

# **State Teachers Retirement System of Ohio**

## **Actuarial Experience Review**

July 1, 2011 to June 30, 2016



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March 3, 2017

Board of Trustees  
State Teachers Retirement System of Ohio  
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Ladies and Gentlemen:

This report presents the results of the actuarial review of the demographic and economic experience of the State Teachers Retirement System of Ohio (STRS Ohio) for the period July 1, 2011 through June 30, 2016. This experience review was prepared in accordance with Section 3307.51(B) of the Retirement Code, which requires the actuary for STRS Ohio to make an actuarial investigation into the mortality, service, and other experience of the members, retirees and beneficiaries covered under the System at least once in each five-year period.

All current actuarial assumptions were reviewed as part of this study. This review is the basis for our recommendation of the assumptions to be used for the July 1, 2017 actuarial valuation of pension benefits and the January 1, 2018 actuarial valuation of retiree health care benefits.

In preparing the results presented in this report, we have relied upon information (some oral and some in writing) that STRS Ohio provided to us 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 this information 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 System'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 actuaries are independent. Both are Fellows of the Society of Actuaries, Enrolled Actuaries, and Members of the American Academy of Actuaries, and both are experienced in performing experience studies for large public retirement systems. They both meet the Qualification Standards of the American Academy of Actuaries.

Respectfully submitted,

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# I. Executive Summary

## A. Introduction

Actuarial valuations are prepared annually to determine whether the contributions being made by members and employers are sufficient to fund the State Teachers Retirement System of Ohio. Each actuarial valuation is highly dependent on the assumptions that the actuary uses to project the benefits expected to be paid in the future to all members of STRS Ohio. 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.

If actual experience exactly matches the expected experience, the actual annual cost of STRS Ohio 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. STRS Ohio recognizes actuarial gains and losses each year, reflecting the net difference between actual experience and anticipated experience. Determination of the funding period 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*).

## I. Executive Summary

This study reviews the actuarial experience of STRS Ohio for the five-year period from July 1, 2011 through June 30, 2016, 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.

# I. Executive Summary

## 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 the System, including the funding period, the funded ratio and the adequacy of contributions made by members and employers (as compared to the Actuarially Determined Employer Contribution). We have reviewed both economic and demographic experience of the System 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 STRS Ohio.

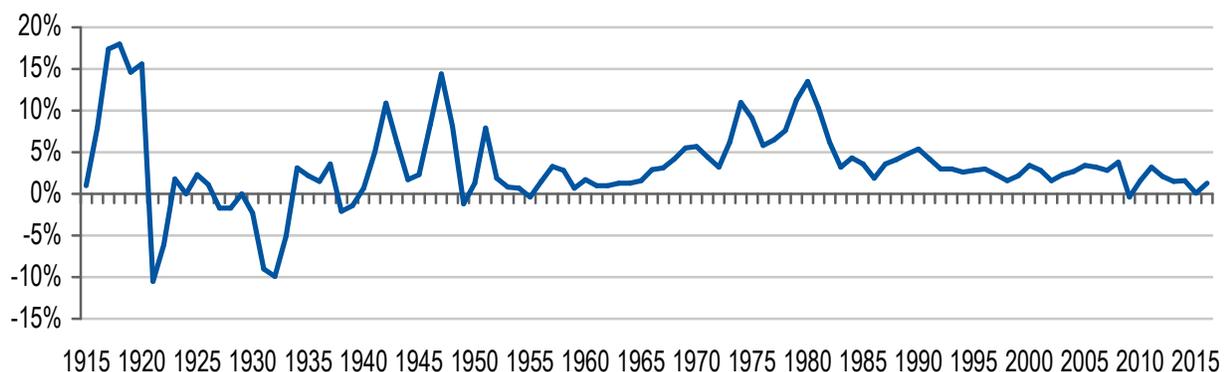
The detailed analysis of each individual assumption is discussed later in this report.

### Economic Assumptions

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

#### *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 less than 2.50% over a 20-year horizon as stated by Callan, Segal Rogerscasey<sup>1</sup>, and other leading investment advisors. In light of all sources of inflation expectations reviewed in our study, we recommend a decrease in the current assumption of 2.75% to 2.50%. We also recommend changes to the other economic assumptions since these 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 rate of individual salary increases is comprised of inflation, and merit and seniority increases. Finally, payroll growth is a function of inflation and merit increases.

<sup>1</sup> In 2017, Segal Rogerscasey acquired Marco Consulting Group, and is now Segal Marco Advisors.

# I. Executive Summary

## *Rate of Investment Return*

The System has averaged investment returns of 5.8% and 6.9% over the last 10 years and 20 years, respectively. The current assumption is 7.75%. Thus, on average the System has underperformed the assumption, but less-so as more years are included in the experience period.

Based on the System's target allocation and the 10-year Capital Market Assumptions (CMA) provided by Callan, the net real rate of investment return (net investment and administrative expenses) is 4.48%, compared to the current expectation of 5.00%. Since we recommend that the inflation assumption be reduced to 2.5%, and the investment return assumption is the combination of expected inflation plus expected real rate of return, we recommend lowering the investment return assumption from 7.75% to 7.00%.

## *Rate of Individual Salary Increases*

We study the merit and seniority increases separately from inflation. Analysis of the distribution of merit and seniority increases by age during the study period shows that these increases were less than expected.

Accounting for the recommended decrease in the inflation assumption, we recommend decreasing the current age-based assumption that grades from 12.25% at age 25 to 3.25% at age 65 to rates that grade from 11.50% at age 25 to 2.50% at age 65.

## *Payroll Growth*

The payroll growth rate is used to estimate annual increases in payroll in order to determine the amortization payment toward the unfunded accrued liability (UAL) and the funding period. The current payroll growth assumption is 3.5% for two years and 4.0% thereafter. Actual average increases in covered payroll have been -0.6% and 0.6% over the last 5 and 10 years, respectively. Based upon an open group projection using the recommended individual salary increase assumption, aggregate projected payroll is expected to increase by 2.99% per year over 10 years and 2.69% over 20 years. As our recommendation for the investment return assumption is weighted toward the next 10 years, we recommend lowering the payroll growth assumption to 3.0% for all future years.

# I. Executive Summary

## Demographic Assumptions

The demographic assumptions include mortality, retirement, termination (or withdrawal), disability incidence, percent married, and spouse age difference. Demographic assumptions specific to the retiree health care valuation include retiree health care plan participation.

### *Mortality*

The current post-retirement mortality table for healthy annuitant lives is the RP-2000 Combined Mortality Table with static projection to 2022 using Scale AA. The actual rate of mortality was slightly less than expected for both male and female healthy annuitants over the study period. In order to minimize gains and losses due to experience, we suggest changing the mortality assumption to the latest Society of Actuaries' mortality table ("RP-2014"), adjusted to better match experience of the System. Additionally, in order to account for future mortality improvement, we recommend applying the latest generational mortality improvement scale ("MP-2016"), which is intended to be used with the RP-2014 tables.

The valuation of disabled lives relies on a separate mortality table. The current mortality table for disabled lives is an age-based table of rates developed by the prior actuary. Experience for disabled annuitants has been less than expected based on the current assumptions. We recommend updating this assumption to a variation of the RP-2014 Disability Mortality Table adjusted for the credibility of the size of the experience data and building in future mortality improvements projected on a generational basis using Scale MP-2016.

The current mortality table for active members is the same as for healthy annuitants for early ages. As very few members die in active status, the actual experience is insufficient to set an assumption. In addition, the liability associated with active death is a small percentage of the total liability. Since we are using the RP-2014 Annuitant Table for retired lives, we recommend using the RP-2014 Employer Table for active members, building in future mortality improvements projected on a generational basis using Scale MP-2016.

### *Retirement*

The current retirement rates for active members of the Defined Benefit (DB) Plan are based on members' age, gender, and years of service at retirement. There are different retirement rates depending on grandfather status. Grandfathered members are those eligible to retire as of July 1, 2015. The actual retirement experience over the period of the study is skewed due to 2012 pension reform changes and therefore provide an unreliable basis for developing a revised retirement assumption. We recommend the continued use of the DB Plan retirement rates, with appropriate simplifications.

The current retirement assumption for inactive vested members of the DB Plan is that members will retire at age 60, or the first age at which unreduced benefits are available, if earlier. Effective with the 2012 pension reform, unreduced benefits are not available prior to age 65 (without 35 years of service). Therefore, we recommend adding retirement rates of 5% at each early retirement age through age 64 and assume that 100% of remaining inactive vested members retire at age 65, or the first age at which unreduced benefits are available.

## I. Executive Summary

A separate age-based table is applied to active members who were hired on or after July 1, 2001 and elected to participate in the Combined Plan. As there is not enough retirement experience for this group, we recommend continued use of the current assumption. We believe the current assumed pattern of retirement for the Combined Plan members is not unreasonable, and we will continue to track actual Combined Plan retirement experience as it emerges.

### *Termination*

The current turnover rates are based on gender, age and service. Service-based rates apply to non-vested members with less than five years of service. Age-based tables apply to vested members with five or more years of service. The actual turnover experience over the study period was analyzed net of rehires to arrive at the “net” termination experience. The experience shows that actual turnover for both non-vested and vested members was less than expected. Therefore, we recommend decreasing termination rates in both tables.

### *Disability Retirement*

The current disability retirement rates are based on members’ age and gender. During the experience study period, the number of disabilities was reasonably close to expectation, and experience was similar for males and females. Therefore, we recommend a unisex, age-based table with slightly increased rates.

### *Other Demographic Assumptions*

Other demographic assumptions that impact the valuation are the percent married, age difference, and retiree health participation assumptions.

We do not collect spousal information for active employees but we have spousal information for retirees. The current percent married assumption is 80% for males and 60% for females. We found 76% of male retirees and 47% of female retirees appeared married based on their annuity options elected. Additionally, we found that, on average, male retirees were approximately 3.1 years older and female retirees were approximately 0.4 years younger than their respective spouses, compared to the current assumption of 3 years older for male members and 1 year younger for female members. We recommend no changes to the percent married or age difference assumptions.

The current retiree health participation rates are based on status at termination (retirement, disability, inactive vested). During the experience study period, the number of new service retirees electing health coverage was reasonably close to expectations, and the number of new disabled retirees and inactive vested electing health coverage at retirement was less than expected. Therefore, we recommend no changes to the service retiree participation assumption and reducing the participation assumption for disabled retirees and inactive vested participants.

# I. Executive Summary

## Summary of Actuarial Experience

For the five-year period under review, the System has experienced actuarial gains, except for the years ended June 30, 2012 and June 30, 2015. Investment returns on the market value of assets has averaged 5.8% and 6.9% over the last 10 and 20 years. Despite a general underperformance relative to expected, the imputed return on the actuarial value of assets has produced gains during the study period. Experience for non-investment assumptions has produced losses over all five years of the study period. A summary of the historical gains and losses is shown below.

Valuation Date <sup>1</sup>	Actuarial Accrued Liability (AAL) (\$ in millions)	Total Actuarial Gain/(Loss)		Actuarial Asset Investment Gain/(Loss)		Non-Investment Gain/(Loss)	
		Amount (\$ in millions)	% of AAL	Amount (\$ in millions)	% of AAL	Amount (\$ in millions)	% of AAL
July 1, 2016	\$100,756	\$290	0.3%	\$774	0.7%	-\$485	-0.5%
July 1, 2015	99,015	-232	-0.2%	1,068	1.1%	-1,301	-1.3%
July 1, 2014	96,167	3,178	3.3%	3,334	3.5%	-156	-0.2%
July 1, 2013	94,367	2,092	2.2%	2,483	2.6%	-391	-0.4%
July 1, 2012	106,302	-3,982	3.7%	325	0.3%	-4,307	-4.1%

<sup>1</sup> Information for years prior to July 1, 2013 is based on valuations performed by PricewaterhouseCoopers, LLP

# I. Executive Summary

## 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
<b>Economic Assumptions</b>		
Inflation	2.75%	2.50%
Investment Return	7.75%	7.00%
Rate of Individual Salary Increases	Merit/seniority rates based on age, plus inflation	Decreases to merit/seniority rates. Total rates also lowered by 0.25% due to lower recommended inflation
Payroll Growth	3.50% for two years, 4.00% thereafter	3.00%
<b>Demographic Assumptions</b>		
Healthy Post-Retirement Mortality	RP-2000 Combined Table, males set back two years through age 89, females set back four years through age 79, set back one year from 80 through 89	RP-2014 Healthy Annuitant Table with 50% of rates through age 69, 70% of rate between 70 and 79, 90% of rates between 80 and 84. Mortality improvement based on MP-2016 scale
Disabled Post-Retirement Mortality	Rates developed based on experience	RP-2014 Disabled Mortality Table with 90% of rates for males and 100% of rates for females. Mortality improvement based on MP-2016 scale.
Healthy Pre-Retirement Mortality	Healthy Post-Retirement Mortality with adjustments at earlier ages	RP-2014 Employee Mortality Table with generational mortality improvement using scale MP-2016
Active Retirement	Current rates vary based on members' age, gender, and years of service at retirement. Separate tables of rates for grandfathered and non-grandfathered.	Minor modifications to format of current rates
Inactive Vested Retirement	100% at age 60	5% through age 64 and 100% at age 65
Termination	Service-based rates apply to non-vested terminations within the first five years of service. Age-based rates apply after the first five years of service.	Lower rates for both non-vested and vested termination tables
Disability Retirement	Age and gender-based rates	Unisex rates by age with slightly increased rates
<b>Other Demographic Assumptions</b>		
Percent Married	80% of male members and 60% of female members are assumed to be married	No change
Age of Difference	Male members are 3 years older and female members are 1 year younger than their spouses	No change
Retiree Health Participation	75% of eligible service retirees 84% of eligible disabled retirees 47% of inactive vested participants who did not cash out	75% of eligible service retirees 65% of eligible disabled retirees 30% of inactive vested participants who did not cash out

# I. Executive Summary

## Impact of Assumption and Method Changes on Valuation Results

The following tables detail the impact of the change in assumptions and methods on the June 30, 2016 actuarial valuation results.

