Public Employees' Retirement Association of Colorado

ACTUARIAL EXPERIENCE REVIEW

Analysis of Actuarial Experience during the Period January 1, 2016 through December 31, 2019

October 26, 2020 / Brad Ramirez, FSA, MAAA, EA / Matthew Strom, FSA, MAAA, EA / Tanya Dybal, FSA, MAAA, EA

Segal

Segal

101 North Wacker
Suite 400
Chicago, IL 60606
segalco.com

Via Email

October 28, 2020

The Board of Trustees
Public Employees' Retirement Association of Colorado
1301 Pennsylvania Street
Denver, CO 80203-2386

Re: Actuarial Experience Review for the Period January 1, 2016 through December 31, 2019

Dear Trustees:

This report presents the results of the actuarial experience review of the demographic and economic experience of the Public Employees' Retirement Association of Colorado (PERA) for the period January 1, 2016 to December 31, 2019.

All current actuarial assumptions and methods were reviewed as part of this study. This study is the basis for our recommendation of the actuarial methods and assumptions to be used beginning with the December 31, 2020 actuarial valuation for the PERA Division and Health Care Trust Funds.

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

This review recommends assumptions to be used in the valuation to measure PERA'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.

Segal valuation results and experience study analysis are based on proprietary actuarial modeling software. The actuarial valuation models generate a comprehensive set of liability and cost calculations that are presented to meet regulatory, legislative and client requirements. Deterministic cost projections are based on a proprietary forecasting model. Raw experience study analysis of actual and expected decrements are

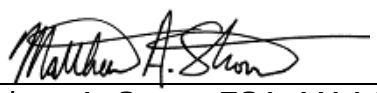
generated by a model, which is used to develop recommended assumption changes. Our Actuarial Technology and Systems unit, comprised of both actuaries and programmers, is responsible for the initial development and maintenance of these models. The models have a modular structure that allows for a high degree of accuracy, flexibility and user control. The client team programs the assumptions and the plan provisions, validates the models, and reviews test lives and results, under the supervision of the responsible actuaries.

It is important to note that this experience study analysis is based on census data and information through December 31, 2019. Due to the COVID-19 pandemic, market and demographic conditions may have changed significantly since this date. PERA's actuarial funded status does not reflect short term fluctuations in the market or plan demographics, but rather is based on asset and liability values on the last day of a plan year.

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

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

Respectively submitted,



Matthew A. Strom, FSA, MAAA, EA
Senior Vice President and Consulting Actuary

Brad Ramirez, FSA, MAAA, EA
Vice President and Consulting Actuary

Tanya Dybal, FSA, MAAA, EA
Senior Consultant and Actuary

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Public Employees' Retirement Association of Colorado

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I. Executive Summary

A. Introduction

Actuarial valuations of the Public Employees' Retirement Association of Colorado (PERA) five Division Trust Funds (State, School, Local Government, Judicial, and Denver Public Schools) are prepared annually to determine the actuarial contribution rate required to fund PERA on an actuarial reserve basis. Each actuarial valuation involves a projection of the benefits expected to be paid in the future to all members of PERA. 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 purpose of this report is to present the results of the actuarial methods and assumptions used in the actuarial valuation of the PERA Division Trust Funds. With the Board's approval of the recommendations in this report, these assumptions and methods would be used beginning with the December 31, 2020 actuarial valuation.

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

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

When setting the demographic assumptions (other than mortality), we typically develop proposed assumption rates by moving between the current assumption rate and the rate that the experience shows for that particular decrement. For example, if the probability of termination in the 20-24 age group is currently 8%, and the experience during the study period shows that 10% of eligible members actually terminated, we would propose adjusting the termination rate to 9% or 8.67%. We choose this methodology in order to smooth any changes in actual experience in case the experience during the study period is an anomaly.

For the demographic assumptions, we have reviewed the experience during the study period on a benefit-weighted basis. A member who is eligible to retire at any retirement age with a large pension may be more likely to retire than a member of the same age with a smaller benefit.

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

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

This study reviews the actuarial experience of PERA for the four-year period beginning January 1, 2016 and ending December 31, 2019, compares this experience to the current actuarial assumptions, and recommends changes to the assumptions as necessary. Economic assumption recommendations were primarily developed based on inputs related to economic forecasts and capital market expectations.

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

B. Recommendations

The experience review provides an opportunity for the Board, staff, and actuary to consider how specific assumptions or methods affect the funding of PERA, including the funded status and the adequacy of contributions made by members and employers (as compared to the actuarially determined contribution). We have reviewed both economic and demographic experience of the 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 PERA.

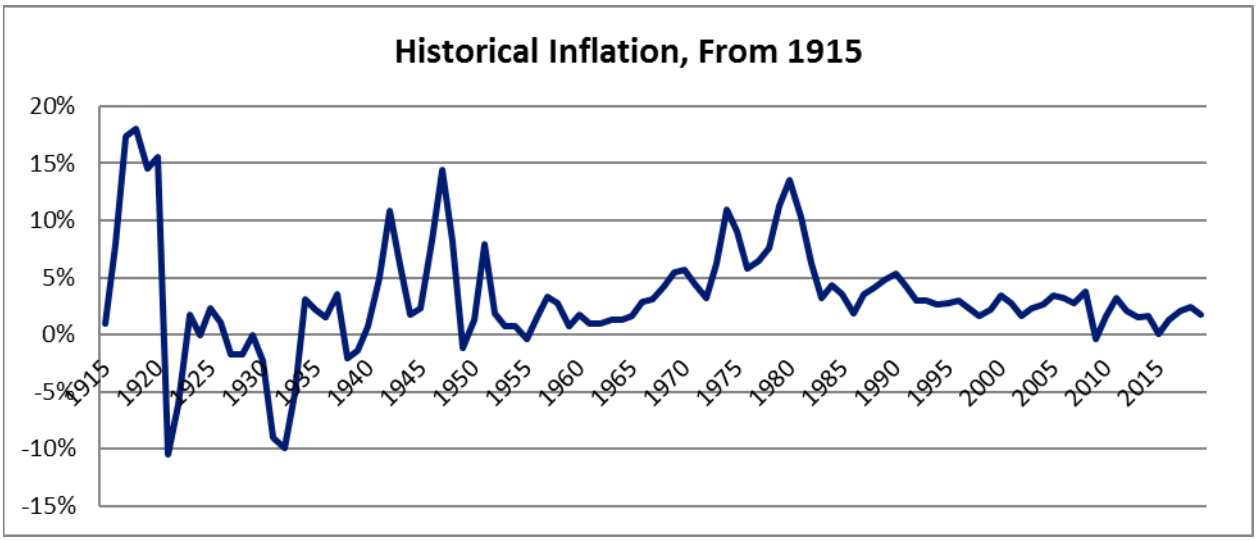
The detailed analysis of each individual assumption is discussed later in this report.

Economic Assumptions

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

Inflation

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



The current inflation assumption is 2.4% per annum. The outlook for inflation is under 2.2%, over a 20-year time horizon according to the Horizon Survey of Capital Market Assumptions (2020 Edition) and other professional forecasters. In light of all sources of inflation expectations reviewed in our study, we recommend lowering the inflation assumption from 2.4% to 2.3%.

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

Investment Return

PERA has averaged investment returns of 9.1% and 6.2% over the last 10 years and 20 years, respectively. The current assumption is 7.25%.

Based on PERA's target allocation and the 20-year composite Capital Market Assumptions provided in the Horizon Survey of Capital Market Assumptions (2020 Edition), the net expected real rate of investment return (net of investment expenses) is 5.10%, compared to the current assumption of 4.85%. Since we recommend that the inflation assumption be reduced to 2.30%, and the investment return assumption is the combination of expected inflation plus expected real rate of return, the 50th percentile expected return over the next 20 years is 7.40%. We recommend retaining the investment return assumption of 7.25%, which represents a 53% likelihood of achieving 7.25% over the long term.

Administrative Expenses

We recommend no change to the administrative expense assumption of 0.40% of payroll.

Active Member Growth Assumption

The projection of PERA's funding over 50 years requires an assumption regarding future new entrants to PERA. Based upon our analysis as well as data included in the Colorado Department of Affairs State Demography Office – Dashboard, we recommend that the active member growth assumptions be adjusted as follows:

Division	Current Active Member Growth Assumption	Proposed Active Member Growth Assumption
State	1.25%	0.25%
School	1.25%	1.00%
Local Government	1.00%	1.00%
Judicial	1.00%	0.25%
DPS	1.25%	1.00%

Rates of Individual Salary Increases

We studied the merit and seniority increases (plus productivity) separately from inflation. The current salary scale assumptions are based on age for all divisions. Based on our study, we recommend that the proposed increase rates be age-based for all divisions except Judicial, which would be based on service. The current salary increase assumption is the same for School and DPS Divisions (PERA Benefit Structure). Members under the DPS Benefit Structure, regardless of division, have a different salary increase assumption. The experience shows that the salary increase assumption for School should be different from the salary increase assumption for Denver Public Schools (both PERA and DPS Benefit Structures). Analysis of the distribution of merit and seniority increases by years since date of hire during the study period shows that these increases were greater than expected for members under age 65. Based on experience, we recommend increases to the merit and seniority portion of

individual salary increases (full rates in the appendix). The proposed salary increase assumptions represent approximately one-third of the actual salary increase above expected.

Payroll Growth Rate

The payroll growth rate is used for determining the effective amortization period and to determine the amortization payment of the unfunded actuarial accrued liability when the actuarially determined contribution rate is determined as a level percent-of-payroll. Based upon our analysis, we recommend lowering the current payroll growth assumption from 3.50% to 3.00%.

Demographic Assumptions

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

Mortality

Healthy Post-Retirement Mortality

Currently, PERA uses healthy post-retirement mortality rates based on the RP-2014 Healthy Annuitant Mortality Table (sex distinct) and the MP-2015 projection scale. For State and Local Government Division Trust Funds, the mortality table is the RP-2014 Healthy Annuitant Mortality Table with adjustments for credibility and gender. For males the adjustments are a 73% factor applied to the rates for ages below 80 and a 108% factor applied to the rates for ages 80 and above, projected to 2018 using the MP-2015 projection scale. For females the adjustments are a 78% factor applied to the rates for ages below 80 and a 109% factor applied to the rates for ages 80 and above, projected to 2020 using the MP-2015 projection scale.

For the School, Judicial, and DPS Division Trust Funds, the mortality table is the RP-2014 White Collar Healthy Annuitant Mortality Table with adjustments for credibility and gender. For males the adjustments are a 93% factor applied to the rates for ages below 80 and a 113% factor applied to the rates for ages 80 and above, projected to 2018 using the MP-2015 projection scale. For females the adjustments are a 68% factor applied to the rates for ages below 80 and a 106% factor applied to the rates for ages 80 and above, projected to 2020 using the MP-2015 projection scale.

In 2019, the Society of Actuaries published a series of mortality tables derived from public plan experience, called Pub-2010. The published mortality tables are based on three broad categories: teachers (PubT-2010), public safety (PubS-2010), and general employees (PubG-2010). In addition, contingent survivor tables were published.

Pursuant to Senate Bill 2018-200 (SB 18-200) and beginning January 1, 2020, the Local Government Division will have members under the "State Trooper" benefit structure, and therefore, all references and tables discussing/displaying proposed assumptions pertaining to "Troopers" will apply to both the State and Local Government Divisions.

We recommend updating the base tables to the appropriate Pub-2010 mortality tables, with adjustments for PERA-specific experience where credible data exists. In order to reflect future

improvements in mortality, we recommend updating the mortality projection scale to MP-2019 and applying mortality improvement on a generational basis. The recommended healthy retiree base mortality tables are as follows:

- State and Local Government Divisions (Non-Troopers) – PubG-2010 Retired Lives Table for males using 94% of the rates prior to age 80 and 90% of the rates for ages 80 and older. For females, the PubG-2010 Retired Lives Table using 87% of the rates prior to age 80 and 107% of the rates for ages 80 and older.
- State and Local Government Divisions (Troopers) – PubS-2010 Retired Lives Table.
- School and Denver Public Schools Divisions – PubT-2010 Retired Lives Table for males using 112% of the rates prior to age 80 and 94% of the rates for ages 80 and older. For females, the PubT-2010 Retired Lives Table using 83% of the rates prior to age 80 and 106% of the rates for ages 80 and older.
- Judicial Division – PubG-2010 Above Median Retired Lives Table.

Beneficiary Mortality

Beneficiary mortality is currently based on the same tables used for healthy retired members. For State and Local Government Division Trust Funds, the mortality table is the RP-2014 Healthy Annuitant Mortality Table with adjustments for credibility and gender. For males the adjustments are a 73% factor applied to the rates for ages below 80 and a 108% factor applied to the rates for ages 80 and above, projected to 2018 using the MP-2015 projection scale. For females the adjustments are a 78% factor applied to the rates for ages below 80 and a 109% factor applied to the rates for ages 80 and above, projected to 2020 using the MP-2015 projection scale.

For the School, Judicial, and DPS Division Trust Funds, the mortality table is the RP-2014 White Collar Healthy Annuitant Mortality Table with adjustments for credibility and gender. For males the adjustments are a 93% factor applied to the rates for ages below 80 and a 113% factor applied to the rates for ages 80 and above, projected to 2018 using the MP-2015 projection scale. For females the adjustments are a 68% factor applied to the rates for ages below 80 and a 106% factor applied to the rates for ages 80 and above, projected to 2020 using the MP-2015 projection scale.

Based upon our analysis, we recommend that the mortality table for healthy beneficiaries applicable to all divisions be updated to the Pub-2010 Contingent Survivor Table for males using 97% of the rates for all ages. For females, the mortality table would be updated to the Pub-2010 Contingent Survivor Table for females using 105% of the rates for all ages.

Disabled Mortality

The current mortality table for disabled lives is the RP-2014 Disabled Mortality Table incorporating a 90% factor for males and females. Experience for disabled annuitants has been consistent with the current assumptions. We recommend that the mortality table for disability retirees applicable to all divisions (except Troopers) be updated to the Pub-2010 Non-Safety Disabled Lives Table for males and females using 99% of the rates for all ages. For Troopers within the State Division, there was limited experience on which to base the assumption. We recommend that the mortality table for disability retirees applicable to Troopers be updated to

the Pub-2010 Safety Disabled Lives Table for males and females. In order to reflect future improvements in mortality, we recommend updating the mortality projection scale to MP-2019.

Pre-Retirement Mortality

The current mortality assumptions for active members are based on the RP-2014 White Collar Employee Mortality Table. To allow for an appropriate margin of improved mortality prospectively, the mortality rates incorporate a 70 percent factor applied to male rates and a 55 percent factor applied to female rates.

Very few members die in active service and the liability associated with active deaths is a small percentage of the total liability. Since plan experience is insufficient to set the assumption, we recommend using the following tables for active members and applying a generational projection using Scale MP-2019.

- PubG-2010 Employee Table for the State and Local Government Divisions (Non-Troopers)
- PubT-2010 Employee Table for the School and Denver Public Schools Divisions
- PubG-2010 Above Median Employee Table for the Judicial Division
- PubS-2010 Employee Table for the State and Local Government Divisions (Troopers)

Retirement

The eligibility criteria for retirement differs by division and date of hire. We have analyzed retirement experience on a benefit-weighted basis for the following groups:

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

There is little retirement experience for the newer tiers (employees hired after July 1, 2005) to analyze. However, the retirement rates take into account each member's eligibility requirements.

For reduced benefits, there were slightly more retirements than expected. However, among divisions and different genders, some groups did experience slightly fewer reduced retirements than expected. We recommend modifications to rates at several ages across most divisions. Current reduced retirement rates for the Judicial Division and Troopers within the State Division are unisex. There is not enough evidence in the recent experience to warrant a change to sex-distinct rates for either group at this time. However, for the Judicial Division, the experience supports a single set of retirement rates (not split by reduced/unreduced eligibility). Current rates associated with reduced retirement for the State (Non-Troopers) and Local Government Divisions are similar, but not exact. Actual experience is close enough that we recommend combining the exposures of these two groups and developing a single set of assumptions to apply to both. Current rates for the School and DPS Divisions (PERA Benefit Structure) are the same and we believe it is appropriate to continue in this manner.

For unreduced benefits in the first year of eligibility, in aggregate, there were fewer unreduced retirements than expected. However, the experience was not consistent among divisions and different genders, as some groups did experience slightly more unreduced retirements than

expected. We recommend modifications to rates at several ages across most divisions. Current unreduced retirement rates for the Judicial Division and Troopers within the State Division are unisex. There is not enough evidence in the recent experience to warrant a change to sex-distinct rates for either group at this time. As noted earlier, for the Judicial Division, the experience supports a single set of retirement rates (not split by reduced/unreduced eligibility). Current rates associated with unreduced retirement for the State (Non-Troopers) and Local Government Divisions are similar, but not exact. Actual experience is close enough that we recommend combining the exposures of these two groups and developing a single set of assumptions to apply to both. Current rates for the School and DPS Divisions (PERA Benefit Structure) are the same and we believe it is appropriate to continue in this manner.

We separately studied experience for members becoming eligible for *unreduced retirement*. In addition, we individually analyzed the experience *during the first year members were eligible for unreduced retirement.* Typically, there is a higher tendency to retire upon attaining first eligibility for unreduced benefits and a few years thereafter. This was the case for several PERA divisions. In general, for members retiring with unreduced benefits in the legacy tiers, this increased tendency to retire at (or just after) first eligibility is already built into the retirement rate schedules. However, newer benefit tiers have later ages for retirement eligibility. Therefore, to better reflect expected future experience, we recommend adding additional rates of retirement for the first five years of eligibility for unreduced retirement to active members whose first eligibility for unreduced retirement is between age 55 and 64.

For inactive vested retirements, the current assumption is that 100% of inactive members who terminated employment with less than five years of service elect to withdraw their contributions. Current inactive members in the PERA Benefit Structure who are assumed to leave their contributions in the plan in order to be eligible for a benefit at their retirement date are assumed to retire at age 62 with an unreduced pension benefit. Current inactive members in the DPS Benefit Structure who are assumed to leave their contributions in the plan in order to be eligible for a benefit at their retirement date are assumed to retire at age 65 with an unreduced pension benefit.

We reviewed actual experience related to inactive vested members. Actual experience shows that some members retire earlier than the current assumption, but not an amount material enough to warrant a change in the current assumption at this point.

Termination

The current assumption for termination uses Select and Ultimate Tables for the State Division (Non-Troopers), School and DPS Divisions (PERA Benefit Structure), and Local Government Division. Because all DPS Benefit Structure members have more than five years of service, the termination assumptions are based on age only. We have analyzed the ultimate period to determine if the select period should be extended or eliminated and recommend that the current select period be retained.

The current select termination rates vary by gender. Based on our analysis, we recommend that unisex rates be adopted and that the select termination rates be increased. Currently, the School Division and DPS Division use the same rates of termination. However, a review of the actual experience shows that the DPS Division has materially higher turnover among the active population. We are recommending a new schedule of termination rates for the DPS Division that trend closer to actual experience over the study period.

The current ultimate termination assumptions are sex distinct and based on age. We recommend changes (primarily decreases) to the rates of termination.

Refunds of Contributions

For all but the Judicial Division, the current assumption is that 35% of the vested members who terminate elect to withdraw their contributions and matching employer contributions; while the remaining 65% elect to leave their contributions in the plan in order to be eligible for a benefit at their retirement date. For Judicial Division members, the current assumption is that 100% of the vested members who terminate elect to leave their contribution in in the plan in order to be eligible for a benefit at their retirement date. Current active members assumed to terminate service and leave their contribution in the plan in order to be eligible for a benefit at their retirement date are assumed to retire with a reduced benefit, if applicable, at an age based upon benefit structure, Non-Trooper/Trooper, and/or service.

There is very little actual experience from the Judicial Division. We recommend maintaining the current 100% assumption for this group.

For all other divisions, we examined actual refund of contribution elections for members during the experience period. The observed election percentage during the experience period is around 33.6%. We recommend maintaining the current assumption of 35%.

Disability Retirement

The current disability incidence rates are based on age and are unisex for all divisions. Rates are the largest for Troopers within the State Division and are the lowest for the School and DPS Divisions (PERA Benefit Structure). Aggregate experience for the period January 1, 2016 to December 31, 2019 resulted in net losses for PERA, although the Judicial Division had no disability retirements during the experience period, which resulted in actuarial gains.

The State and Local Government Divisions have similar disability rates, with minor differences starting at age 35. Actual experience is comparable between these two groups and they have been aggregated for purposes of developing a proposed assumption. Similarly, the School and DPS Divisions (PERA Benefit Structure) have different disability rates than the Judicial Division or members under the DPS Benefit Structure. However, since all of these groups have similar profiles for disability incidence, they were combined for purposes of developing a proposed assumption.

For the State and Local Government Divisions (Non-Troopers), we recommend a uniform decrease of 19% applied to the current composite disability retirement rates. We recommend no changes to the disability retirement rates for Troopers. For the School, DPS and Judicial Divisions, we recommend a uniform decrease of 19% applied to the current composite disability retirement rates.

Spouse Information

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

- 100% of members are married (80% for members of the DPS Division Trust Fund)
- Male spouses are two years older than female spouses

- 100% of spouses are of the opposite gender

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

Summary of Actuarial Experience

For the four-year period under review, PERA has experienced both actuarial gains and actuarial losses. Investment returns on the market value of assets have averaged 9.1% and 6.2% over the last 10 and 20 years, respectively. Investment returns on the actuarial value of assets have averaged 7.0% and 6.2% over the last 10 and 20 years, respectively. Experience for all other assumptions has varied between producing gains and losses on a year-by-year basis over the study period, but net experience over the entire period has generally produced actuarial losses. A summary of the demographic historical gains and losses (dollars in millions) by division is shown below.

