	Female					
20	28.00%			28.00%		
25	13.50%	16.00%		13.50%	12.00%	
30	13.50%	8.00%	6.00%	13.50%	7.00%	6.00%
35	13.00%	7.00%	3.50%	13.00%	7.00%	4.00%
40	11.00%	6.50%	3.00%	12.00%	6.50%	3.00%
45	10.50%	6.00%	2.30%	10.75%	6.00%	2.50%
50	10.00%	5.00%	2.40%	10.75%	5.50%	3.00%
55	10.00%	5.00%	2.75%	10.75%	5.00%	3.00%
60	10.50%	5.50%	0.00%	11.50%	5.50%	0.00%
64	13.00%	6.50%	0.00%	15.00%	7.50%	0.00%

COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS BASED ON PROPOSED RATES

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	MALE			FEMALE		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	Withdrawals with less than 5 years of service					
20	130	123.9	1.049	219	205.0	1.068
25	2,000	1,960.2	1.020	5,657	5,769.5	0.981
30	2,157	2,123.5	1.016	5,867	5,797.6	1.012
35	1,580	1,491.0	1.060	3,956	3,885.7	1.018
40	1,132	1,107.5	1.022	3,331	3,169.5	1.051
45	1,006	977.7	1.029	2,904	2,803.0	1.036
50	742	719.6	1.031	2,112	2,057.9	1.026
53 & Over	1,331	1,224.7	1.087	2,940	2,664.5	1.103
TOTAL	**10,078**	**9,728.1**	**1.036**	**26,986**	**26,352.7**	**1.024**
	Withdrawals with at least 5 but less than 10 years of service					
25	48	43.4	1.106	92	109.7	0.839
30	664	660.5	1.005	2,673	2,708.9	0.987
35	760	754.8	1.007	2,431	2,383.1	1.020
40	562	532.1	1.056	1,771	1,722.5	1.028
45	454	445.0	1.020	1,648	1,618.6	1.018
50	357	343.5	1.039	1,325	1,271.2	1.042
53 & Over	813	733.0	1.109	2,006	1,891.0	1.061
TOTAL	**3,658**	**3,512.3**	**1.041**	**11,946**	**11,705.0**	**1.021**
	Withdrawals with 10 or greater years of service					
30	18	19.0	0.947	60	59.1	1.015
35	330	317.2	1.040	1,547	1,488.6	1.039
40	541	508.9	1.063	1,931	1,847.9	1.045
45	595	563.3	1.056	2,117	2,023.1	1.046
50	492	467.8	1.052	2,050	1,960.4	1.046
53 & Over	632	606.2	1.043	2,783	2,485.4	1.120
TOTAL	**2,608**	**2,482.4**	**1.051**	**10,488**	**9,864.5**	**1.063**

RATES OF DISABILITY RETIREMENT

COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS

CENTRAL AGE GROUP	NUMBER OF DISABILITY RETIREMENTS					
	MALE			FEMALE		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
27 & Under	0	1.7	0.000	0	5.7	0.000
30	0	5.2	0.000	0	11.7	0.000
35	2	10.6	0.189	10	19.3	0.518
40	9	19.0	0.474	34	43.3	0.785
45	28	33.5	0.836	88	90.8	0.969
50	40	59.5	0.672	177	195.9	0.904
53 & Over	109	127.6	0.854	486	570.6	0.852
TOTAL	**188**	**257.1**	**0.731**	**795**	**937.3**	**0.848**

The following graphs show a comparison of the current expected, actual, and proposed rates of disability retirement.

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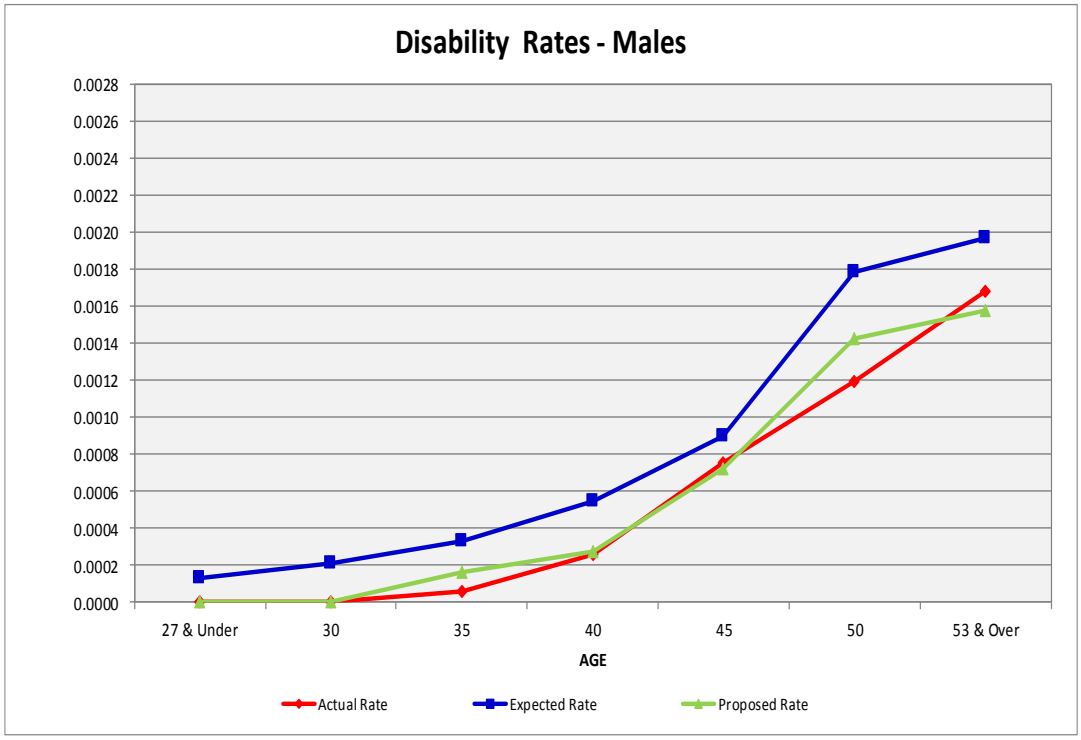
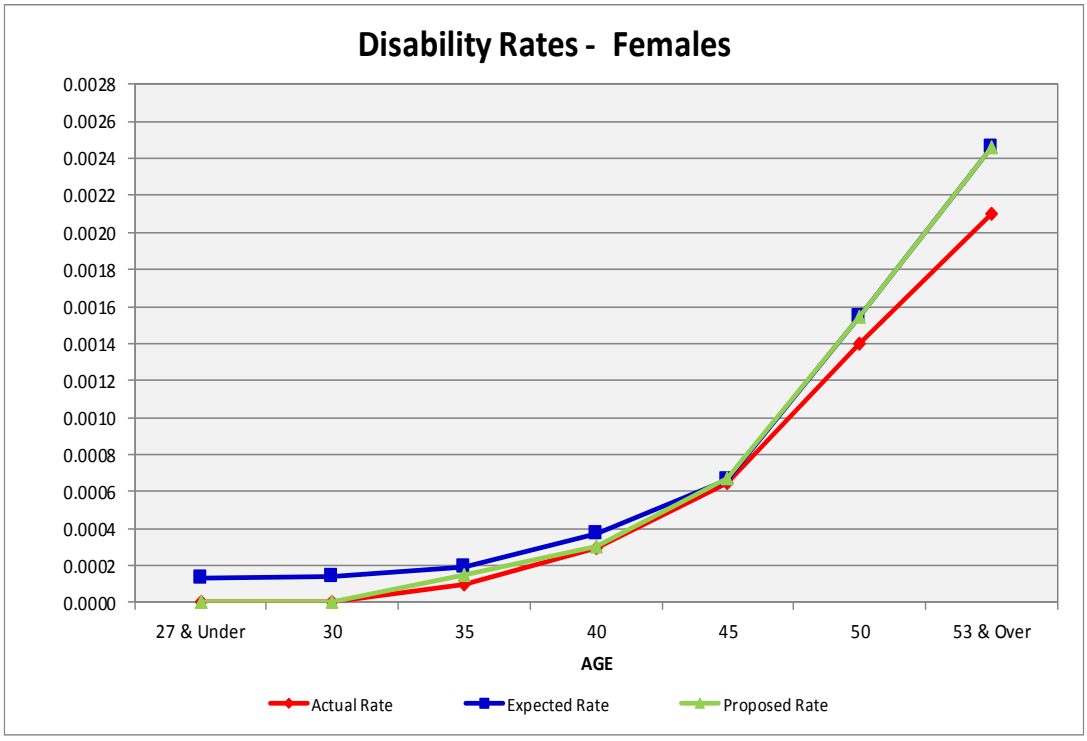

Disability Rates - Males
0.0028
0.0026
0.0024
0.0022
0.0020
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
27 & Under
30
35
40
45
50
53 & Over
AGE
Actual Rate
Expected Rate
Proposed Rate


Disability Rates - Females
0.0028
0.0026
0.0024
0.0022
0.0020
0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
27 & Under
30
35
40
45
50
53 & Over
AGE
Actual Rate
Expected Rate
Proposed Rate

During the period under investigation, the actual rates of disability retirement were less than expected in all age groups. We recommend the rates of disability retirement be revised to reflect the experience of the System. The following table shows a comparison between the present disability retirement rates and the proposed rates.