Description	Current Assumptions (\$ in Millions)	Proposed Mortality Assumption (\$ in Millions)	Proposed Mortality and Other Demographic Assumptions (\$ in Millions)
Actuarial Accrued Liability (AAL)	\$100,756	\$104,889	\$104,768
Actuarial Value of Assets (AVA)	70,115	70,115	70,115
Unfunded Accrued Liability (UAL)	\$30,642	\$34,775 <b>+4,133</b>	\$34,653 <b>-122</b>
Funded Percentage	69.6%	66.8% <b>-2.7%</b>	66.9% <b>+0.1%</b>
Funding Period	26.6 years	35.4 years <b>+8.8 years</b>	36.9 years <b>+1.6 years</b>
Normal Cost Rate	10.58%	11.13% <b>+0.55%</b>	11.54% <b>+0.42%</b>

Description	Proposed Demographic Assumptions and Current Economic Assumptions (\$ in Millions)	Proposed Demographic Assumptions and 7.00% Return (\$ in Millions)	Proposed Demographic, 7.00% Return, and Other Economic <sup>1</sup> Assumptions (\$ in Millions)
Actuarial Accrued Liability (AAL)	\$104,768	\$113,583	\$112,241
Actuarial Value of Assets (AVA)	70,115	70,115	70,115
Unfunded Accrued Liability (UAL)	\$34,653	\$43,469 <b>+8,815</b>	\$42,127 <b>-1,342</b>
Funded Percentage	66.9%	61.7% <b>-5.2%</b>	62.5% <b>+0.7%</b>
Funding Period	36.9 years	70.7 years <b>+33.8 years</b>	Infinite
Normal Cost Rate	11.54%	14.04% <b>+2.50%</b>	12.83% <b>-1.21%</b>

<sup>1</sup> Rate of individual salary increases and payroll growth

## I. Executive Summary

Description	Current Assumptions (\$ in Millions)	Proposed Assumptions (\$ in Millions)	Impact (\$ in Millions)
Actuarial Accrued Liability (AAL)	\$100,756	\$112,241	<b>+11,485</b>
Actuarial Value of Assets (AVA)	70,115	70,115	0
Unfunded Accrued Liability (UAL)	30,642	\$42,127	<b>+11,485</b>
Funded Percentage	69.6%	62.5%	<b>-7.1%</b>
Funding Period	26.6 years	Infinite	<b>Infinite</b>
Normal Cost Rate	10.58%	12.83%	<b>+2.25%</b>

The changes in mortality assumption would increase the June 30, 2016 actuarial accrued liability by approximately \$4,133 million, or 4.1%. This increase was slightly offset by changes in the termination, disability, and retirement assumptions, which lowered the actuarial accrued liability by \$122 million, or 0.1%.

The net impact of the recommended economic assumption changes would increase the actuarial accrued liability by approximately \$7,473 million, or 7.1%. The primary driver of the increase in the actuarial accrued liability is the lowering of the investment return assumption from 7.75% to 7.00%. The changes to the rate of individual salary increases and inflation assumptions decreased the accrued liability by \$1,342 million, or 0.1%.

Overall, the recommended economic and demographic changes would increase the actuarial accrued liability by \$11,485 million, or 11.4%, increase the normal cost rate by 2.25%, and increase the funding period to infinite.

### Impact of Assumption Changes on Retiree Health Care Valuation Results

The following table details the impact of the change in assumptions on the results of the January 1, 2017 actuarial valuation of retiree health care benefits.

Description	Current Assumptions (\$ in Millions)	Proposed Assumptions (\$ in Millions)	Impact (\$ in Millions)
Actuarial Accrued Liability (AAL)	\$3,885	\$4,792	<b>+907</b>
Market Value of Assets (MVA)	3,222	3,222	0
Unfunded Accrued Liability (UAL)	\$663	\$1,570	<b>+907</b>
Funded Percentage	82.9%	67.2%	<b>-15.7%</b>
Solvency Period	22 years	18 years	<b>-4 years</b>

The assumption changes increase the retiree health actuarial accrued liability (AAL) by \$907 million, primarily due to lowering the rate of return from 7.75% to 7.00%. As a result, the solvency period is reduced four years, from 22 years to 18 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 actuarial valuation results. 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 STRS Ohio's valuation results are:

- Inflation
- Rate of Investment Return
- Rate of Individual Salary Increases
- 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 rate of investment return assumption includes an inflation component and a real rate of return component. The components of the salary increase assumption are inflation and merit increases. The main component of the payroll growth assumption is inflation.

## II. Economic Assumptions

### 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, the National Consumer Price Index for all urban consumers (CPI-U).

The table below shows that recent inflation experience is well below the longer-term average rate.

Average Annual Change as of June 30, 2016	CPI-U
Past 5 Years	1.32%
Past 10 Years	1.74%
Past 20 Years	2.18%
Past 30 Years	2.66%
Past 50 Years	4.10%

The average annual rate of increase in the CPI-U in the past 10 years has been at its lowest levels since the early 1960s. Historical trend is a less important consideration for the assumed rate of inflation, but assists in determining the reasonable bounds of expected inflation.

Horizon's 2016 Survey of Capital Market Assumptions<sup>1</sup>, which includes Segal Rogerscasey and Callan, indicates that the average median inflation assumption is 2.31% over the next 20 years. The future expectations of the 35 individual advisors in the survey range from 2.00% to 2.80%.

Next, we considered the measure of future inflation expectation by observing market-based forecasts. 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.

Because of the inflation protection, TIPS' yields are almost always considerably lower than those of regular Treasury securities of similar maturities. As of the last week of June 2016, the yields on 30-year Treasury Bonds were as follows:

- Inflation indexed: 0.88%
- Non-inflation indexed: 2.49%

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<sup>1</sup> This survey, prepared by Horizon Actuarial Services, LLC, compiles and averages the capital market assumptions of 35 investment advisors.

## II. Economic Assumptions

The difference of 1.61% means that 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 1.61% per year over the next 30 years. The financial market's current expectations of inflation over the next 30 years is one indicator of future trend. However, additional risk premiums and investor preferences can be factored into the bond yields that is unrelated to market expectations of inflation, possibly distorting the reliability of this indicator.

As a check of the validity of this assumption, we reference the *2016 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds (2016 OASDI Trustees Report)*. Three inflation assumptions used in this report was 2.00% for the low-cost projection, 2.60% for the intermediate projection, and 3.20% for the high-cost projection.

The Public Plans Data (PPD) database maintained by the Center for Retirement Research at Boston College includes general information on 160 public pension systems. Based on PPD, the average inflation assumption for 2015 is 3.05%, compared to an average of 3.27% for 2011.

Considering the level indicated by financial market data (1.61%) and the median rate used by peer retirement systems (3.05%), we recommend the inflation assumption to be lowered from 2.75% to 2.50%.

## II. Economic Assumptions

### B. Rate of Investment Return

The rate of investment 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 Systems' portfolio mix, and historical returns.

The current assumption is 7.75%, which is composed of the following components:

- Inflation: 2.75%; and,
- Real Rate of Return: 5.00%, net of investment and administrative expenses

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

Average Annual Return as of June 30, 2016	Market Value of Assets Basis	Actuarial Value of Assets Basis
Past 10 Years	5.8%	7.2%
Past 15 Years	6.1%	6.0%
Past 20 Years	6.9%	7.5%

The average annual rate of return over the past 10, 15, and 20 years has been lower than the current assumption of 7.75% on both a market value of assets as well as an actuarial value of assets basis. 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.

In developing the real rate of return, we examined the CMA used by Callan. The current assumptions for the asset classes and the portfolio's expected real return are shown below.

Asset Class	Callan 10-Year Annual Arithmetic Real Return	Target Allocation <sup>1</sup>	Weighted Real Return
Liquidity Reserves	0.00%	1%	0.00%
Fixed Income	0.80%	18%	0.14%
Domestic Equities	6.60%	31%	2.05%
International Equities	6.75%	26%	1.76%
Real Estate	4.95%	10%	0.50%
Private Equity	10.90%	7%	0.76%
Opportunistic/Diversified	4.90%	7%	0.34%
<b>Total</b>		<b>100%</b>	<b>5.55%</b>
Adjustment to Geometric			(0.87%)
<b>Geometric Real Rate of Return</b>			<b>4.68%</b>

<sup>1</sup> Based on STRS Ohio Investment Policy

## II. Economic Assumptions

Using the System's target asset allocation and the CMA provided by Callan, the expected real rate of return is 4.68%.

The real rate of return for the portfolio must be reduced to account for investment and administrative expenses. The investment expenses as a percent of the average market value of assets for the past five years are shown on the following table:

Year Ended June 30	Average Market Value of Assets (\$ in Millions)	Investment Expense	
		Amount (\$ in Millions)	Percent
2016	\$68,161	\$227	0.33%
2015	68,908	221	0.31%
2014	62,638	192	0.31%
2013	58,708	183	0.31%
2012	61,358	175	0.28%
<b>Total</b>	<b>\$319,773</b>	<b>\$998</b>	<b>0.31%</b>

STRS Ohio staff estimates that two-thirds of the investment expenses related to real estate and alternative investment fees are included in capital market return assumptions. Callan verified in communication with STRS Ohio and Segal that their capital market expectations were net of expenses for these two asset classes. For the fiscal year ending June 30, 2016, 76% of fees to external asset managers are related to real estate and alternative investments. Therefore, the adjustment for investment expense experience is 0.11%.

The administrative expenses as a percent of the average market value of assets for the past five years are shown on the following table:

Year Ended June 30	Average Market Value of Assets (\$ in Millions)	Administrative Expense	
		Amount (\$ in Millions)	Percent
2016	\$68,161	\$66	0.10%
2015	68,908	60	0.09%
2014	62,638	60	0.10%
2013	58,708	59	0.10%
2012	61,358	58	0.09%
<b>Total</b>	<b>\$319,773</b>	<b>\$303</b>	<b>0.09%</b>

Considering actual recent experience and expected future trends, we recommend a 0.20% reduction in the real rate of return to account for investment and administrative expenses.

## II. Economic Assumptions

Accounting for investment and administrative expenses, the expected net real rate of return can be determined as follows:

Gross Real Rate of Return	4.68%
Less Expenses	<u>(0.20%)</u>
<b>Net Real Rate of Return</b>	<b>4.48%</b>

In other words, there is a 50% likelihood of earning an annual real rate of return, net of expenses, of at least 4.48% using Callan's CMA, which are based on a 10-year horizon.

The following table summarizes the components of the proposed investment return assumption.

<b>Assumption Component</b>	<b>Proposed Assumption</b>
Net Real Rate of Return	4.48%
Inflation	2.50%
<b>Total Return Assumption</b>	<b>6.98%</b>

Segal Rogerscasey's CMA indicate a 0.50% increase in the real rate of return when comparing 10-year and 20-year horizons. This suggests a possible investment return assumption range of 6.95% to 7.45%. However, given the uncertainty of CMA over a longer horizon, we would not reflect the full 50 basis point adjustment in our recommended rate.

After considering the longer STRS Ohio investment horizon, but giving greater weight to the next 10 years, we recommend lowering the investment return assumption from 7.75% to 7.00%.

## II. Economic Assumptions

### C. Rate of Individual Salary Increase

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

The estimated rate of individual salary increases consists of two components:

- Inflation; and
- Merit and seniority increases

The inflation component represents the "across the board" average annual increase in salaries shown in the experience data. The merit and seniority 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 increase assumption (including inflation) uses age-based rates that range from 12.25% at age 25 to 3.25% at age 65. The historical compensation data adjusted by approximately 1.80% to account for actual inflation during the study period was evaluated based on age and service. The strongest relationship continues to be based on members' age, with a trend of inflation and merit and seniority increases occurring through age 65, and modest inflationary increases occurring thereafter.

The following tables and graph compares the actual, expected and proposed individual salary increases during the period of the experience study, adjusted to remove inflation.