State Division
Demographic Gains/(Losses) 2016 to 2019

Decrement	Actuarial Valuation as of December 31			
	2019	2018	2017	2016
Age/Service Retirements	$ (42.6)	$ (62.6)	$ (73.2)	$ (45.1)
Disability Retirements	(1.5)	(5.6)	(11.5)	(10.8)
Deaths	(12.8)	(38.1)	6.0	(11.4)
Withdrawals	(13.0)	24.0	(78.9)	(64.0)
Pay Increases	(68.7)	(36.9)	46.6	97.9
New Members	(65.6)	(65.7)	(82.3)	(75.5)
Other	(31.4)	(176.0)	(32.3)	(26.8)
Total	**(235.6)**	**(360.9)**	**(225.6)**	**(135.7)**
Actuarial Accrued Liability (AAL)	25,717.7	25,509.9	24,782.1	25,669.9
Total as a % of AAL	**-0.9%**	**-1.4%**	**-0.9%**	**-0.5%**

School Division
Demographic Gains/(Losses) 2016 to 2019

Decrement	Actuarial Valuation as of December 31			
	2019	2018	2017	2016
Age/Service Retirements	$ (49.4)	$ (96.7)	$ (111.8)	$ (68.3)
Disability Retirements	(6.3)	(5.2)	(7.9)	(8.3)
Deaths	(6.5)	(71.3)	(5.2)	(72.3)
Withdrawals	(143.3)	(60.5)	(162.8)	(136.3)
Pay Increases	(300.6)	(85.4)	117.7	210.4
New Members	(99.3)	(107.6)	(98.6)	(85.8)
Other	(29.6)	(248.8)	(45.6)	(46.5)
Total	**(635.0)**	**(675.5)**	**(314.2)**	**(207.1)**
Actuarial Accrued Liability (AAL)	42,425.1	41,598.4	40,046.2	41,353.0
Total as a % of AAL	**-1.5%**	**-1.6%**	**-0.8%**	**-0.5%**

Local Government Division
Demographic Gains/(Losses) 2016 to 2019

Decrement	Actuarial Valuation as of December 31			
	2019	2018	2017	2016
Age/Service Retirements	$ (3.8)	$ (9.7)	$ (8.3)	$ (9.9)
Disability Retirements	(0.8)	(1.8)	(1.5)	(1.9)
Deaths	10.5	(5.2)	8.1	1.8
Withdrawals	(12.9)	(0.7)	(17.5)	(21.5)
Pay Increases	(14.5)	4.0	21.4	(25.1)
New Members	(12.8)	(15.1)	(15.5)	(18.8)
Other	(9.2)	(56.8)	(8.1)	(3.7)
Total	**(43.5)**	**(85.3)**	**(21.4)**	**(79.1)**
Actuarial Accrued Liability (AAL)	5,316.4	5,240.9	5,045.9	5,213.1
Total as a % of AAL	**-0.8%**	**-1.6%**	**-0.4%**	**-1.5%**

Judicial Division
Demographic Gains/(Losses) 2016 to 2019

Decrement	Actuarial Valuation as of December 31			
	2019	2018	2017	2016
Age/Service Retirements	$ (3.9)	$ 0.5	$ (2.0)	$ (2.1)
Disability Retirements	(0.1)	0.1	0.1	0.1
Deaths	(1.5)	(2.6)	0.5	(1.3)
Withdrawals	0.8	0.4	(0.4)	(0.5)
Pay Increases	0.7	0.7	4.2	(2.1)
New Members	(5.6)	(1.8)	(1.4)	(2.4)
Other	(0.2)	(4.5)	(0.9)	(0.6)
Total	**(9.8)**	**(7.2)**	**0.1**	**(8.9)**
Actuarial Accrued Liability (AAL)	462.0	447.8	428.1	447.1
Total as a % of AAL	**-2.1%**	**-1.6%**	**0.0%**	**-2.0%**

Denver Public Schools Division
Demographic Gains/(Losses) 2016 to 2019

Decrement	Actuarial Valuation as of December 31			
	2019	2018	2017	2016
Age/Service Retirements	$ 4.3	$ (9.0)	$ (16.1)	$ (13.6)
Disability Retirements	(0.8)	(0.8)	(2.1)	(1.4)
Deaths	5.6	(0.8)	11.6	3.3
Withdrawals	18.3	42.0	8.4	16.4
Pay Increases	(8.5)	(44.4)	24.4	(6.1)
New Members	(30.1)	(41.2)	(40.5)	(30.5)
Other	22.9	(24.9)	25.7	9.4
Total	**11.7**	**(79.1)**	**11.4**	**(22.5)**
Actuarial Accrued Liability (AAL)	4,263.4	4,248.6	4,088.5	4,246.4
Total as a % of AAL	**0.3%**	**-1.9%**	**0.3%**	**-0.5%**

Impact of Assumption Changes on Valuation Results

The following tables detail the impact of recommended assumption changes, using the December 31, 2019 actuarial valuation results for illustrative purposes. When the proposed set of assumptions is used in the December 31, 2020 valuations, the relative impact is expected to be similar to the results shown below (as a percentage of the actuarial accrued liability and normal cost). However, the actual impact may vary due to underlying changes that occur between valuation dates. The comparability may also be affected by the actual investment return and demographic experience during the year.

Change in Present Value of Future Benefits
($ in Millions)

Division	Before Changes	Reflecting Termination	Reflecting Termination, Retirement and Disability	Reflecting Termination, Retirement, Disability, and Mortality	Reflecting all Demographic Changes, Salary Scale and Payroll Growth
State	$28,219.1	$28,417.1	$28,540.9	$29,311.3	$29,402.7
% Change		0.7%	0.4%	2.7%	0.3%
Cumulative		0.7%	1.1%	3.9%	4.2%
School	47,405.0	48,130.8	48,322.7	49,699.3	50,205.0
% Change		1.5%	0.4%	2.8%	1.0%
Cumulative		1.5%	1.9%	4.8%	5.9%
Local Gov't	5,842.7	5,924.9	5,939.9	6,101.3	6,147.7
% Change		1.4%	0.3%	2.7%	0.8%
Cumulative		1.4%	1.7%	4.4%	5.2%
Judicial	536.7	537.4	539.2	539.0	538.5
% Change		0.1%	0.3%	0.0%	-0.1%
Cumulative		0.1%	0.5%	0.4%	0.3%
DPS	5,026.0	4,961.5	4,966.8	5,089.4	5,203.2
% Change		-1.3%	0.1%	2.5%	2.2%
Cumulative		-1.3%	-1.2%	1.3%	3.5%

Change in Actuarial Accrued Liability
($ in Millions)

Division	Before Changes	Reflecting Termination	Reflecting Termination, Retirement and Disability	Reflecting Termination, Retirement, Disability, and Mortality	Reflecting all Demographic Changes, Salary Scale and Payroll Growth
State	$25,717.6	$25,699.9	$25,901.5	$26,594.2	$26,600.3
% Change		-0.1%	0.8%	2.7%	0.0%
Cumulative		-0.1%	0.7%	3.4%	3.4%
School	42,425.1	42,453.4	42,782.6	43,970.9	44,136.7
% Change		0.1%	0.8%	2.8%	0.4%
Cumulative		0.1%	0.8%	3.6%	4.0%
Local Gov't	5,316.4	5,319.1	5,348.8	5,492.8	5,503.4
% Change		0.1%	0.6%	2.7%	0.2%
Cumulative		0.1%	0.6%	3.3%	3.5%
Judicial	462.0	462.0	466.4	465.3	462.0
% Change		0.0%	1.0%	-0.2%	-0.7%
Cumulative		0.0%	1.0%	0.7%	0.0%
DPS	4,263.4	4,226.9	4,236.9	4,334.8	4,374.6
% Change		-0.9%	0.2%	2.3%	0.9%
Cumulative		-0.9%	-0.6%	1.7%	2.6%

Change in Total Normal Cost Rate

Division	Before Changes	Reflecting Termination	Reflecting Termination, Retirement and Disability	Reflecting Termination, Retirement, Disability, and Mortality	Reflecting all Demographic Changes, Salary Scale and Payroll Growth
State	11.66%	12.22%	12.40%	12.77%	13.00%
Delta		0.56%	0.18%	0.37%	0.23%
Cumulative		0.56%	0.74%	1.11%	1.34%
School	12.73%	13.62%	13.84%	14.30%	14.80%
Delta		0.89%	0.22%	0.46%	0.50%
Cumulative		0.89%	1.11%	1.57%	2.07%
Local Gov't	11.14%	12.01%	12.14%	12.50%	12.92%
Delta		0.87%	0.13%	0.36%	0.42%
Cumulative		0.87%	1.00%	1.36%	1.78%
Judicial	16.76%	16.83%	17.17%	17.35%	17.69%
Delta		0.07%	0.34%	0.18%	0.34%
Cumulative		0.07%	0.41%	0.59%	0.93%
DPS	12.19%	12.23%	12.29%	12.71%	13.41%
Delta		0.04%	0.06%	0.42%	0.70%
Cumulative		0.04%	0.10%	0.52%	1.22%

Change in Actuarially Determined Contribution Rate

Division	Before Changes	Reflecting Termination	Reflecting Termination, Retirement and Disability	Reflecting Termination, Retirement, Disability, and Mortality	Reflecting all Demographic Changes, Salary Scale and Payroll Growth
State	21.05%	21.58%	22.11%	23.70%	25.08%
Delta		0.53%	0.53%	1.59%	1.38%
Cumulative		0.53%	1.06%	2.65%	4.03%
School	20.61%	21.53%	22.08%	23.77%	25.49%
Delta		0.92%	0.55%	1.69%	1.72%
Cumulative		0.92%	1.47%	3.16%	4.88%
Local Gov't	10.84%	11.73%	12.09%	13.56%	14.58%
Delta		0.89%	0.36%	1.47%	1.02%
Cumulative		0.89%	1.25%	2.72%	3.74%
Judicial	14.13%	14.18%	14.97%	15.04%	15.70%
Delta		0.05%	0.79%	0.07%	0.66%
Cumulative		0.05%	0.84%	0.91%	1.57%
DPS	8.22%	8.00%	8.13%	9.25%	10.58%
Delta		-0.22%	0.13%	1.12%	1.33%
Cumulative		-0.22%	-0.09%	1.03%	2.36%

Change in Funded Percentage (AVA Basis)

Division	Before Changes	Reflecting Termination	Reflecting Termination, Retirement and Disability	Reflecting Termination, Retirement, Disability, and Mortality	Reflecting all Demographic Changes, Salary Scale and Payroll Growth
State	58.02%	58.06%	57.61%	56.11%	56.10%
Delta		0.04%	-0.45%	-1.50%	-0.01%
Cumulative		0.04%	-0.41%	-1.91%	-1.92%
School	59.90%	59.86%	59.40%	57.79%	57.58%
Delta		-0.04%	-0.46%	-1.61%	-0.21%
Cumulative		-0.04%	-0.50%	-2.11%	-2.32%
Local Gov't	80.66%	80.62%	80.17%	78.07%	77.92%
Delta		-0.04%	-0.45%	-2.10%	-0.15%
Cumulative		-0.04%	-0.49%	-2.59%	-2.74%
Judicial	74.04%	74.05%	73.34%	73.51%	74.04%
Delta		0.01%	-0.71%	0.17%	0.53%
Cumulative		0.01%	-0.70%	-0.53%	0.00%
DPS	79.99%	80.68%	80.49%	78.67%	77.96%
Delta		0.69%	-0.19%	-1.82%	-0.71%
Cumulative		0.69%	0.50%	-1.32%	-2.03%

Change in Valuation Effective Amortization Period

Division	Before Changes	Reflecting Termination	Reflecting Termination, Retirement and Disability	Reflecting Termination, Retirement, Disability, and Mortality	Reflecting all Demographic Changes, Salary Scale and Payroll Growth
State	27 years	29 years	30 years	35 years	42 years
Delta		+2 years	+1 year	+5 years	+7 years
Cumulative		+2 years	+3 years	+8 years	+15 years
School	28 years	30 years	32 years	39 years	53 years
Delta		+2 years	+2 years	+7 years	+14 years
Cumulative		+2 years	+4 years	+11 years	+25 years
Local Gov't	22 years	25 years	27 years	37 years	52 years
Delta		+3 years	+2 years	+10 years	+15 years
Cumulative		+3 years	+5 years	+15 years	+30 years
Judicial	16 years	16 years	18 years	18 years	18 years
Delta		+0 years	+2 years	+0 years	+0 years
Cumulative		+0 years	+2 years	+2 years	+2 years
DPS	25 years	24 years	24 years	34 years	76 years
Delta		-1 year	+0 years	+10 years	+42 years
Cumulative		-1 year	-1 year	+9 years	+51 years

Change in Projected Number of Years Until 100% Funded Percentage
(Based on Open Group Projections and Proposed Headcount Increase Assumptions)

Division	Before Changes	After all Demographic and Economic Changes
State Delta	22 years	33 years +11 years
School Delta	24 years	35 years +11 years
Local Gov't Delta	14 years	23 years +9 years
Judicial Delta	12 years	14 years +2 years
DPS Delta	11 years	14 years +3 years

II. Actuarial Methods

A. Actuarial Cost Method

The systematic financing of a pension plan requires that contributions be made in an orderly fashion while a member is actively employed, so that the accumulation of these contributions, together with investment earnings should be sufficient to provide promised benefits and cover administrative expenses. The actuarial valuation is the process used to determine the contribution rates.

The actuarial valuation does not directly affect the amount of benefits paid or the actual cost of those benefits. Over the life of the plan, actuaries cannot change the cost of the pension or health plan, regardless of the funding method used or the assumptions selected. However, the choice of actuarial methods and assumptions will affect the timing of contributions.

The valuation or determination of the present value of all future benefits to be paid by PERA reflects assumptions that reflect anticipated future experience. The choice of a funding method does not affect the determination of the present value of future benefits. Rather, the funding method determines the allocation of this value. The purpose of the funding method is to allocate the present value of future benefits into annual costs. In order to do this allocation, the funding method separates the present value into two components:

- The portion attributable to the past, which is called the **actuarial accrued liability**; and
- The portion attributable to the future, which is called the **present value of future normal costs**.

The portion of the present value of future normal costs that is allocated to the current year is called the **normal cost**. The difference between the actuarial accrued liability and the assets is called the **unfunded actuarial accrued liability**.

There are various actuarial cost methods, each of which has different characteristics. However, the Governmental Accounting Standards Board Statement Numbers 67, 68, 74 and 75 require that the Entry Age cost method be used for financial reporting. The Entry Age cost method is the most common funding method for public retirement systems and is the method currently used by PERA for financial reporting and funding.

Under the Entry Age cost method, the cost of each member's benefit is determined to be a level percentage of salary from date of hire to end of employment. The normal cost is the calculated level percentage multiplied by the member's annual salary. The present value of future normal cost is equal to the calculated level percentage multiplied by the present value of the member's assumed earnings for all future years, including the current year. The actuarial accrued liability is equal to the present value of future benefits minus the present value of future normal costs.

The annual contribution is equal to the normal cost plus, if necessary, the amortization of the unfunded actuarial accrued liability. The amortization is based upon the investment return assumption, the payroll growth assumption and the number of years over which the unfunded actuarial accrued liability is amortized.

Because the Entry Age cost method provides a stable contribution rate and is a reasonable allocation method, **we recommend that PERA continue the use of the Entry Age Normal actuarial cost method for the Division Trust Funds and the Health Care Trust Funds**.

B. Asset Valuation Method

PERA uses an "actuarial" value of assets for purposes of establishing the actuarially determined employer contributions. The current method smooths investment gains and losses for each fiscal year by recognizing these gains and losses evenly over a four-year period. This method does not impose a corridor, which would place a limit on the spread between actuarial value of assets (AVA) and market value of assets (MVA).

An essential part of the public sector budgeting process is that material budget items, including pension contributions, should have a level cost pattern from year to year to the extent possible. Recognizing investment gains and losses through a reasonable smoothing method is one way that plans limit the potential volatility that may result in fluctuations in contributions due to investment results.

The actuary's guide for determining the reasonableness of an asset smoothing method is Actuarial Standard of Practice (ASOP) No. 44. The following is an excerpt from this ASOP that establishes the qualities a reasonable asset smoothing method must exhibit.

From ASOP No. 44:

3.3 Selecting Methods Other Than Market Value -- If the considerations in section 3.2 have led the actuary to conclude that an asset valuation method other than market value may be appropriate, the actuary should select an asset valuation method that is designed to produce actuarial values of assets that bear a reasonable relationship to the corresponding market values. The qualities of such an asset valuation method include the following:

a. The asset valuation method is likely to produce actuarial values of assets that are sometimes greater than and sometimes less than the corresponding market values.

b. The asset valuation method is likely to produce actuarial values of assets that, in the actuary's professional judgment, satisfy both of the following:

1. The asset values fall within a reasonable range around the corresponding market values. For example, there might be a corridor centered at market value, outside of which the actuarial value of assets may not fall, in order to assure that the difference from market value is not greater than the actuary deems reasonable.

2. Any differences between the actuarial value of assets and the market value are recognized within a reasonable period of time. For example, the actuary might use a method where the actuarial value of assets converges toward market value at a pace that the actuary deems

reasonable, if the investment return assumption is realized in future periods.

In lieu of satisfying both (1) and (2) above, an asset valuation method could satisfy section 3.3(b) if, in the actuary's professional judgment, the asset valuation method either (i) produces values within a sufficiently narrow range around market value or (ii) recognizes differences from market value in a sufficiently short period.

The two key principles that arise from ASOP 44 are that acceptable asset smoothing must create asset values that fall within a reasonable range around market value and that they are recognized in a reasonable period of time. In lieu of satisfying both of these principles, a smoothing method could satisfy the requirements if, in the actuary's professional judgment, the range around market value is sufficiently narrow or the differences are recognized in a sufficiently short period.

Segal has established an internal policy, which is consistent with others in the actuarial community, that four years is a sufficiently short period to constitute a reasonable asset smoothing method even if no corridor is used. **Therefore, we recommend the current asset valuation method be retained**.

C. Amortization of Unfunded Actuarial Accrued Liability

The actuarial accrued liability is the portion of the actuarial present value of future benefits that is not included in the present value of future normal costs. Therefore, the actuarial accrued liability represents the liability that theoretically should have been funded through the accumulation of prior normal costs. An unfunded actuarial accrued liability (UAAL) exists when the actuarial accrued liability exceeds the actuarial value of assets. The UAAL results from the following:

- Plan improvements that have not been completely funded;
- Experience that is less favorable than expected;
- Assumption changes that increase liabilities; and
- Contributions that are less than the actuarially determined contributions.

There are various methods that can be used to amortize the UAAL, each with a different payment stream. Each method has three characteristics:

- The period over which the UAAL is amortized;
- The rate at which the amortization payment increases; and
- The number of components of the UAAL (i.e., amortization bases).

Current PERA Amortization Method

The current amortization method used by the Division Trust Funds and the Health Care Trust Funds is as follows:

- The existing UAAL on December 31, 2017 is amortized over 30 years.
- Any increase (or decrease) in the UAAL existing as of December 31, 2017 is amortized over the remaining period of the initial 30-year period from the date of the valuation.
- Annual future actuarial experience gains and losses are amortized over 30 years from the date of the valuation.
- Future assumption changes are amortized over 30 years from the date of the valuation.
- Future benefit enhancements/reductions over the number of years, as determined by the Board, to represent the anticipated duration of payment of the enhancement or, if a reduction, duration of the benefit to the plan. This determination will be based on the nature of the benefit change and the demographics of the membership group affected by the change, not to exceed 25 years from the date of the valuation.
- If any future annual actuarial valuation indicates a division has a negative UAAL, the actuarially determined contribution (ADC) is equal to the normal cost until the funded ratio equals or exceed 120%. At that time, the ADC shall be equal to the Normal Cost less an amount equal to 15-year amortization of the portion of the negative UAAL above the 120% funded ratio.

Because the current amortization method used by the Division Trust Funds and the Health Care Trust Funds will fund the existing UAAL over a set period, the method is reasonable and we recommend it be retained.

D. Administrative Expense Assumption

The current administrative expense load added to the normal cost is 0.40% of payroll. Below is a table showing the amount of administrative expenses and payroll for the Division Trust Funds in aggregate over the past four years ($ in thousands).

As of December 31	Administrative Expense	Annual Reported Payroll	Percentage
2016	$38,492	$8,359,071	0.46%
2017	40,248	8,585,478	0.47%
2018	41,089	9,121,874	0.45%
2019	39,186	9,570,668	0.41%
Total	**$159,015**	**$35,637,091**	**0.45%**

Despite an average over the past four years of 0.45% of total plan payroll, we note that administrative expenses have been trending down over the past few years. It is our understanding from discussions with PERA staff that reduction of expenses will be an ongoing focus of effort. **Therefore, we recommend maintaining the current administrative expense assumption of 0.40% of payroll**.

E. Active Member Growth Assumption

The annual actuarial valuation provides a snapshot of PERA as of the valuation date. On an annual basis, actuarial projections are useful to assess trends and to generate expected actuarial metrics for each year in the projection period. The projection of PERA's funding levels over 50 years requires an assumption regarding future new entrants to PERA, as well as the actuarial assumptions that are used to estimate the timing of future events for current active members. As members are assumed to terminate service for any reason, they are replaced with a sufficient number of new entrants to increase the size of the active membership of each division in the future. The PERA Board is currently assuming the following active member growth rates:

Division	Active Member Growth Assumption
State	1.25%
School	1.25%
Local Government	1.00%
Judicial	1.00%
DPS	1.25%

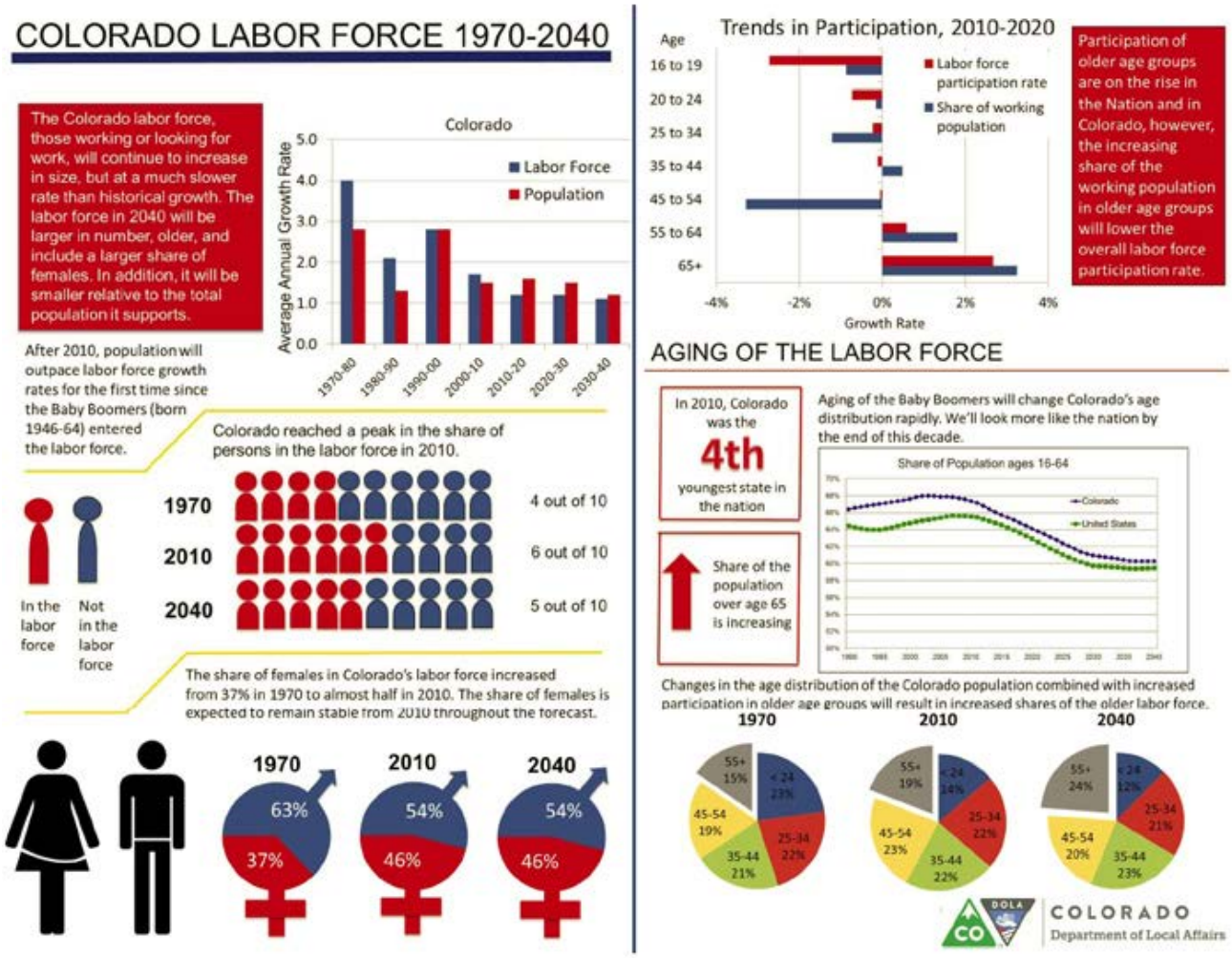
PERA active membership over the past 10 years is as follows:

As of December 31	State Division	School Division	Local Government Division	Judicial Division	DPS Division
2009	54,333	119,390	16,166	317	N/A
2010	54,977	116,486	16,144	317	13,171
2011	54,956	114,820	16,065	329	13,571
2012	54,804	115,294	12,097	329	13,911
2013	55,354	117,727	11,954	332	14,816
2014	55,300	119,618	12,084	334	15,414
2015	55,291	120,239	12,176	334	15,929
2016	55,725	121,945	12,736	335	15,950
2017	55,686	122,990	12,770	332	15,991
2018	55,511	126,333	13,260	332	16,148
2019	55,252	128,938	13,086	339	15,679
Current Active Growth Assumption	1.25%	1.25%	1.00%	1.00%	1.25%
Average Annual Increase over Last 10 Years (Nine for DPS)	0.17%	0.77%	-2.09%	0.67%	1.96%
Average Annual Increase over Last Five Years	-0.02%	1.51%	1.61%	0.30%	0.34%

As the shown in the table above, over the last 10 years DPS is the only division that exceeded the population growth assumption. Over the past five years, School and Local Government are the only divisions that exceeded the population growth assumption.