COMPARATIVE RATES OF DISABILITY RETIREMENTS

AGE	RATES OF DISABILITY			
	MALE		FEMALE	
	Present	Proposed	Present	Proposed
25	0.0135%	0.0000%	0.0130%	0.0000%
30	0.0210%	0.0000%	0.0140%	0.0000%
35	0.0330%	0.0165%	0.0190%	0.0152%
40	0.0550%	0.0275%	0.0390%	0.0312%
45	0.0900%	0.0720%	0.0650%	0.0650%
50	0.1700%	0.1360%	0.1400%	0.1400%
55	0.3000%	0.2400%	0.3400%	0.3400%

COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS BASED ON PROPOSED RATES

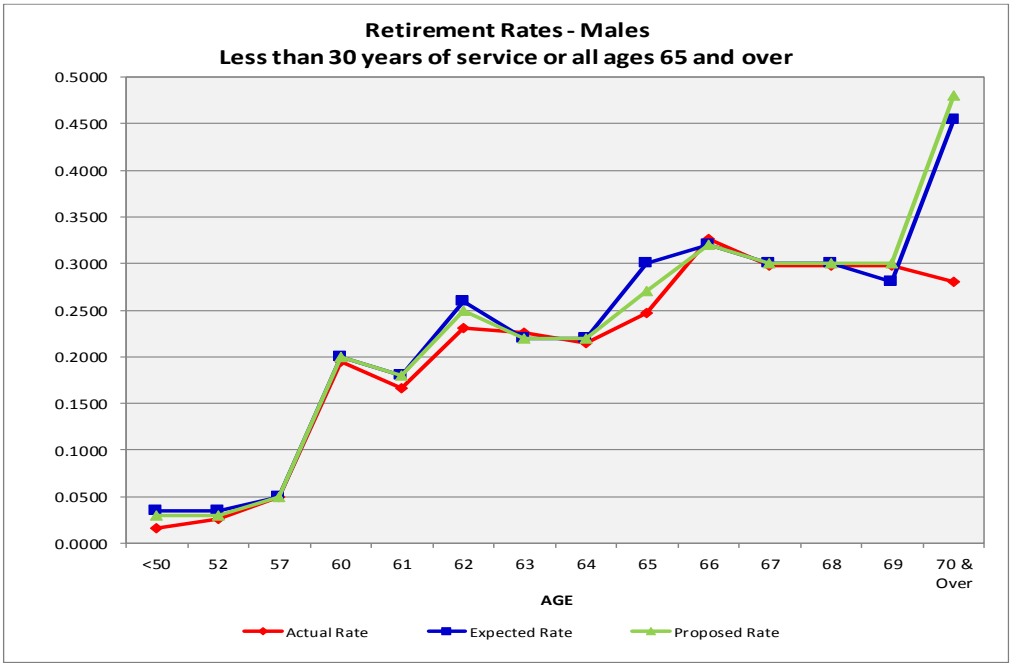
CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS					
	MALE			FEMALE		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
27 & Under	0	0.0	0.000	0	0.0	0.000
30	0	0.0	0.000	0	0.0	0.000
35	2	5.3	0.377	10	15.4	0.649
40	9	9.5	0.947	34	34.6	0.983
45	28	26.8	1.045	88	90.8	0.969
50	40	47.6	0.840	177	195.9	0.904
53 & Over	109	102.1	1.068	486	570.6	0.852
TOTAL	**188**	**191.3**	**0.983**	**795**	**907.3**	**0.876**

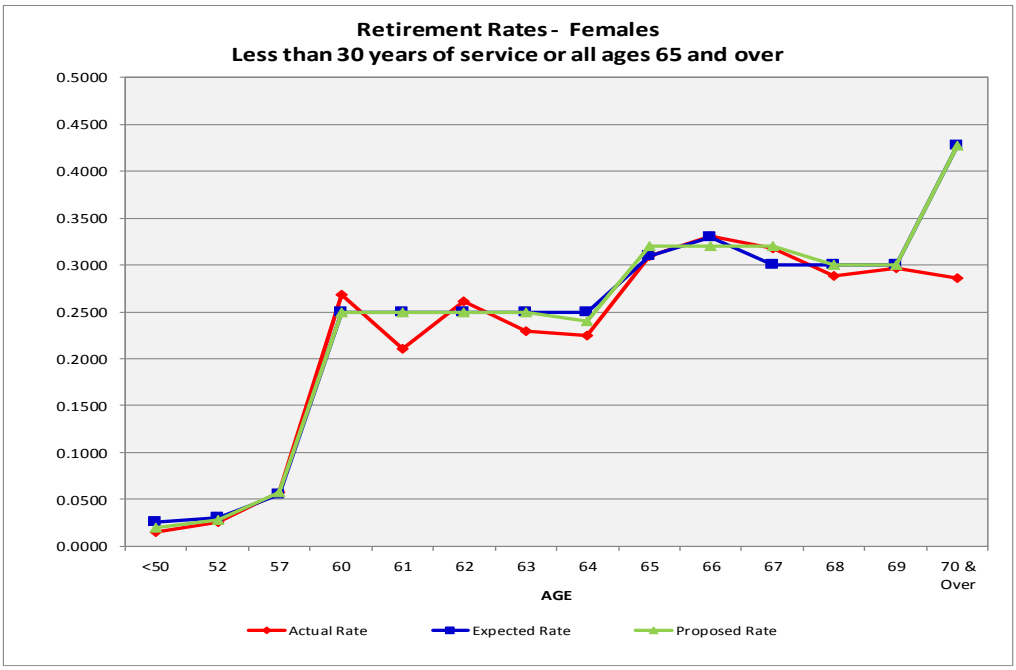
RATES OF RETIREMENT

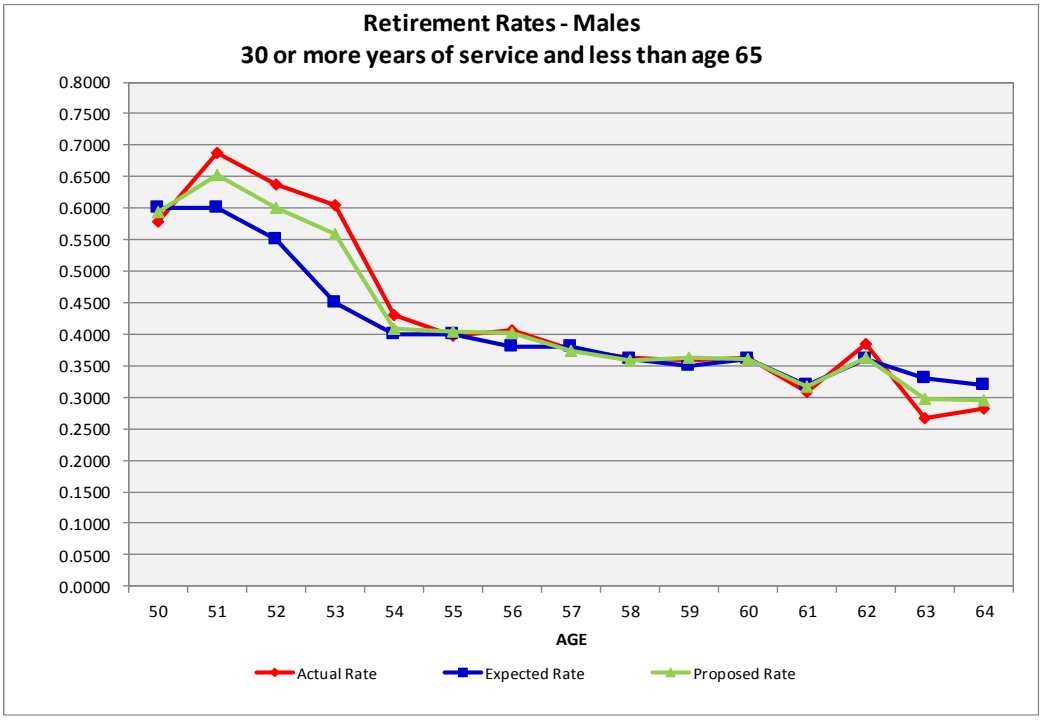
COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