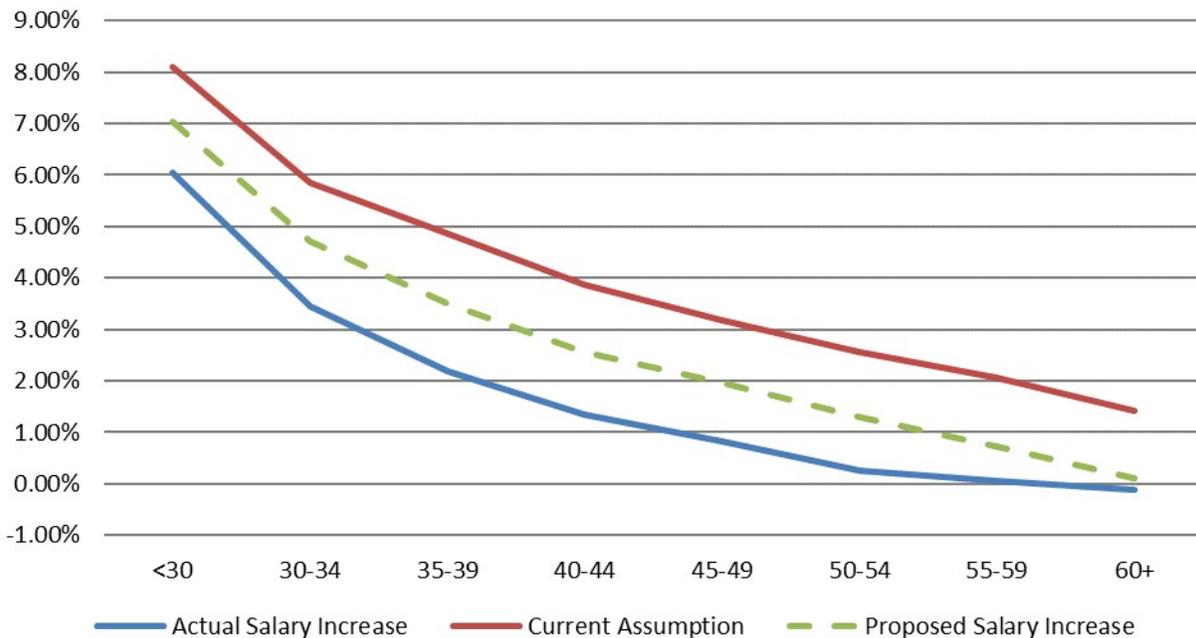
Age	Total Exposure	Actual Increase Above Inflation	Expected Increase Above Inflation	Proposed Increase Above Inflation
<30	94,311	6.05%	8.09%	7.05%
30 - 34	103,981	3.45%	5.86%	4.71%
35 - 39	109,923	2.19%	4.87%	3.49%
40 - 44	115,626	1.34%	3.87%	2.55%
45 - 49	100,724	0.81%	3.19%	1.95%
50 - 54	88,218	0.25%	2.55%	1.31%
55 - 59	68,032	0.06%	2.06%	0.72%
60+	45,441	-0.11%	1.45%	0.10%
<b>Total</b>	<b>726,256</b>	<b>1.67%</b>	<b>3.97%</b>	<b>2.71%</b>

## II. Economic Assumptions

**Table 1:  
Actual and Expected Salary Increases  
Compared to Proposed, In Excess of Inflation**

Age Range	Prior Increases (in \$000s)	Actual Increase <sup>1</sup> (in \$000s)	Expected Increase <sup>2</sup> (in \$000s)	Actual to Expected	Proposed Increase <sup>3</sup> (in \$000s)	Proposed to Expected
<30	3,684	3,907	3,982	98.1%	3,944	99.1%
30 - 34	5,258	5,439	5,566	97.7%	5,506	98.8%
35 - 39	6,481	6,623	6,796	97.5%	6,707	98.8%
40 - 44	7,249	7,346	7,529	97.6%	7,434	98.8%
45 - 49	6,564	6,617	6,773	97.7%	6,692	98.9%
50 - 54	5,878	5,893	6,028	97.8%	5,955	99.0%
55 - 59	4,559	4,562	4,653	98.0%	4,592	99.3%
60+	3,060	3,057	3,104	98.5%	3,063	99.8%
<b>Total</b>	<b>42,733</b>	<b>43,445</b>	<b>44,431</b>	<b>97.8%</b>	<b>43,892</b>	<b>99.0%</b>

**Graph 1:  
Actual and Expected Salary Increases  
Compared to Proposed, In Excess of Inflation**



<sup>1</sup> Adjusted for actual average inflation of approximately 1.80% during the experience period.

<sup>2</sup> Adjusted for assumed inflation of 2.75%.

<sup>3</sup> Proposed rate of individual salary increases table does not reflect underlying assumption for inflation.

## II. Economic Assumptions

As shown above, the actual rate of individual salary increases above inflation was less than the expected rate for all age bands. Based on this experience, we recommend decreasing the merit component of the individual salary increases, as well as a 0.25% reduction due to lower recommended inflation. The table showing the proposed total rates of individual salary increases is included in Appendix A.

## II. Economic Assumptions

### D. Payroll Growth

The payroll growth assumption represents the expected annual increase in total covered payroll from one year to the next. The payroll growth assumption is used to estimate annual increases in payroll in order to determine the amortization payment toward the unfunded accrued liability (UAL) and the funding period. The amortization payment is expected to increase each year as payroll increases, meaning that amortization payments are back loaded.

A lower payroll growth assumption is more conservative, as lower payroll growth rate results in larger amortization payments. For example, an assumed rate of payroll growth of 0% uses level amortization payments, similar to that of a mortgage.

The current assumption for payroll growth is 3.50% for two years, 4.0% per year thereafter. The System's historical payroll amounts and active population headcounts since the 2006 fiscal year are shown in the table below.

Year Ended June 30	Covered Payroll <sup>1</sup> (\$ in millions)	% Increase/Decrease From Prior Year	Active Member Headcount	% Increase/Decrease From Prior Year
2016	\$10,069.3	0.8%	169,212	2.6%
2015	9,985.2	1.6%	164,925	-2.6%
2014	9,833.0	-0.9%	169,295	-0.4%
2013	9,917.9	-1.8%	169,945	-1.8%
2012	10,102.5	-2.6%	173,044	-2.7%
2011	10,369.4	0.3%	177,897	1.2%
2010	10,342.5	2.2%	175,842	0.6%
2009	10,122.1	2.9%	174,807	0.9%
2008	9,834.2	2.2%	173,327	-0.5%
2007	9,620.4	1.8%	174,110	-0.6%
2006	9,455.4	--	175,065	--
	5-year average:	-0.6%	5-year average:	-1.0%
	10-year average:	0.6%	10-year average:	-0.3%

Using the recommended rate of individual salary increase assumption from the prior section, we performed an open group projection. Results showed that, on average, projected total payroll increases by 2.99% per year over 10 years and 2.69% over 20 years.

Based on experience and a recommended decrease to the assumed inflation rate, we recommend lowering the assumption from 3.50% for two years and 4.00% per year thereafter to 3.00% for all future years.

<sup>1</sup> Excludes payroll from the Defined Contribution and Alternative Retirement Plans.

### III. Demographic Assumptions

The demographic assumptions used to value the System reflect the expected occurrences of various events among members of the System. The assumptions should reflect specific characteristics of the System 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 Retirement; 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 procedure for selecting demographic assumptions. The first step 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 tables for males/females). The final step is to select the specific assumption and evaluate the reasonableness of each assumption. The specific experience of the System 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.

## III. Demographic Assumptions

### A. Mortality

One of the most basic 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. STRS Ohio currently uses three sets of mortality tables for its population: post-retirement mortality, disabled mortality, and pre-retirement mortality tables.

#### 1. Healthy Post-Retirement Mortality

The mortality experience of healthy retirees is important as it helps estimate the durations over which retirement benefits are paid. Lower mortality rates mean longer benefit payment periods and, therefore, higher benefit costs.

Currently, STRS Ohio uses healthy post-retirement mortality rates based on RP-2000 Combined Mortality Table with static projection to 2022. Male rates are set back two years through age 89 with no setback for age 90 and above while female rates are set back four years through age 79, one year from age 80 through 89, and no set back from age 90 and above.

The experience analysis for the past five years reveals that, in total, fewer participants in pay status have died than expected on a counts basis as well as a benefits-weighted basis. For the post-retirement mortality assumption, our analysis uses a benefits-weighted approach, which weights the probability of death with each annuitant's pension benefit amount. This methodology takes into consideration any correlation between the health of the annuitant and the size of their benefit.

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

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual Deaths to Expected Deaths
<b>Basis – Counts</b>				
Male	220,730	5,375	5,581	96.3%
Female	405,976	7,933	8,444	93.9%
<b>Total</b>	<b>626,706</b>	<b>13,308</b>	<b>14,025</b>	<b>94.9%</b>
<b>Basis – Benefits (in 000's)</b>				
Male	11,274,458	218,720	244,603	89.4%
Female	16,529,238	226,579	249,429	90.8%
<b>Total</b>	<b>27,803,696</b>	<b>445,299</b>	<b>494,032</b>	<b>90.1%</b>

We recommend revising the post-retirement mortality assumption to use a variation of the latest Society of Actuaries' mortality tables ("RP-2014"). To better match STRS Ohio's experience, we have adjusted the base RP-2014 Annuitant Mortality Table by applying 50% of rates through age 69, 70% of rates between ages 70 and 79, 90% of rates between ages 80 and 84, and 100% of rates thereafter. The proposed healthy post-retirement mortality rates are included in Appendix B.

### III. Demographic Assumptions

In order to reflect future improvements in life expectancy, we recommend applying the latest generational mortality improvement scale (“MP-2016”), which is intended to be used with the RP-2014 tables, from 2014 forward. Applying a generational adjustment to the mortality table results in slight improvements in life expectancy in each future year and decreases the likelihood, for example, that the projected life expectancy of a 35-year old active member today will be understated when benefit payments are projected to start 30 years from now.

Table 2 shows further detail regarding the post-retirement mortality experience for the study period. Graphs 2A and 2B present this information graphically for both males and females.

**Table 2:**  
**Healthy Post-Retirement Mortality Rates**  
**Actual and Expected Experience, Benefits-Weighted Basis (in 000's)**

*Male*

Age Range	Exposures	Actual Deaths	Actual Mortality Rate	Expected Deaths	Current Mortality Rate	Proposed Death	Proposed Mortality Rate	Ratio of Actual Rate to Proposed Rate
55 – 59	727,777	1,874	0.3%	1,961	0.3%	2,457	0.3%	76.3%
60 – 64	2,283,562	9,933	0.4%	11,593	0.5%	10,401	0.5%	95.5%
65 – 69	3,039,575	21,150	0.7%	28,779	1.0%	19,709	0.7%	107.3%
70 – 74	2,190,726	28,542	1.3%	34,573	1.6%	30,768	1.4%	92.8%
75 – 79	1,439,404	35,157	2.4%	39,329	2.7%	32,826	2.3%	107.1%
80 – 84	938,099	45,765	4.9%	48,178	5.1%	46,498	5.0%	98.4%
85 and over	655,314	76,299	11.6%	80,191	12.2%	75,447	11.5%	101.1%
<b>Total</b>	<b>11,274,458</b>	<b>218,720</b>	<b>1.9%</b>	<b>244,603</b>	<b>2.2%</b>	<b>218,107</b>	<b>1.9%</b>	<b>100.3%</b>

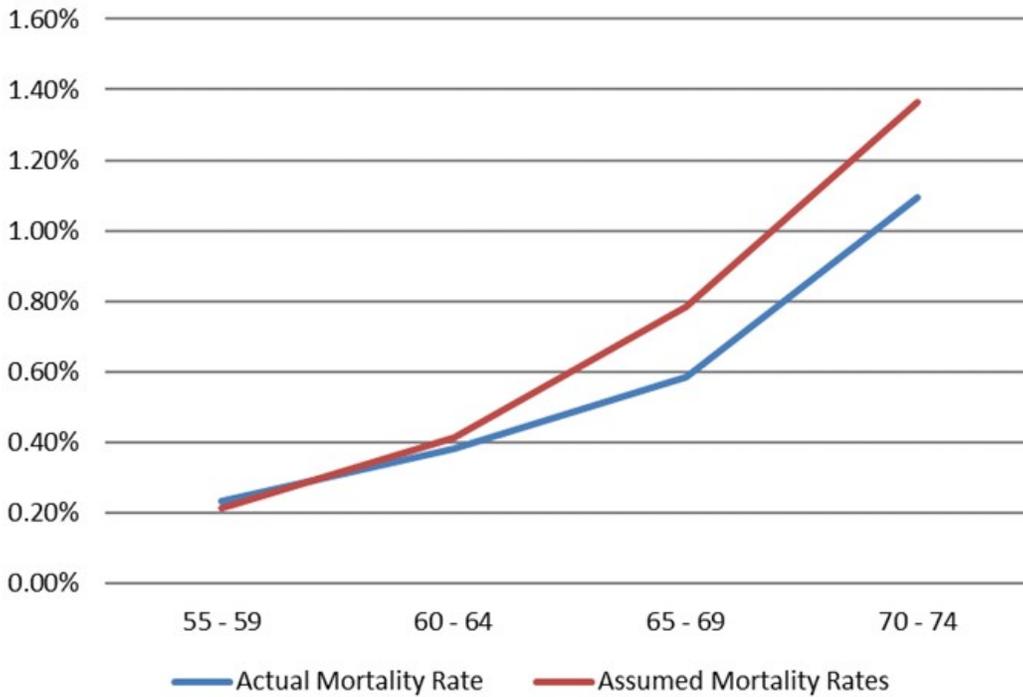
*Female*

Age Range	Exposures	Actual Deaths	Actual Mortality Rate	Expected Deaths	Current Mortality Rate	Proposed Death	Proposed Mortality Rate	Ratio of Actual Rate to Proposed Rate
55 – 59	1,541,764	3,452	0.2%	2,923	0.2%	3,358	0.2%	102.8%
60 – 64	4,389,984	15,470	0.4%	16,082	0.4%	13,890	0.3%	111.4%
65 – 69	4,455,398	22,742	0.5%	29,959	0.7%	21,398	0.5%	106.3%
70 – 74	2,669,649	24,666	0.9%	31,815	1.2%	28,915	1.1%	85.3%
75 – 79	1,590,109	28,188	1.8%	30,661	1.9%	28,172	1.8%	100.1%
80 – 84	990,460	37,490	3.8%	42,928	4.3%	38,425	3.9%	97.6%
85 and over	891,874	94,571	10.6%	95,057	10.7%	91,814	10.3%	103.0%
<b>Total</b>	<b>16,529,238</b>	<b>226,579</b>	<b>1.4%</b>	<b>249,429</b>	<b>1.5%</b>	<b>225,973</b>	<b>1.4%</b>	<b>100.3%</b>
<b>Grand Total</b>	<b>27,803,696</b>	<b>445,299</b>	<b>1.6%</b>	<b>494,032</b>	<b>1.8%</b>	<b>444,080</b>	<b>1.6%</b>	<b>100.3%</b>