Segal has reviewed the data included in the "Colorado Department of Affairs State Demography Office – Dashboard". Below are some highlights from the Dashboard:

- From 2008 to 2018, the Colorado population increased at an annual average rate of 1.51%. From 2013 to 2018, the average annual population increase was 0.78%.
- Due to the changing age distribution in Colorado, growth rates of the labor force are expected to slow significantly over the forecast horizon of 2040 as compared to historical growth. The labor force in 2040 will look considerably different from today's labor force. The labor force in 2040 will be much larger in number, it will be older, and it will include a larger share of females. Additionally, the labor force will be smaller relative to the total population it supports.
- The following infographic is included in the Dashboard:



Based upon historical increases in active member population and the information included in the Colorado Department of Affairs State Demography Office – Dashboard, we recommend that the active member growth assumption be adjusted as follows:

Division	Current Active Member Growth Assumption	Proposed Active Member Growth Assumption
State	1.25%	0.25%
School	1.25%	1.00%
Local Government	1.00%	1.00%
Judicial	1.00%	0.25%
DPS	1.25%	1.00%

III. Economic Assumptions

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

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

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

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

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

A. Inflation

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

The table below shows that recent inflation experience has occurred at a historically low rate.

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

Average Annual Change as of December 31, 2019	CPI-U
5-Year Average	1.82%
10-Year Average	1.75%
20-Year Average	2.14%
30-Year Average	2.40%

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

Since 2012, Horizon Actuarial Services, LLC has published survey results that summarize the capital market assumptions of various investment firms. Based on the survey results from the 2020 Edition of the Survey of Capital Market Assumptions, the average 10-year inflation assumption across 39 survey respondents was 1.97% and the average 20-year inflation assumption across a subset of 18 survey respondents that provided assumptions for 20 years was 2.16%.

The table below compares the 2020 Horizon Survey results to other sources.

Source	10-Year	20-Year	30-Year
Federal Reserve Bank of Philadelphia First Quarter 2020 Survey of Professional Forecasters	2.20%		
Aon			2.30%
Segal Marco Advisors	2.00%	2.00%	
2020 Horizon Survey of Capital Market Assumptions	1.97%	2.16%	

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

The following table compares the yields on US Treasury Bonds as of December 31, 2019, with and without inflation indexing.

US Treasury Bonds as of December 31, 2019	10-Year Yield	20-Year Yield	30-Year Yield
Non-Inflation Indexed	1.92%	2.25%	2.39%
Inflation Indexed	0.15%	0.39%	0.58%
Difference	1.77%	1.86%	1.81%

Because of the inflation protection, TIPS' yields are considerably lower than those of regular Treasury securities of similar maturities. As of December 31, 2019, 30-year Treasuries yielded 2.39% while 30-year TIPS yielded 0.58%. In order for 30-year TIPS to match the return of the conventional 30-year Treasury for a buy-and-hold income investor, inflation would have to measure 1.81% per year over the next 30 years. The market's expectation of inflation alone is not a definitive basis for an inflation assumption due to other factors that affect the yields of those securities, but is useful as one indicator of future trend. In addition, it is also important to note that the market's view of inflation over 20 years is around 10 basis points greater than the 10-year horizon and is consistent with the 30-year horizon.

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

Lastly, the Philadelphia Federal Reserve Bank Survey of Professional Forecasters indicates inflation expectations for a 10-year period of 2.20%. The market's expectation for inflation over 20-30 years is approximately 10 basis points higher than the next 10 years. This is consistent with the 30-year assumption from Aon, although slightly higher than the inflation expectations from the Horizon Survey. Considering all of this information, **we recommend that the inflation assumption be lowered from 2.40% to 2.30%**.

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

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

B. Investment Rate of Return

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

The current investment return assumption is 7.25%, which is comprised of the following components:

- Inflation: 2.40%
- Real rate of return: 4.85%

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

Average Annual Return as of December 31, 2019	Market Value of Assets	Actuarial Value of Assets
Past 5 Years	8.4%	7.8%
Past 10 Years	9.1%	7.0%
Past 15 Years	7.4%	6.9%
Past 20 Years	6.2%	6.2%
Past 30 Years	8.6%	7.8%

The Investment return on an actuarial value of assets basis has been above the 7.25% return for the past five years and the past 30 years, but lower than the assumption for other periods. The investment return on the market value of assets basis has been above the current assumption for the past five-, 10-, 15-, and 30-year periods. Historical trend is a less important consideration for the assumed rate of investment return, but is useful in determining the reasonable bounds of expected investment return.

In September 2019, Aon prepared a portfolio analysis of PERA's investments and determined that the current investment return assumption of 7.25% was achievable.

Segal based our analysis of the expected real rate of return on the Horizon Survey of Capital Market Assumptions (2020 Edition). This survey compiles and averages the capital market assumptions of 39 investment consultants (including Aon and Segal Marco Advisors). All investment consultants provided assumptions for a 10-year period and 18 respondents provided assumptions for 20-year periods. The expected arithmetic returns are used to determine the expected return by asset class. The 20-year expected geometric real rate of return was generated from the 50th percentile of 5,000 simulated portfolio return trials.

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

Horizon Study Asset Classes	Horizon Study 20-Year Annual Arithmetic Real Return	Target Allocation	Weighted Real Return
US Equity – Large Cap	6.20%	20.3%	1.26%
US Equity – Small/Mid Cap	7.38%	9.9%	0.73%
Non-US Equity – Developed	6.93%	18.5%	1.28%
Non-US Equity – Emerging	9.17%	6.4%	0.59%
US Corporate Bonds – Core	1.58%	23.6%	0.37%
Cash	0.12%	1.0%	0.00%
Real Estate	5.75%	8.5%	0.49%
Hedge Funds	3.94%	1.6%	0.07%
Infrastructure	6.29%	1.7%	0.10%
Private Equity	10.38%	8.5%	0.88%
Total		**100.0%**	**5.77%**
Adjustment to Geometric			(0.67%)
Geometric Real Rate of Return			**5.10%**

Using the Fund's target asset allocation and the capital market assumptions provided in the 2020 Horizon Survey, the expected real return is 5.10%. This means that over a 20-year period, PERA is expected to earn an annual rate of return of at least 5.10% half of the time. Reflecting the proposed inflation assumption of 2.30% results in a nominal 50th percentile return of 7.40%. The current 7.25% assumption includes some provision for adverse experience, increasing the likelihood of meeting the expectation over a 20-year period to 53%.

Based on this analysis, we recommend retaining the investment return assumption of 7.25%.

C. Salary Scale

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

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

- Inflation
- Productivity
- Merit and seniority increases

The inflation and productivity components are combined to produce the assumed rate of wage inflation (payroll growth). The productivity assumption is currently 1.1%. As described in the next section, we recommend a decrease in the productivity assumption to 0.7%. The inflation and productivity components represents the "across the board" average annual increase in salaries shown in the experience data. The merit component includes the additional increases in salary due to performance, seniority, promotions, etc.

Since merit and seniority increases are unique to each retirement system, it is appropriate to base this assumption on recent experience. We study the merit and seniority increases in combination with productivity and separately from inflation, which represents "non-inflation" increases in individual salaries.

The current salary scale assumption for each division is a table based on age. The historical compensation data, adjusted by inflation during the study period, was evaluated based on age and years since date of hire age. The strongest relationship for most divisions continues to be based on age. However, for the Judicial Division, experience has more correlation with members' years since date of hire.

The actual historical compensation data for the experience period (shown in the tables that follow) have been adjusted by approximately 2.1% to account for actual inflation during the study period. The expected salary increase rates have been adjusted by 2.4% to account for the current assumed rate of inflation. The current salary scale assumptions are based on age for all divisions. Based on our study, we recommend that the proposed increase rates be age-based for all divisions except Judicial, which would be based on service. The current salary increase assumption is the same for the School and DPS Divisions (PERA Benefit Structure). Members under the DPS Benefit Structure, regardless of division, have a different salary increase assumption. The experience shows that the salary increase assumption for School should be different from the salary increase assumption for Denver Public Schools (both PERA and DPS Benefit Structures). The proposed increase rates are based on ages (or service) as of the valuation date and do not reflect any underlying assumptions for inflation, while the proposed increase rates plus inflation reflect our proposed assumption for inflation of 2.30%. Proposed non-inflationary increases have been developed based on weighting the current

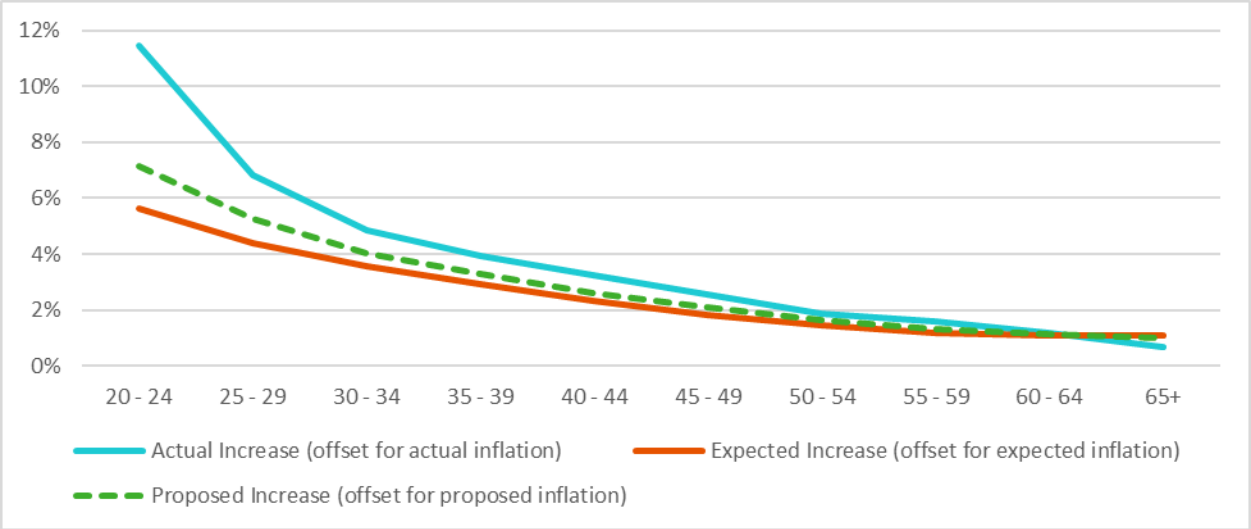
assumption (i.e., historical experience) by two-thirds and recent experience by one-third. In addition, 2018 and 2019 salary increases for certain members of State and School Divisions include larger-than-anticipated adjustments that are not expected to continue in the future. As a result, we have further adjusted the data in the experience period for these divisions by weighting 2018 and 2019 experience half as much as experience from 2016 and 2017.

The following tables show the actual salary increase experience compared to the current and proposed assumptions. Experience has been adjusted to remove actual inflation over the experience period, which averaged approximately 2.1%.

State Division (Non-Troopers)[3]

Age	Prior Year Salaries (in $000s)	Actual Salaries[4] (in $000s)	Actual Salary Increase	Expected Salary Increases (in $000s)	Expected Salary Increase Rate	Proposed Salary Increase Rate
20 – 24	121,827	135,766	11.44%	128,711	5.65%	7.14%
25 – 29	435,299	465,006	6.82%	454,499	4.41%	5.25%
30 – 34	684,069	717,333	4.86%	708,432	3.56%	4.04%
35 – 39	826,055	858,699	3.95%	850,222	2.93%	3.29%
40 – 44	1,034,065	1,067,663	3.25%	1,058,013	2.32%	2.60%
45 – 49	1,105,622	1,133,672	2.54%	1,125,652	1.81%	2.10%
50 – 54	1,058,756	1,078,746	1.89%	1,074,001	1.44%	1.62%
55 – 59	938,886	954,017	1.61%	949,787	1.16%	1.32%
60 – 64	610,148	617,392	1.19%	616,860	1.10%	1.13%
65 +	233,386	234,946	0.67%	235,954	1.10%	1.00%
Total	**7,048,113**	**7,263,241**	**3.05%**	**7,202,130**	**2.19%**	**2.49%**

Salary Increase Experience – State Division (Non-Troopers)

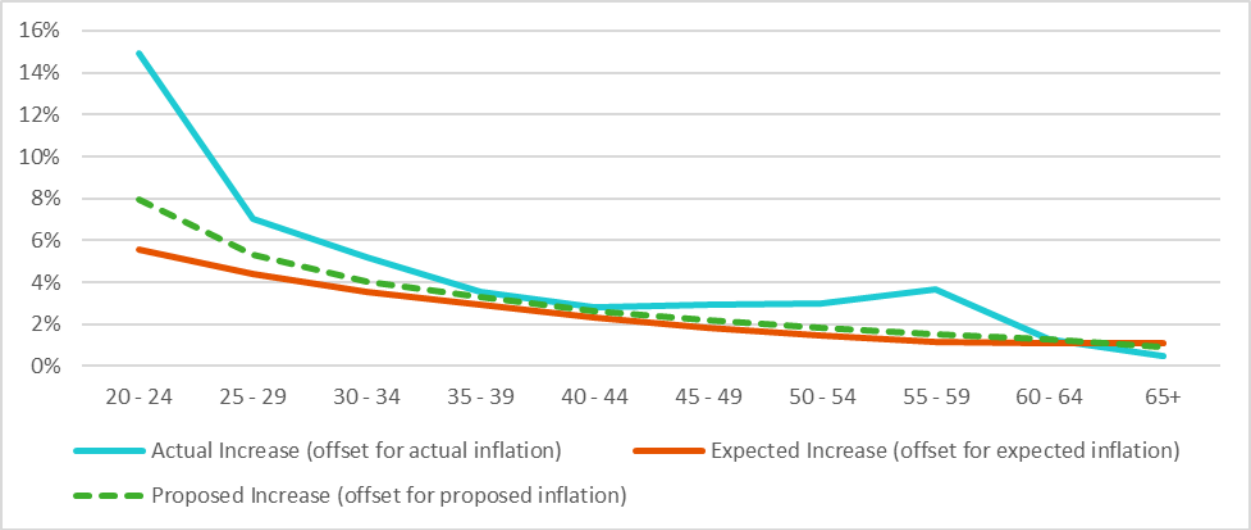


[3] Salaries shown reflect 50% weighting of 2018 and 2019 experience.
[4] Adjusted for actual average inflation of approximately 2.1% during the experience period.

State and Local Government Divisions (Troopers)

Age	Prior Year Salaries (in $000s)	Actual Salaries[5] (in $000s)	Actual Salary Increase	Expected Salary Increases (in $000s)	Expected Salary Increase Rate	Proposed Salary Increase Rate
20 – 24	4,804	5,520	14.91%	5,072	5.59%	7.95%
25 – 29	21,836	23,378	7.06%	22,799	4.41%	5.32%
30 – 34	41,210	43,356	5.21%	42,675	3.56%	4.03%
35 – 39	49,059	50,783	3.51%	50,500	2.94%	3.31%
40 – 44	65,260	67,080	2.79%	66,784	2.34%	2.62%
45 – 49	67,099	69,087	2.96%	68,326	1.83%	2.23%
50 – 54	27,276	28,088	2.98%	27,677	1.47%	1.85%
55 – 59	7,275	7,540	3.64%	7,359	1.16%	1.51%
60 – 64	3,280	3,323	1.30%	3,316	1.10%	1.25%
65 +	1,190	1,196	0.51%	1,203	1.10%	0.92%
Total	**288,287**	**299,351**	**3.87%**	**295,713**	**2.58%**	**3.02%**

Salary Increase Experience – State and Local Government Divisions (Troopers)

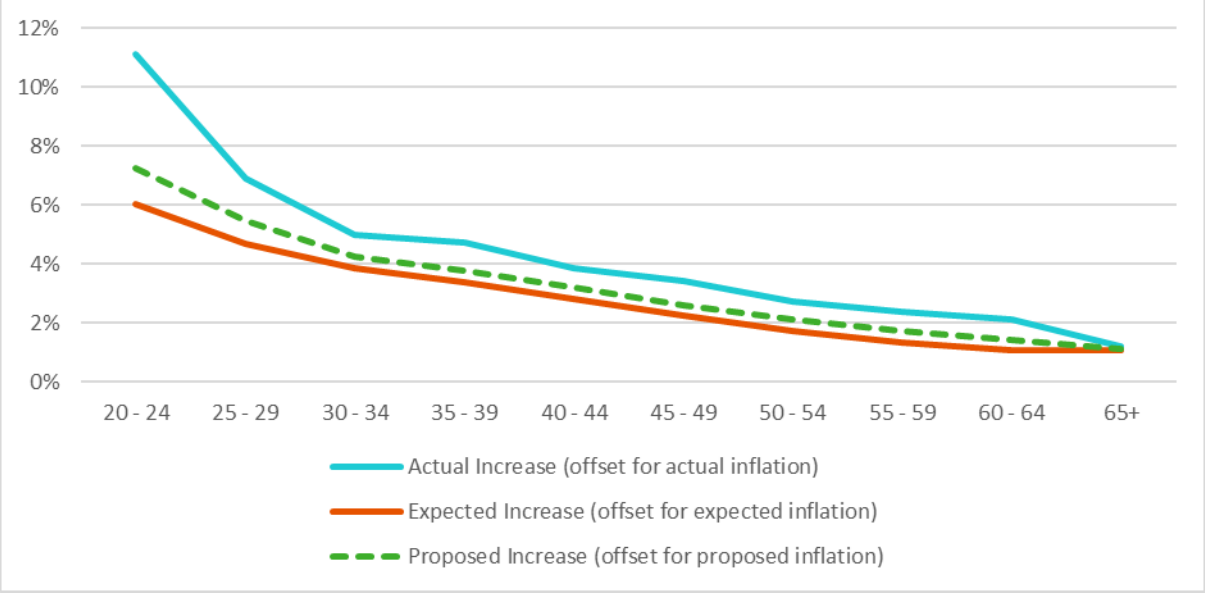


[5] Adjusted for actual average inflation of approximately 2.1% during the experience period.

School Division[6]

Age	Prior Year Salaries (in $000s)	Actual Salaries[7] (in $000s)	Actual Salary Increase	Expected Salary Increases (in $000s)	Expected Salary Increase Rate	Proposed Salary Increase Rate
20 – 24	306,577	340,629	11.11%	325,104	6.04%	7.25%
25 – 29	921,069	984,819	6.92%	964,427	4.71%	5.49%
30 – 34	1,239,130	1,301,011	4.99%	1,286,949	3.86%	4.26%
35 – 39	1,618,224	1,694,793	4.73%	1,672,786	3.37%	3.79%
40 – 44	1,910,811	1,984,731	3.87%	1,964,322	2.80%	3.19%
45 – 49	2,017,846	2,086,880	3.42%	2,062,951	2.24%	2.60%
50 – 54	1,769,684	1,817,986	2.73%	1,800,206	1.72%	2.11%
55 – 59	1,330,436	1,362,211	2.39%	1,348,031	1.32%	1.73%
60 – 64	649,748	663,578	2.13%	656,895	1.10%	1.43%
65 +	221,420	224,107	1.21%	223,856	1.10%	1.14%
Total	**11,984,947**	**12,460,745**	**3.97%**	**12,305,528**	**2.67%**	**3.11%**

Salary Increase Experience – School Division

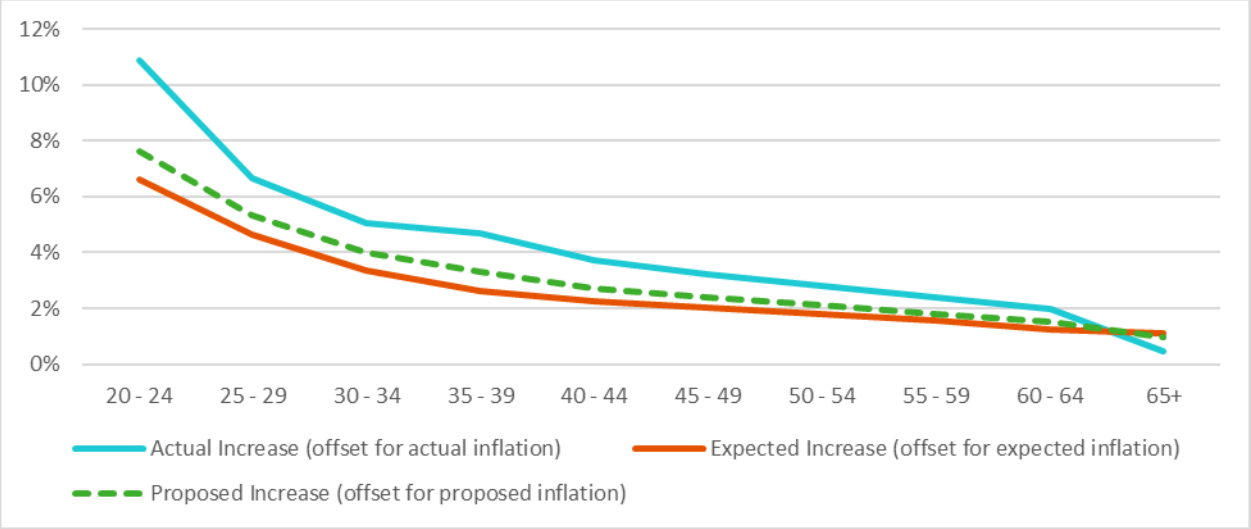


[6] Salaries shown reflect 50% weighting of 2018 and 2019 experience.
[7] Adjusted for actual average inflation of approximately 2.1% during the experience period.