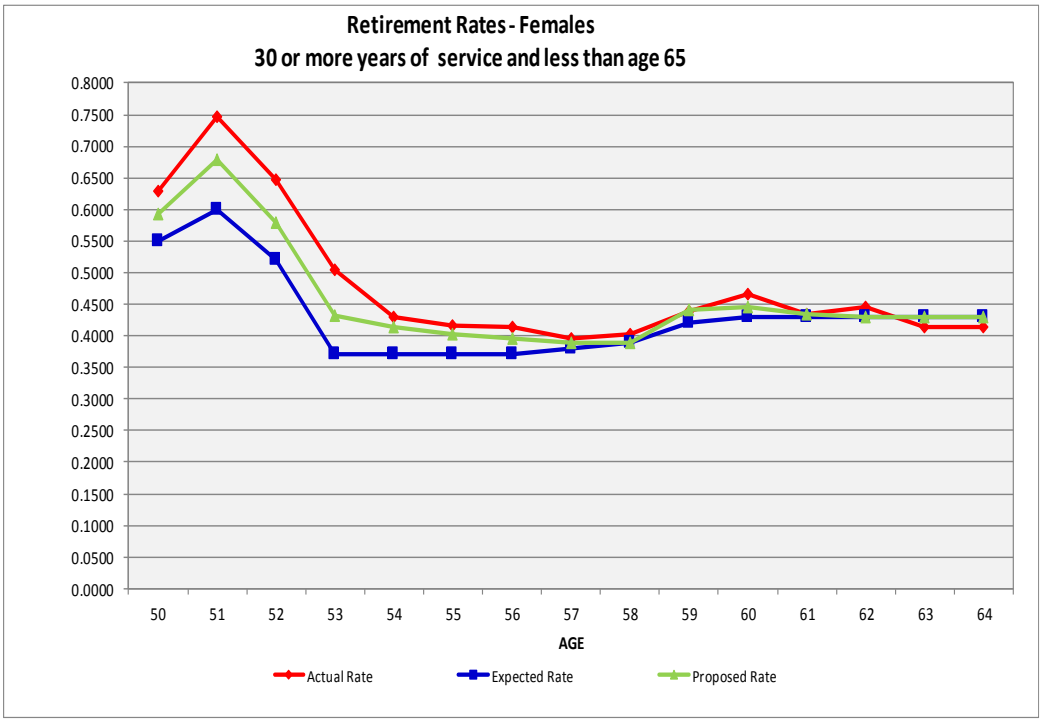
CENTRAL AGE OF GROUP	NUMBER OF SERVICE RETIREMENTS					
	MALE			FEMALE		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	Less than 30 years of service or all ages 65 and over					
49 & Under	18	39.4	0.457	98	166.4	0.589
52	124	163.9	0.757	446	514.8	0.866
57	144	145.0	0.993	720	685.6	1.050
60	531	545.6	0.973	3,586	3,343.0	1.073
61	392	422.6	0.928	2,104	2,498.3	0.842
62	472	532.0	0.887	2,066	1,975.0	1.046
63	362	353.3	1.025	1,367	1,491.5	0.917
64	284	291.7	0.974	1,045	1,161.0	0.900
65	316	384.0	0.823	1,306	1,306.7	0.999
66	346	339.5	1.019	1,013	1,009.1	1.004
67	237	238.2	0.995	710	670.8	1.058
68	180	181.5	0.992	454	472.5	0.961
69	139	130.8	1.063	353	357.3	0.988
70 & Over	427	690.9	0.618	816	1,219.4	0.669
TOTAL	**3,972**	**4,458.4**	**0.891**	**16,084**	**16,871.4**	**0.953**
	30 or more years of service and less than age 65					
50 & Under	47	45.6	1.031	166	144.7	1.147
51	66	57.6	1.146	338	271.8	1.244
52	111	95.7	1.160	607	487.8	1.244
53	186	138.2	1.346	684	501.0	1.365
54	167	155.6	1.073	672	579.8	1.159
55	180	181.2	0.993	705	628.3	1.122
56	195	182.0	1.071	679	607.9	1.117
57	170	172.1	0.988	608	584.1	1.041
58	154	153.0	1.007	609	589.7	1.033
59	150	146.3	1.025	618	591.4	1.045
60	140	139.0	1.007	624	576.2	1.083
61	108	112.0	0.964	504	497.9	1.012
62	127	119.2	1.065	461	444.2	1.038
63	72	89.1	0.808	333	346.6	0.961
64	72	81.9	0.879	272	282.1	0.964
TOTAL	**1,945**	**1,868.5**	**1.041**	**7,880**	**7,133.5**	**1.105**

The analysis of the experience reflects that the current assumed rates of retirement slightly over-anticipate retirements for members prior to 30 years of service but under-anticipate the rates for those with 30 years or more of service requirements before age 65, particularly when first achieving 30 years. Fewer retirements than expected create gains to the System, while more than expected create losses, particularly for unreduced retirement at younger ages. We recommend adjustment to the rates to reflect the experience as well as maintain a reasonable degree of margin. The following graphs show a comparison of the present, actual, and proposed rates of service retirements.






Retirement Rates - Males
30 or more years of service and less than age 65
0.8000
0.7500
0.7000
0.6500
0.6000
0.5500
0.5000
0.4500
0.4000
0.3500
0.3000
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64
AGE
Actual Rate
Expected Rate
Proposed Rate


Retirement Rates - Females
30 or more years of service and less than age 65
0.8000
0.7500
0.7000
0.6500
0.6000
0.5500
0.5000
0.4500
0.4000
0.3500
0.3000
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64
AGE
Actual Rate
Expected Rate
Proposed Rate

The following table shows a comparison of the present and proposed rates of service retirement.

COMPARATIVE RATES OF RETIREMENT

AGE	RATES OF SERVICE RETIREMENT							
	MALE				FEMALE			
	Present		Proposed		Present		Proposed	
	< 30 years of service	>= 30 years of service	< 30 years of service	>= 30 years of service*	< 30 years of service	>= 30 years of service	< 30 years of service	>= 30 years of service**
50	3.5%	60.0%	3.0%	52.0%	3.0%	55.0%	2.8%	50.0%
51	3.5%	60.0%	3.0%	58.0%	3.0%	60.0%	2.8%	58.0%
52	3.5%	55.0%	3.0%	54.0%	3.0%	52.0%	2.8%	48.0%
53	3.5%	45.0%	3.0%	50.0%	3.0%	37.0%	2.8%	35.0%
54	3.5%	40.0%	3.0%	36.0%	3.0%	37.0%	2.8%	35.0%
55	5.0%	40.0%	5.0%	37.0%	5.5%	37.0%	5.8%	35.0%
56	5.0%	38.0%	5.0%	37.0%	5.5%	37.0%	5.8%	35.0%
57	5.0%	38.0%	5.0%	35.0%	5.5%	38.0%	5.8%	35.0%
58	5.0%	36.0%	5.0%	33.0%	5.5%	39.0%	5.8%	35.0%
59	5.0%	35.0%	5.0%	34.0%	5.5%	42.0%	5.8%	40.0%
60	20.0%	36.0%	20.0%	34.0%	25.0%	43.0%	25.0%	40.0%
61	18.0%	32.0%	18.0%	30.0%	25.0%	43.0%	25.0%	40.0%
62	26.0%	36.0%	25.0%	35.0%	25.0%	43.0%	25.0%	43.0%
63	22.0%	33.0%	22.0%	28.0%	25.0%	43.0%	25.0%	43.0%
64	22.0%	32.0%	22.0%	28.0%	25.0%	43.0%	24.0%	43.0%
65	30.0%	30.0%	27.0%	27.0%	31.0%	31.0%	32.0%	32.0%
66	32.0%	32.0%	32.0%	32.0%	33.0%	33.0%	32.0%	32.0%
67	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	32.0%	32.0%
68	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
69	28.0%	28.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
70	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
71	25.0%	25.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
72	25.0%	25.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
73	25.0%	25.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
74	25.0%	25.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
75	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

*An additional 10% are assumed to retire at 30 years of service for ages between 50 and 64.
**An additional 15% are assumed to retire at 30 years of service for ages between 50 and 61.

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS
BASED ON PROPOSED RATES OF RETIREMENT

CENTRAL AGE OF GROUP	NUMBER OF SERVICE RETIREMENTS					
	MALE			FEMALE		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	Less than 30 years of service or all ages 65 and over					
49 & Under	18	33.8	0.533	98	133.1	0.736
52	124	140.5	0.883	446	471.9	0.945
57	144	145.0	0.993	720	716.8	1.004
60	531	545.6	0.973	3,586	3,343.0	1.073
61	392	422.6	0.928	2,104	2,498.3	0.842
62	472	511.5	0.923	2,066	1,975.0	1.046
63	362	353.3	1.025	1,367	1,491.5	0.917
64	284	291.7	0.974	1,045	1,114.6	0.938
65	316	345.6	0.914	1,306	1,348.8	0.968
66	346	339.5	1.019	1,013	978.6	1.035
67	237	238.2	0.995	710	715.5	0.992
68	180	181.5	0.992	454	472.5	0.961
69	139	140.1	0.992	353	357.3	0.988
70 & Over	427	729.4	0.585	816	1,219.4	0.669
TOTAL	**3,972**	**4,418.3**	**0.899**	**16,084**	**16,836.3**	**0.955**
	30 or more years of servicce and less than age 65					
50 & Under	47	46.9	1.002	166	156.6	1.060
51	66	62.6	1.054	338	307.9	1.098
52	111	104.5	1.062	607	542.2	1.120
53	186	171.5	1.085	684	585.1	1.169
54	167	158.5	1.054	672	649.9	1.034
55	180	183.2	0.983	705	682.7	1.033
56	195	192.2	1.015	679	648.4	1.047
57	170	169.5	1.003	608	596.6	1.019
58	154	152.2	1.012	609	587.7	1.036
59	150	151.3	0.991	618	620.5	0.996
60	140	139.2	1.006	624	598.0	1.043
61	108	111.1	0.972	504	503.9	1.000
62	127	120.4	1.055	461	444.2	1.038
63	72	80.0	0.900	333	346.6	0.961
64	72	75.4	0.955	272	282.1	0.964
TOTAL	**1,945**	**1,918.5**	**1.014**	**7,880**	**7,552.4**	**1.043**