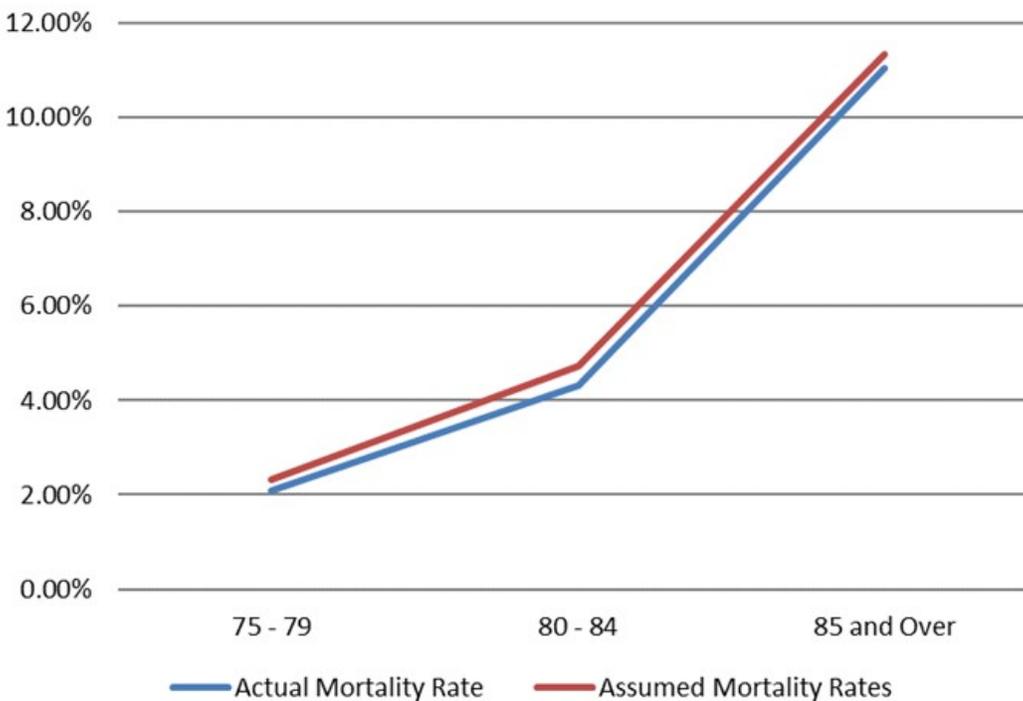
### III. Demographic Assumptions

**Graph 2.A:  
Healthy Post-Retirement Mortality Rates  
Actual Versus Expected Experience, Benefits-Weighted Basis**

*Ages 55-74*



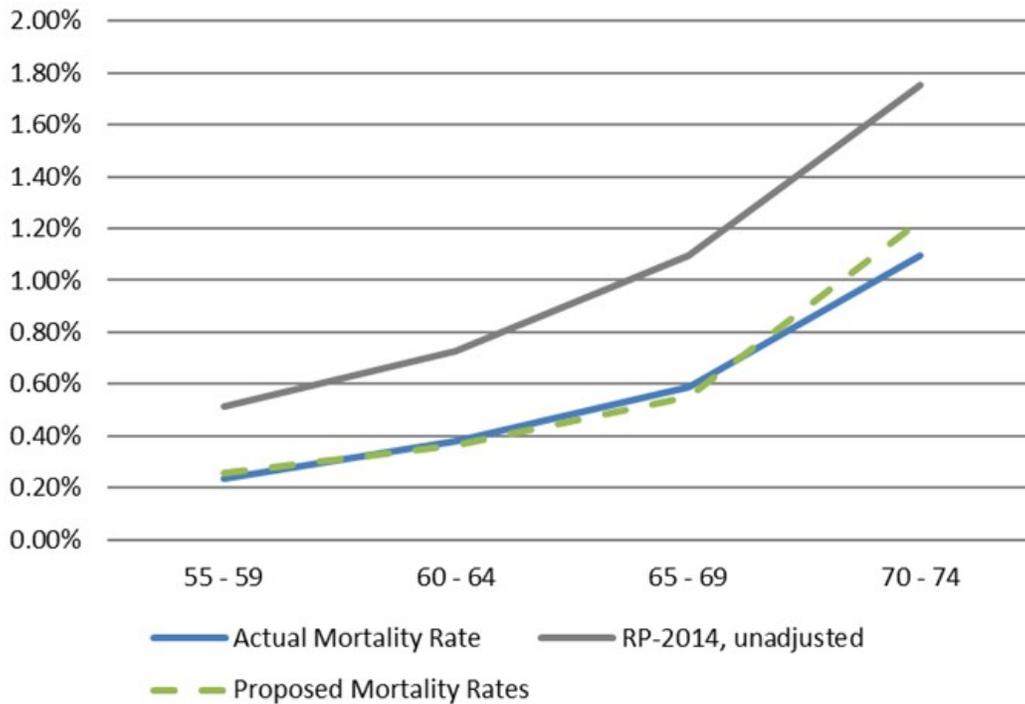
*Ages 75 and Over*



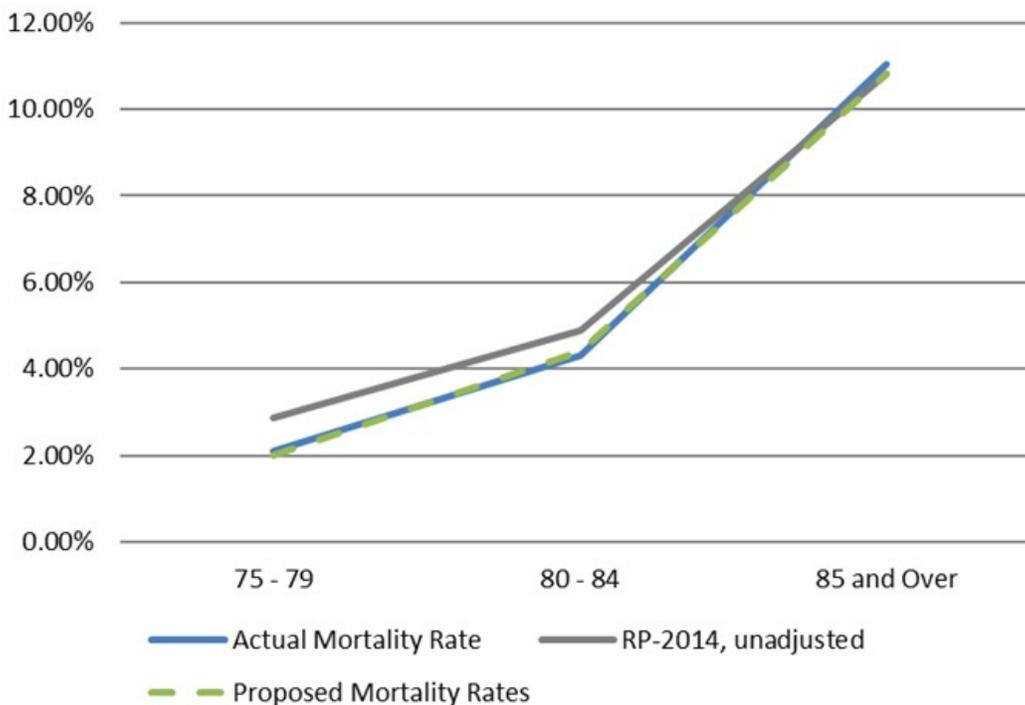
### III. Demographic Assumptions

**Graph 2.B:**  
**Healthy Post-Retirement Mortality Rates**  
**Actual Versus Proposed Experience, Benefits-Weighted Basis**

*Ages 55-74*



*Ages 75 and Over*



## III. Demographic Assumptions

### 2. Disabled Post-Retirement Mortality

Mortality experience among disabled annuitants is studied separately from service retirees because of characteristically high levels of mortality exhibited by disability retirees. The current rates are based on gender and age, and were developed in prior experience studies.

The experience analysis for the past five years reveals that fewer disabled annuitants have died than expected. Similar to healthy post-retirement mortality, our analysis of the disabled mortality rates uses a benefits-weighted approach.

The following table summarizes the disabled annuitant mortality experience by basis and gender for the study period:

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual Deaths to Expected Deaths
<b>Basis – Counts</b>				
Male	9,428	377	418	90.1%
Female	19,295	634	677	93.7%
<b>Total</b>	<b>28,723</b>	<b>1,011</b>	<b>1,095</b>	<b>92.3%</b>
<b>Basis – Benefits (in 000's)</b>				
Male	379,375	13,695	15,491	85.6%
Female	670,409	18,597	21,140	88.0%
<b>Total</b>	<b>1,049,784</b>	<b>32,292</b>	<b>37,132</b>	<b>87.0%</b>

We recommend changing the mortality assumption for disabled lives to use a variation of the most recent RP-2014 Disabled Mortality Table. The unadjusted table results in the following ratios:

- 83.7% is the ratio of actual to proposed deaths for male disabled lives
- 100.7% is the ratio of actual to proposed deaths for female disabled lives

After adjusting for the credibility of the size of the experience data, we recommend using 90% of male rates and 100% of female rates from the RP-2014 Disabled Mortality Table. This will produce a ratio of actual to expected deaths for the entire population of about 97%. The proposed disabled post-retirement mortality rates are included in Appendix B. Similar to the proposed healthy post-retirement mortality assumption, we recommend applying future mortality improvement projected on a generational basis using projection scale MP-2016 from 2014 forward.

On the following pages, Table 3 summarizes the disabled annuitant mortality experience for the study period. Graph 3 presents this information graphically for both males and females.

### III. Demographic Assumptions

**Table 3:  
Disabled Post-Retirement Mortality Rates  
Actual Versus Expected Experience, Compared to Proposed,  
Benefits-Weighted Basis (in 000's)**

*Male*

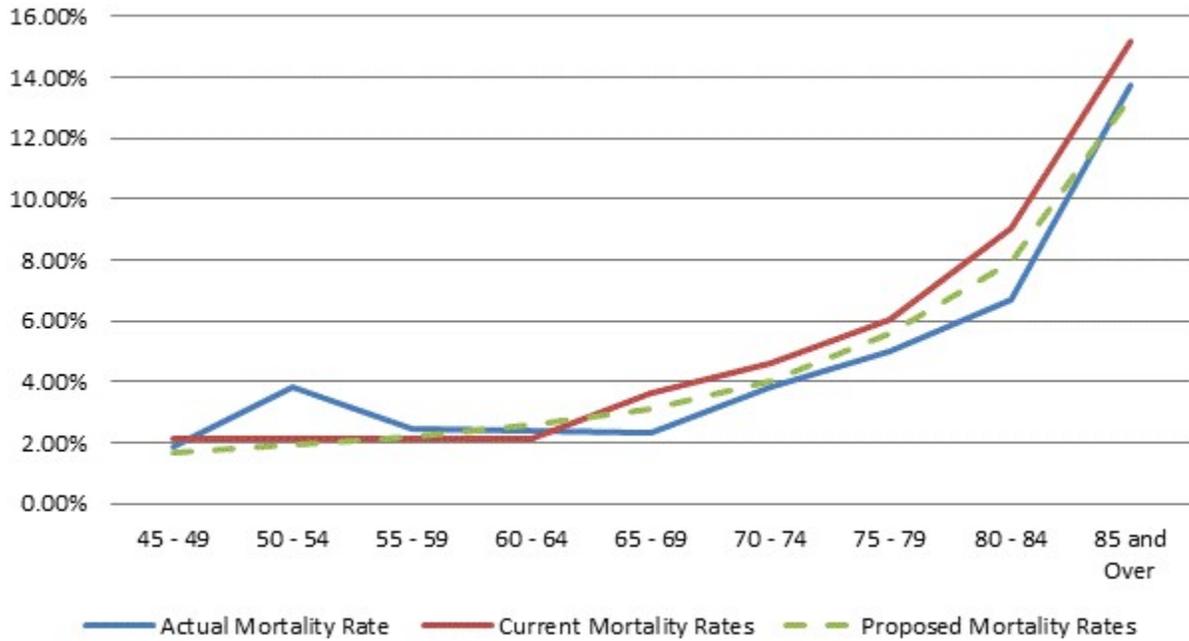
Age Range	Exposures	Actual Deaths	Actual Mortality Rate	Expected Deaths	Current Mortality Rate	Proposed Death	Proposed Mortality Rate	Ratio of Actual Rate to Proposed Rate
45 – 49	7,906	147	1.96%	170	2.2%	135	1.7%	109.3%
50 – 54	20,407	777	3.8%	440	2.2%	399	2.0%	194.8%
55 – 59	38,485	943	2.5%	830	2.2%	858	2.2%	109.9%
60 – 64	81,649	1,948	2.4%	1,760	2.2%	2,105	2.6%	92.5%
65 – 69	94,833	2,193	2.3%	3,458	3.7%	2,957	3.1%	74.2%
70 – 74	59,519	2,277	3.8%	2,753	4.6%	2,398	4.0%	95.0%
75 – 79	38,776	1,941	5.0%	2,337	6.0%	2,158	5.6%	90.0%
80 – 84	24,475	1,642	6.7%	2,219	9.1%	1,936	7.9%	84.8%
85 and Over	13,326	1,826	13.7%	2,026	15.2%	1,775	13.3%	102.9%
<b>Total</b>	<b>379,375</b>	<b>13,695</b>	<b>3.6%</b>	<b>15,991</b>	<b>4.2%</b>	<b>14,720</b>	<b>3.9%</b>	<b>93.0%</b>