Local Government Division (Non-Troopers)

Age	Prior Year Salaries (in $000s)	Actual Salaries[8] (in $000s)	Actual Salary Increase	Expected Salary Increases (in $000s)	Expected Salary Increase Rate	Proposed Salary Increase Rate
20 – 24	44,575	49,422	10.87%	47,523	6.61%	7.61%
25 – 29	138,630	147,889	6.68%	145,068	4.64%	5.32%
30 – 34	206,084	216,471	5.04%	213,008	3.36%	4.01%
35 – 39	268,511	281,102	4.69%	275,540	2.62%	3.29%
40 – 44	311,978	323,522	3.70%	318,936	2.23%	2.71%
45 – 49	342,856	353,823	3.20%	349,754	2.01%	2.40%
50 – 54	343,765	353,326	2.78%	349,997	1.81%	2.10%
55 – 59	298,997	306,092	2.37%	303,690	1.57%	1.81%
60 – 64	168,388	171,695	1.96%	170,520	1.27%	1.50%
65 +	57,045	57,321	0.48%	57,672	1.10%	0.97%
Total	**2,180,828**	**2,260,664**	**3.66%**	**2,231,708**	**2.33%**	**2.76%**

Salary Increase Experience – Local Government Division (Non-Troopers)

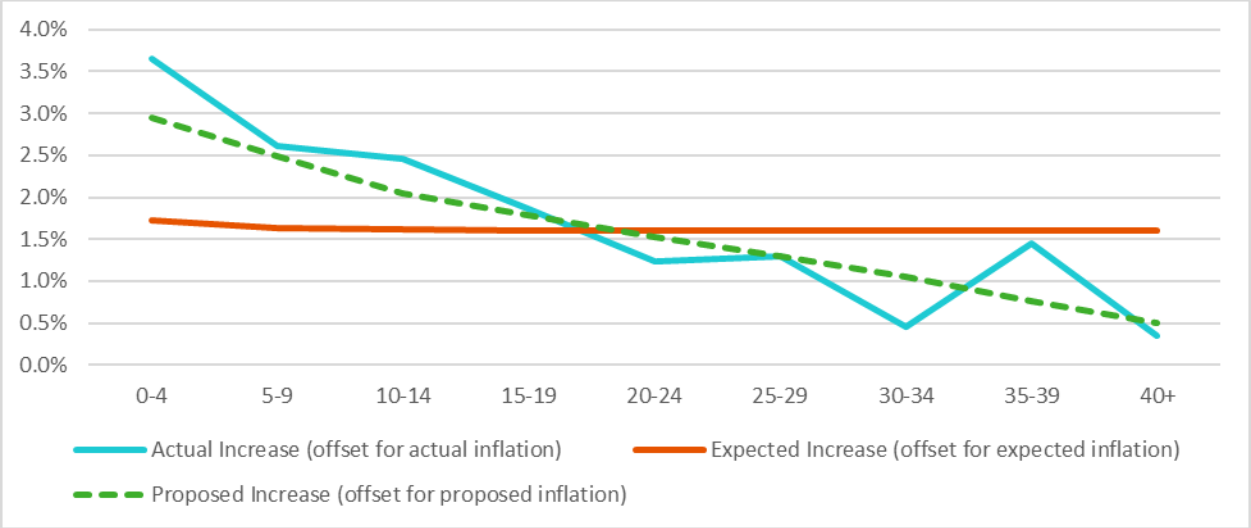


[8] Adjusted for actual average inflation of approximately 2.1% during the experience period.

Judicial Division

Years from Hire	Prior Year Salaries (in $000s)	Actual Salaries[9] (in $000s)	Actual Salary Increase	Expected Salary Increases (in $000s)	Expected Salary Increase Rate[10]	Proposed Salary Increase Rate
0 – 4	33,361	34,578	3.65%	33,938	1.73%	2.94%
5 – 9	42,538	43,652	2.62%	43,234	1.64%	2.48%
10 – 14	40,311	41,299	2.45%	40,961	1.61%	2.05%
15 – 19	26,667	27,163	1.86%	27,095	1.60%	1.79%
20 – 24	17,578	17,794	1.23%	17,859	1.60%	1.52%
25 – 29	16,481	16,694	1.29%	16,744	1.60%	1.30%
30 – 34	4,192	4,211	0.45%	4,259	1.60%	1.06%
35 – 39	3,195	3,242	1.45%	3,246	1.60%	0.75%
40 +	634	637	0.35%	645	1.60%	0.50%
Total	**184,957**	**189,268**	**2.33%**	**187,982**	**1.64%**	**2.11%**

Salary Increase Experience – Judicial Division



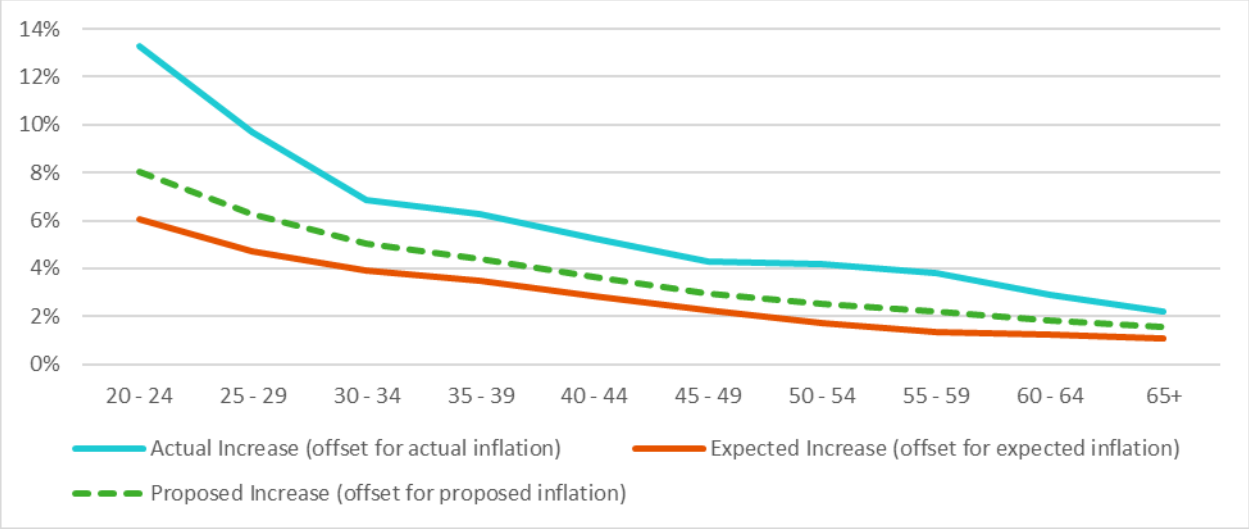
[9] Adjusted for actual average inflation of approximately 2.1% during the experience period.

[10] Current schedule of salary increases rates is based on age; exhibit shows increases adjusted to be service-based.

Denver Public Schools Division

Age	Prior Year Salaries (in $000s)	Actual Salaries[11] (in $000s)	Actual Salary Increase	Expected Salary Increases (in $000s)	Expected Salary Increase Rate	Proposed Salary Increase Rate
20 – 24	85,518	96,870	13.27%	90,701	6.06%	8.02%
25 – 29	321,370	352,455	9.67%	336,439	4.69%	6.28%
30 – 34	382,634	408,822	6.84%	397,602	3.91%	5.02%
35 – 39	367,377	390,354	6.25%	380,115	3.47%	4.38%
40 – 44	293,730	309,144	5.25%	302,062	2.84%	3.62%
45 – 49	272,041	283,721	4.29%	278,114	2.23%	2.93%
50 – 54	222,263	231,513	4.16%	226,100	1.73%	2.52%
55 – 59	168,098	174,514	3.82%	170,400	1.37%	2.19%
60 – 64	104,311	107,355	2.92%	105,586	1.22%	1.85%
65 +	41,698	42,615	2.20%	42,157	1.10%	1.54%
Total	**2,259,040**	**2,397,362**	**6.12%**	**2,329,276**	**3.11%**	**4.11%**

Salary Increase Experience – Denver Public Schools Division



[11] Adjusted for actual average inflation of approximately 2.1% during the experience period.

D. Payroll Growth (Wage Inflation)

The payroll growth assumption represents the expected annual increase in total covered payroll from one year to the next. This assumption is used to determine the amortization of unfunded actuarial accrued liability (in the actuarially determined contribution) as a level percentage of payroll. The current assumption for payroll growth is 3.50% per year and consists of the following components:

Component	Current Assumption
Inflation	2.40%
Productivity	1.10%
Total	3.50%

The Social Security Administration publishes data on wage growth in the United States. A comparison of wage inflation with price inflation over various periods is shown in the table below. Currently the wage data is only available through calendar year 2018. The difference between wage inflation and price inflation is the measure of the real rate of wage inflation.

Productivity can be measured as the excess of the increase in the National Average Wage over inflation. As of December 2018:

Period	General Wage Growth	Price Inflation (CPI-U)	Productivity
2008 – 2018	2.35%	1.80%	0.55%
2003 – 2018	2.88%	2.09%	0.79%
1998 – 2018	3.00%	2.16%	0.84%

Productivity over the prior 10-year period of 0.55% is much lower as compared to productivity over the prior 15 and 20-year periods of 0.79% and 0.84%, respectively.

A lower payroll growth assumption is more conservative. To the extent that actual payroll increases were more than 3.50%, more dollars have gone toward paying off the unfunded liability than anticipated and future amortization payments are lower. If actual payroll increases were less than 3.50%, fewer dollars have gone toward paying off the unfunded liability than anticipated and future amortization payments are higher.

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

Year Ended December 31	Total Payroll ($ in millions)	Number of Active Members
2019	$9,570.7	213,294
2014	7,795.7	202,750
2010	7,506.2	201,095

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

Period	Increase in Total Payroll	Increase in Active Members
5-year average	4.2%	1.0%
9-year average	2.7%	0.7%

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

Component	Current	Recommended
Inflation	2.4%	2.3%
Productivity	1.1%	0.7%
Total	3.5%	3.0%

III. Demographic Assumptions

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

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

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

A. Mortality Rates

One of the most significant actuarial assumptions is the probability of death, which drives expectations of annuitant longevity and, therefore, the duration of pension payments. 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. PERA currently uses three types of mortality tables for its members: post-retirement mortality, disabled mortality, and pre-retirement mortality.

In 2019, the Society of Actuaries (SOA) published a series of mortality tables derived from public plan experience, referred to as Pub-2010. The published mortality tables are based on three broad categories: teachers, public safety, and general employees. In addition, the study concluded that surviving annuitants demonstrated worse mortality than the primary annuitants. As a result, separate contingent survivor tables were developed.

We analyzed the experience by weighting the probability of death with each annuitant's pension benefit amount. This methodology takes into consideration the correlation between the annuitant mortality and the level of benefit.

In 2008, the SOA published an article recommending that mortality assumptions include an adjustment for credibility. Under this approach, the number of actual deaths in a sub-group needed for "full credibility" is 1,082. Full credibility in this context means 90% confidence that the actual experience will be within 5% of the expected value. Partial credibility can be assigned where actual deaths in a group or sub-group are less than 1,082. Partially credible results can be blended with an appropriate, unadjusted published base table. In some instances we combine male and female experience of a particular group to improve credibility. While in these instances we show the results of the analysis in this report using male and female experience combined, the actual proposed tables to be used in the actuarial valuations will rely on sex distinct mortality tables with the same adjustment applied to each gender.

When reviewing the actual experience under each of the four categories below, we compared actual experience with the current mortality table and with the applicable Pub-2010 mortality table. We recommend updating the base tables to the appropriate Pub-2010 mortality tables, with adjustments for PERA-specific experience where credible data exists. We also recommend the use of the Pub-2010 Contingent Survivor Mortality Table. In order to reflect future improvements in mortality, we recommend using the mortality projection scale to MP-2019.

Post-Retirement Healthy Mortality

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

Currently, PERA uses healthy post-retirement mortality rates based on the RP-2014 Healthy Annuitant Mortality Table (sex distinct) and the MP-2015 projection scale. For the State and Local Government Division Trust Funds, the mortality table is the RP-2014 Healthy Annuitant Mortality Table with adjustments for credibility and gender. For males the adjustments are a 73% factor applied to the rates for ages below 80 and a 108% factor applied to the rates for

ages 80 and above, projected to 2018 using the MP-2015 projection scale. For females the adjustments are a 78% factor applied to the rates for ages below 80 and a 109% factor applied to the rates for ages 80 and above, projected to 2020 using the MP-2015 projection scale.

For the School, Judicial, and DPS Division Trust Funds, the mortality table is the RP-2014 White Collar Healthy Annuitant Mortality Table with adjustments for credibility and gender. For males the adjustments are a 93% factor applied to the rates for ages below 80 and a 113% factor applied to the rates for ages 80 and above, projected to 2018 using the MP-2015 projection scale. For females the adjustments are a 68% factor applied to the rates for ages below 80 and a 106% factor applied to the rates for ages 80 and above, projected to 2020 using the MP-2015 projection scale.

Based upon our analysis, we recommend that four sets of mortality tables be used for the following divisions:

- State and Local Government Divisions (Non-Troopers)
- State and Local Government Divisions (Troopers)
- School and DPS Divisions
- Judicial Division

State and Local Government Divisions (Non-Troopers)

The experience during the study period shows that, for females fewer members in pay status have died than expected. On a benefit-weighted basis, the actual number of deaths was 96% of expected. For males, on a benefit-weighted basis, more members in pay status have died than expected; the ratio of actual-to-expected was 103%. When compared to the unadjusted PubG-2010 mortality tables, we continue to see a difference in mortality rates before and after age 80, particularly for male experience where the actual number of deaths prior to age 80 is 114% of expected based on that table yet the actual number for ages 80 and later is 94% of expected.

During the experience study period, there were 1,534 female deaths and 1,963 male deaths, broken out as follows:

	Female		Male		Total	
Age	Deaths	Credibility	Deaths	Credibility	Deaths	Credibility
<80	538	70.5%	958	94.1%	1,496	n/a
80+	996	95.9%	1,005	96.4%	2,001	n/a
Total	**1,534**	**n/a**	**1,963**	**n/a**	**3,497**	**n/a**

We used these credibility adjustments to develop the recommended mortality assumption on a sex-distinct basis for rates before and after age 80.

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

State and Local Government Divisions (Non-Troopers)

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected
Benefits Basis (in 000's)				
Female	**2,832,021**	**43,401**	**44,995**	**96%**
<80	2,533,540	18,630	22,121	84%
80+	298,481	24,771	22,875	108%
Male	**3,463,239**	**79,879**	**77,352**	**103%**
<80	2,975,878	40,581	35,635	114%
80+	487,360	39,298	41,717	94%
Total	**6,295,260**	**123,280**	**122,347**	**101%**

The total amount of benefits released due to healthy post-retirement mortality among the retiree population was 123,280,000. Applying the State and Local Government Divisions (Non-Troopers) exposures to the unadjusted PubG-2010 Retiree Table would result in 132,845,000 in benefits released due to mortality, for an aggregate actual-to-proposed ratio of 93%. Applying credibility-weighted adjustments by gender and age (pre and post age 80) results in a better fit of the published table to this group's own experience, as shown in the following table:

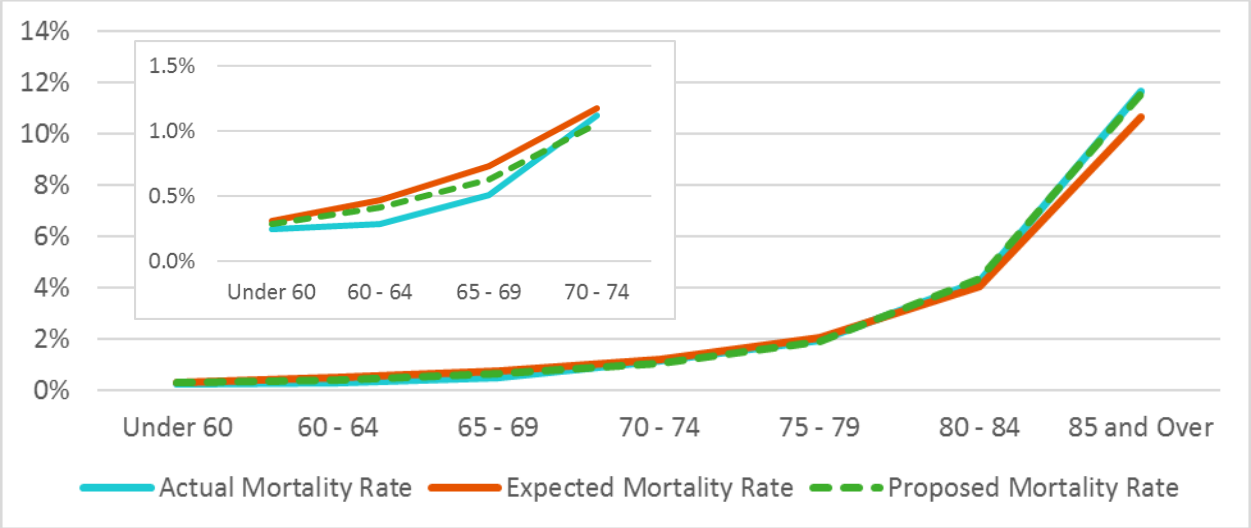
Gender	Actual Deaths	Unadjusted PubG-2010 Deaths	Ratio of Actual to Unadjusted	Credibility Applied to Actual	Credibility Weighted Deaths	Ratio of Actual to Weighted
Benefits Basis (in 000's)						
Female	**43,401**	**46,000**	**94%**		**44,585**	**97%**
<80	18,630	22,872	81%	70.5%	19,881	94%
80+	24,771	23,128	107%	95.9%	24,704	100%
Male	**79,879**	**86,845**	**92%**		**80,194**	**100%**
<80	40,581	43,259	94%	94.1%	40,740	100%
80+	39,298	43,586	90%	96.4%	39,454	100%
Total	**123,280**	**132,845**	**93%**		**124,779**	**99%**

The adjustments applied to the mortality rates are calculated using Ratio of Actual to Unadjusted and Credibility Applied to Actual. For example, for females below age 80, the adjustment is 87% = (81% x 70.5% +100% x 29.5%).

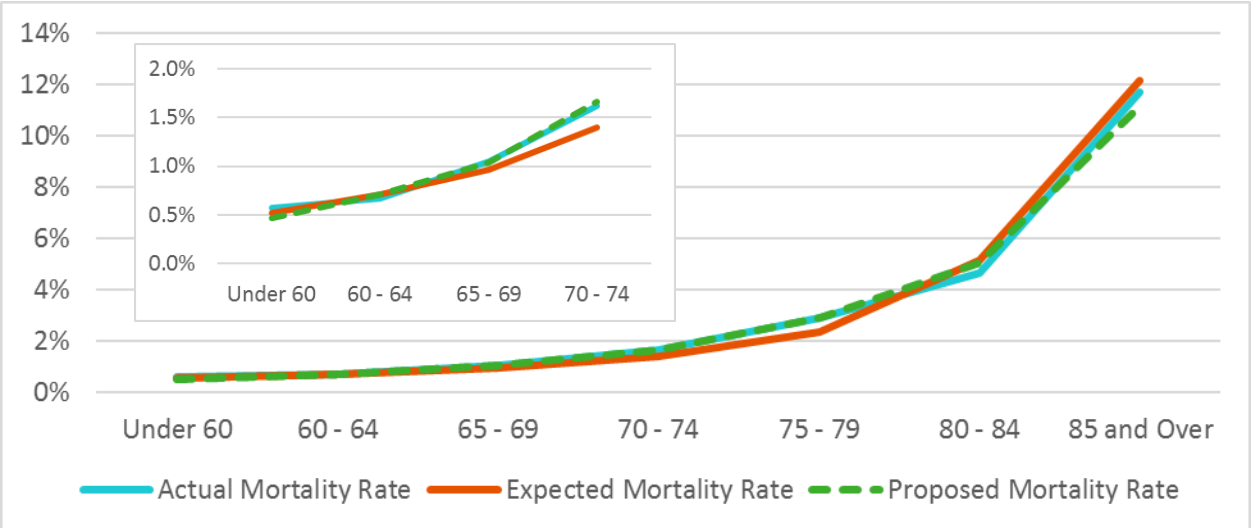
The credibility weightings as outlined above applied to the State and Local Government Divisions (Non-Troopers) exposures would result in 124,779,000 in benefits released due to mortality, for an aggregate actual-to-weighted rate of 99%. Therefore, we recommend that the mortality table for healthy retirees applicable to the State and Local Government Divisions (Non-Troopers) be updated to the PubG-2010 Retired Lives Table for males using 94% of the rates prior to age 80 and 90% of the rates for ages 80 and older. For females, the mortality table would be updated to the PubG-2010 Retired Lives Table using 87% of the rates prior to age 80 and 107% of the rates for ages 80 and older. In aggregate, this assumption would result in 124,537,000 in benefits released due to mortality and is close to the number of credibility-

weighted deaths during the study period. In order to reflect future improvements in mortality, we recommend updating the mortality projection scale to MP-2019. The following graphs show the actual mortality rate, expected mortality rate, and proposed mortality rate by female and male.

Actual Versus Proposed Experience, Benefit-Weighted Basis
Healthy Retiree Mortality – **Female**
State and Local Government Divisions (Non-Troopers)



Actual Versus Proposed Experience, Benefit-Weighted Basis
Healthy Retiree Mortality – **Male**
State and Local Government Divisions (Non-Troopers)



State and Local Government Divisions (Troopers)

Troopers within the State Division retiree population are only identified for two of the four years of the experience period. Due to this insufficient experience for the Troopers subgroup, we recommend using the unadjusted PubS-2010 Retired Lives Tables for males and females. In order to reflect future improvements in mortality, we recommend using the mortality projection scale to MP-2019.

School and DPS Divisions

The experience during the study period shows that, for females fewer members in pay status have died than expected. On a benefit-weighted basis, the actual number of deaths was 98% of expected. Similarly, for males, on a benefit-weighted basis, fewer members in pay status have died than expected; the ratio of actual-to-expected was 97%. When compared to the unadjusted PubT-2010 mortality tables, we continue to see a difference in mortality rates before and after age 80. For example, for female experience, the actual number of deaths prior to age 80 is 82% of expected based on that table yet the actual number for ages 80 and later is 106% of expected. Conversely, for male experience, the actual number of deaths prior to age 80 is 114% of expected based on that table while the actual number for ages 80 and later is 94% of expected.

During the experience study period, there were 3,037 female deaths and 1,822 male deaths, broken out as follows:

	Female		Male		Total	
Age	Deaths	Credibility	Deaths	Credibility	Deaths	Credibility
<80	1,015	96.8%	851	88.7%	1,866	n/a
80+	2,022	100.0%	971	94.7%	2,993	n/a
Total	**3,037**	**n/a**	**1,822**	**n/a**	**4,859**	**n/a**

We used these credibility adjustments to develop the recommended mortality assumption on a sex-distinct basis for rates before and after age 80.