RATES OF PRE-RETIREMENT MORTALITY

COMPARISON OF ACTUAL AND EXPECTED PRE-RETIREMENT MORTALITY

CENTRAL AGE OF GROUP	NUMBER OF DEATHS					
	MALE			FEMALE		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
27 & Under	2	4.4	0.455	1	8.8	0.114
30	4	10.8	0.370	9	21.2	0.425
35	9	22.8	0.395	14	44.8	0.313
40	12	34.6	0.347	34	77.0	0.442
45	24	52.2	0.460	57	142.5	0.400
50	35	66.3	0.528	66	198.1	0.333
53 & Over	91	265.2	0.343	177	678.7	0.261
TOTAL	**177**	**456.3**	**0.388**	**358**	**1,171.1**	**0.306**

The experience indicates that the pre-retirement mortality rates were significantly lower than anticipated. However, death in active service accounts for a very small part of the liability of the System and the small number of deaths don't provide creditable data for analysis. Therefore, we are recommending the same tables and adjustments that we are recommending for post-retirement. We recommend that the rates of mortality in active service for both males and females be changed to the Pub-2010 Teachers Headcount Weighted Below Median Employee mortality table with ages set forward one year and adjusted 106%. Future improvement in mortality rates is assumed using the MP-2019 projection scale generationally. The rates of improvement have been reduced by 20% for all years prior to the ultimate rate. The following table shows a comparison between the present death rates and the proposed rates. The proposed rates shown below are based on a projection to 2015. Actual mortality rates would be projected generationally. Generational mortality projection is discussed in the next section.

COMPARATIVE RATES OF PRE-RETIREMENT MORTALITY

AGE	RATES OF MORTALITY			
	MALE		FEMALE	
	Present	Proposed*	Present	Proposed*
20	0.0320%	0.0375%	0.0177%	0.0139%
25	0.0349%	0.0336%	0.0192%	0.0148%
30	0.0412%	0.0437%	0.0245%	0.0235%
35	0.0717%	0.0549%	0.0441%	0.0345%
40	0.1001%	0.0714%	0.0655%	0.0493%
45	0.1399%	0.1087%	0.1043%	0.0728%
50	0.1983%	0.1799%	0.1555%	0.1107%
55	0.2810%	0.2828%	0.2228%	0.1687%
60	0.4092%	0.4441%	0.3058%	0.2554%
64	0.5330%	0.6475%	0.4015%	0.3665%

*Rates as of 2015

RATES OF POST-RETIREMENT MORTALITY

The current basis for rate of post-retirement mortality for service retirees and beneficiaries the RP-2000 White Collar Mortality Table with future mortality improvement projected to 2025 with the Society of Actuaries' projection scale BB set forward one year for males. The current basis for rate of post-retirement mortality for disability retirees is the RP-2000 Disabled Mortality Table with future mortality improvement projected to 2025 with Society of Actuaries' projection scale BB set forward two years for males and four years for females.

COMPARISON OF ACTUAL AND EXPECTED CASES OF POST-RETIREMENT DEATHS

CENTRAL AGE OF GROUP	NUMBER OF DEATHS AMONG SERVICE RETIREMENTS AND BENEFICIARIES					
	MALE			FEMALE		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
47 & Under	12	2.8	4.286	7	1.9	3.684
50	5	3.1	1.613	7	4.2	1.667
55	36	18.1	1.989	56	42.2	1.327
60	106	78.2	1.355	239	225.8	1.058
65	277	270.0	1.026	672	745.0	0.902
70	436	425.2	1.025	881	1,029.8	0.856
75	563	516.9	1.089	945	1,053.6	0.897
80	663	599.9	1.105	1,193	1,096.0	1.089
85	652	628.0	1.038	1,390	1,189.0	1.169
90	449	443.3	1.013	1,308	964.7	1.356
93 & Over	236	213.1	1.107	1,040	814.1	1.277
TOTAL	**3,435**	**3,198.6**	**1.074**	**7,738**	**7,166.3**	**1.080**

CENTRAL AGE OF GROUP	NUMBER OF DEATHS AMONG DISABILITY RETIREMENTS					
	MALE			FEMALE		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
47 & Under	8	3.4	2.353	30	7.0	4.286
50	11	9.8	1.122	15	16.7	0.898
55	28	19.7	1.421	64	45.5	1.407
60	34	33.2	1.024	107	83.2	1.286
65	28	28.6	0.979	85	98.5	0.863
70	29	24.3	1.193	75	86.4	0.868
75	20	20.2	0.990	61	60.4	1.010
80	8	13.0	0.615	33	36.5	0.904
85	5	7.7	0.649	32	34.4	0.930
90	5	3.6	1.389	27	24.9	1.084
93 & Over	1	0.5	2.000	15	12.7	1.181
TOTAL	**177**	**164.0**	**1.079**	**544**	**506.2**	**1.075**

There are two widely used approaches for reflecting future improvements in mortality:

(1) Static table with "margin"
(2) Generational mortality.

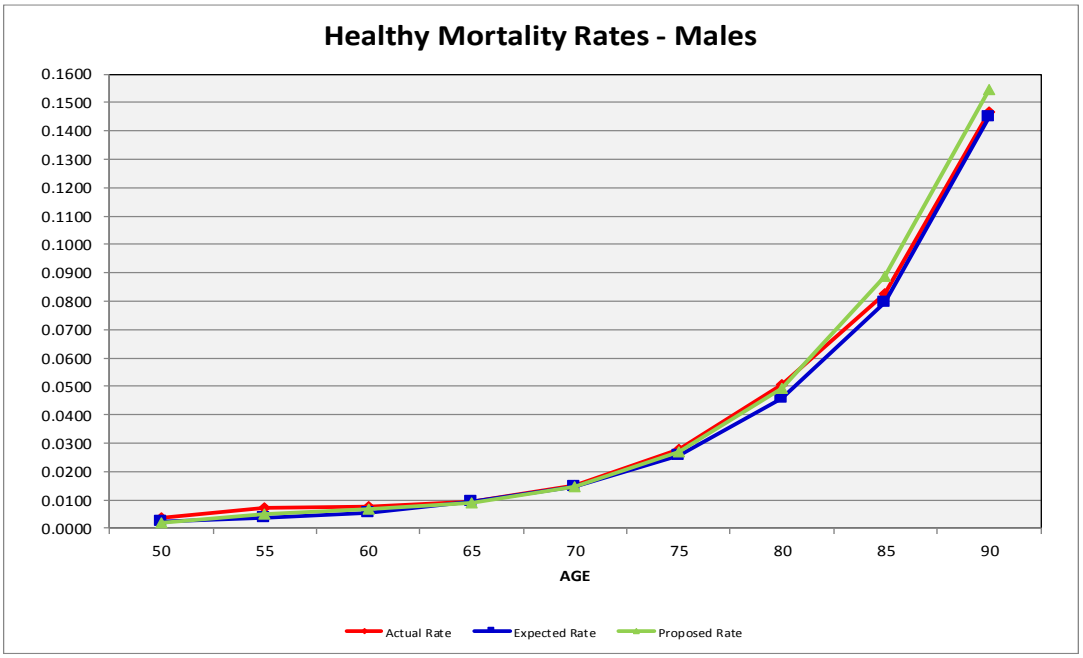
The first approach to reflecting mortality improvements is through the use of a static mortality table with "margin." Under this approach, the mortality assumption will include a margin (lower mortality rates than experienced) to account for a reasonable degree of future improvement. While there is no formal guidance for the amount of margin required (how far above 100% is appropriate for the A/E ratio), we typically prefer to have a margin of around 10% at the core retirement ages. The goal is still for the general shape of the curve to be a reasonable fit to the observed experience. Depending on the magnitude and duration of actual mortality improvements in the future, the margin may decrease and eventually become insufficient. If and when that occurs, the assumption would need to be updated.