*Female*

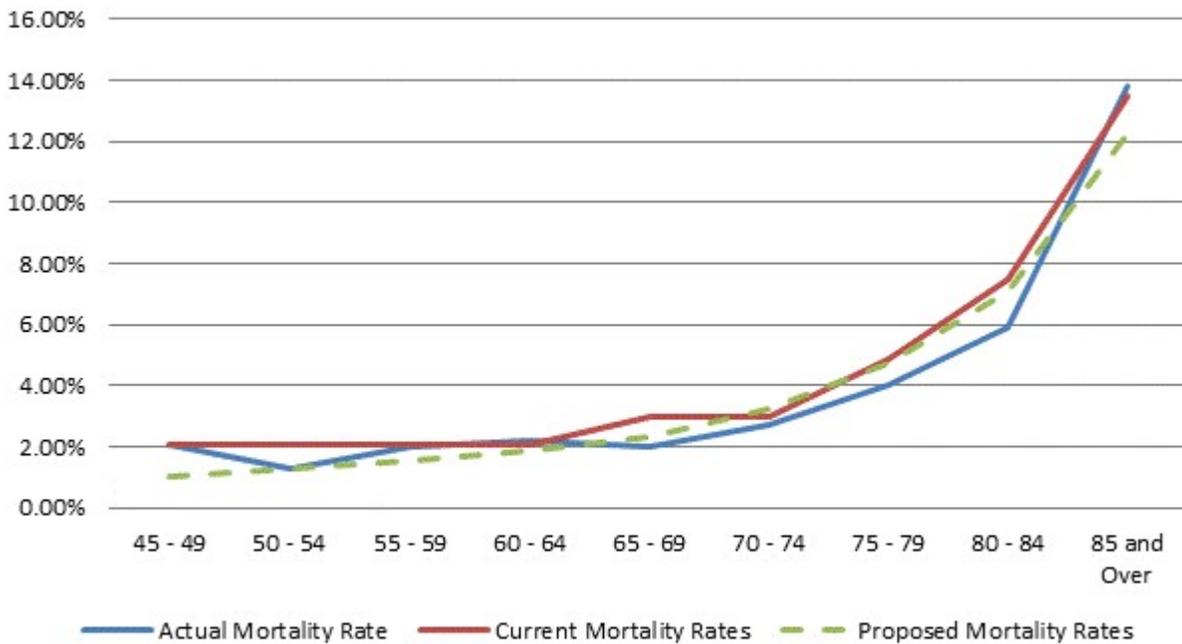
Age Range	Exposures	Actual Deaths	Actual Mortality Rate	Expected Deaths	Current Mortality Rate	Proposed Death	Proposed Mortality Rate	Ratio of Actual Rate to Proposed Rate
45 – 49	27,677	567	2.1%	572	2.1%	288	1.0%	196.6%
50 – 54	56,881	749	1.3%	1,175	2.1%	745	1.3%	100.5%
55 – 59	99,852	2,029	2.0%	2,062	2.1%	1,556	1.6%	130.4%
60 – 64	165,174	3,590	2.2%	3,411	2.1%	3,046	1.8%	117.9%
65 – 69	139,570	2,810	2.0%	4,117	3.0%	3,233	2.3%	86.9%
70 – 74	84,518	2,312	2.7%	2,493	3.0%	2,733	3.2%	84.6%
75 – 79	47,957	1,923	4.0%	2,340	4.9%	2,277	4.8%	84.5%
80 – 84	26,741	1,577	5.9%	2,001	7.5%	1,893	7.1%	83.3%
85 and Over	22,040	3,040	13.8%	2,971	13.5%	2,701	12.3%	112.6%
<b>Total</b>	<b>670,409</b>	<b>18,597</b>	<b>2.8%</b>	<b>21,141</b>	<b>3.2%</b>	<b>18,471</b>	<b>2.8%</b>	<b>100.7%</b>
<b>Grand Total</b>	<b>1,049,784</b>	<b>32,292</b>	<b>3.1%</b>	<b>37,132</b>	<b>3.5%</b>	<b>33,191</b>	<b>3.2%</b>	<b>97.3%</b>

### III. Demographic Assumptions

**Graph 3:**  
**Disabled Post-Retirement Mortality Rates**  
**Actual Versus Expected Experience, Compared to Proposed,**  
**Benefits-Weighted Basis**  
*Males*



*Females*



## III. Demographic Assumptions

### 3. Healthy Pre-Retirement Mortality

The mortality experience of active and terminated vested members should be considered for several reasons. First, in combination with termination 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 assumption is based on the healthy post-retirement mortality rates, with additional adjustments at earlier ages. Over the period of the experience study, very few members died while in active status, which does not provide enough credible experience to base the pre-retirement mortality assumption strictly on experience. In addition, the liability associated with pre-retirement mortality is a relatively small percentage compared to the total liability. We conclude that plan experience is insufficient to set an assumption.

Since we are using the RP-2014 Annuitant Mortality Table for the retired lives, we recommend using the RP-2014 Employee Table for the healthy pre-retirement mortality assumption. The proposed healthy pre-retirement mortality rates are included in Appendix B. Similar to the healthy post-retirement mortality assumption, we also recommend applying the latest generational mortality improvement scale (MP-2016), in order to account for future mortality improvements.

### III. Demographic Assumptions

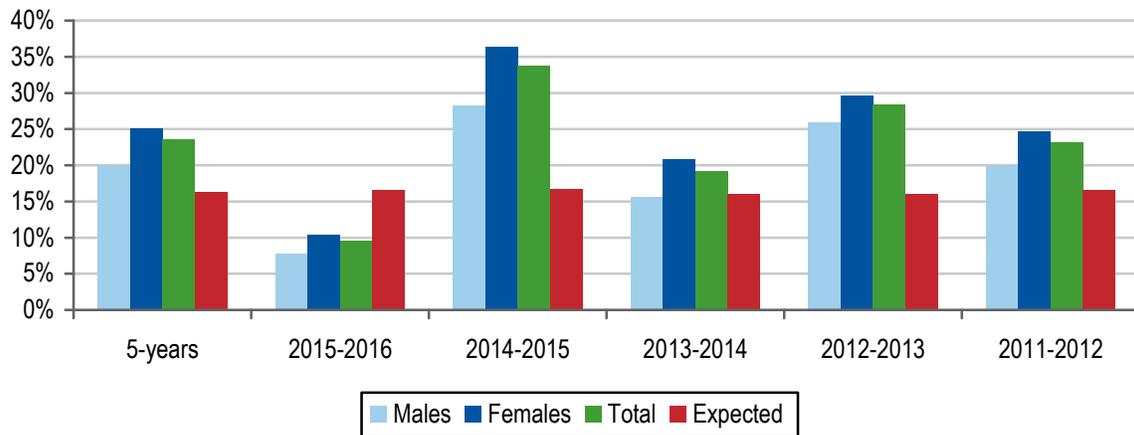
#### B. Retirement

##### 1. Active Retirement

The current DB Plan retirement assumption for active members is based on members’ age, gender, and years of service at retirement. There are three tables of rates: applicable through July 1, 2014, grandfathered after July 1, 2014, and non-grandfathered after July 1, 2014.

The experience shows that 23,544 Defined Benefit Plan members retired from active status during the study period. As the table and graph below illustrates, the actual retirement experience has been greater than expected in all years except for 2015/2016.

**Actual and Expected Active Retirement for DB Plan**



	5-year Average	2015-2016	2014-2015	2013-2014	2012-2013	2011-2012
Expected	16.3%	16.6%	16.6%	16.1%	15.9%	16.5%
Actual	23.5%	9.5%	33.8%	19.2%	28.5%	23.2%

The main reason for accelerated retirement through 2015, followed by far fewer retirements in 2016, was the 2012 pension reform changes. While we did examine the experience to determine whether there is enough difference to warrant a revised retirement assumption, it appears that actual retirement experience provides an unreliable basis for developing an assumption. Therefore, we recommend the continued use of the DB Plan rates, with appropriate simplifications. The revised rates are included in Appendix C.

Retirement rates for the Combined Plan are based on members’ gender and age. The size of the covered group under the Combined Plan does not provide enough credible experience to warrant an assumption change. Given the lack of experience, we recommend continued use of the Combined Plan retirement rates.

We will continue to monitor actual retirement experience for the Combined Plan as it emerges.

### III. Demographic Assumptions

#### 2. Inactive Vested Retirement

The current assumption for inactive vested members is that all will retire at age 60, or the first age at which unreduced benefits are available, if earlier.

The following table summarizes the inactive vested experience for members under age 60 by gender for the study period:

<b>Gender</b>	<b>Exposures</b>	<b>Actual Retirements</b>	<b>Ratio of Actual Retirements to Exposures</b>
Male	3,885	154	4.0%
Female	6,578	430	6.5%
<b>Total</b>	<b>10,463</b>	<b>584</b>	<b>5.6%</b>

Subsequent to the 2012 pension reform, unreduced benefits are no longer available prior to age 65 without 35 years of service. Therefore, we recommend adding retirement rates of 5% at each early retirement age through age 64 and assume that 100% of remaining inactive vested members retire at age 65, or the first age at which unreduced benefits are available.

### III. Demographic Assumptions

#### C. Termination

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

Terminations before retirement age 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. In some cases, members who leave the plan with five or more years of service and are eligible for deferred vested benefits withdraw their deposits, thus forfeiting the portion of their accrued benefit rights based on employer contributions.

The turnover 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. These terminations are offset by rehired members to arrive at “net” turnover for each year of the study period.

Currently, the turnover assumption used in the valuation is based on the members’ age, gender, and service. The current assumption has separate rates for members with less than five years of service (service-based) and five or more years of service (age-based).

Actual terminations were significantly lower than expected for both non-vested and vested termination rates, as shown in the table below.

Gender	Exposures	Actual Terminations	Expected Terminations	Actual to Expected
<b>Termination – Non-Vested</b>				
Male	73,175	11,922	15,671	76%
Female	163,466	18,510	33,367	55%
<b>Total</b>	<b>236,641</b>	<b>30,432</b>	<b>49,038</b>	<b>62%</b>
<b>Termination – Vested</b>				
Male	138,693	2,796	3,160	88%
Female	375,311	6,980	8,722	80%
<b>Total</b>	<b>514,004</b>	<b>9,776</b>	<b>11,882</b>	<b>82%</b>

After reviewing the experience further, we recommend decreasing termination rates to reflect the experience over the past five years. Comparisons of the actual experience, expected turnovers, and proposed rates for members with less than five years of service are shown in Tables 4. A comparison of the actual experience, expected turnovers, and proposed rates for members with at least five years of service is shown in Table 5. The complete listing of the proposed termination rates are included in Appendix D.

### III. Demographic Assumptions

**Table 4:**  
**Non-Vested Termination**  
**Actual and Expected Experience Compared to Proposed, Service-Based**  
**Male**

Years of Service	Exposures	Actual Terminations <sup>1</sup>	Actual Turnover Rate	Expected Terminations	Ratio of Actual to Expected Rate	Proposed Terminations	Ratio of Actual to Proposed Rate
0 - 0.99	19,894	5,584	28.1%	6,963	80.2%	5,968	93.6%
1 - 1.99	17,969	3,006	16.7%	4,492	66.9%	3,594	83.6%
2 - 2.99	13,699	1,535	11.2%	2,055	74.7%	2,055	74.7%
3 - 3.99	11,516	1,082	9.4%	1,152	94.0%	1,152	94.0%
4 - 4.99	10,097	715	7.1%	1,010	70.8%	1,010	70.8%
<b>Total</b>	<b>73,175</b>	<b>11,922</b>	<b>16.3%</b>	<b>15,671</b>	<b>76.1%</b>	<b>13,778</b>	<b>86.5%</b>

*Female*

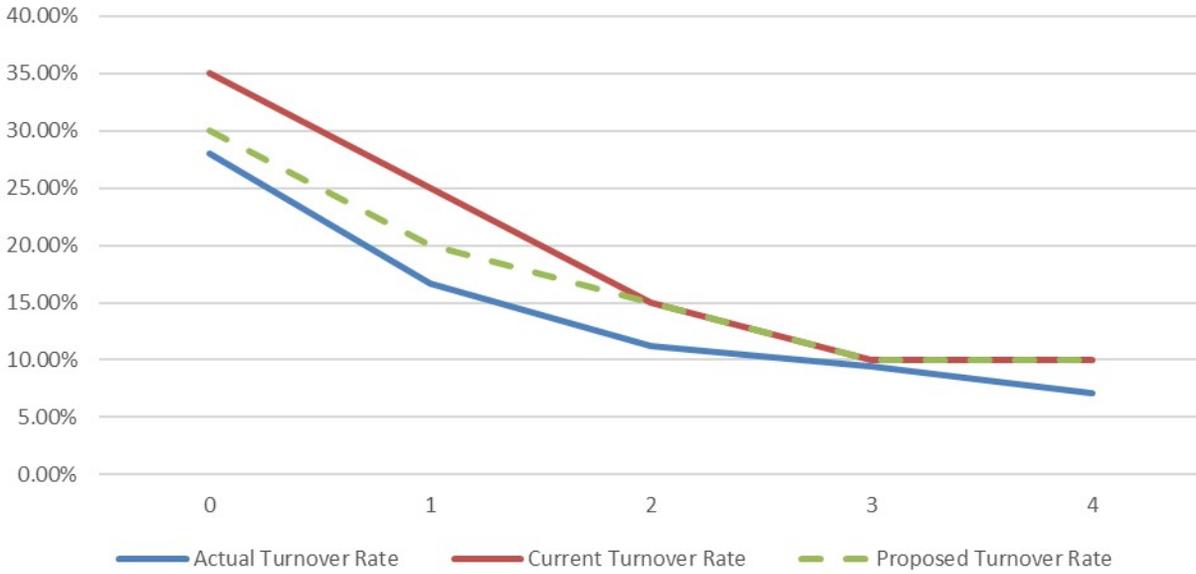
Years of Service	Exposures	Actual Terminations <sup>1</sup>	Actual Turnover Rate	Expected Terminations	Ratio of Actual to Expected Rate	Proposed Terminations	Ratio of Actual to Proposed Rate
0 - 0.99	37,299	7,147	19.2%	13,055	54.8%	9,325	76.7%
1 - 1.99	40,726	5,293	13.0%	10,182	52.0%	8,145	65.0%
2 - 2.99	31,725	2,712	8.6%	4,759	57.0%	3,173	85.5%
3 - 3.99	27,752	1,918	6.9%	2,775	69.1%	2,775	69.1%
4 - 4.99	25,964	1,440	5.6%	2,596	55.5%	2,596	55.5%
<b>Total</b>	<b>163,466</b>	<b>18,510</b>	<b>11.3%</b>	<b>33,367</b>	<b>55.5%</b>	<b>26,014</b>	<b>71.2%</b>