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

School and DPS Divisions

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected
Benefits Basis (in 000's)				
Female	**6,441,338**	**85,518**	**86,914**	**98%**
<80	5,690,471	34,001	38,485	88%
80+	750,867	51,517	48,429	106%
Male	**3,135,182**	**68,937**	**71,175**	**97%**
<80	2,624,837	32,909	31,063	106%
80+	510,345	36,027	40,112	90%
Total	**9,576,520**	**154,455**	**158,089**	**98%**

The total amount of benefits released due to healthy post-retirement mortality among the retiree population was 154,455,000. Applying the School and DPS Division exposures to the unadjusted PubT-2010 Retiree Table would result in 157,141,000 in benefits released due to mortality, for an aggregate actual-to-proposed ratio of 98%. Applying credibility-weighted adjustments by gender and age (pre and post age 80) results in a better fit of the published table to this group's own experience, as shown in the following table:

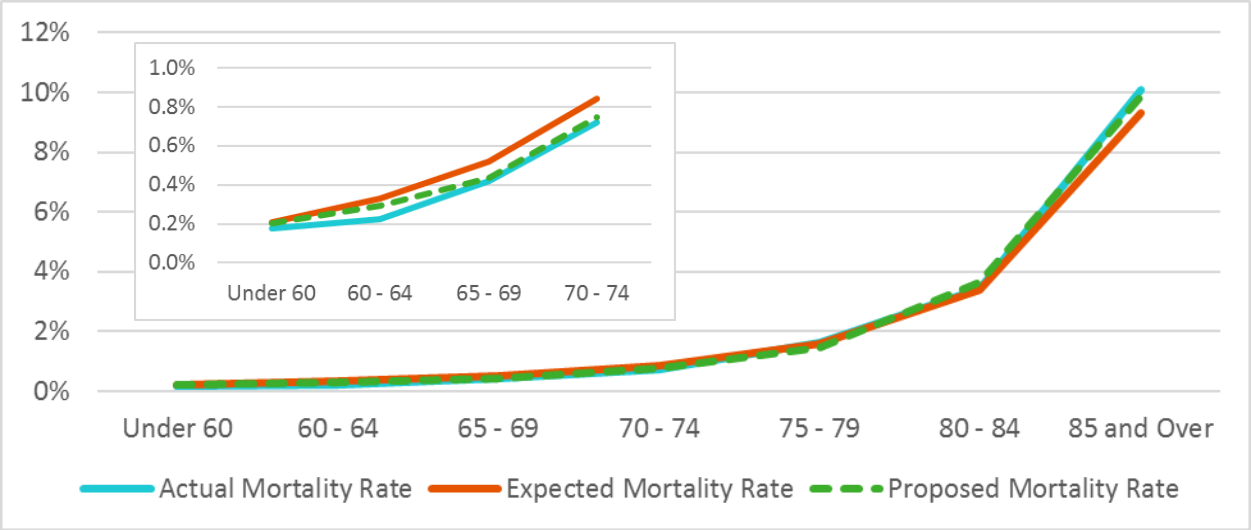
Gender	Actual Deaths	Unadjusted PubT-2010 Deaths	Ratio of Actual to Unadjusted	Credibility Applied to Actual	Credibility Weighted Deaths	Ratio of Actual to Weighted
Benefits Basis (in 000's)						
Female	**85,518**	**90,109**	**95%**		**85,753**	**100%**
<80	34,001	41,426	82%	96.8%	34,236	99%
80+	51,517	48,683	106%	100.0%	51,517	100%
Male	**68,937**	**67,032**	**103%**		**68,588**	**101%**
<80	32,909	28,805	114%	88.7%	32,444	102%
80+	36,027	38,228	94%	94.7%	36,144	100%
Total	**154,455**	**157,141**	**98%**		**154,341**	**100%**

The adjustments applied to the mortality rates are calculated using Ratio of Actual to Unadjusted and Credibility Applied to Actual. For example, for females below age 80, the adjustment is 83% = (82% x 96.8% +100% x 3.2%).

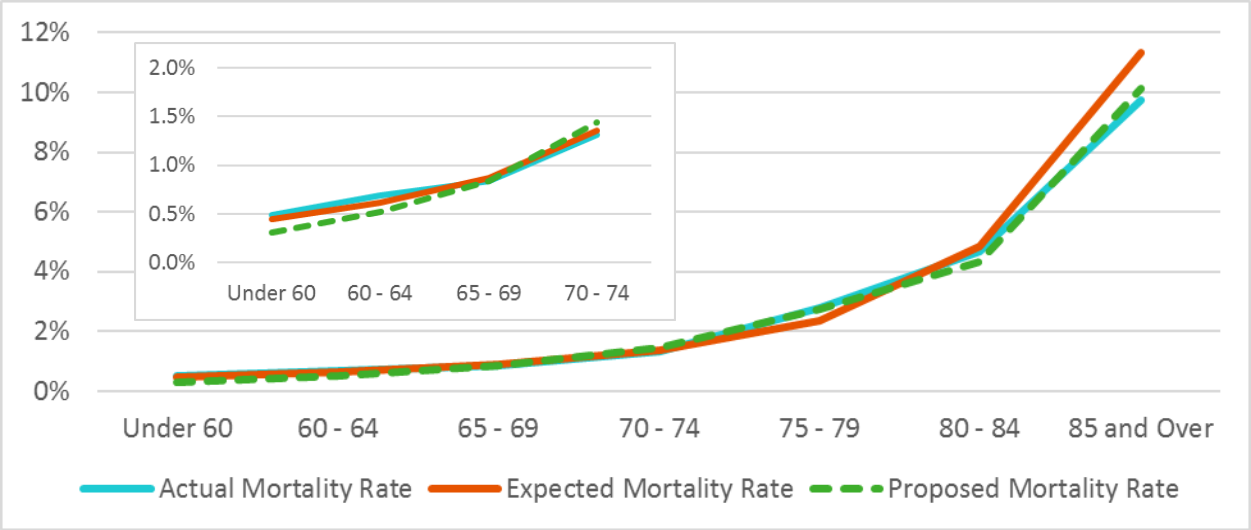
The credibility weightings as outlined above applied to the School and DPS Division exposures would result in 154,341,000 in benefits released due to mortality, for an aggregate actual-to-weighted rate of 100%. Therefore, we recommend that the mortality table for healthy retirees applicable to the School and DPS Divisions be updated to the PubT-2010 Retired Lives Table for males using 112% of the rates prior to age 80 and 94% of the rates for ages 80 and older. For females, the mortality table would be updated to the PubT-2010 Retired Lives Table using 83% of the rates prior to age 80 and 106% of the rates for ages 80 and older. In aggregate, this assumption would result in 154,183,000 in benefits released due to mortality and is close to the

number of credibility-weighted deaths during the study period. In order to reflect future improvements in mortality, we recommend updating the mortality projection scale to MP-2019. The following graphs show the actual mortality rate, expected mortality rate, and proposed mortality rate by female and male.

Actual Versus Proposed Experience, Benefit-Weighted Basis
Healthy Retiree Mortality – **Female**
School and DPS Divisions



Actual Versus Proposed Experience, Benefit-Weighted Basis
Healthy Retiree Mortality – **Male**
School and DPS Divisions



Judicial Division

Because of the size of the annuitant population of the Judicial Division, the experience was combined for males and females. The experience during the study period shows that more members in pay status have died than expected. On a benefit-weighted basis, the actual number of deaths was 104% of expected. Since the vast majority of retirees in this group have annuities greater than the average of those in the PubG-2010 dataset, we believe that the PubG-2010 Above Median mortality table represents the appropriate base table.

During the experience study period, there was 1 female death and 33 male deaths, broken out as follows:

Age	Female		Male		Total	
	Deaths	Credibility	Deaths	Credibility	Deaths	Credibility
Total	1	n/a	33	n/a	34	17.7%

Given the relatively low credibility of the Judicial Division subgroup, we have not attempted to blend this group's actual experience with the unadjusted PubG-2010 Above Median tables.

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

Judicial Division

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected
Benefits Basis (in 000's)				
Total	84,347	1,879	1,810	104%

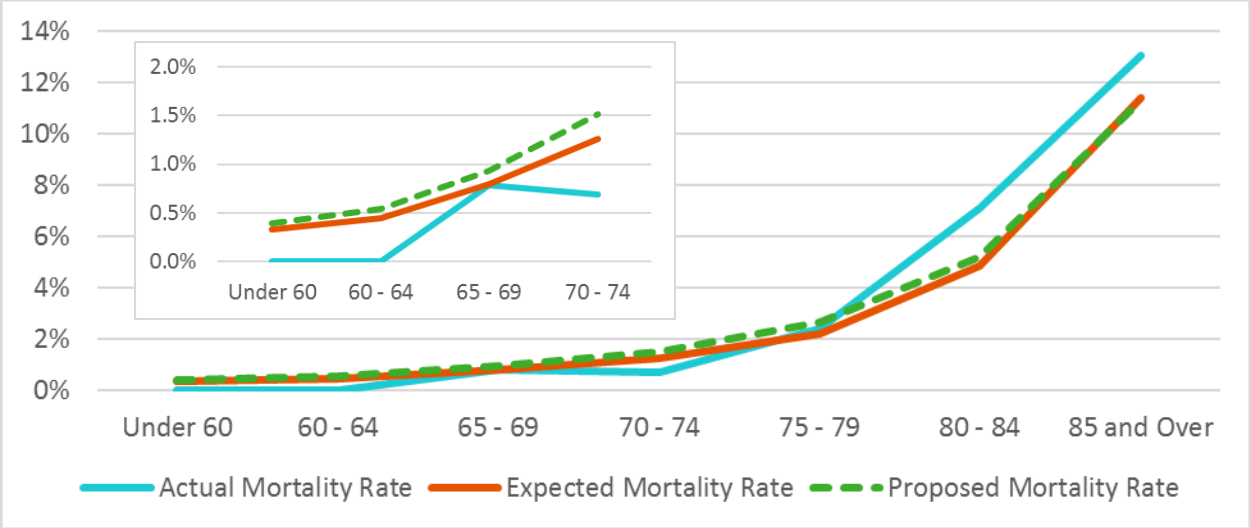
The total amount of benefits released due to healthy post-retirement mortality among the retiree population was 1,879,000. Applying the Judicial Division exposures to the unadjusted PubG-2010 Above Median Retiree Table would result in 2,010,000 in benefits released due to mortality, for an aggregate actual-to-proposed ratio of 93%.

Gender	Actual Deaths	Unadjusted PubG-2010 Above Median Deaths	Ratio of Actual to Unadjusted	Credibility Applied to Actual	Credibility Weighted Deaths	Ratio of Actual to Weighted
Benefits Basis (in 000's)						
Total	1,879	2,010	93%	0.0%	2,010	93%

We recommend that the mortality table for healthy retirees applicable to the Judicial Division be updated to the PubG-2010 Above Median Retired Lives Table for males and females. In order to reflect future improvements in mortality, we recommend updating the mortality projection scale to MP-2019. The following graphs show the actual mortality rate, expected mortality rate, and proposed mortality rate on a unisex basis.

Actual Versus Proposed Experience, Benefit-Weighted Basis
Healthy Retiree Mortality – **Unisex**

Judicial Division



Beneficiary Mortality

Beneficiary mortality is currently based on the same tables used for healthy retired members. For the State and Local Government Division Trust Funds, the mortality table is the RP-2014 Healthy Annuitant Mortality Table with adjustments for credibility and gender. For males the adjustments are a 73% factor applied to the rates for ages below 80 and a 108% factor applied to the rates for ages 80 and above, projected to 2018 using the MP-2015 projection scale. For females the adjustments are a 78% factor applied to the rates for ages below 80 and a 109% factor applied to the rates for ages 80 and above, projected to 2020 using the MP-2015 projection scale.

For the School, Judicial, and DPS Division Trust Funds, the mortality table is the RP-2014 White Collar Healthy Annuitant Mortality Table with adjustments for credibility and gender. For males the adjustments are a 93% factor applied to the rates for ages below 80 and a 113% factor applied to the rates for ages 80 and above, projected to 2018 using the MP-2015 projection scale. For females the adjustments are a 68% factor applied to the rates for ages below 80 and a 106% factor applied to the rates for ages 80 and above, projected to 2020 using the MP-2015 projection scale.

Based upon our analysis, we recommend that one set of mortality tables be used for all divisions combined.

All Divisions

The beneficiary experience during the study period shows that, for both males and females, more members in pay status have died than expected. For females, on a benefit-weighted basis, the actual number of deaths was 116% of expected. For males, on a benefit-weighted basis, the ratio of actual-to-expected was 115%. We believe that the Pub-2010 Contingent Survivor mortality table represents the appropriate base table.

During the experience study period, there were 1,664 female deaths and 422 male deaths, broken out as follows:

Age	Female		Male		Total	
	Deaths	Credibility	Deaths	Credibility	Deaths	Credibility
Total	1,664	100.0%	422	62.4%	2,086	n/a

We used these credibility adjustments to develop the recommended mortality assumption on a sex-distinct basis.

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

All Divisions

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected
Benefits Basis (in 000's)				
Female	881,534	44,338	38,169	116%
Male	162,413	7,057	6,130	115%
Total	1,043,947	51,395	44,299	116%

The total amount of benefits released due to healthy post-retirement mortality among the beneficiary population was 51,395,000. Applying the PERA beneficiary exposures to the unadjusted Pub-2010 Contingent Survivor Table would result in 49,644,000 in benefits released due to mortality, for an aggregate actual-to-proposed ratio of 104%. Applying credibility-weighted adjustments by gender results in a better fit of the published table to this group's own experience, as shown in the following table:

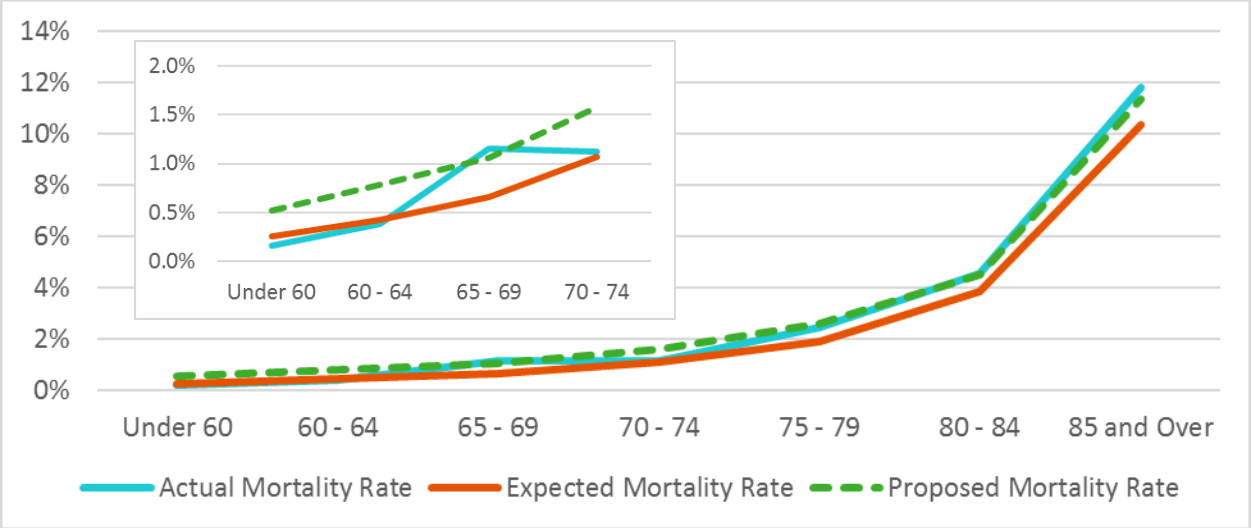
Gender	Actual Deaths	Unadjusted Pub-2010 Contingent Survivor Deaths	Ratio of Actual to Unadjusted	Credibility Applied to Actual	Credibility Weighted Deaths	Ratio of Actual to Weighted
Benefits Basis (in 000's)						
Female	44,338	42,177	105%	100.0%	44,338	100%
Male	7,057	7,467	95%	62.4%	7,211	98%
Total	51,395	49,644	104%		51,549	100%

The adjustments applied to the mortality rates are calculated using Ratio of Actual to Unadjusted and Credibility Applied to Actual. For example, for males, the adjustment is 97% = (95% x 62.4% +100% x 37.6%).

The credibility weightings as outlined above applied to the PERA beneficiary exposures would result in 51,549,000 in benefits released due to mortality, for an aggregate actual-to-weighted rate of 100%. Therefore, we recommend that the mortality table for healthy beneficiaries applicable to all divisions be updated to the Pub-2010 Contingent Survivor Table for males using 97% of the rates for all ages. For females, the mortality table would be updated to the Pub-2010 Contingent Survivor Table for females using 105% of the rates for all ages. In aggregate, this assumption would result in 51,529,000 in benefits released due to mortality and is close to the number of credibility-weighted deaths during the study period. In order to reflect future improvements in mortality, we recommend updating the mortality projection scale to MP-2019. The following graphs show the actual mortality rate, expected mortality rate, and proposed mortality rate by female and male.

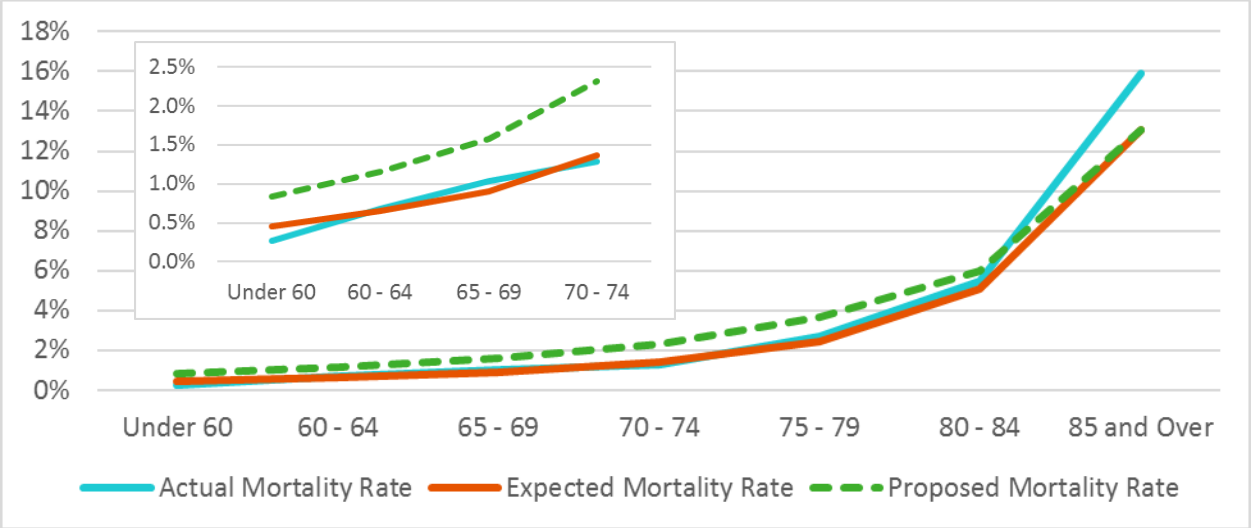
Actual Versus Proposed Experience, Benefit-Weighted Basis
Healthy Beneficiary Mortality – **Female**

All Divisions



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

All Divisions



Disabled Mortality

The current mortality table for all disabled lives is the RP-2014 Disabled Retiree Mortality Table incorporating a 90% factor to both male rates and female rates. Experience for disabled annuitants has been consistent with the current assumptions, as the ratio of actual to expected deaths on a benefit-weighted basis is 107% for females and 101% for males.

During the experience study period, there were 471 female deaths and 441 male deaths, broken out as follows:

Age	Female		Male		Total	
	Deaths	Credibility	Deaths	Credibility	Deaths	Credibility
Total	471	n/a	441	n/a	912	91.8%

We used this credibility adjustment to develop the recommended mortality assumption on a unisex basis.

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

All Divisions (Except Troopers)

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected
Benefits Basis (in 000's)				
Total	540,984	22,093	21,266	104%

The total amount of benefits released due to mortality among the disability retiree population was 22,093,000. Applying the PERA disability retiree exposures to the unadjusted Pub-2010 Non-Safety Disabled Retiree Table would result in 22,298,000 in benefits released due to mortality, for an aggregate actual-to-proposed ratio of 99%.

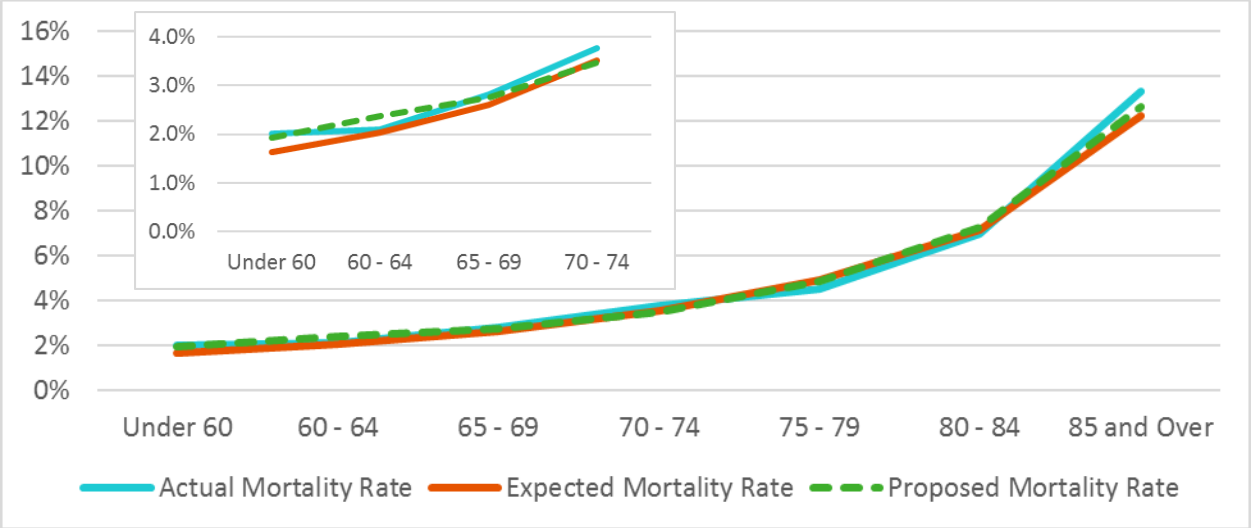
Gender	Actual Deaths	Unadjusted Pub-2010 Non-Safety Disabled Deaths	Ratio of Actual to Unadjusted	Credibility Applied to Actual	Credibility Weighted Deaths	Ratio of Actual to Weighted
Benefits Basis (in 000's)						
Total	22,093	22,298	99%	91.8%	22,110	100%

We recommend that the mortality table for disability retirees applicable to all divisions (except Troopers) be updated to the Pub-2010 Non-Safety Disabled Lives Table for males and females using 99% of the rates for all ages. For Troopers within the State Division, there was limited experience on which to base the assumption. We recommend that the mortality table for disability retirees applicable to Troopers (in either the State or Local Government Division) be updated to the Pub-2010 Safety Disabled Lives Table for males and females. In order to reflect future improvements in mortality, we recommend updating the mortality projection scale to MP-

2019. The following graphs show the actual mortality rate, expected mortality rate, and proposed mortality rate for Non-Troopers on a unisex basis.