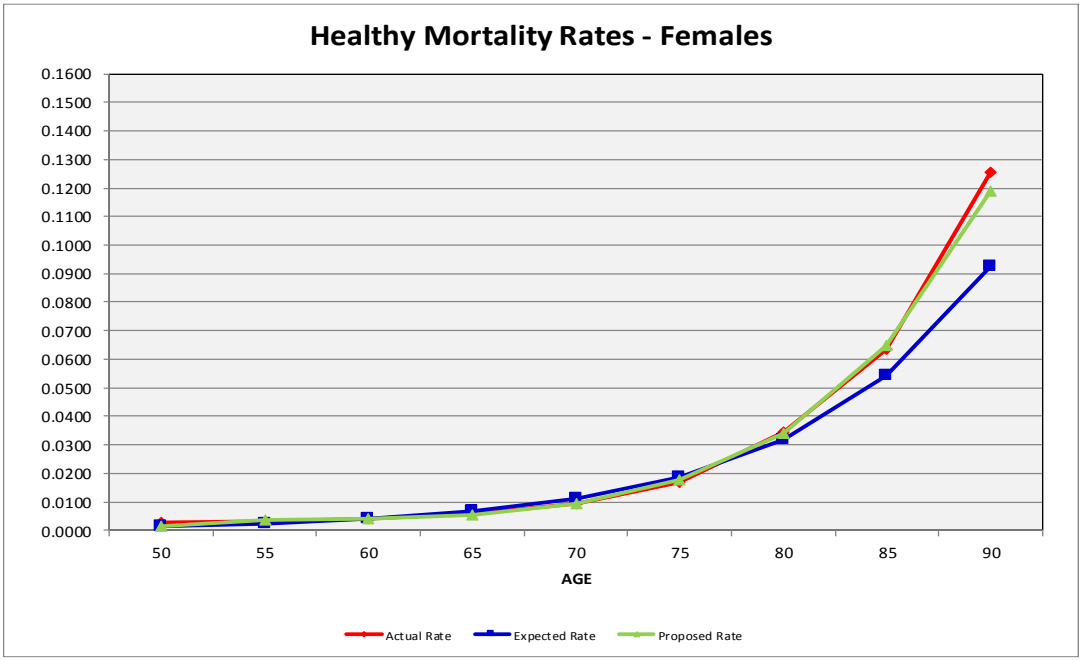
The more modern approach, referred to as generational mortality, directly anticipates future improvements in mortality by using a different set of mortality rates for each year of birth, with the rates for later years of birth assuming lower mortality than the rates for earlier years of birth. The varying mortality rates by year of birth create a series of tables that contain "built-in" mortality improvements, e.g., a member who turns age 65 in 2035 has a longer life expectancy than a member who turns age 65 in 2020. When using generational mortality, the A/E ratios for the observed experience are set near 100% as future mortality improvements will be included through the generational projection of mortality improvement eliminating the need to include a margin in the rates.

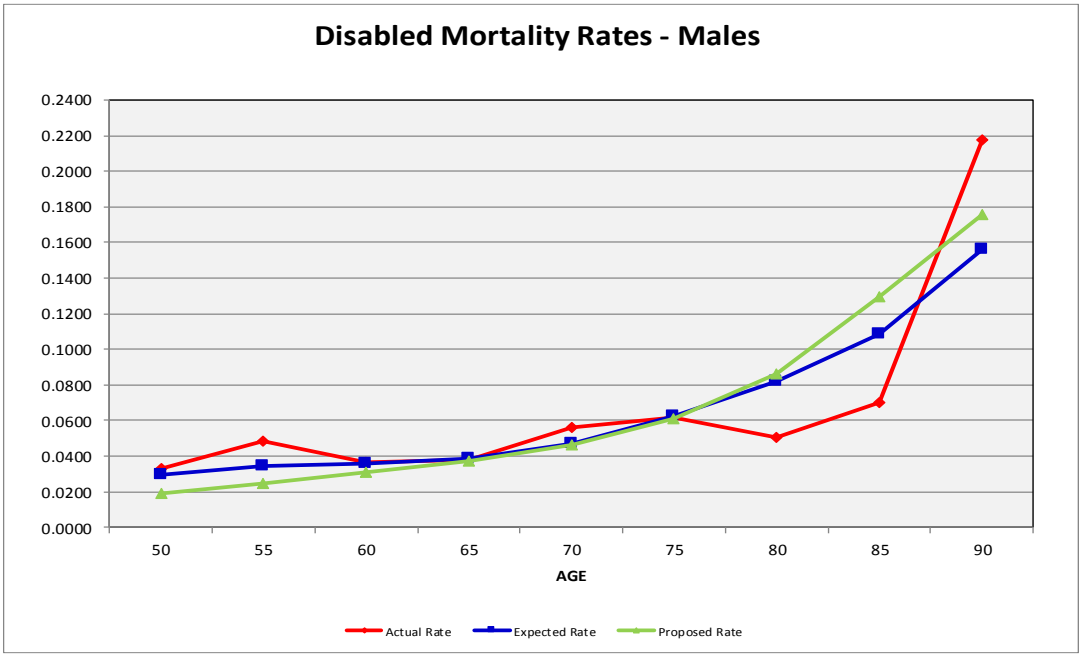
The mortality assumption used during the study period has maintained a reasonable margin appropriate for the static projection of mortality improvement. With this experience study, we recommend the adoption of a generational projection of mortality improvement. This method of projecting improvement utilizes an age specific rate of improvement in mortality rates for each future year which are produced from analysis published by the Society of Actuaries. The selected improvement scale, the most recently published MP-2019 improvement scale, is applied to a base mortality table which should reasonably reflect the current mortality experience of the studied population. For service retirees and beneficiaries, we recommend the base mortality table use of the Pub-2010 Teachers Headcount Weighted Below Median Healthy Retiree mortality table with ages set forward one year and adjusted 106% as the base mortality table. Future improvement in mortality rates is reflected by applying the MP-2019 projection scale generationally. The rates of improvement have been reduced by 20% for all years prior to the ultimate rate. This reduction in the projected improvement rates is based on our review of the actual rates of improvement measured in the mortality experience of retirees and beneficiaries from the three prior experience studies. Based on our analysis, the rates of improvement realized have been over 20% less than those expected under the MP-2019 improvement scale. We recommend reducing the MP-2019 improvement rates by 20% for all years prior to 2035, the year that ultimate rates are in effect, and 100% of the ultimate rate of improvement thereafter.

Disability retirement accounts for a very small part of the liability of the System and the small number of disabilities don't provide creditable data for analysis. Therefore, we are recommending

the same tables and adjustments that we are recommending for service retirement. We recommend that for disability retirements, the Pub-2010 Teachers Mortality Table for Disabled Retirees with ages set forward one year and adjusted 106%. Future improvement in mortality rates is assumed using the MP-2019 projection scale generationally. The rates of improvement have been reduced by 20% for all years prior to the ultimate rate. The following graphs show a comparison of the present, actual and proposed rates of post-retirement mortality. The proposed rates shown in the graphs are based on the tables described above, projected to 2015, which is the mid-point of the experience study period and were the rates used to set the rates of healthy mortality going forward. Note that actual and proposed rates track fairly well.






Disabled Mortality Rates - Males
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0.2200
0.2000
0.1800
0.1600
0.1400
0.1200
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0.0800
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50
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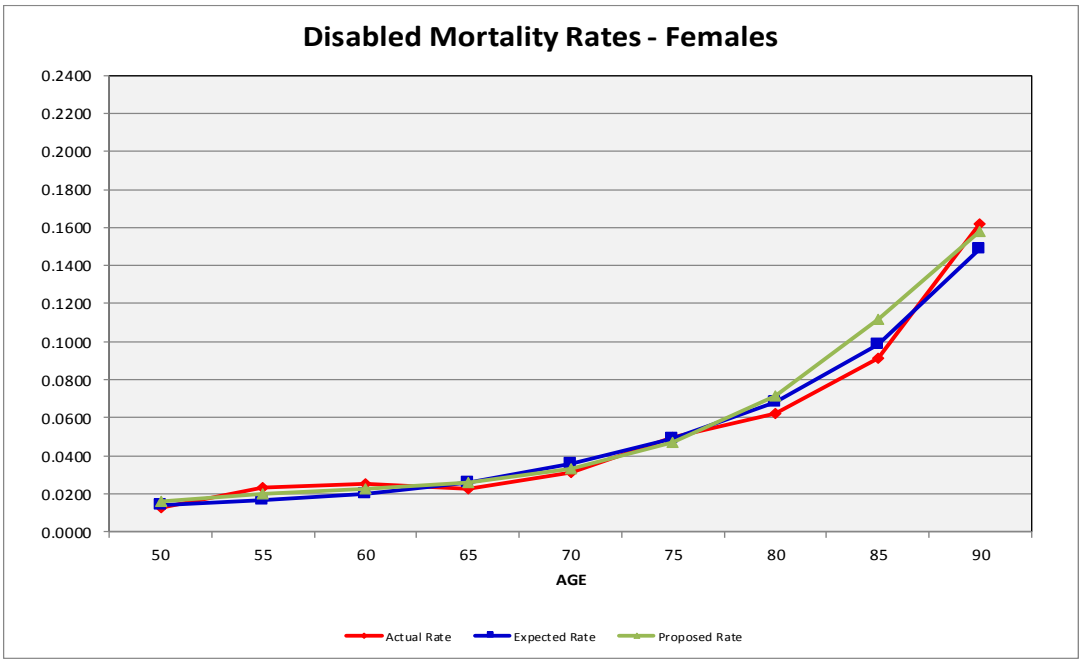
AGE
Actual Rate
Expected Rate
Proposed Rate


Disabled Mortality Rates - Females
0.2400
0.2200
0.2000
0.1800
0.1600
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
50
55
60
65
70
75
80
85
90
AGE
Actual Rate
Expected Rate
Proposed Rate

The following table shows a comparison of the present and proposed rates of post-retirement mortality. The proposed rates shown below are based on a projection to 2015. Actual mortality rates will be projected generationally to the year of the measurement.