<b>Grand Total</b>	<b>236,641</b>	<b>30,432</b>	<b>12.9%</b>	<b>49,038</b>	<b>62.1%</b>	<b>40,972</b>	<b>74.3%</b>
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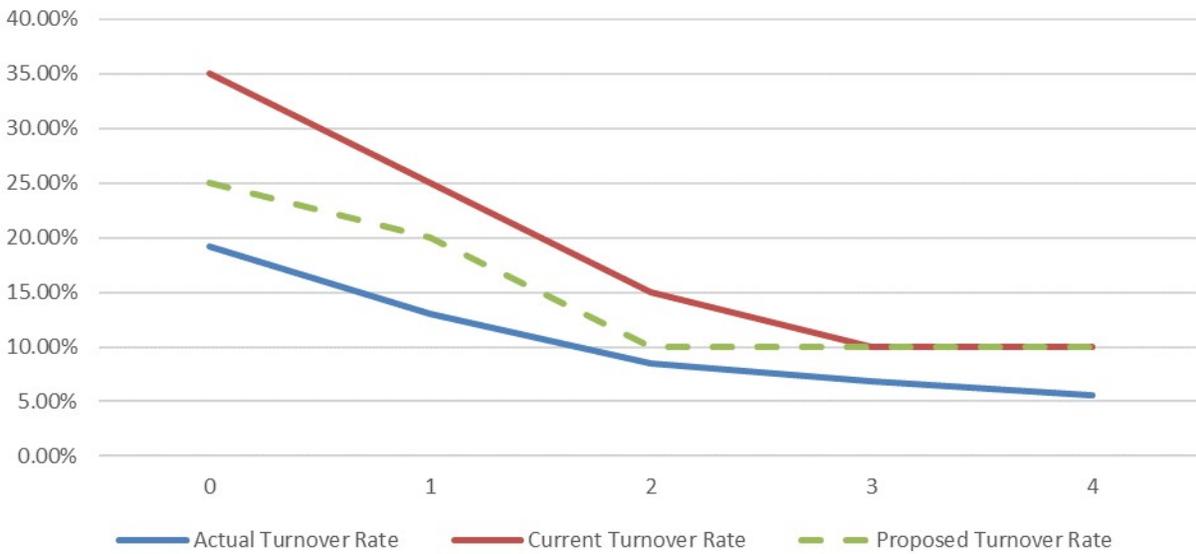
<sup>1</sup> Actual terminations as shown in the table are net of rehired employees.

### III. Demographic Assumptions

**Graph 4:  
Non-Vested Termination  
Actual and Expected Experience Compared to Proposed, Service-Based  
Male**



#### Female



### III. Demographic Assumptions

**Table 5:**  
**Vested Termination**  
**Actual and Expected Experience Compared to Proposed, Age-Based**  
*Male*

Age Range	Exposures	Actual Terminations <sup>1</sup>	Actual Turnover Rate	Expected Terminations	Ratio of Actual to Expected Rate	Proposed Terminations	Ratio of Actual to Proposed Rate
< 30	3,358	110	3.3%	128	86.1%	120	91.6%
30 – 34	18,909	424	2.2%	396	107.2%	436	97.3%
35 – 39	26,932	478	1.8%	488	97.9%	484	98.8%
40 – 44	29,215	500	1.7%	561	89.2%	511	97.8%
45 – 49	26,558	426	1.6%	530	80.4%	517	82.4%
50 – 54	22,271	472	2.1%	603	78.3%	548	86.2%
55 – 59 <sup>2</sup>	11,450	386	3.4%	455	84.8%	405	95.2%
<b>Total</b>	<b>138,693</b>	<b>2,796</b>	<b>2.0%</b>	<b>3,160</b>	<b>88.5%</b>	<b>3,021</b>	<b>92.6%</b>

*Female*

Age Range	Exposures	Actual Terminations <sup>1</sup>	Actual Turnover Rate	Expected Terminations	Ratio of Actual to Expected Rate	Proposed Terminations	Ratio of Actual to Proposed Rate
< 30	13,723	530	3.9%	753	70.4%	673	78.8%
30 – 34	58,100	1,619	2.8%	1,936	83.6%	1,767	91.7%
35 – 39	68,390	1,037	1.5%	1,379	75.2%	1,198	86.6%
40 – 44	73,321	815	1.1%	1,134	71.9%	952	85.7%
45 – 49	67,056	885	1.3%	942	94.0%	935	94.6%
50 – 54	57,867	954	1.7%	1,477	64.6%	1,170	81.6%
55 – 59 <sup>2</sup>	36,854	1,140	3.1%	1,101	103.5%	1,106	103.1%
<b>Total</b>	<b>375,311</b>	<b>6,980</b>	<b>1.9%</b>	<b>8,722</b>	<b>80.0%</b>	<b>7,799</b>	<b>89.5%</b>

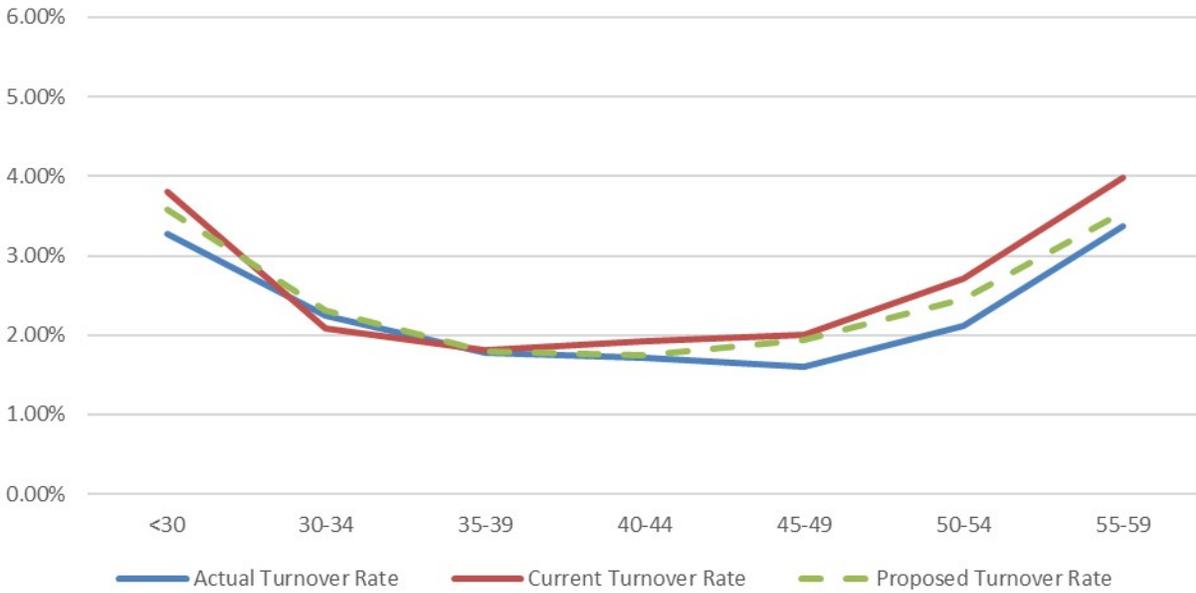
<b>Grand Total</b>	<b>514,004</b>	<b>9,776</b>	<b>1.9%</b>	<b>11,882</b>	<b>82.3%</b>	<b>10,820</b>	<b>90.4%</b>
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<sup>1</sup> Actual terminations as shown in the table are net of rehired employees.

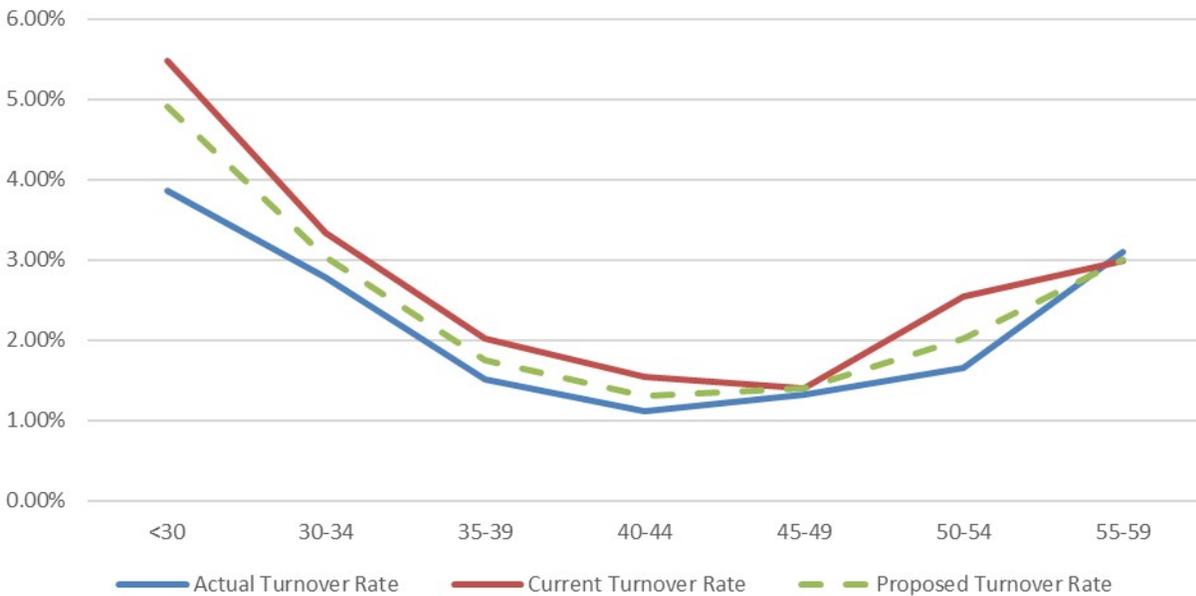
<sup>2</sup> Excludes terminations from members who are eligible for retirement.

### III. Demographic Assumptions

**Graph 5:  
Vested Termination  
Actual and Expected Experience Compared to Proposed, Age-Based  
Male**



**Females**



### III. Demographic Assumptions

#### D. Disability Retirement

Disability rate tables function in the same way as mortality tables. The rate at each age indicates the probability of becoming disabled before the next age. Disability rates add liability for the value of the 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 members' age and gender and range from 0.008% at age 20 to 0.30% at age 65. The following table summarizes the disability experience for the plan during the study period. Overall, the number of actual male disabilities was less and the actual female disabilities was more than the number of assumed disabilities.

Gender	Exposures	Actual Disabilities	Actual Disability Rate	Expected Disabilities	Ratio of Actual Disabilities to Expected Disabilities
Male	244,995	222	0.09%	306	72.6%
Female	610,901	698	0.11%	502	138.9%
<b>Total</b>	<b>855,896</b>	<b>920</b>	<b>0.11%</b>	<b>808</b>	<b>113.9%</b>

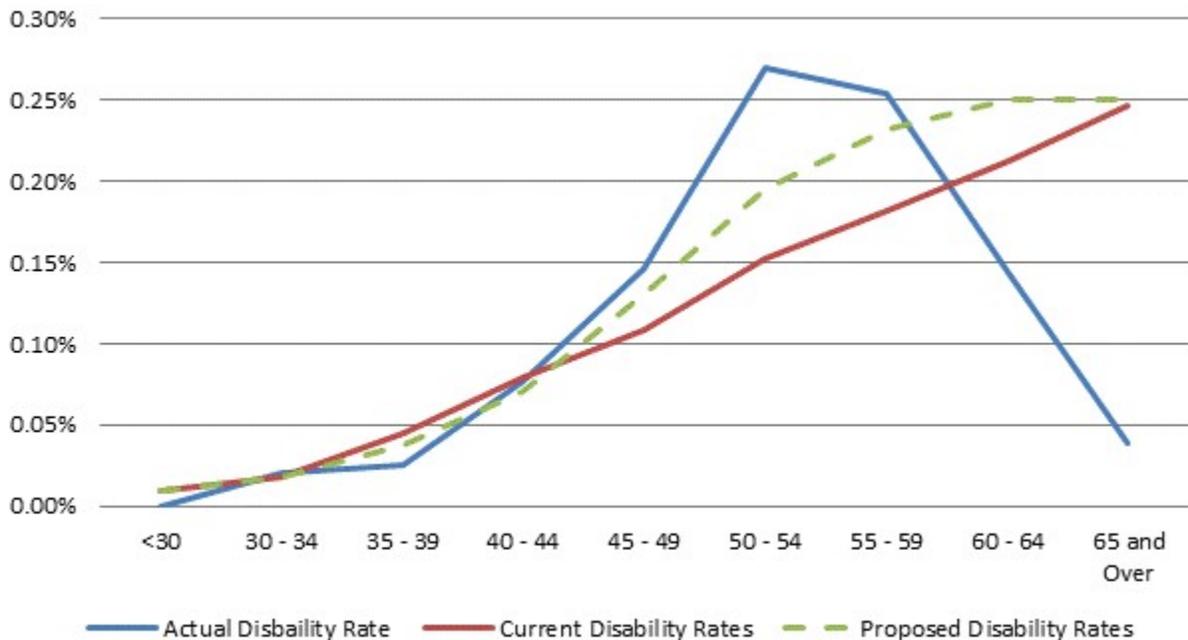
In light of the above, considering the small sample size, and given experience for males and females was similar, we recommend a unisex age-based table with slightly increased rates. The complete listing of the proposed disability rates are included in Appendix E.