Actual Versus Proposed Experience, Benefit-Weighted Basis
Disabled Retiree Mortality – **Unisex**

All Divisions (Except Troopers)



Pre-Retirement Mortality

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

Mortality assumptions for active members are based on the RP-2014 White Collar Employee Mortality Table. To allow for an appropriate margin of improved mortality prospectively, the mortality rates incorporate a 70 percent factor applied to male rates and a 55 percent factor applied to female rates.

Very few members die in active service and the liability associated with active deaths is a small percentage of the total liability. Since plan experience is insufficient to set the assumption, we recommend using the following tables for active members and applying generational projection using Scale MP-2019.

- PubG-2010 Employee Table for the State and Local Government Divisions (Non-Troopers)
- PubT-2010 Employee Table for the School and Denver Public Schools Divisions
- PubG-2010 Above Median Employee Table for the Judicial Division
- PubS-2010 Employee Table for the State and Local Government Divisions (Troopers)

The following tables provide a summary of pre-retirement mortality experience on a benefit-weighted basis (in 000's) by division and gender for the study period:

State Division

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected	Proposed Deaths	Ratio of Actual to Proposed
Benefits Basis (in 000's)						
Female	1,679,109	1,247	1,313	95%	2,180	57%
Male	1,557,471	2,305	2,528	91%	3,448	67%
Total	**3,236,580**	**3,552**	**3,841**	**92%**	**5,628**	**63%**

School Division

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected	Proposed Deaths	Ratio of Actual to Proposed
Benefits Basis (in 000's)						
Female	3,871,125	1,667	2,476	67%	3,694	45%
Male	1,517,254	1,254	1,860	67%	2,205	57%
Total	**5,388,379**	**2,921**	**4,336**	**67%**	**5,899**	**50%**

Local Government Division

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected	Proposed Deaths	Ratio of Actual to Proposed
Benefits Basis (in 000's)						
Female	360,646	362	262	138%	437	83%
Male	415,646	444	585	76%	846	52%
Total	**776,292**	**806**	**847**	**95%**	**1,283**	**63%**

Judicial Division

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected	Proposed Deaths	Ratio of Actual to Proposed
Benefits Basis (in 000's)						
Female	21,569	0	23	0%	34	0%
Male	43,369	0	149	0%	149	0%
Total	**64,938**	**0**	**172**	**0%**	**183**	**0%**

Denver Public Schools Division

Gender	Exposures	Actual Deaths	Expected Deaths	Ratio of Actual to Expected	Proposed Deaths	Ratio of Actual to Proposed
Benefits Basis (in 000's)						
Female	195,181	87	213	41%	316	28%
Male	81,756	40	169	24%	194	21%
Total	**276,937**	**127**	**382**	**33%**	**510**	**25%**

B. Retirement Rates

Active Retirement

The eligibility criteria for retirement differs by division and date of hire. The age and service requirements to be eligible for an **unreduced retirement benefit** are as follows:

Members, except State Troopers, hired before July 1, 2005 who have 5 or more years of service credit as of January 1, 2011:

Age	Service Credit (Years)
50	30
55	Age + Service = 80 or more
60	20
65	5
65	60 payroll postings

Members, except State Troopers, hired on or after July 1, 2005, but before January 1, 2007, and who have 5 or more years of service credit as of January 1, 2011:

Age	Service Credit (Years)
Any	35
55	Age + Service = 80 or more
60	20
65	5
65	60 payroll postings

Members, except State Troopers, hired on or after July 1, 2007, but before January 1, 2011, regardless of service credit as of January 1, 2011, and those hired before January 1, 2011, who have less than 5 years of service credit:

Age	Service Credit (Years)
Any	35
55	30
55	Age + Service = 85 or more
60	25
65	5
65	60 payroll postings

Members, except State Troopers, hired on or after January 1, 2011, but before January 1, 2017 and members, except State Troopers, hired on or after January 1, 2017, but before January 1, 2020 whose last 10 years of service credit are in either the School or DPS Division:

Age	Service Credit (Years)
Any	35
58	Age + Service = 88 or more
65	5
65	60 payroll postings

Members, except State Troopers, hired on or after January 1, 2017 but before January 1, 2020 whose last 10 years of service credit are not in either the School or DPS Divisions:

Age	Service Credit (Years)
Any	35
60	Age + Service = 90 or more
65	5
65	60 payroll postings

Members, except State Troopers, hired on or after January 1, 2020:

Age	Service Credit (Years)
Any	35
64	Age + Service = 94 or more
65	5
65	60 payroll postings

State Troopers hired before January 1, 2020:

Age	Service Credit (Years)
Any	30
50	25
55	20
60	Age + Service = 80 or more
65	5
65	60 payroll postings

State Troopers hired on or after January 1, 2020:

Age	Service Credit (Years)
Any	35
55	25
55	Age + Service = 80 or more
65	5
65	60 payroll postings

The Age and Service Credit requirements to be eligible for a **reduced retirement benefit** are as follows:

Members, except State Troopers, hired before January 1, 2020:

Age	Service Credit (Years)
50	25
55	20
60	5

Members, except State Troopers, hired on or after January 1, 2020:

Age	Service Credit (Years)
55	25
60	5

State Troopers hired before January 1, 2020:

Age	Service Credit (Years)
50	20
60	5

State Troopers hired on or after January 1, 2020:

Age	Service Credit (Years)
55	20
60	5

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

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

There is little retirement experience for the newer tiers (those hired after July 1, 2005) to analyze. However, the retirement rates take into account each member's eligibility requirements. Where possible, we have made modifications to certain age/service combinations to reflect our best estimate of emerging retirement experience under the newer tiers.

Reduced Retirement Benefit

The experience showed that, in aggregate, there were slightly more reduced retirements than expected. However, among divisions and different genders, some groups did experience slightly fewer reduced retirements than expected. We recommend modifications to rates at several ages across most divisions. Current reduced retirement rates for the Judicial Division and Troopers within the State Division are unisex. There is not enough evidence in the recent experience to warrant a change to sex-distinct rates for either group at this time. However, for the Judicial Division, the experience supports a single set of retirement rates (not split by reduced/unreduced eligibility). Current rates associated with reduced retirement for the State (Non-Troopers) and Local Government Divisions are similar, but not exact. Actual experience is close enough that we recommend combining the exposures of these two groups and developing a single set of assumptions to apply to both. The current rates shown in the following exhibits reflect those of the State Division (Non-Troopers). Current rates for the School and DPS Divisions (PERA Benefit Structure) are the same and we believe it is appropriate to continue in this manner.

The following tables and graphs show the actual reduced retirement experience compared to the current and proposed assumptions.

State and Local Government Divisions (Non-Troopers)
Reduced Retirements – Females

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
50	12,545	7.93%	10.0%	79%	9.0%	88%
51	13,787	5.90%	10.0%	59%	8.0%	74%
52	13,942	6.01%	10.0%	60%	8.0%	75%
53	13,877	7.55%	10.0%	75%	9.0%	84%
54	13,157	12.25%	10.0%	122%	12.0%	102%
55	12,657	17.25%	10.0%	172%	15.0%	115%
56	9,377	11.49%	10.0%	115%	11.0%	104%
57	6,194	13.87%	10.0%	139%	12.0%	116%
58	3,358	18.74%	10.0%	187%	15.0%	125%
59	1,278	52.43%	10.0%	524%	35.0%	150%
60	25,675	6.05%	10.0%	60%	8.0%	76%
61	20,842	6.03%	10.0%	60%	8.0%	75%
62	16,977	8.25%	10.0%	83%	9.0%	92%
63	13,420	7.84%	10.0%	78%	9.0%	87%
64	10,795	9.23%	10.0%	92%	9.0%	103%
Total	187,880	9.04%	10.0%	90%	9.7%	93%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Reduced Retirements – Females

State and Local Government Divisions (Non-Troopers)
Reduced Retirements – Males

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
50	13,247	9.35%	9.5%	98%	9.5%	98%
51	14,512	12.10%	9.5%	127%	11.0%	110%
52	14,273	13.25%	9.5%	139%	11.0%	120%
53	14,806	13.44%	9.5%	141%	12.0%	112%
54	15,122	15.98%	9.5%	168%	12.0%	133%
55	13,819	14.09%	9.5%	148%	12.0%	117%
56	10,095	9.63%	9.5%	101%	9.5%	101%
57	6,377	20.61%	9.5%	217%	15.0%	137%
58	3,169	20.21%	9.5%	213%	15.0%	135%
59	1,396	49.01%	9.5%	516%	35.0%	140%
60	22,710	5.19%	9.5%	55%	7.5%	69%
61	19,815	7.00%	9.5%	74%	7.5%	93%
62	15,873	5.34%	9.5%	56%	7.5%	71%
63	13,345	6.39%	9.5%	67%	7.5%	85%
64	9,904	8.05%	9.5%	85%	7.5%	107%
Total	188,463	10.57%	9.5%	111%	9.9%	107%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Reduced Retirements – Males

State and Local Government Divisions (Troopers)
Reduced Retirements – Unisex

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
50	1,513	16.52%	10.0%	165%	10.0%	165%
51	1,350	3.63%	10.0%	36%	10.0%	36%
52	992	10.43%	10.0%	104%	10.0%	104%
53	839	6.54%	10.0%	65%	10.0%	65%
54	597	38.87%	10.0%	389%	10.0%	389%
55	0	0.00%	5.0%	0%	5.0%	0%
56	0	0.00%	5.0%	0%	5.0%	0%
57	0	0.00%	5.0%	0%	5.0%	0%
58	0	0.00%	5.0%	0%	5.0%	0%
59	0	0.00%	5.0%	0%	5.0%	0%
60	241	0.00%	10.0%	0%	10.0%	0%
61	164	0.00%	10.0%	0%	10.0%	0%
62	45	0.00%	10.0%	0%	10.0%	0%
63	64	0.00%	10.0%	0%	10.0%	0%
64	38	57.11%	10.0%	571%	10.0%	571%
Total	5,844	12.17%	10.0%	122%	10.0%	122%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Reduced Retirements – Unisex

School and DPS Divisions (PERA Benefit Structure)
Reduced Retirements – Females

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
50	33,630	5.28%	8.0%	66%	7.0%	75%
51	36,557	5.92%	8.0%	74%	7.0%	84%
52	38,236	8.57%	8.0%	111%	8.0%	111%
53	38,202	12.11%	8.0%	151%	10.0%	121%
54	36,408	15.35%	10.0%	153%	14.0%	109%
55	28,770	14.01%	10.0%	140%	12.0%	116%
56	20,908	11.94%	11.0%	110%	12.0%	100%
57	14,690	10.70%	11.0%	96%	12.0%	88%
58	8,852	22.45%	11.0%	207%	16.0%	142%
59	4,206	58.24%	11.0%	533%	34.0%	173%
60	41,897	8.25%	11.0%	74%	9.0%	90%
61	31,655	6.32%	11.0%	59%	9.0%	72%
62	22,764	7.94%	11.0%	72%	10.0%	80%
63	15,440	9.01%	11.0%	81%	10.0%	89%
64	11,230	10.79%	11.0%	96%	10.0%	105%
Total	383,445	10.40%	9.7%	107%	10.2%	102%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Reduced Retirements – Females

School and DPS Divisions (PERA Benefit Structure)
Reduced Retirements – Males

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
50	16,091	9.21%	8.0%	114%	8.0%	114%
51	18,113	6.58%	8.0%	82%	8.0%	82%
52	20,865	10.20%	8.0%	127%	9.0%	113%
53	21,428	9.41%	8.0%	123%	9.0%	109%
54	21,289	12.26%	10.0%	124%	12.0%	104%
55	11,465	8.74%	10.0%	87%	9.0%	96%
56	6,504	8.85%	10.0%	88%	9.0%	98%
57	4,403	7.44%	10.0%	74%	9.0%	83%
58	2,348	14.37%	10.0%	142%	12.0%	119%
59	1,081	39.44%	10.0%	394%	24.0%	164%
60	13,684	7.91%	10.0%	78%	8.0%	97%
61	11,565	5.51%	12.0%	45%	9.0%	60%
62	9,781	9.40%	12.0%	78%	10.0%	94%
63	7,303	8.51%	12.0%	68%	10.0%	82%
64	5,390	9.78%	12.0%	84%	10.0%	100%
Total	171,310	9.29%	9.5%	98%	9.4%	99%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Reduced Retirements – Males

All Divisions (DPS Benefit Structure)
Reduced Retirements – Females

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
50	1,249	5.32%	5.0%	106%	5.0%	106%
51	1,546	9.17%	5.0%	183%	7.0%	131%
52	2,122	14.75%	5.0%	295%	10.0%	147%
53	2,865	10.55%	10.0%	106%	10.0%	106%
54	2,997	24.64%	10.0%	246%	10.0%	246%
55	4,603	11.99%	10.0%	120%	10.0%	120%
56	4,145	9.45%	10.0%	95%	10.0%	95%
57	4,328	7.68%	10.0%	77%	10.0%	77%
58	4,197	8.07%	10.0%	81%	10.0%	81%
59	3,943	16.82%	12.0%	140%	14.0%	120%
60	4,171	16.84%	15.0%	112%	17.0%	99%
61	3,918	17.61%	15.0%	117%	17.0%	104%
62	3,577	16.49%	15.0%	110%	17.0%	97%
63	3,644	14.67%	15.0%	98%	17.0%	86%
64	3,184	17.03%	15.0%	114%	17.0%	100%
Total	50,490	13.67%	11.5%	119%	12.7%	108%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Reduced Retirements – Females

All Divisions (DPS Benefit Structure)
Reduced Retirements – Males

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
50	550	7.25%	8.0%	91%	8.0%	91%
51	489	8.85%	8.0%	111%	8.0%	111%
52	653	7.57%	8.0%	95%	8.0%	95%
53	1,442	11.68%	8.0%	146%	10.0%	117%
54	1,163	15.40%	11.0%	140%	10.0%	154%
55	1,937	15.33%	11.0%	139%	10.0%	153%
56	1,510	7.36%	11.0%	67%	10.0%	74%
57	1,281	8.64%	11.0%	79%	10.0%	86%
58	1,385	8.20%	11.0%	75%	10.0%	82%
59	1,313	13.33%	15.0%	89%	15.0%	89%
60	1,625	17.32%	15.0%	115%	15.0%	115%
61	1,385	9.22%	17.0%	54%	16.0%	58%
62	1,501	16.14%	17.0%	95%	16.0%	101%
63	1,077	11.45%	17.0%	67%	16.0%	72%
64	890	5.99%	17.0%	35%	16.0%	37%
Total	18,199	11.62%	12.7%	91%	12.2%	95%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Reduced Retirements – Males

Unreduced Retirement Benefit

The experience showed that, in aggregate, there were fewer unreduced retirements than expected. However, the experience was not consistent among divisions and different genders, as some groups did experience slightly more unreduced retirements than expected. We recommend modifications to rates at several ages across most divisions. Current unreduced retirement rates for the Judicial Division and Troopers within the State Division are unisex. There is not enough evidence in the recent experience to warrant a change to sex-distinct rates for either group at this time. As noted earlier, for the Judicial Division, the experience supports a single set of retirement rates (not split by reduced/unreduced eligibility). The analysis of those rates is shown at the conclusion of this subsection. Current rates associated with unreduced retirement for the State (Non-Troopers) and Local Government Divisions are similar, but not exact. Actual experience is close enough that we recommend combining the exposures of these two groups and developing a single set of assumptions to apply to both. The current rates shown in the following exhibits reflect those of the State Division (Non-Troopers). Current rates for the School and DPS Divisions (PERA Benefit Structure) are the same and we believe it is appropriate to continue in this manner.

In addition to retirement experience for all members eligible for unreduced retirement, we separately studied members during the first year they were eligible for unreduced retirement. Typically, there is a higher tendency to retire upon attaining first eligibility for unreduced benefits and a few years thereafter. This was the case for several PERA divisions. In general, for members retiring with unreduced benefits in the legacy tiers, this increased tendency to retire at (or just after) first eligibility is already built into the retirement rate schedules. However, newer benefit tiers have later ages for retirement eligibility. Therefore, in order to better reflect expected future experience, we recommend adding the following rates of retirement applicable to active members whose first eligibility for unreduced retirement is between age 55 and 64:

Year of Eligibility	State and Local Government Divisions (Non-Troopers)		School and DPS Divisions (PERA Benefit Structure)		Troopers
	Female	Male	Female	Male	Unisex
1st year	20%	30%	28%	28%	20%
2nd year	9%	13%	10%	4%	20%
3rd year	9%	13%	10%	4%	20%
4th year	9%	13%	10%	4%	20%
5th year	9%	13%	10%	4%	20%

These rates are additive to the rates included in the following schedules of proposed unreduced retirement rates. For example, a proposed rate of 25% at age 55 for females in the State Division would become 45% if this were the member's first year of eligibility, the proposed rate of 20% at age 56 for females would be 29% in their second year of eligibility, etc.

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

State and Local Government Divisions (Non-Troopers)
Unreduced Retirements – Females

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
< 55	47,642	31.28%	36.1%	87%	33.7%	93%
55	27,306	25.35%	25.0%	101%	25.0%	101%
56	27,527	16.95%	24.0%	71%	20.0%	85%
57	31,126	17.19%	20.0%	86%	19.0%	90%
58	33,777	18.80%	18.0%	104%	18.0%	104%
59	35,626	18.75%	18.0%	104%	18.0%	104%
60	36,594	20.97%	21.0%	100%	21.0%	100%
61	35,907	18.97%	18.0%	105%	18.0%	105%
62	33,997	20.70%	19.0%	109%	20.0%	104%
63	32,073	17.99%	19.0%	95%	18.0%	100%
64	30,991	23.65%	19.0%	124%	21.0%	113%
65	35,420	32.55%	22.0%	148%	27.0%	121%
66	24,519	27.45%	26.0%	106%	27.0%	102%
67	18,744	25.71%	24.0%	107%	25.0%	103%
68	14,068	23.97%	25.0%	96%	24.0%	100%
69	10,689	21.99%	24.0%	92%	24.0%	92%
70 – 74	21,543	24.35%	25.0%	97%	24.0%	101%
Total	497,548	22.82%	22.5%	101%	22.5%	101%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Unreduced Retirements – Females

State and Local Government Divisions (Non-Troopers)
Unreduced Retirements – Males

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
< 55	37,394	35.93%	41.6%	86%	38.7%	93%
55	28,535	27.84%	25.0%	111%	26.0%	107%
56	30,959	18.10%	20.0%	90%	19.0%	95%
57	34,526	16.99%	20.0%	85%	18.0%	94%
58	36,725	16.83%	18.0%	94%	17.0%	99%
59	37,806	19.78%	20.0%	99%	20.0%	99%
60	38,442	20.28%	20.0%	101%	20.0%	101%
61	37,001	19.34%	18.0%	107%	19.0%	102%
62	34,716	23.21%	22.0%	106%	23.0%	101%
63	31,482	19.93%	20.0%	100%	20.0%	100%
64	30,732	24.84%	20.0%	124%	22.0%	113%
65	34,027	29.00%	24.0%	121%	27.0%	107%
66	24,470	32.24%	26.0%	124%	29.0%	111%
67	18,289	30.17%	25.0%	121%	28.0%	108%
68	14,162	26.13%	22.0%	119%	24.0%	109%
69	12,406	23.13%	22.0%	105%	24.0%	96%
70 – 74	28,277	24.61%	25.0%	98%	24.0%	103%
Total	509,950	23.58%	22.8%	103%	23.2%	102%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Unreduced Retirements – Males

State and Local Government Divisions (Troopers)
Unreduced Retirements – Unisex

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
50	2,047	47.41%	40.0%	119%	40.0%	119%
51	1,445	29.14%	32.0%	91%	28.0%	104%
52	1,538	24.63%	32.0%	77%	28.0%	88%
53	1,460	9.83%	32.0%	31%	28.0%	35%
54	1,476	29.68%	32.0%	93%	28.0%	106%
55	1,151	13.52%	32.0%	42%	28.0%	48%
56	687	52.74%	32.0%	165%	28.0%	188%
57	565	41.52%	32.0%	130%	28.0%	148%
58	549	21.64%	32.0%	68%	28.0%	77%
59	288	0.00%	32.0%	0%	28.0%	0%
60	647	21.05%	32.0%	66%	28.0%	75%
61	619	16.10%	32.0%	50%	28.0%	57%
62	642	23.63%	32.0%	74%	28.0%	84%
63	357	0.00%	32.0%	0%	28.0%	0%
64	115	49.15%	32.0%	154%	28.0%	176%
Total	13,585	26.99%	33.2%	81%	29.8%	91%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Unreduced Retirements – Unisex

School and DPS Divisions (PERA Benefit Structure)
Unreduced Retirements – Females

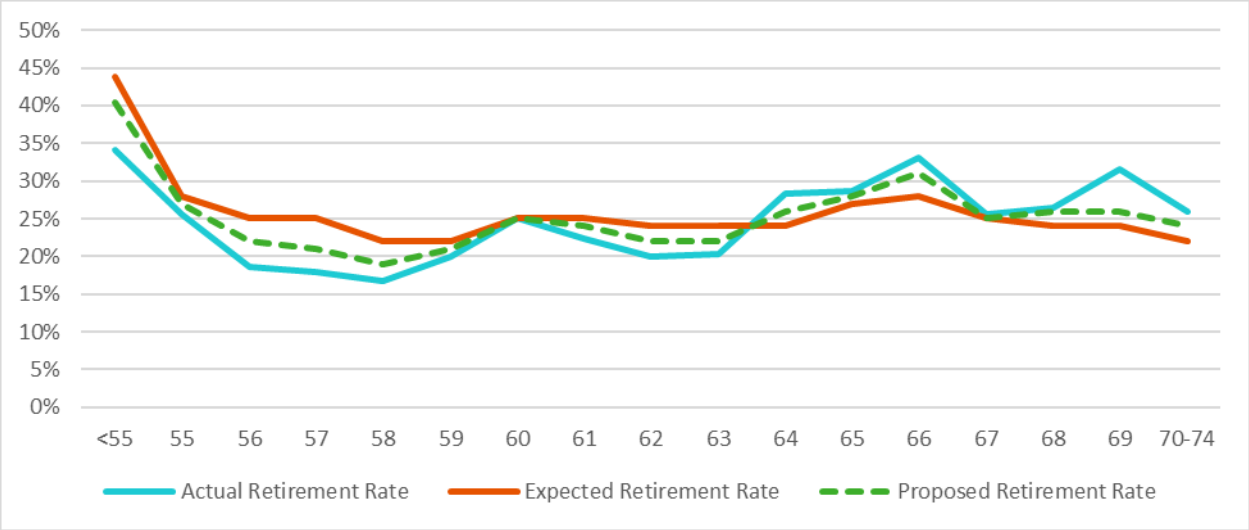
Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
< 55	41,681	33.09%	45.0%	74%	38.8%	85%
55	59,092	27.13%	29.0%	94%	28.0%	97%
56	56,464	22.66%	25.0%	91%	24.0%	94%
57	57,353	20.21%	25.0%	81%	23.0%	88%
58	59,151	21.82%	22.0%	99%	22.0%	99%
59	61,184	22.89%	22.0%	104%	22.0%	104%
60	62,243	22.93%	25.0%	92%	24.0%	96%
61	60,036	22.32%	24.0%	93%	23.0%	97%
62	57,495	24.40%	27.0%	90%	26.0%	94%
63	49,759	22.86%	24.0%	95%	24.0%	95%
64	43,040	27.08%	24.0%	113%	24.0%	113%
65	42,146	35.17%	26.0%	135%	31.0%	113%
66	26,748	29.79%	28.0%	106%	29.0%	103%
67	19,208	26.13%	25.0%	105%	26.0%	100%
68	14,584	27.26%	22.0%	124%	25.0%	109%
69	11,507	27.58%	22.0%	125%	25.0%	110%
70 – 74	20,338	25.16%	23.8%	106%	24.9%	101%
Total	742,029	25.06%	25.9%	97%	25.5%	98%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Unreduced Retirements – Females