COMPARATIVE RATES OF POST-RETIREMENT MORTALITY

AGE	SERVICE RETIREMENTS AND BENEFICIARIES			
	MALE		FEMALE	
	Present	Proposed*	Present	Proposed*
35	0.0602%	0.0549%	0.0432%	0.0345%
40	0.0889%	0.0714%	0.0598%	0.0493%
45	0.1352%	0.1087%	0.0942%	0.0728%
50	0.2136%	0.1799%	0.1474%	0.1107%
55	0.3478%	0.5241%	0.2281%	0.3901%
60	0.5197%	0.6440%	0.3638%	0.4136%
65	0.9071%	0.8433%	0.6397%	0.5260%
70	1.4666%	1.4580%	1.1229%	0.9329%
75	2.5894%	2.7028%	1.9017%	1.7905%
80	4.5768%	4.9635%	3.1857%	3.4310%
85	8.0034%	9.0522%	5.4864%	6.5905%
90	15.1656%	16.0712%	9.5675%	12.3050%

***Rates as of 2015**

AGE	DISABILITY RETIREMENTS			
	MALE		FEMALE	
	Present	Proposed*	Present	Proposed*
35	2.0938%	0.6444%	0.6911%	0.5093%
40	2.0938%	0.8444%	0.6911%	0.7386%
45	2.3306%	1.2146%	0.9865%	1.1004%
50	2.9279%	1.8432%	1.4019%	1.6181%
55	3.4400%	2.4790%	1.6567%	1.9679%
60	3.5881%	3.0569%	1.9670%	2.2548%
65	3.8275%	3.7177%	2.6129%	2.6170%
70	4.7566%	4.6328%	3.6157%	3.3740%
75	6.3153%	6.1798%	5.0131%	4.7842%
80	8.3527%	8.8648%	6.9358%	7.2311%
85	10.9122%	13.0223%	9.6851%	11.2015%
90	17.2787%	18.8001%	15.3358%	16.0832%

***Rates as of 2015**

COMPARISON OF ACTUAL AND EXPECTED CASES OF POST-RETIREMENT DEATHS BASED ON PROPOSED RATES OF MORTALITY

CENTRAL AGE OF GROUP	NUMBER OF DEATHS AMONG SERVICE RETIREMENTS AND BENEFICIARIES					
	MALE			FEMALE		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
47 & Under	12	2.4	5.000	7	1.5	4.667
50	5	2.7	1.852	7	3.1	2.258
55	36	26.0	1.385	56	63.5	0.882
60	106	91.8	1.155	239	244.4	0.978
65	277	257.7	1.075	672	617.4	1.088
70	436	423.8	1.029	881	862.6	1.021
75	563	539.8	1.043	945	992.4	0.952
80	663	651.0	1.018	1,193	1,181.5	1.010
85	652	699.7	0.932	1,390	1,427.0	0.974
90	449	472.0	0.951	1,308	1,239.0	1.056
93 & Over	236	225.6	1.046	1,040	1,114.1	0.933
TOTAL	**3,435**	**3,392.5**	**1.013**	**7,738**	**7,746.5**	**0.999**

CENTRAL AGE OF GROUP	NUMBER OF DEATHS AMONG DISABILITY RETIREMENTS					
	MALE			FEMALE		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
47 & Under	8	1.7	4.706	30	7.7	3.896
50	11	6.2	1.774	15	19.3	0.777
55	28	14.4	1.944	64	54.2	1.181
60	34	28.3	1.201	107	95.0	1.126
65	28	27.6	1.014	85	98.9	0.859
70	29	23.8	1.218	75	81.0	0.926
75	20	19.8	1.010	61	57.7	1.057
80	8	13.7	0.584	33	38.0	0.868
85	5	9.2	0.543	32	39.0	0.821
90	5	4.0	1.250	27	26.3	1.027
93 & Over	1	0.5	2.000	15	13.9	1.079
TOTAL	**177**	**149.2**	**1.186**	**544**	**531.0**	**1.024**

RATES OF SALARY INCREASE

COMPARISON OF ACTUAL AND EXPECTED RATES OF SALARY INCREASE OF ACTIVE MEMBERS

SERVICE	SALARIES AT END OF YEAR ($1,000's)		
	Actual	Expected	Ratio of Actual to Expected
0	311,756	258,929	1.204
1	3,016,994	2,863,932	1.053
2	2,532,956	2,511,197	1.009
3	2,152,239	2,136,553	1.007
4	1,834,694	1,820,922	1.008
5	1,783,059	1,777,909	1.003
6	1,918,042	1,910,237	1.004
7	2,122,321	2,105,504	1.008
8	2,318,565	2,302,946	1.007
9	2,455,039	2,432,705	1.009
10	2,356,426	2,342,362	1.006
11	2,252,797	2,232,660	1.009
12	2,135,689	2,130,926	1.002
13	2,046,370	2,034,281	1.006
14	1,978,624	1,971,023	1.004
15	1,955,841	1,942,062	1.007
16	1,855,912	1,849,616	1.003
17	1,726,555	1,712,781	1.008
18	1,611,946	1,607,890	1.003
19	1,516,822	1,506,302	1.007
20 & Over	10,473,630	10,514,000	0.996
Total	**50,356,277**	**49,964,737**	**1.008**

The current assumed rates of salary increase were somewhat greater than the actual rates of increase averaged over the study period in most service categories. However, we believe that salary increases during the study period were not necessarily indicative of the expected long-term future rate of salary increase. Therefore, we recommend no change to the current salary increase rates at this time.

Section V
Other Assumptions and Methods and Administrative Procedures

ADMINISTRATIVE EXPENSES: This assumption is currently 0.25% of payroll (included in normal contribution). The actual administrative expenses over the experience study period have been approximately 0.20% of payroll. We recommend a change in this assumption to 0.20% of payroll.

ASSETS: Currently, the actuarial value of assets recognizes a portion of the difference between the market value of assets and the expected actuarial value of assets, based on the assumed valuation rate of return. The amount recognized each year is 20% of the difference between market value and expected actuarial value. We recommend maintaining the current smoothing method.

COST OF LIVING: Currently, we assume cost of living increases of 1.5% semi-annually. We recommend maintaining this assumption.

OPTION FACTORS: The option factors currently used by the Retirement System are based on the mortality tables and investment rate of return (discount rate) used in the valuation. We recommend that the factors be revised to be based on the mortality table recommended for the valuation.

PERCENT MARRIED: This assumption is used to determine who will receive death in active service benefits. The beneficiaries of unmarried members are assumed to receive a refund of member contributions. We recommend keeping this assumption for death in active service benefits as 100% married for both males and females.

UNUSED SICK LEAVE: Currently, we assume a 1.25% load on liabilities for members who retire on early retirement, a 1.25% load for members who retire with unreduced retirement before 30 years of service and a 1.75% load for members who retire with 30 or more years of service. Based on data we received from the Retirement System on members who converted unused leave at retirement over the past five years, we recommend changing the loads on liabilities to 1.50% for members who retire on early retirement and for members who retire with unreduced retirement before 30 years of service and a 2.00% load for members who retire with 30 or more years of service.

VALUATION COST METHOD: Currently, the valuation uses the entry age actuarial cost method. This is the most widely used cost method of large public sector plans and has demonstrated the highest degree of stability as compared to alternative methods. We recommend no change to this assumption.

VESTED TERMINATION BENEFIT ELECTION: Currently, we assume that 60% of vested members under age 50 and 80% of members age 50 and over who terminate with 10 or more years of service before retirement eligibility will choose to receive a benefit payable at age 60. Other members are assumed to receive a refund of contribution. Based on the latest experience, we recommend changing the percentage who will elect to receive a benefit to 70% for those who terminate before age 50 and leaving the percentage who will elect to receive a benefit as 80% for members who terminate at age 50 and over.

APPENDIX A

Historical June CPI (U) Index

Fiscal Year Ending 6/30	CPI (U)	Fiscal Year Ending 6/30	CPI (U)
1964	31.0	1992	140.2
1965	31.6	1993	144.4
1966	32.4	1994	148.0
1967	33.3	1995	152.5
1968	34.7	1996	156.7
1969	36.6	1997	160.3
1970	38.8	1998	163.0
1971	40.6	1999	166.2
1972	41.7	2000	172.4
1973	44.2	2001	178.0
1974	49.0	2002	179.9
1975	53.6	2003	183.7
1976	56.8	2004	189.7
1977	60.7	2005	194.5
1978	65.2	2006	202.9
1979	72.3	2007	208.352
1980	82.7	2008	218.815
1981	90.6	2009	215.693
1982	97.0	2010	217.965
1983	99.5	2011	225.722
1984	103.7	2012	229.478
1985	107.6	2013	233.504
1986	109.5	2014	238.343
1987	113.5	2015	238.638
1988	118.0	2016	241.018
1989	124.1	2017	244.955
1990	129.9	2018	251.989
1991	136.0		

APPENDIX B

Capital Market Assumptions and Asset Allocation

Real Rates of Return and Standard Deviations by Asset Class

Asset Class	Expected Real Rate of Return*	Standard Deviation
Fixed Income	-0.1%	4.7%
Domestic Large Cap Stocks	8.9%	19.8%
Domestic Small Cap Stocks	13.2%	31.6%
Int'l Developed Mkt Stocks	8.9%	21.8%
Int'l Emerging Mkt Stocks	5.1%	31.7%

**Net of inflation*

Asset Class Correlation Coefficients

Asset Class	Fixed Income	US Large Stocks	US Small Stocks	Int'l Dev Mkt Stocks	Int'l EM Mkt Stocks
Fixed Income	1.00				
Domestic Large Cap Stocks	0.00	1.00			
Domestic Small Cap Stocks	-0.10	0.79	1.00		
Int'l Developed Mkt Stocks	-0.11	0.67	0.51	1.00	
Int'l Emerging Mkt Stocks	-0.11	0.67	0.51	0.71	1.00