### III. Demographic Assumptions

**Table 6:**  
**Disability Retirement**  
**Actual and Expected Experience Compared to Proposed, Age-Based**  
*Male and Female Combined*

Age Range	Exposures	Actual Disabilities	Actual Disability Rate	Expected Disabilities	Ratio of Actual to Expected Rate	Proposed Disabilities	Ratio of Actual to Proposed Rate
< 30	104,434	0	0.00%	10	0.0%	0.01%	0.0%
30 – 34	114,926	23	0.02%	20	112.9%	0.02%	109.6%
35 – 39	121,489	31	0.03%	54	57.1%	0.04%	67.3%
40 – 44	127,233	98	0.08%	101	97.4%	0.07%	109.7%
45 - 49	113,552	166	0.15%	123	135.3%	0.13%	111.7%
50 – 54	103,600	280	0.27%	158	177.1%	0.20%	138.1%
55 – 59	91,342	232	0.25%	166	139.9%	0.23%	109.8%
60 – 64	56,160	81	0.14%	119	68.1%	0.25%	57.7%
65 & Over	23,160	9	0.04%	57	15.7%	0.25%	15.5%
<b>Total</b>	<b>855,896</b>	<b>920</b>	<b>0.11%</b>	<b>808</b>	<b>113.8%</b>	<b>0.11%</b>	<b>99.2%</b>

**Graph 6:**  
**Disability Retirement**  
**Actual and Expected Experience Compared to Proposed, Age-Based**  
*Male and Female Combined*



## III. Demographic Assumptions

### E. Other Demographic Assumptions

#### Spouse Information

The current assumption for members as they relate to their spouses are:

- Percent Married – 80% of male members and 60% of female members are assumed to be married; and
- Age Difference – male members are three years older than their spouses and females are one year younger than their spouses

The following table summarizes the experience for the plan during the study period. Overall, the actual percent married and the actual age differences were similar to the expectation.

Gender	Percent Married		Age Difference	
	All Retirees	Newly Retired	All Retirees	Newly Retired
Male	76.2%	76.9%	3.1 years older	2.5 years older
Female	47.4%	55.6%	0.4 years younger	1.5 years younger

In light of the above, we recommend no changes to either assumption.

### III. Demographic Assumptions

#### Retiree Health Participation

The current assumption is 75% of future eligible service retirees, 84% of future eligible disabled retirees and 47% of inactive vested participants who do not cash out are assumed to elect health coverage at retirement.

The following table summarizes the participation experience of each group from January 1, 2013 to December 31, 2016:

	Exposures	Actual	Expected	Ratio of Actual Enrollees to Expected Enrollees	Actual Participation	Expected Participation
Service Retiree	28,230	20,810	21,173	98.3%	74%	75%
Disabled	987	622	829	75.0%	63%	84%
Inactive Vested	1,041	273	489	55.8%	26%	47%

The actual number of service retirees who enrolled in health coverage is close to the expected number. We recommend no change to the 75% participation assumption.

The actual number of disabled retirees who enrolled in health coverage is lower than the expected number. We recommend decreasing the participation assumption to 65% for eligible disabled retirees.

The actual number of inactive vested participants who did not cash out their pension who enrolled in health coverage is also lower than the expected number. We recommend decreasing the participation assumption to 30% for eligible inactive vested participants who do not cash out their pension.

## IV. Appendix

### Appendix A: Proposed Salary Increases

Age	Total Exposures	Actual Increase <sup>1</sup>	Expected Increase <sup>2</sup>	Proposed Increase <sup>3</sup>	Proposed Increase Plus Inflation <sup>4</sup>
20	4	14.83%	9.90%	10.00%	12.50%
21	97	18.31%	10.34%	10.00%	12.50%
22	2,389	9.51%	10.28%	10.00%	12.50%
23	6,163	9.51%	10.29%	10.00%	12.50%
24	9,468	9.26%	10.26%	9.75%	12.25%
25	11,913	7.84%	10.26%	9.00%	11.50%
26	13,812	6.23%	8.33%	7.25%	9.75%
27	15,348	5.25%	7.44%	6.25%	8.75%
28	16,941	4.73%	6.96%	5.75%	8.25%
29	18,169	4.24%	6.63%	5.50%	8.00%
30	19,168	4.10%	6.24%	5.25%	7.75%
31	20,097	3.68%	6.09%	5.00%	7.50%
32	21,049	3.60%	5.73%	4.75%	7.25%
33	21,636	3.12%	5.74%	4.50%	7.00%
34	22,031	2.98%	5.62%	4.25%	6.75%
35	22,056	2.68%	5.44%	4.00%	6.50%
36	22,052	2.53%	5.15%	3.75%	6.25%
37	21,875	2.20%	4.92%	3.50%	6.00%
38	21,674	1.91%	4.54%	3.25%	5.75%
39	22,266	1.69%	4.35%	3.00%	5.50%
40	23,039	1.53%	4.02%	2.75%	5.25%
41	23,350	1.41%	4.02%	2.75%	5.25%
42	23,469	1.38%	3.93%	2.50%	5.00%
43	23,347	1.31%	3.73%	2.50%	5.00%
44	22,421	1.10%	3.63%	2.25%	4.75%
45	21,283	1.12%	3.48%	2.25%	4.75%
46	20,422	0.90%	3.34%	2.00%	4.50%
47	19,856	0.75%	3.19%	2.00%	4.50%
48	19,623	0.80%	3.03%	1.75%	4.25%
49	19,540	0.48%	2.88%	1.75%	4.25%
50	18,996	0.52%	2.73%	1.50%	4.00%
51	18,136	0.36%	2.65%	1.50%	4.00%
52	17,311	0.32%	2.55%	1.25%	3.75%
53	17,060	0.06%	2.46%	1.25%	3.75%
54	16,715	-0.05%	2.33%	1.00%	3.50%
55	15,775	0.07%	2.25%	1.00%	3.50%

<sup>1</sup> Adjusted for actual average inflation of approximately 1.80% during the experience period.

<sup>2</sup> Adjusted for assumed inflation of 2.75%.

<sup>3</sup> Proposed rate of individual salary increases table does not reflect underlying assumption for inflation.

<sup>4</sup> Reflects proposed assumption for inflation of 2.50%.

## IV. Appendix

### Appendix A: Proposed Salary Increases *continued*

Age	Total Exposures	Actual Increase <sup>1</sup>	Expected Increase <sup>2</sup>	Proposed Increase <sup>3</sup>	Proposed Increase Plus Inflation <sup>4</sup>
56	14,835	0.15%	2.15%	0.75%	3.25%
57	13,863	-0.05%	2.03%	0.75%	3.25%
58	12,586	0.05%	1.96%	0.50%	3.00%
59	10,973	0.08%	1.84%	0.50%	3.00%
60	9,550	0.09%	1.74%	0.25%	2.75%
61	8,359	-0.05%	1.76%	0.25%	2.75%
62	7,125	0.04%	1.23%	0.00%	2.50%
63	5,405	-0.12%	1.26%	0.00%	2.50%
64	3,742	-0.44%	1.19%	0.00%	2.50%
65+	11,260	-0.44%	1.14%	0.00%	2.50%
<b>Total</b>	<b>726,249</b>	<b>1.67%</b>	<b>3.97%</b>	<b>2.71%</b>	<b>5.21%</b>

<sup>1</sup> Adjusted for actual average inflation of approximately 1.8% during the experience period.

<sup>2</sup> Adjusted for assumed inflation of 2.75%.

<sup>3</sup> Proposed rate of individual salary increases table does not reflect underlying assumption for inflation.

<sup>4</sup> Reflects proposed assumption for inflation of 2.50%.

## IV. Appendix

### Appendix B: Proposed Mortality Rates

#### Healthy Post-Retirement Mortality Rates<sup>1</sup>

Age	Male		Female	
	Current Mortality Rates	Proposed Mortality Rates	Current Mortality Rates	Proposed Mortality Rates
50	0.14%	0.20%	0.08%	0.14%
55	0.19%	0.29%	0.13%	0.18%
60	0.37%	0.39%	0.27%	0.26%
65	0.73%	0.55%	0.52%	0.40%
70	1.31%	1.17%	0.98%	0.90%
75	2.16%	1.88%	1.60%	1.47%
80	3.99%	4.02%	3.56%	3.14%
85	7.52%	7.75%	5.96%	6.05%
90	16.79%	13.59%	12.33%	10.71%
95	25.60%	21.86%	18.61%	17.90%
100	33.71%	31.40%	23.23%	27.09%

#### Disabled Post-Retirement Mortality<sup>1</sup>

Age	Male		Female	
	Current Mortality Rates	Proposed Mortality Rates	Current Mortality Rates	Proposed Mortality Rates
45	2.16%	1.53%	2.07%	0.90%
50	2.16%	1.84%	2.07%	1.19%
55	2.16%	2.10%	2.07%	1.45%
60	2.16%	2.39%	2.07%	1.70%
65	3.08%	2.85%	2.95%	2.09%
70	4.62%	3.63%	2.95%	2.82%
75	5.08%	4.89%	4.43%	4.10%
80	7.81%	6.90%	6.35%	6.10%
85	11.77%	10.20%	9.76%	9.04%
90	17.43%	15.57%	14.71%	13.27%
95	25.36%	22.25%	21.79%	19.59%
100	36.00%	29.40%	31.70%	27.82%

<sup>1</sup> Proposed mortality rates above are sample rates for 2014. For actuarial valuation purposes, mortality rates will be projected from 2014 on a generational basis using the MP-2016 improvement scale.

## IV. Appendix

### Appendix B: Proposed Mortality Rates *continued*

#### Healthy Pre-Retirement Mortality<sup>1</sup>

Age	Male		Female	
	Current Mortality Rates	Proposed Mortality Rates	Current Mortality Rates	Proposed Mortality Rates
20	0.02%	0.04%	0.01%	0.02%
25	0.03%	0.05%	0.01%	0.02%
30	0.04%	0.05%	0.02%	0.02%
35	0.06%	0.05%	0.03%	0.03%
40	0.08%	0.06%	0.04%	0.04%
45	0.08%	0.10%	0.06%	0.07%
50	0.10%	0.17%	0.06%	0.11%
55	0.14%	0.28%	0.10%	0.17%
60	0.28%	0.47%	0.14%	0.24%
65	0.55%	0.83%	0.26%	0.37%
70	0.98%	1.39%	0.49%	0.63%
75	1.63%	2.32%	0.81%	1.08%
80	3.00%	3.88%	1.78%	1.84%

<sup>1</sup> Proposed mortality rates above are sample rates for 2014. For actuarial valuation purposes, mortality rates will be projected from 2014 on a generational basis using the MP-2016 improvement scale.

## IV. Appendix

### Appendix C: Proposed Retirement Rates

#### Defined Benefit Plan

#### Grandfathered Rates – Males

Age	Under 25 Years of Service		25-29 Years of Service		30-34 Years of Service		35 or More Years of Service	
	Current	Proposed	Current	Proposed	Current	Proposed	Current	Proposed
<53	0%	0%	0%	0%	20%	20%	40%	30%
53	0%	0%	0%	0%	20%	20%	40%	30%
54	0%	0%	0%	0%	20%	20%	60%	40%
55	0%	0%	6%	6%	20%	20%	60%	40%
56	0%	0%	6%	6%	20%	20%	60%	40%
57	0%	0%	6%	6%	20%	20%	60%	40%
58	0%	0%	6%	6%	20%	20%	60%	40%
59	0%	0%	7%	7%	20%	20%	55%	40%
60	10%	10%	7%	7%	20%	20%	55%	40%
61	10%	10%	7%	7%	20%	20%	55%	40%
62	12%	12%	8%	8%	20%	20%	55%	40%
63	12%	12%	8%	8%	12%	25%	55%	35%
64	12%	12%	12%	12%	12%	25%	40%	25%
65	20%	20%	20%	20%	12%	25%	40%	25%
66	20%	20%	20%	20%	12%	25%	40%	25%
67	15%	15%	20%	20%	12%	25%	35%	25%
68	15%	15%	20%	20%	12%	25%	30%	20%
69	15%	15%	20%	20%	12%	25%	30%	20%
70	15%	15%	20%	20%	12%	25%	30%	20%
71	15%	15%	20%	20%	12%	25%	30%	20%
72	15%	15%	20%	20%	12%	25%	30%	20%
73	15%	15%	20%	20%	12%	25%	30%	20%
74	15%	15%	20%	20%	12%	25%	30%	20%
75	100%	100%	100%	100%	100%	100%	100%	100%

## IV. Appendix

### Appendix C: Proposed Retirement Rates *continued*

#### Defined Benefit Plan

#### Grandfathered Rates – Female

Age	Under 25 Years of Service		25-29 Years of Service		30-34 Years of Service		35 or More Years of Service	
	Current	Proposed	Current	Proposed	Current	Proposed	Current	Proposed
<53	0%	0%	0%	0%	20%	20%	50%	35%
53	0%	0%	0%	0%	20%	20%	50%	35%
54	0%	0%	0%	0%	20%	20%	60%	40%
55	0%	0%	9%	9%	20%	20%	60%	40%
56	0%	0%	9%	9%	20%	20%	60%	40%
57	0%	0%	9%	9%	20%	20%	60%	40%
58	0%	0%	9%	9%	20%	20%	55%	40%
59	0%	0%	10%	10%	25%	25%	55%	40%
60	10%	10%	10%	10%	30%	30%	55%	45%
61	10%	10%	10%	10%	30%	30%	55%	45%
62	10%	10%	12%	12%	30%	30%	55%	45%
63	10%	10%	12%	12%	35%	35%	55%	45%
64	15%	15%	20%	20%	35%	35%	55%	45%
65	25%	25%	30%	30%	35%	35%	55%	45%
66	20%	20%	30%	30%	35%	35%	55%	45%
67	20%	20%	20%	20%	35%	35%	55%	45%
68	20%	20%	20%	20%	35%	35%	55%	45%
69	20%	20%	20%	20%	35%	35%	55%	45%
70	20%	20%	20%	20%	35%	35%	40%	40%
71	20%	20%	20%	20%	35%	35%	40%	40%
72	20%	20%	20%	20%	35%	35%	40%	40%
73	20%	20%	20%	20%	35%	35%	40%	40%
74	20%	20%	20%	20%	35%	35%	40%	40%
75	100%	100%	100%	100%	100%	100%	100%	100%