School and DPS Divisions (PERA Benefit Structure)
Unreduced Retirements – Males

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
< 55	25,333	34.04%	43.9%	78%	40.4%	84%
55	29,370	25.51%	28.0%	91%	27.0%	94%
56	28,391	18.54%	25.0%	74%	22.0%	84%
57	26,858	17.87%	25.0%	71%	21.0%	85%
58	25,786	16.73%	22.0%	76%	19.0%	88%
59	25,470	19.93%	22.0%	91%	21.0%	95%
60	23,272	25.10%	25.0%	100%	25.0%	100%
61	18,339	22.42%	25.0%	90%	24.0%	93%
62	15,866	19.90%	24.0%	83%	22.0%	90%
63	14,777	20.37%	24.0%	85%	22.0%	93%
64	13,251	28.32%	24.0%	118%	26.0%	109%
65	14,688	28.61%	27.0%	106%	28.0%	102%
66	10,716	33.04%	28.0%	118%	31.0%	107%
67	7,607	25.64%	25.0%	103%	25.0%	103%
68	5,944	26.40%	24.0%	110%	26.0%	102%
69	5,029	31.58%	24.0%	132%	26.0%	121%
70 – 74	10,409	25.96%	22.0%	118%	24.0%	108%
Total	301,105	23.58%	26.3%	90%	25.0%	94%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Unreduced Retirements – Males



All Divisions (DPS Benefit Structure)
Unreduced Retirements – Females

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
< 55	1,122	34.74%	30.5%	114%	30.5%	114%
55	3,548	38.17%	30.0%	127%	34.0%	112%
56	2,785	23.73%	25.0%	95%	24.0%	99%
57	2,426	24.07%	25.0%	96%	25.0%	96%
58	2,344	20.05%	20.0%	100%	20.0%	100%
59	2,658	32.59%	24.0%	136%	28.0%	116%
60	2,835	18.60%	30.0%	62%	25.0%	74%
61	3,005	28.85%	28.0%	103%	28.0%	103%
62	2,495	30.99%	30.0%	103%	30.0%	103%
63	2,085	31.78%	30.0%	106%	31.0%	103%
64	2,359	53.53%	30.0%	178%	42.0%	127%
65	4,762	40.75%	35.0%	116%	38.0%	107%
66	2,799	35.93%	35.0%	103%	35.0%	103%
67	2,415	32.88%	32.0%	103%	32.0%	103%
68	1,449	23.96%	30.0%	80%	27.0%	89%
69	1,538	28.13%	30.0%	94%	29.0%	97%
70 – 74	3,766	26.46%	30.0%	88%	29.4%	90%
Total	44,390	31.4%	29.4%	107%	30.4%	103%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Unreduced Retirements – Females

All Divisions (DPS Benefit Structure)
Unreduced Retirements – Males

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
< 55	1,311	23.45%	34.8%	67%	29.8%	79%
55	1,981	29.81%	30.0%	99%	30.0%	99%
56	2,271	20.63%	20.0%	103%	20.0%	103%
57	2,171	28.81%	24.0%	120%	26.0%	111%
58	2,062	20.94%	22.0%	95%	22.0%	95%
59	1,675	27.23%	25.0%	109%	26.0%	105%
60	1,292	29.13%	22.0%	132%	26.0%	112%
61	836	7.38%	20.0%	37%	18.0%	41%
62	1,101	29.01%	25.0%	116%	27.0%	107%
63	1,112	38.69%	40.0%	97%	40.0%	97%
64	816	28.74%	20.0%	144%	24.0%	120%
65	1,909	46.33%	30.0%	154%	38.0%	122%
66	975	30.77%	30.0%	103%	30.0%	103%
67	670	13.32%	30.0%	44%	30.0%	44%
68	517	44.59%	30.0%	149%	30.0%	149%
69	469	32.28%	30.0%	108%	30.0%	108%
70 – 74	804	47.61%	30.0%	159%	30.0%	159%
Total	21,972	28.86%	26.6%	109%	27.6%	104%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Unreduced Retirements – Males

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

Judicial Division
All Retirements – Unisex

Age	Exposures (Benefits, in 000's)	Actual Retirement Rate	Expected Retirement Rate	Ratio of Actual to Expected	Proposed Retirement Rate	Ratio of Actual to Proposed
50	0	0.00%	6.0%	0%	6.0%	0%
51	0	0.00%	6.0%	0%	6.0%	0%
52	217	0.00%	6.0%	0%	6.0%	0%
53	657	0.00%	6.0%	0%	6.0%	0%
54	973	18.54%	6.0%	937%	10.0%	185%
55	1,839	2.13%	6.0%	48%	10.0%	21%
56	2,212	22.46%	6.0%	440%	10.0%	225%
57	2,323	11.17%	6.0%	233%	10.0%	112%
58	1,828	5.31%	6.0%	93%	8.0%	66%
59	1,812	6.44%	6.0%	109%	8.0%	80%
60	3,211	13.49%	8.0%	275%	10.0%	135%
61	2,365	8.79%	8.0%	163%	10.0%	88%
62	2,577	10.44%	8.0%	196%	10.0%	104%
63	2,913	11.20%	8.0%	220%	10.0%	112%
64	3,153	1.38%	8.0%	22%	8.0%	17%
65 - 69	13,691	23.38%	15.0%	156%	20.0%	117%
70 - 74	4,331	37.75%	40.0%	94%	40.0%	94%
Total	44,102	16.57%	11.6%	143%	15.7%	122%

Actual Versus Proposed Experience, Benefit-Weighted Basis
All Retirements – Unisex

Inactive Vested Retirement

The current assumption is that 100% of inactive members who terminated employer with less than five years of service elect to withdraw their contributions. Current inactive members in the PERA Benefit Structure who are assumed to leave their contributions in the plan in order to be eligible for a benefit at their retirement date are assumed to retire at age 62 with an unreduced pension benefit. Current inactive members in the DPS Benefit Structure who are assumed to leave their contributions in the plan in order to be eligible for a benefit at their retirement date are assumed to retire at age 65 with an unreduced pension benefit.

We reviewed actual experience related to inactive vested members. Actual experience shows that some members retire earlier than the current assumption, but not an amount material enough to warrant a change in the current assumption at this point.

C. Termination

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

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

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

The current assumption for termination uses “select and ultimate” tables for the State Division (Non-Troopers), School and DPS Divisions (PERA Benefit Structure), and Local Government Division. Because all DPS Benefit Structure members have more than five years of service, the termination assumptions are based on age only. Termination experience for the Judicial Division does not follow a select and ultimate pattern and as a result, the termination assumption is based on age only. We have analyzed the experience to determine if the select period should be extended or eliminated and recommend that the current select period be retained. With the exception of the DPS Division (PERA Benefit Structure), proposed rates of termination have been developed based on weighting the current assumption (i.e., historical experience) by two-thirds and recent experience by one-third.

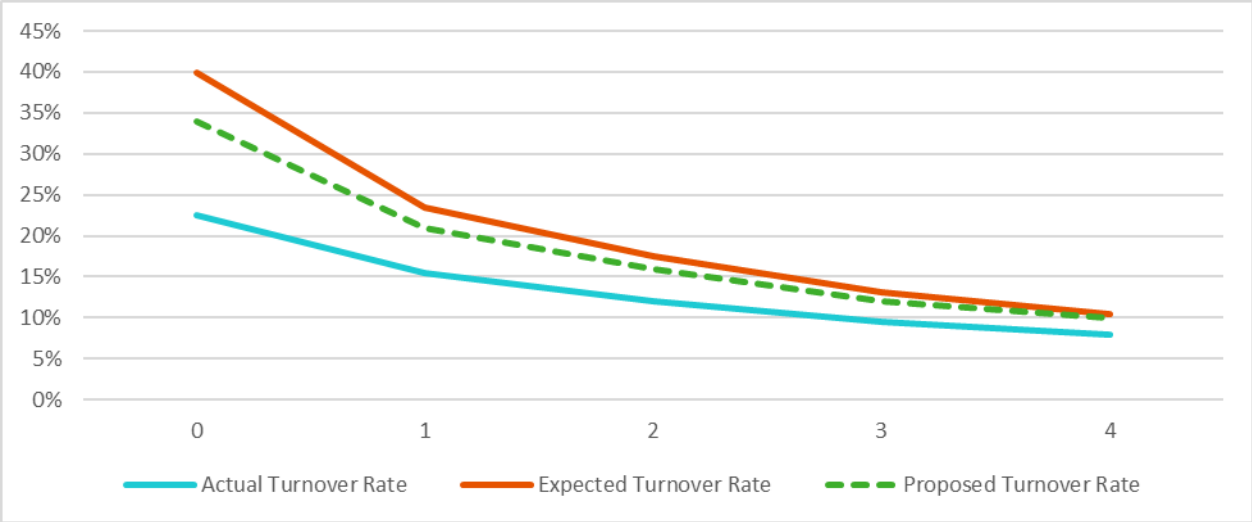
Select Termination Rates

The current select termination rates vary by gender. Based on our analysis, we recommend that unisex rates be adopted and that the select termination rates be decreased. The following tables provide a summary of select termination rates by division for the study period:

State and Local Government Divisions (Non-Troopers)
0 to 5 Years From Hire – Unisex

Years from Hire	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate[12]	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
0	13,819	22.49%	39.96%	56%	34.00%	66%
1	36,567	15.46%	23.48%	66%	21.00%	74%
2	53,270	12.07%	17.52%	69%	16.00%	75%
3	64,605	9.45%	13.04%	72%	12.00%	79%
4	73,567	7.96%	10.52%	76%	10.00%	80%
Total	241,828	11.23%	16.38%	69%	14.89%	75%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Select Period Termination – Unisex

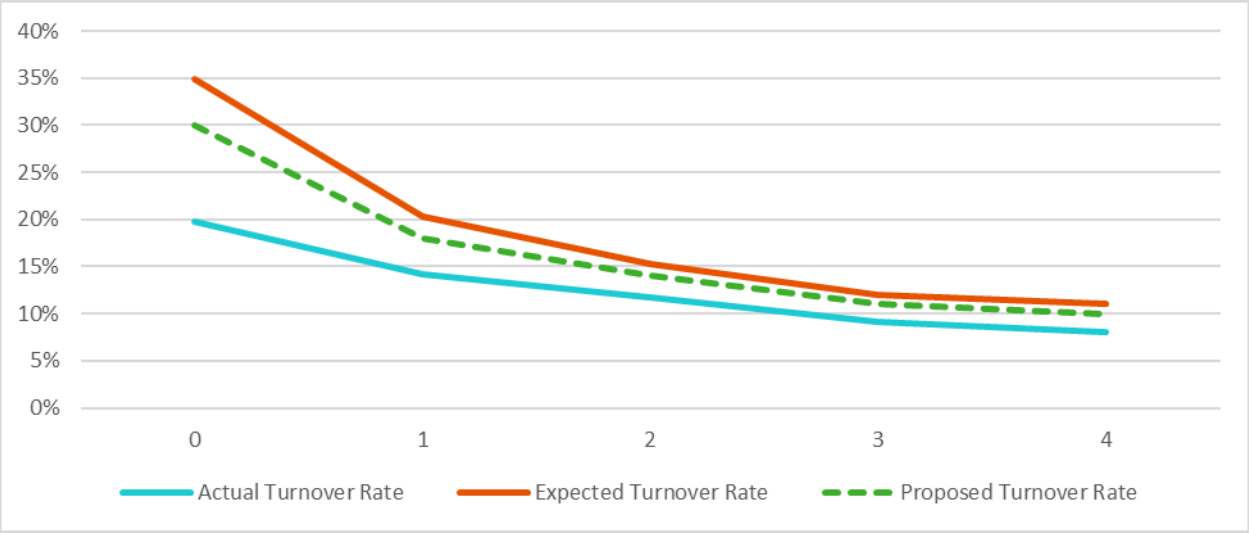


[12] Current select period rates are sex distinct; exhibit shows composite unisex rates.

School Division
0 to 5 Years From Hire – Unisex

Years from Hire	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate[13]	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
0	13,274	19.81%	34.89%	57%	30.00%	66%
1	39,936	14.23%	20.29%	70%	18.00%	79%
2	61,296	11.69%	15.28%	76%	14.00%	83%
3	77,589	9.15%	12.00%	76%	11.00%	83%
4	89,217	8.05%	11.00%	73%	10.00%	81%
Total	281,312	10.58%	14.65%	72%	13.23%	80%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Select Period Termination – Unisex

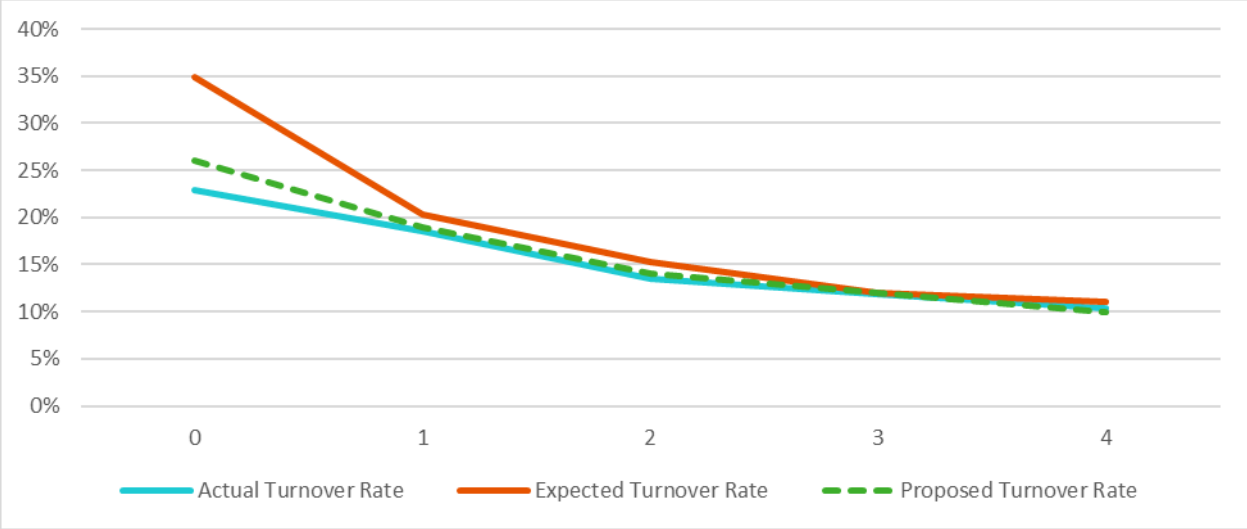


[13] Current select period rates are sex distinct; exhibit shows composite unisex rates.

DPS Division (PERA Benefit Structure)
0 to 5 Years From Hire – Unisex

Years from Hire	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate[14]	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
0	3,190	22.85%	34.94%	65%	26.00%	88%
1	9,201	18.57%	20.30%	91%	19.00%	98%
2	13,828	13.46%	15.30%	88%	14.00%	96%
3	16,861	11.90%	12.00%	99%	12.00%	99%
4	18,884	10.35%	11.00%	94%	10.00%	103%
Total	61,964	13.33%	14.84%	90%	13.60%	98%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Select Period Termination – Unisex



Currently, the School and DPS Divisions use the same rates of termination. However, a review of the actual experience shows that the DPS Division has materially higher turnover among the active population. We are recommending a new schedule of termination rates for the DPS Division that trend closer to actual experience over the study period.

[14] Current select period rates are sex distinct; exhibit shows composite unisex rates.

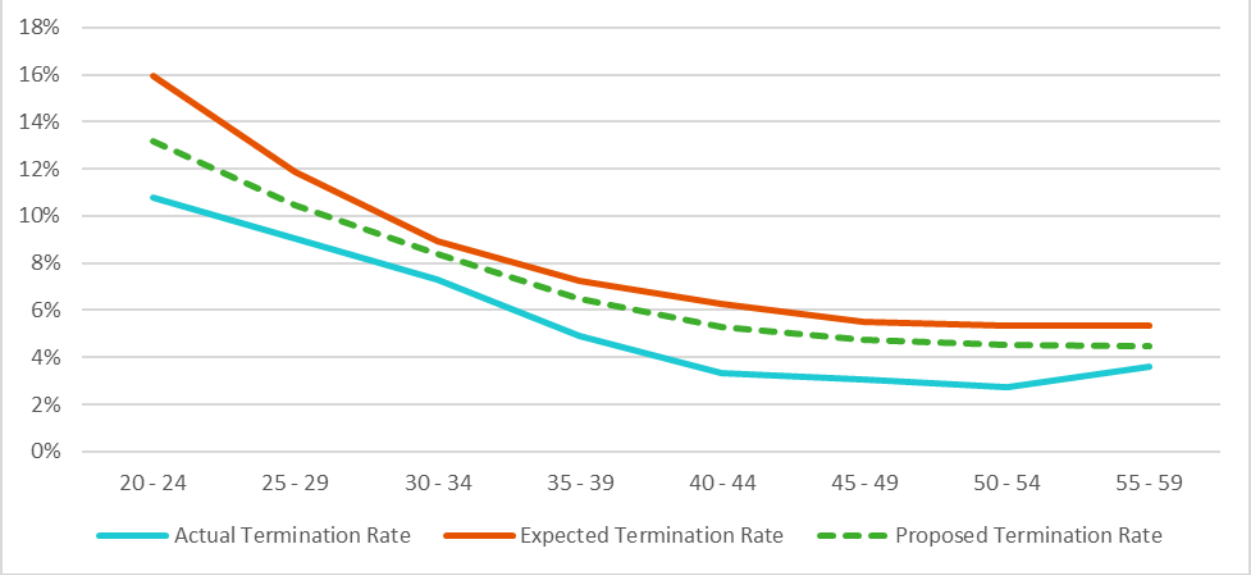
Ultimate Termination Rates

The current ultimate termination assumptions are sex-distinct and based on age. We recommend changes (primarily decreases) to the rates of termination. The following tables and graphs show the actual, expected, and proposed termination rates based on age and gender.

State and Local Government Divisions (Non-Troopers)
More Than 5 Years From Hire – Females

Age	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
20 – 24	101	10.77%	15.93%	68%	13.18%	82%
25 – 29	6,450	9.05%	11.85%	76%	10.44%	87%
30 – 34	43,376	7.29%	8.95%	81%	8.36%	87%
35 – 39	105,348	4.93%	7.26%	68%	6.50%	76%
40 – 44	168,404	3.32%	6.24%	53%	5.31%	63%
45 – 49	272,525	3.04%	5.53%	55%	4.77%	64%
50 – 54	227,225	2.76%	5.37%	51%	4.53%	61%
55 +	151,589	3.62%	5.36%	68%	4.50%	80%
Total	975,017	3.55%	5.97%	59%	5.15%	69%

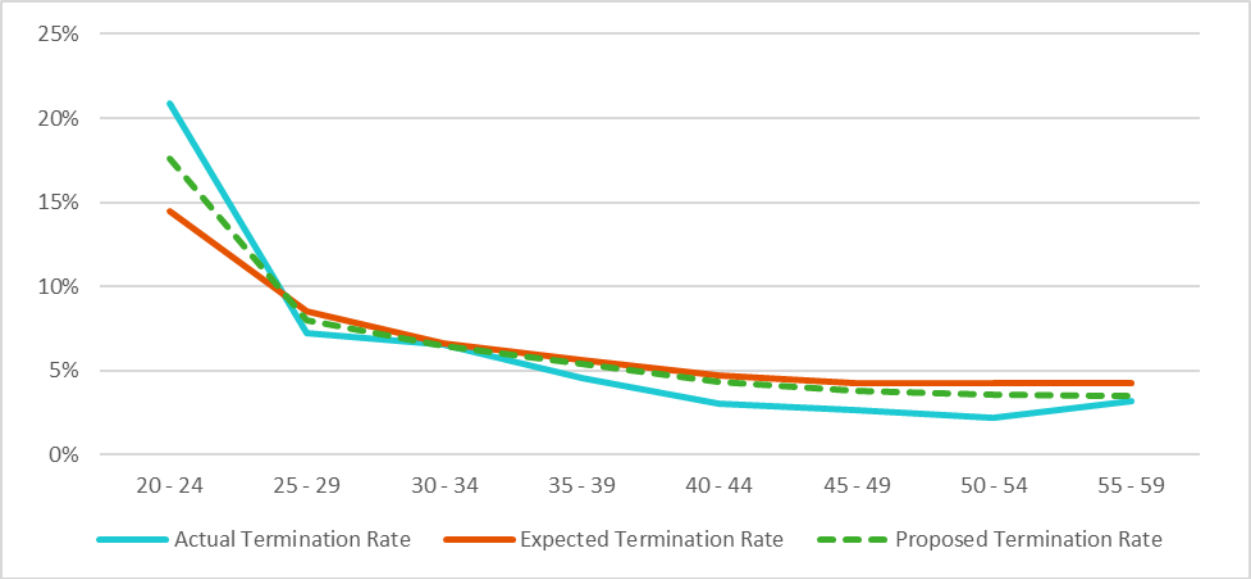
Actual Versus Proposed Experience, Benefit-Weighted Basis
Ultimate Termination Rates – Females



State and Local Government Divisions (Non-Troopers)
More Than 5 Years From Hire – Males

Age	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
20 – 24	64	20.91%	14.49%	144%	17.58%	119%
25 – 29	6,792	7.23%	8.56%	84%	7.98%	91%
30 – 34	45,300	6.54%	6.61%	99%	6.44%	102%
35 – 39	105,291	4.58%	5.65%	81%	5.41%	85%
40 – 44	184,113	3.01%	4.72%	64%	4.31%	70%
45 – 49	291,700	2.63%	4.30%	61%	3.78%	70%
50 – 54	222,472	2.18%	4.30%	51%	3.61%	60%
55 – 59	138,901	3.23%	4.29%	75%	3.51%	92%
Total	994,634	3.10%	4.65%	67%	4.13%	75%