Asset Allocation Targets

Asset Class	Asset Allocation
Fixed Income	30.0%
Domestic Large Cap Stocks	51.0%
Domestic Small Cap Stocks	1.5%
Int'l Developed Mkt Stocks	12.4%
Int'l Emerging Mkt Stocks	5.1%

APPENDIX C

Social Security Administration Calendar Year Wage Index

Calendar Year	Wage Index	Annual Increase	Calendar Year	Wage Index	Annual Increase
1963	$4,396.64		1991	$21,811.60	3.73%
1964	4,576.32	4.09%	1992	22,935.42	5.15
1965	4,658.72	1.80	1993	23,132.67	0.86
1966	4,938.36	6.00	1994	23,753.53	2.68
1967	5,213.44	5.57	1995	24,705.66	4.01
1968	5,571.76	6.87	1996	25,913.90	4.89
1969	5,893.76	5.78	1997	27,426.00	5.84
1970	6,186.24	4.96	1998	28,861.44	5.23
1971	6,497.08	5.02	1999	30,469.84	5.57
1972	7,133.80	9.80	2000	32,154.82	5.53
1973	7,580.16	6.26	2001	32,921.92	2.39
1974	8,030.76	5.94	2002	33,252.09	1.00
1975	8,630.92	7.47	2003	34,064.95	2.44
1976	9,226.48	6.90	2004	35,648.55	4.65
1977	9,779.44	5.99	2005	36,952.94	3.66
1978	10,556.03	7.94	2006	38,651.41	4.60
1979	11,479.46	8.75	2007	40,405.48	4.54
1980	12,513.46	9.01	2008	41,334.97	2.30
1981	13,773.10	10.07	2009	40,711.61	(1.51)
1982	14,531.34	5.51	2010	41,673.83	2.36
1983	15,239.24	4.87	2011	42,979.61	3.13
1984	16,135.07	5.88	2012	44,321.67	3.12
1985	16,822.51	4.26	2013	44,888.16	1.28
1986	17,321.82	2.97	2014	46,481.52	3.55
1987	18,426.51	6.38	2015	48,098.63	3.48
1988	19,334.04	4.93	2016	48,642.15	1.13
1989	20,099.55	3.96	2017	50,321.89	3.45
1990	21,027.98	4.62			

APPENDIX D

TABLE 1
RATES OF SEPARATION FROM ACTIVE SERVICE - MALES

AGE	Rates of Withdrawal Service			Death*	Disability	Rates of Retirement	
	0 - 4	5 - 9	10+			< 30 years of service	>= 30 years of service**
19	0.27000	0.00000	0.00000	0.000391	0.000000		
20	0.27000	0.00000	0.00000	0.000375	0.000000		
21	0.27000	0.00000	0.00000	0.000358	0.000000		
22	0.27000	0.00000	0.00000	0.000331	0.000000		
23	0.22000	0.13000	0.00000	0.000315	0.000000		
24	0.20000	0.13000	0.00000	0.000320	0.000000		
25	0.17000	0.13000	0.00000	0.000336	0.000000		
26	0.16000	0.13000	0.00000	0.000352	0.000000		
27	0.15000	0.13000	0.00000	0.000379	0.000000		
28	0.14000	0.10000	0.08000	0.000395	0.000000		
29	0.14000	0.08000	0.07000	0.000422	0.000000		
30	0.14000	0.06500	0.06000	0.000437	0.000000		
31	0.14000	0.06500	0.06000	0.000463	0.000000		
32	0.14000	0.06500	0.06000	0.000487	0.000000		
33	0.14000	0.06250	0.04000	0.000509	0.000125		
34	0.14000	0.06250	0.03500	0.000530	0.000145		
35	0.14000	0.06250	0.03500	0.000549	0.000165		
36	0.14000	0.06250	0.03500	0.000577	0.000185		
37	0.14000	0.06250	0.03500	0.000603	0.000205		
38	0.13000	0.06250	0.03250	0.000638	0.000225		
39	0.13000	0.06250	0.03250	0.000671	0.000250		
40	0.13000	0.06250	0.02750	0.000714	0.000275	0.03000	
41	0.13000	0.06250	0.02750	0.000766	0.000300	0.03000	
42	0.13000	0.06250	0.02750	0.000827	0.000325	0.03000	
43	0.13000	0.06000	0.02750	0.000899	0.000560	0.03000	
44	0.13000	0.06000	0.02500	0.000982	0.000640	0.03000	
45	0.13000	0.06000	0.02500	0.001087	0.000720	0.03000	0.65000
46	0.13000	0.06000	0.02500	0.001204	0.000800	0.03000	0.65000
47	0.13000	0.06000	0.02500	0.001324	0.000880	0.03000	0.65000
48	0.11250	0.05750	0.02750	0.001468	0.000960	0.03000	0.65000
49	0.11250	0.05750	0.02750	0.001626	0.001040	0.03000	0.65000
50	0.11250	0.05750	0.02750	0.001799	0.001360	0.03000	0.52000
51	0.11250	0.05500	0.02750	0.001977	0.001760	0.03000	0.58000
52	0.11250	0.05500	0.03000	0.002169	0.002160	0.03000	0.54000
53	0.11500	0.05500	0.03250	0.002375	0.002240	0.03000	0.50000
54	0.11500	0.05500	0.03250	0.002595	0.002320	0.03000	0.36000
55	0.11750	0.05500	0.03250	0.002828	0.002400	0.05000	0.37000
56	0.11750	0.05750	0.03500	0.003083	0.002560	0.05000	0.37000
57	0.11750	0.05750	0.03500	0.003369	0.002800	0.05000	0.35000
58	0.12000	0.06000	0.03500	0.003684	0.003600	0.05000	0.33000
59	0.12000	0.06000	0.03500	0.004046	0.004400	0.05000	0.34000
60	0.12000	0.06000		0.004441		0.20000	0.34000
61	0.13000	0.06000		0.004876		0.18000	0.30000
62	0.13000	0.06000		0.005361		0.25000	0.35000
63	0.15000	0.07500		0.005894		0.22000	0.28000
64	0.15000	0.07500		0.006475		0.22000	0.28000
65	0.15000	0.07500		0.007128		0.27000	0.27000
66	0.15000	0.07500		0.007838		0.32000	0.32000
67	0.15000	0.07500		0.008605		0.30000	0.30000
68	0.15000	0.07500		0.009438		0.30000	0.30000
69	0.15000	0.07500		0.010305		0.30000	0.30000
70	0.15000	0.07500		0.011229		0.30000	0.30000
71	0.15000	0.07500		0.012205		0.30000	0.30000
72	0.15000	0.07500		0.013226		0.30000	0.30000
73	0.15000	0.07500		0.014336		0.30000	0.30000
74	0.15000	0.07500		0.015516		0.30000	0.30000
75	0.00000	0.00000		0.017745		1.00000	1.00000

*Rates as of 2015
**An additional 10% are assumed to retire at 30 years of service for ages between 50 and 64.