## IV. Appendix

### Appendix C: Proposed Retirement Rates *continued*

#### Defined Benefit Plan

#### Non-grandfathered Rates – Male

Age	Under 25 Years of Service		25-29 Years of Service		30-34 Years of Service <sup>1</sup>		35 or More Years of Service <sup>1</sup>	
	Current	Proposed	Current	Proposed <sup>2</sup>	Current	Proposed	Current	Proposed
<53	0%	0%	0%	0%	20%	20%	20%	20%
53	0%	0%	0%	0%	20%	20%	20%	20%
54	0%	0%	0%	0%	20%	20%	20%	20%
55	0%	0%	3%	3%	20%	20%	20%	20%
56	0%	0%	3%	3%	20%	20%	20%	20%
57	0%	0%	3%	3%	20%	20%	20%	20%
58	0%	0%	3%	3%	20%	20%	20%	20%
59	0%	0%	5%	5%	20%	20%	20%	20%
60	5%	5%	5%	5%	20%	20%	25%	25%
61	6%	6%	6%	6%	20%	20%	25%	25%
62	7%	7%	7%	7%	20%	20%	25%	25%
63	8%	8%	8%	8%	12%	25%	25%	25%
64	10%	10%	10%	10%	12%	25%	25%	25%
65	20%	20%	20%	20%	12%	25%	25%	25%
66	20%	20%	20%	20%	12%	25%	25%	25%
67	15%	20%	20%	20%	12%	25%	25%	25%
68	15%	20%	20%	20%	12%	25%	20%	20%
69	15%	20%	20%	20%	12%	25%	20%	20%
70	15%	20%	20%	20%	12%	25%	20%	20%
71	15%	20%	20%	20%	12%	25%	20%	20%
72	15%	20%	20%	20%	12%	25%	20%	20%
73	15%	20%	20%	20%	12%	25%	20%	20%
74	15%	20%	20%	20%	12%	25%	20%	20%
75	100%	100%	100%	100%	100%	100%	100%	100%

<sup>1</sup> Use two times 25-29 Years of Service rates if not eligible for unreduced retirement (prior to age 65)

<sup>2</sup> Rates prior to age 60 are zero if retirement eligibility requirements are not met

## IV. Appendix

### Appendix C: Proposed Retirement Rates *continued*

#### Defined Benefit Plan

#### Non-grandfathered Rates – Female

Age	Under 25 Years of Service		25-29 Years of Service		30-34 Years of Service <sup>1</sup>		35 or More Years of Service <sup>1</sup>	
	Current	Proposed	Current	Proposed <sup>2</sup>	Current	Proposed	Current	Proposed
<53	0%	0%	0%	0%	20%	20%	20%	20%
53	0%	0%	0%	0%	20%	20%	20%	20%
54	0%	0%	0%	0%	20%	20%	20%	20%
55	0%	0%	5%	5%	20%	20%	20%	20%
56	0%	0%	5%	5%	20%	20%	20%	20%
57	0%	0%	5%	5%	20%	20%	20%	20%
58	0%	0%	5%	5%	20%	20%	20%	20%
59	0%	0%	5%	5%	25%	25%	25%	25%
60	5%	10%	10%	10%	30%	30%	30%	30%
61	6%	10%	10%	10%	30%	30%	30%	30%
62	7%	10%	10%	10%	30%	30%	30%	30%
63	8%	10%	10%	10%	35%	35%	35%	35%
64	12%	15%	15%	15%	35%	35%	35%	35%
65	25%	30%	30%	30%	35%	35%	35%	35%
66	20%	30%	30%	30%	35%	35%	35%	35%
67	20%	20%	20%	20%	35%	35%	35%	35%
68	20%	20%	20%	20%	35%	35%	35%	35%
69	20%	20%	20%	20%	35%	35%	35%	35%
70	20%	20%	20%	20%	35%	35%	30%	30%
71	20%	20%	20%	20%	35%	35%	30%	30%
72	20%	20%	20%	20%	35%	35%	30%	30%
73	20%	20%	20%	20%	35%	35%	30%	30%
74	20%	20%	20%	20%	35%	35%	30%	30%
75	100%	100%	100%	100%	100%	100%	100%	100%

<sup>1</sup> Use two times 25-29 Years of Service rates if not eligible for unreduced retirement (prior to age 65)

<sup>2</sup> Rates prior to age 60 are zero if retirement eligibility requirements are not met

## IV. Appendix

### Appendix C: Proposed Retirement Rates *continued*

#### Combined Plan

Age	Male	Female
60	13%	22%
61	7%	9%
62	7%	9%
63	7%	9%
64	9%	15%
65	17%	20%
66	15%	13%
67	12%	13%
68	12%	12%
69	12%	12%
70	12%	12%
71	12%	12%
72	12%	12%
73	12%	12%
74	12%	12%
75	100%	100%

## IV. Appendix

### Appendix D: Proposed Termination Rates

#### Non-Vested Terminations

##### Male

Service	Total Exposures	Actual Terminations	Actual Turnover Rate	Proposed Turnover Rate	Proposed Terminations
0 - 0.99	19,894	5,584	28.1%	30.0%	5,968
1 - 1.99	17,969	3,006	16.7%	20.0%	3,594
2 - 2.99	13,699	1,535	11.2%	15.0%	2,055
3 - 3.99	11,516	1,082	9.4%	10.0%	1,152
4 - 4.99	10,097	715	7.1%	10.0%	1,010
<b>Total</b>	<b>73,175</b>	<b>11,922</b>	<b>16.3%</b>	<b>18.8%</b>	<b>13,778</b>

##### Female

Service	Total Exposures	Actual Terminations	Actual Turnover Rate	Proposed Turnover Rate	Proposed Terminations
0 - 0.99	37,299	7,147	19.2%	25.0%	9,325
1 - 1.99	40,726	5,293	13.0%	20.0%	8,145
2 - 2.99	31,725	2,712	8.7%	10.0%	3,173
3 - 3.99	27,752	1,918	6.9%	10.0%	2,775
4 - 4.99	25,964	1,440	5.7%	10.0%	2,596
<b>Total</b>	<b>163,466</b>	<b>18,510</b>	<b>11.3%</b>	<b>15.9%</b>	<b>26,014</b>

## IV. Appendix

### Appendix D: Proposed Termination Rates *continued*

#### Vested Terminations

*Male*

Age	Total Exposures	Actual Terminations	Actual Turnover Rate	Proposed Turnover Rate	Proposed Terminations
23	2	0	0.00%	11.25%	0.2
24	2	0	0.00%	11.25%	0.2
25	2	0	0.00%	11.25%	0.2
26	10	1	10.00%	10.00%	1.0
27	262	10	3.82%	6.00%	15.7
28	1,052	31	2.95%	3.50%	36.8
29	2,028	68	3.35%	3.25%	65.9
30	2,741	74	2.70%	2.75%	75.4
31	3,296	68	2.06%	2.50%	82.4
32	3,880	98	2.53%	2.25%	87.3
33	4,319	97	2.25%	2.25%	97.2
34	4,673	87	1.86%	2.00%	93.5
35	5,035	103	2.05%	2.00%	100.7
36	5,264	89	1.69%	1.75%	92.1
37	5,488	94	1.71%	1.75%	96.0
38	5,552	97	1.75%	1.75%	97.2
39	5,593	95	1.70%	1.75%	97.9
40	5,688	99	1.74%	1.75%	99.5
41	5,892	125	2.12%	1.75%	103.1
42	5,876	94	1.60%	1.75%	102.8
43	5,916	87	1.47%	1.75%	103.5
44	5,843	95	1.63%	1.75%	102.3
45	5,677	91	1.60%	1.75%	99.3
46	5,407	110	2.03%	2.00%	108.1
47	5,237	58	1.11%	2.00%	104.7
48	5,147	102	1.98%	2.00%	102.9
49	5,090	65	1.28%	2.00%	101.8
50	5,089	88	1.73%	2.00%	101.8
51	4,930	95	1.93%	2.25%	110.9
52	4,510	84	1.86%	2.50%	112.8
53	4,064	107	2.63%	2.75%	111.8
54	3,678	98	2.66%	3.00%	110.3
55	2,472	82	3.32%	3.25%	80.3
56	2,373	67	2.82%	3.50%	83.1
57	2,291	80	3.49%	3.50%	80.2
58	2,213	77	3.48%	3.75%	83.0
59	2,101	80	3.81%	3.75%	78.8
<b>Total</b>	<b>138,693</b>	<b>2,796</b>	<b>2.02%</b>	<b>2.18%</b>	<b>3,020.9</b>

## IV. Appendix

### Appendix D: Proposed Termination Rates *continued*

#### Vested Terminations

#### *Female*

Age	Total Exposures	Actual Terminations	Actual Turnover Rate	Proposed Turnover Rate	Proposed Terminations
24	1	0	0.00%	13.25%	0.1
25	2	0	0.00%	12.50%	0.3
26	40	0	0.00%	11.25%	4.5
27	1,695	65	3.83%	8.00%	135.6
28	4,621	194	4.20%	4.75%	219.5
29	7,364	271	3.68%	4.25%	313.0
30	9,249	315	3.41%	3.75%	346.8
31	10,694	339	3.17%	3.50%	374.3
32	11,875	337	2.84%	3.00%	356.3
33	12,850	347	2.70%	2.75%	353.4
34	13,432	281	2.09%	2.50%	335.8
35	13,723	252	1.84%	2.00%	274.5
36	13,772	214	1.55%	1.75%	241.0
37	13,805	213	1.54%	1.75%	241.6
38	13,637	202	1.48%	1.75%	238.6
39	13,453	156	1.16%	1.50%	201.8
40	14,019	171	1.22%	1.50%	210.3
41	14,498	131	0.90%	1.25%	181.2
42	14,799	147	0.99%	1.25%	185.0
43	15,042	187	1.24%	1.25%	188.0
44	14,963	179	1.20%	1.25%	187.0
45	14,443	138	0.96%	1.25%	180.5
46	13,730	184	1.34%	1.25%	171.6
47	13,185	193	1.46%	1.50%	197.8
48	12,889	182	1.41%	1.50%	193.3
49	12,809	188	1.47%	1.50%	192.1
50	12,929	183	1.42%	1.75%	226.3
51	12,685	189	1.49%	1.75%	222.0
52	11,681	170	1.46%	2.00%	233.6
53	10,609	213	2.01%	2.25%	238.7
54	9,963	199	2.00%	2.50%	249.1
55	7,801	234	3.00%	3.00%	234.0
56	7,625	232	3.04%	3.00%	228.8
57	7,578	255	3.37%	3.00%	227.3
58	7,303	242	3.31%	3.00%	219.1
59	6,547	177	2.70%	3.00%	196.4
<b>Total</b>	<b>375,311</b>	<b>6,980</b>	<b>1.86%</b>	<b>2.08%</b>	<b>7,799.2</b>

## IV. Appendix

### Appendix E: Proposed Disability Retirement Rates

*Unisex*

Age Range	Exposures	Actual Disabilities	Actual Disability Rate	Proposed Disability Rate	Proposed Disabilities
Under 30	104,434	0	0.00%	0.01%	10.4
30	21,382	3	0.01%	0.01%	2.1
31	22,250	0	0.00%	0.01%	3.1
32	23,124	7	0.03%	0.02%	4.2
33	23,853	5	0.02%	0.02%	5.2
34	24,317	8	0.03%	0.03%	6.3
35	24,569	5	0.02%	0.03%	7.4
36	24,451	4	0.02%	0.03%	8.3
37	24,447	11	0.04%	0.04%	9.3
38	24,145	7	0.03%	0.04%	10.1
39	23,877	4	0.02%	0.05%	11.0
40	24,628	9	0.04%	0.05%	12.3
41	25,373	13	0.05%	0.06%	15.2
42	25,677	20	0.08%	0.07%	18.0
43	25,749	24	0.09%	0.08%	20.6
44	25,806	32	0.12%	0.09%	23.2
45	24,593	19	0.08%	0.10%	24.6
46	23,362	38	0.16%	0.12%	27.1
47	22,379	29	0.13%	0.13%	29.5
48	21,774	47	0.22%	0.15%	32.2
49	21,444	33	0.15%	0.16%	35.2
50	21,340	49	0.23%	0.18%	38.4
51	21,404	55	0.26%	0.19%	40.2
52	20,868	51	0.24%	0.20%	40.9
53	20,106	72	0.36%	0.20%	41.0
54	19,882	53	0.27%	0.21%	42.1
55	19,645	41	0.21%	0.22%	43.2
56	19,515	49	0.25%	0.23%	44.1
57	18,638	52	0.28%	0.23%	43.2
58	17,308	51	0.29%	0.24%	41.2

## IV. Appendix

### Appendix E: Proposed Disability Rates *continued*

*Unisex*

Age Range	Exposures	Actual Disabilities	Actual Disability Rate	Proposed Disability Rate	Proposed Disabilities
59	16,236	39	0.24%	0.24%	39.6
60	14,723	30	0.20%	0.25%	36.8
61	12,660	18	0.14%	0.25%	31.7
62	11,108	14	0.13%	0.25%	27.8
63	9,561	14	0.15%	0.25%	23.9
64	8,108	5	0.06%	0.25%	20.3
65 & Over	23,160	9	0.04%	0.25%	57.9
<b>Total</b>	<b>855,896</b>	<b>920</b>	<b>0.11%</b>	<b>0.11%</b>	<b>927.9</b>