TABLE 2
RATES OF SEPARATION FROM ACTIVE SERVICE – FEMALES

	Rates of Withdrawal Service					Rates of Retirement	
AGE	0 - 4	5 - 9	10+	Death*	Disability	< 30 years of service	>= 30 years of service**
19	0.28000	0.00000	0.00000	0.000138	0.000000		
20	0.28000	0.00000	0.00000	0.000139	0.000000		
21	0.28000	0.00000	0.00000	0.000130	0.000000		
22	0.28000	0.00000	0.00000	0.000132	0.000000		
23	0.13500	0.12000	0.00000	0.000122	0.000000		
24	0.13500	0.12000	0.00000	0.000135	0.000000		
25	0.13500	0.12000	0.00000	0.000148	0.000000		
26	0.13500	0.12000	0.00000	0.000161	0.000000		
27	0.13500	0.12000	0.00000	0.000174	0.000000		
28	0.13500	0.10000	0.06000	0.000198	0.000000		
29	0.13500	0.08000	0.06000	0.000211	0.000000		
30	0.13500	0.07000	0.06000	0.000235	0.000000		
31	0.13500	0.07000	0.05750	0.000247	0.000000		
32	0.13500	0.07000	0.05500	0.000270	0.000000		
33	0.13000	0.07000	0.05000	0.000292	0.000136		
34	0.13000	0.07000	0.04000	0.000313	0.000144		
35	0.13000	0.07000	0.04000	0.000345	0.000152		
36	0.13000	0.06500	0.04000	0.000364	0.000160		
37	0.13000	0.06500	0.04000	0.000392	0.000168		
38	0.12000	0.06500	0.03000	0.000420	0.000216		
39	0.12000	0.06500	0.03000	0.000457	0.000264		
40	0.12000	0.06500	0.03000	0.000493	0.000312	0.02000	
41	0.12000	0.06500	0.03000	0.000529	0.000336	0.02000	
42	0.11000	0.06000	0.03000	0.000575	0.000360	0.02000	
43	0.11000	0.06000	0.02500	0.000621	0.000470	0.02000	
44	0.10750	0.06000	0.02500	0.000669	0.000560	0.02000	
45	0.10750	0.06000	0.02500	0.000728	0.000650	0.02000	0.60000
46	0.10750	0.05500	0.02500	0.000790	0.000750	0.02000	0.60000
47	0.10750	0.05500	0.02500	0.000854	0.000900	0.02000	0.60000
48	0.10750	0.05500	0.03000	0.000932	0.001000	0.02000	0.60000
49	0.10750	0.05500	0.03000	0.001013	0.001200	0.02000	0.60000
50	0.10750	0.05500	0.03000	0.001107	0.001400	0.02750	0.50000
51	0.10750	0.05000	0.03000	0.001203	0.001800	0.02750	0.58000
52	0.10750	0.05000	0.03000	0.001312	0.002500	0.02750	0.48000
53	0.10750	0.05000	0.03000	0.001432	0.002900	0.02750	0.35000
54	0.10750	0.05000	0.03000	0.001550	0.003000	0.02750	0.35000
55	0.10750	0.05000	0.03000	0.001687	0.003400	0.05750	0.35000
56	0.10750	0.05000	0.03000	0.001831	0.003900	0.05750	0.35000
57	0.10750	0.05000	0.03000	0.001979	0.004500	0.05750	0.35000
58	0.11500	0.05500	0.03000	0.002153	0.005200	0.05750	0.35000
59	0.11500	0.05000	0.03000	0.002341	0.006000	0.05750	0.40000
60	0.11500	0.05500		0.002554		0.25000	0.40000
61	0.11500	0.05500		0.002781		0.25000	0.40000
62	0.11500	0.05500		0.003045		0.25000	0.43000
63	0.15000	0.07500		0.003335		0.25000	0.43000
64	0.15000	0.07500		0.003665		0.24000	0.43000
65	0.15000	0.07500		0.004047		0.32000	0.32000
66	0.15000	0.07500		0.004482		0.32000	0.32000
67	0.15000	0.07500		0.004983		0.32000	0.32000
68	0.15000	0.07500		0.005549		0.30000	0.30000
69	0.15000	0.07500		0.006214		0.30000	0.30000
70	0.15000	0.07500		0.007047		0.30000	0.30000
71	0.15000	0.07500		0.008020		0.30000	0.30000
72	0.15000	0.07500		0.009141		0.30000	0.30000
73	0.15000	0.07500		0.010432		0.30000	0.30000
74	0.15000	0.07500		0.011918		0.30000	0.30000
75	0.00000	0.00000		0.013697		1.00000	1.00000

*Rates as of 2015
**An additional 15% are assumed to retire at 30 years of service for ages between 50 and 61.

TABLE 3
RATES OF SALARY INCREASES

SERVICE	RATE
0	1.0875
1	1.0725
2	1.0575
3	1.0525
4	1.0500
5	1.0500
6	1.0500
7	1.0425
8	1.0375
9	1.0375
10	1.0350
11	1.0350
12	1.0350
13	1.0350
14	1.0325
15	1.0325
16	1.0300
17	1.0300
18	1.0300
19	1.0300
20 & Over	1.0300

TABLE 4
RATES* OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF SERVICE AND BENEFICIARIES OF DECEASED MEMBERS

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.000391	0.000138	71	0.016452	0.010588
20	0.000375	0.000139	72	0.018593	0.012050
21	0.000358	0.000130	73	0.021049	0.013734
22	0.000331	0.000132	74	0.023851	0.015676
23	0.000315	0.000122	75	0.027028	0.017905
24	0.000320	0.000135	76	0.030602	0.020444
25	0.000336	0.000148	77	0.034587	0.023292
26	0.000352	0.000161	78	0.039041	0.026513
27	0.000379	0.000174	79	0.044029	0.030157
28	0.000395	0.000198	80	0.049635	0.034310
29	0.000422	0.000211	81	0.055955	0.039061
30	0.000437	0.000235	82	0.063111	0.044527
31	0.000463	0.000247	83	0.071199	0.050773
32	0.000487	0.000270	84	0.080301	0.057872
33	0.000509	0.000292	85	0.090522	0.065905
34	0.000530	0.000313	86	0.101952	0.074915
35	0.000549	0.000345	87	0.114654	0.085016
36	0.000577	0.000364	88	0.128665	0.096302
37	0.000603	0.000392	89	0.143989	0.108863
38	0.000638	0.000420	90	0.160712	0.123050
39	0.000671	0.000457	91	0.178804	0.138920
40	0.000714	0.000493	92	0.198051	0.156483
41	0.000766	0.000529	93	0.218317	0.175520
42	0.000827	0.000575	94	0.239259	0.195812
43	0.000899	0.000621	95	0.261186	0.217258
44	0.000982	0.000669	96	0.283265	0.239427
45	0.001087	0.000728	97	0.305387	0.261930
46	0.001204	0.000790	98	0.327282	0.284517
47	0.001324	0.000854	99	0.348776	0.307135
48	0.001468	0.000932	100	0.369901	0.329688
49	0.001626	0.001013	101	0.390782	0.352255
50	0.001799	0.001107	102	0.411187	0.374737
51	0.001977	0.001203	103	0.431062	0.396818
52	0.002169	0.001312	104	0.450248	0.418408
53	0.002375	0.001432	105	0.468723	0.439379
54	0.005010	0.003843	106	0.486214	0.459442
55	0.005241	0.003901	107	0.502842	0.478519
56	0.005470	0.003936	108	0.518425	0.496626
57	0.005705	0.003980	109	0.526364	0.513594
58	0.005953	0.004023	110	0.527081	0.527799
59	0.006188	0.004067	111	0.527841	0.528348
60	0.006440	0.004136	112	0.528560	0.528899
61	0.006695	0.004230	113	0.529280	0.529449
62	0.006988	0.004363	114	0.530000	0.530000
63	0.007307	0.004537	115	0.530000	0.530000
64	0.007675	0.004785	116	0.530000	0.530000
65	0.008433	0.005260	117	0.530000	0.530000
66	0.009329	0.005831	118	0.530000	0.530000
67	0.010364	0.006519	119	1.000000	1.000000
68	0.011575	0.007325	120	1.000000	1.000000
69	0.012972	0.008252			
70	0.014580	0.009329			

*Rates as of 2015

TABLE 5
RATES* OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF DISABILITY

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.004236	0.002467	71	0.048747	0.035962
20	0.004016	0.002306	72	0.051444	0.038439
21	0.003774	0.002107	73	0.054500	0.041221
22	0.003603	0.001957	74	0.057940	0.044350
23	0.003495	0.001925	75	0.061798	0.047842
24	0.003504	0.001992	76	0.066103	0.051736
25	0.003736	0.002183	77	0.070900	0.056084
26	0.003971	0.002399	78	0.076232	0.060934
27	0.004219	0.002639	79	0.082143	0.066340
28	0.004488	0.002890	80	0.088648	0.072311
29	0.004752	0.003162	81	0.095770	0.078908
30	0.005021	0.003442	82	0.103505	0.086181
31	0.005289	0.003739	83	0.111836	0.094149
32	0.005568	0.004050	84	0.120744	0.102884
33	0.005851	0.004383	85	0.130223	0.112015
34	0.006147	0.004724	86	0.140302	0.121357
35	0.006444	0.005093	87	0.151074	0.130835
36	0.006773	0.005465	88	0.162552	0.140477
37	0.007132	0.005874	89	0.174851	0.150409
38	0.007522	0.006341	90	0.188001	0.160832
39	0.007955	0.006845	91	0.203357	0.171904
40	0.008444	0.007386	92	0.219659	0.183906
41	0.008995	0.007974	93	0.236102	0.197016
42	0.009624	0.008622	94	0.252755	0.211465
43	0.010357	0.009338	95	0.270439	0.227586
44	0.011191	0.010133	96	0.288744	0.245346
45	0.012146	0.011004	97	0.307955	0.264627
46	0.013230	0.011970	98	0.328018	0.285278
47	0.014450	0.013039	99	0.348776	0.307135
48	0.015800	0.014215	100	0.369901	0.329688
49	0.017278	0.015493	101	0.390782	0.352255
50	0.018432	0.016181	102	0.411187	0.374737
51	0.019644	0.016900	103	0.431062	0.396818
52	0.020912	0.017639	104	0.450248	0.418408
53	0.022201	0.018354	105	0.468723	0.439379
54	0.023502	0.019018	106	0.486214	0.459442
55	0.024790	0.019679	107	0.502842	0.478519
56	0.026023	0.020328	108	0.518425	0.496626
57	0.027200	0.020919	109	0.526364	0.513594
58	0.028337	0.021476	110	0.527081	0.527799
59	0.029446	0.022010	111	0.527841	0.528348
60	0.030569	0.022548	112	0.528560	0.528899
61	0.031731	0.023104	113	0.529280	0.529449
62	0.032970	0.023730	114	0.530000	0.530000
63	0.034292	0.024425	115	0.530000	0.530000
64	0.035689	0.025227	116	0.530000	0.530000
65	0.037177	0.026170	117	0.530000	0.530000
66	0.038753	0.027278	118	0.530000	0.530000
67	0.040426	0.028573	119	1.000000	1.000000
68	0.042220	0.030066	120	1.000000	1.000000
69	0.044172	0.031786			
70	0.046328	0.033740			

*Rates as of 2015