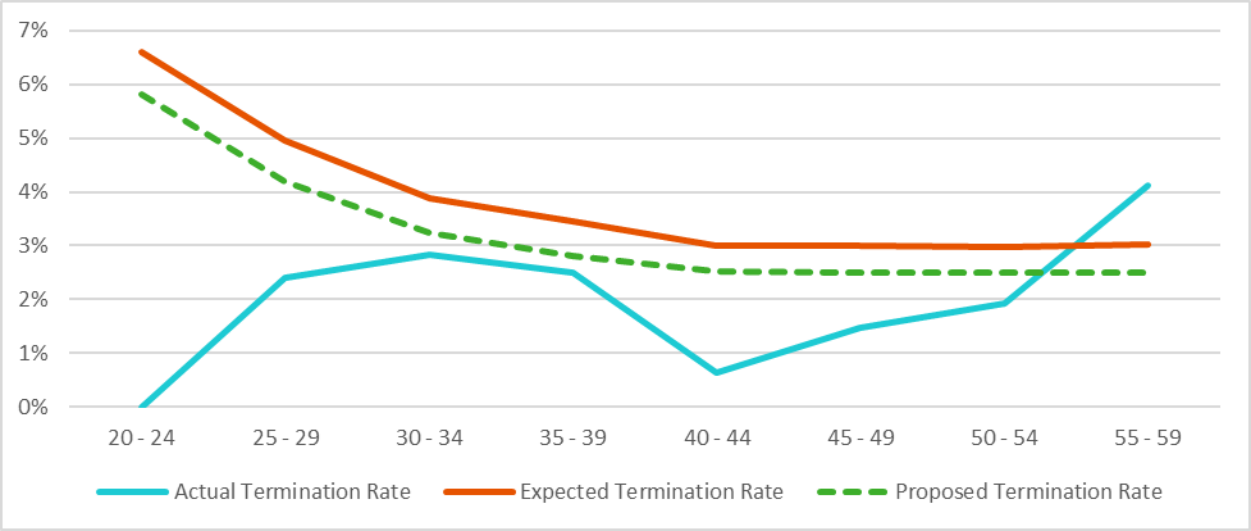
Actual Versus Proposed Experience, Benefit-Weighted Basis
Ultimate Termination Rates – Males



State and Local Government Divisions (Troopers)
All Years of Service – Unisex

Age	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
20 – 24	103	0.00%	6.60%	0%	5.82%	0%
25 – 29	1,354	2.41%	4.96%	49%	4.18%	58%
30 – 34	5,979	2.84%	3.88%	73%	3.25%	87%
35 – 39	11,971	2.50%	3.44%	73%	2.81%	89%
40 – 44	18,811	0.64%	3.00%	21%	2.53%	25%
45 – 49	33,479	1.48%	3.00%	49%	2.50%	59%
50 – 54	5,791	1.92%	3.00%	65%	2.50%	77%
55 – 59	1,817	4.12%	3.00%	136%	2.50%	165%
Total	79,307	1.65%	3.17%	52%	2.64%	62%

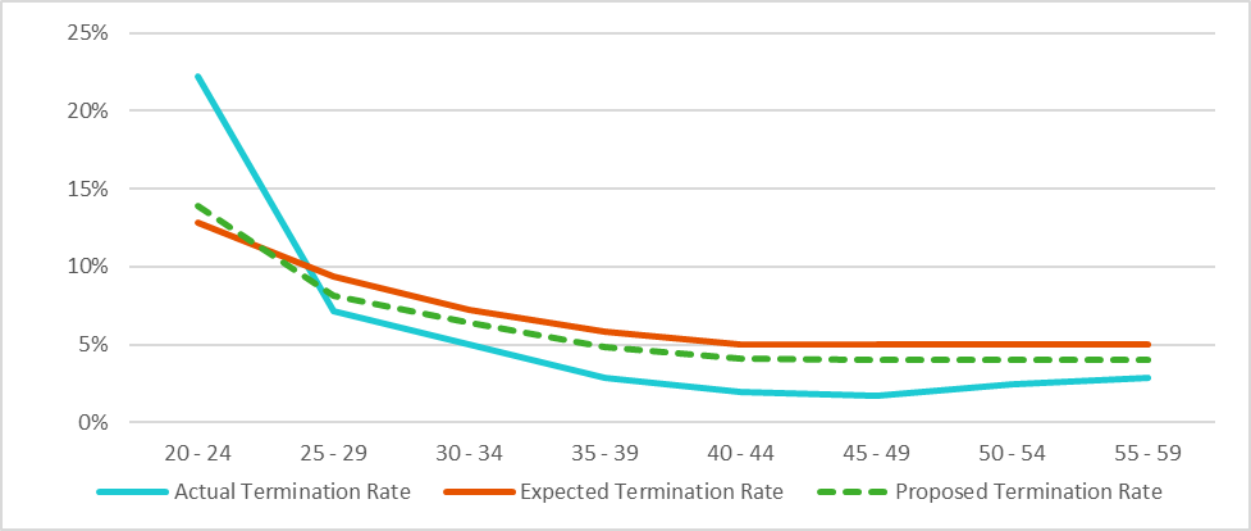
Actual Versus Proposed Experience, Benefit-Weighted Basis
Ultimate Termination Rates – Unisex



School Division
More Than 5 Years From Hire – Females

Age	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
20 – 24	255	22.22%	12.84%	173%	13.92%	160%
25 – 29	21,129	7.14%	9.37%	76%	8.15%	88%
30 – 34	133,121	5.04%	7.27%	69%	6.39%	79%
35 – 39	307,013	2.87%	5.83%	49%	4.88%	59%
40 – 44	469,162	1.94%	5.00%	39%	4.09%	47%
45 – 49	668,496	1.71%	5.00%	34%	4.00%	43%
50 – 54	494,557	2.49%	5.00%	50%	4.00%	62%
55 – 59	290,020	2.91%	5.00%	58%	4.00%	73%
Total	2,383,754	2.45%	5.27%	46%	4.30%	57%

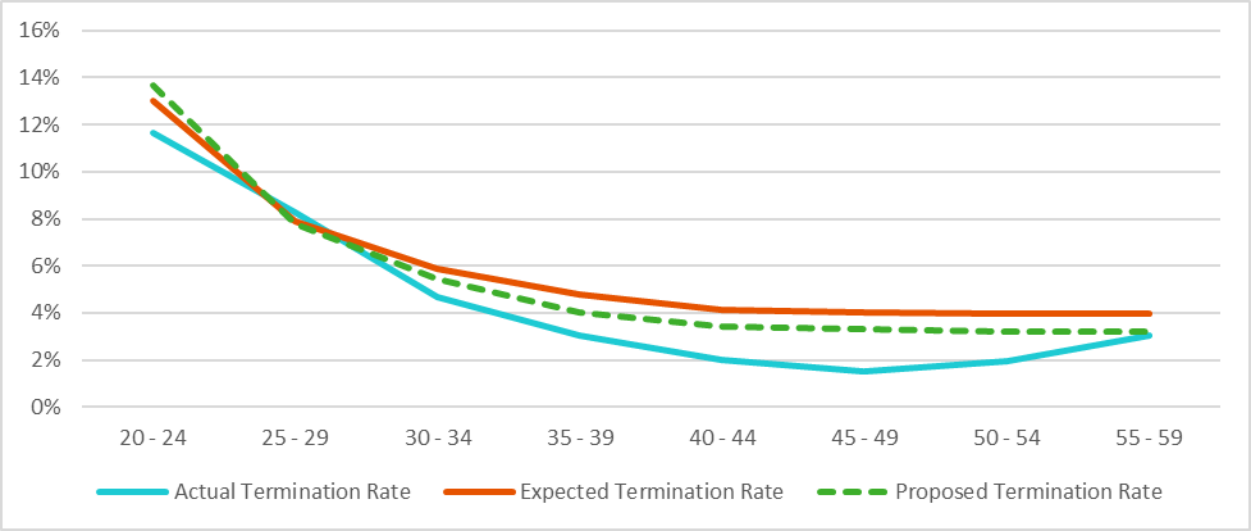
Actual Versus Proposed Experience, Benefit-Weighted Basis
Ultimate Termination Rates – Females



School Division
More Than 5 Years From Hire – Males

Age	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
20 – 24	316	11.66%	13.04%	89%	13.69%	85%
25 – 29	7,500	8.26%	7.88%	105%	7.76%	106%
30 – 34	47,228	4.66%	5.88%	79%	5.44%	86%
35 – 39	118,548	3.02%	4.79%	63%	4.05%	75%
40 – 44	201,684	2.00%	4.14%	48%	3.45%	58%
45 – 49	286,130	1.51%	4.00%	38%	3.30%	46%
50 – 54	189,259	1.93%	4.00%	49%	3.21%	60%
55 – 59	82,183	3.07%	4.00%	77%	3.20%	96%
Total	932,848	2.25%	4.26%	53%	3.55%	63%

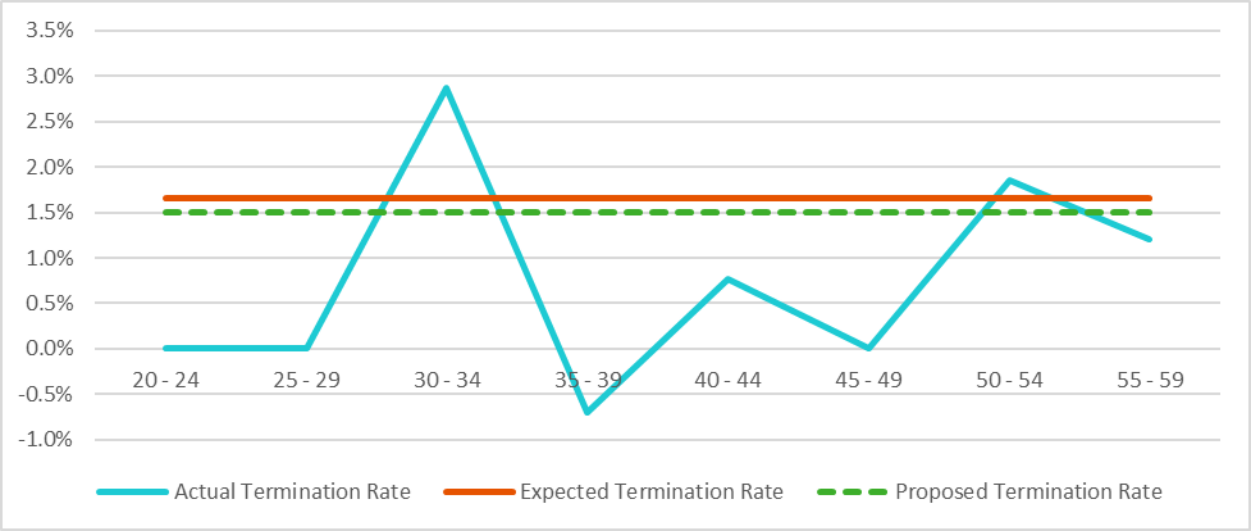
Actual Versus Proposed Experience, Benefit-Weighted Basis
Ultimate Termination Rates – Males



Judicial Division
All Years of Service – Unisex

Age	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
20 – 24	0	0.00%	1.65%	0%	1.50%	0%
25 – 29	5	0.00%	1.65%	0%	1.50%	0%
30 – 34	92	2.87%	1.65%	174%	1.50%	191%
35 – 39	614	-0.69%	1.65%	-42%	1.50%	-46%
40 – 44	2,203	0.76%	1.65%	46%	1.50%	51%
45 – 49	5,699	0.00%	1.65%	0%	1.50%	0%
50 – 54	11,071	1.86%	1.65%	113%	1.50%	124%
55 – 59	7,984	1.21%	1.65%	73%	1.50%	80%
Total	27,669	1.15%	1.65%	69%	1.50%	76%

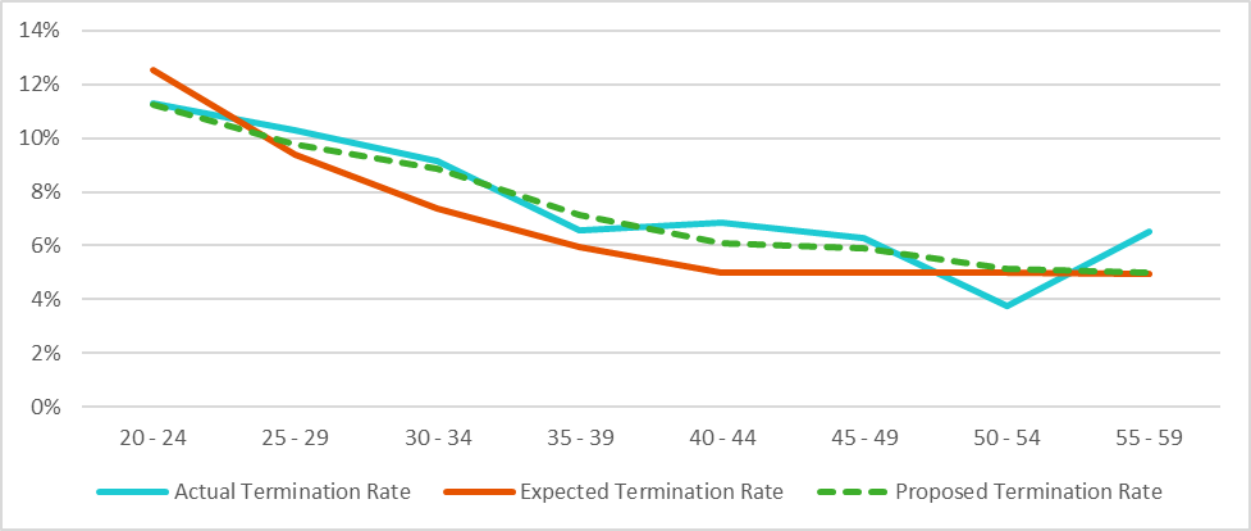
Actual Versus Proposed Experience, Benefit-Weighted Basis
Ultimate Termination Rates – Unisex



DPS Division (PERA Benefit Structure)
More Than 5 Years From Hire – Females

Age	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
20 – 24	57	11.29%	12.55%	90%	11.24%	100%
25 – 29	4,412	10.29%	9.41%	109%	9.77%	105%
30 – 34	17,306	9.16%	7.37%	124%	8.85%	103%
35 – 39	17,868	6.56%	5.94%	110%	7.15%	92%
40 – 44	15,422	6.86%	5.00%	137%	6.12%	112%
45 – 49	14,550	6.29%	5.00%	126%	5.89%	107%
50 – 54	10,696	3.76%	5.00%	75%	5.13%	73%
55 – 59	7,264	6.53%	4.97%	131%	5.00%	131%
Total	87,575	6.93%	5.88%	118%	6.81%	102%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Ultimate Termination Rates – Females

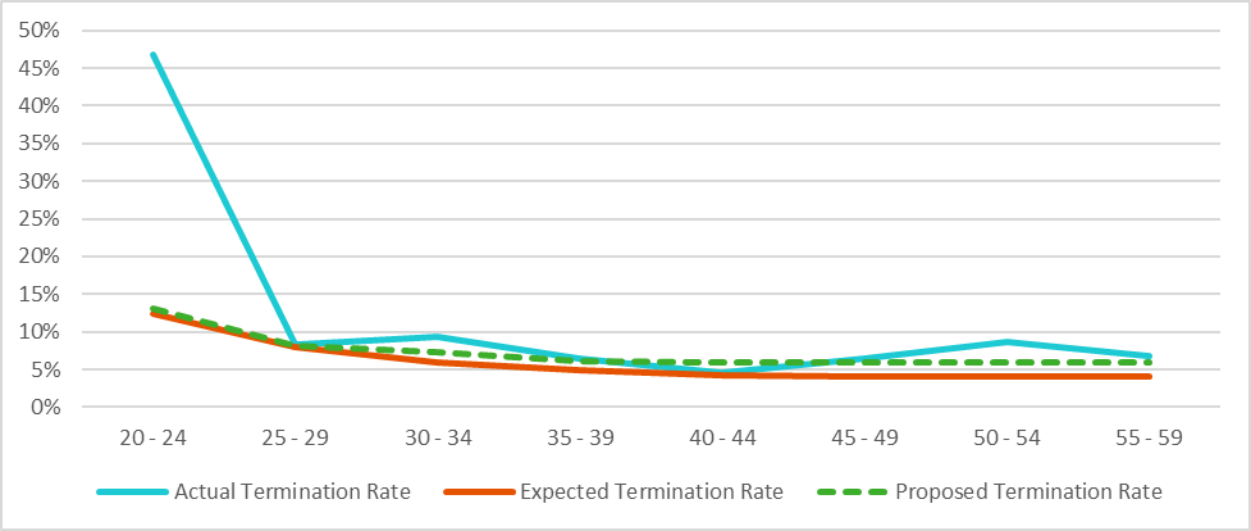


Currently, the School and DPS Divisions use the same rates of termination. However, a review of the actual experience shows that the DPS Division has materially higher turnover among the active population. We are recommending a new schedule of termination rates for the DPS Division that trend closer to actual experience over the study period.

DPS Division (PERA Benefit Structure)
More Than 5 Years From Hire – Males

Age	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
20 – 24	22	46.85%	12.35%	379%	13.08%	358%
25 – 29	942	8.29%	7.89%	105%	8.17%	102%
30 – 34	4,705	9.29%	5.93%	157%	7.32%	127%
35 – 39	7,218	6.50%	4.84%	134%	6.16%	106%
40 – 44	6,566	4.61%	4.16%	111%	6.00%	77%
45 – 49	5,761	6.48%	4.00%	162%	6.00%	108%
50 – 54	3,538	8.60%	4.00%	215%	6.00%	143%
55 – 59	2,109	6.70%	4.00%	167%	6.00%	112%
Total	30,862	6.86%	4.65%	148%	6.31%	109%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Ultimate Termination Rates – Males

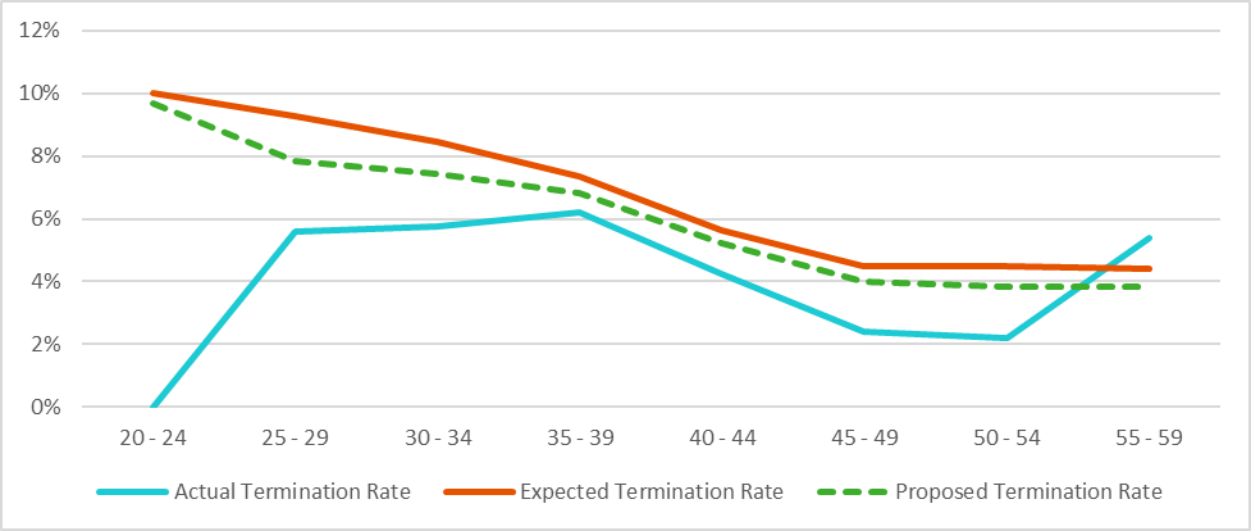


Currently, the School and DPS Divisions use the same rates of termination. However, a review of the actual experience shows that the DPS Division has materially higher turnover among the active population. We are recommending a new schedule of termination rates for the DPS Division that trend closer to actual experience over the study period.

All Divisions (DPS Benefit Structure)
All Years of Service – Females

Age	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
20 – 24	0	0.00%	10.00%	0%	9.70%	0%
25 – 29	472	5.59%	9.28%	60%	7.84%	71%
30 – 34	9,221	5.75%	8.47%	68%	7.44%	77%
35 – 39	19,642	6.20%	7.37%	84%	6.82%	91%
40 – 44	31,151	4.26%	5.64%	75%	5.24%	81%
45 – 49	42,527	2.42%	4.50%	54%	4.00%	60%
50 – 54	35,127	2.21%	4.50%	49%	3.85%	57%
55 – 59	7,998	5.38%	4.39%	122%	3.85%	140%
Total	146,138	3.65%	5.39%	68%	4.83%	76%

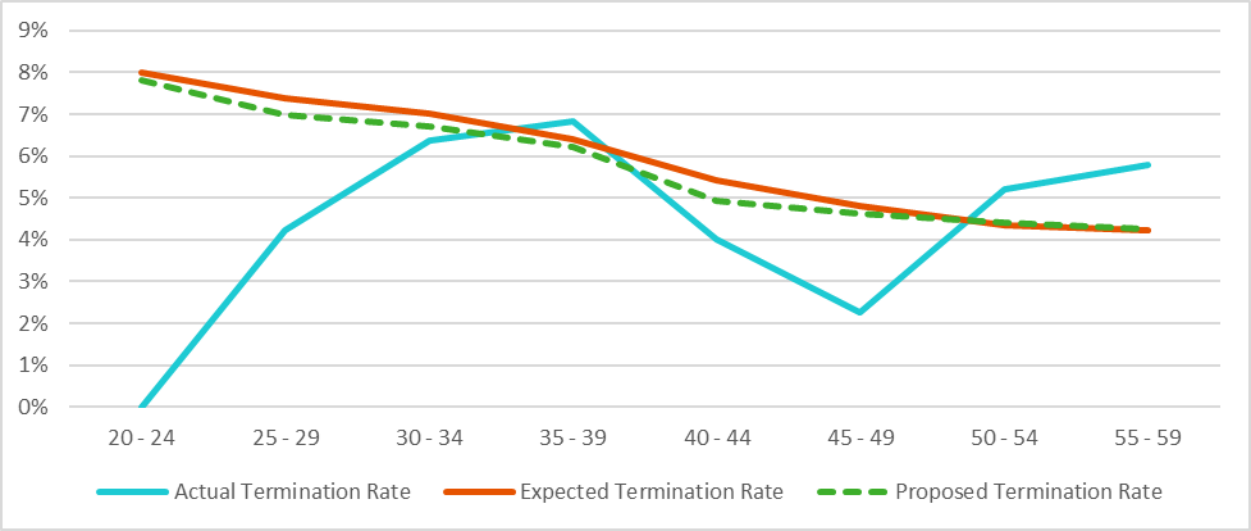
Actual Versus Proposed Experience, Benefit-Weighted Basis
Ultimate Termination Rates – Females



All Divisions (DPS Benefit Structure)
All Years of Service – Males

Age	Exposures (Benefits, in 000's)	Actual Termination Rate	Expected Termination Rate	Ratio of Actual to Expected	Proposed Termination Rate	Ratio of Actual to Proposed
20 – 24	0	0.00%	8.00%	0%	7.82%	0%
25 – 29	343	4.23%	7.39%	57%	6.97%	61%
30 – 34	3,018	6.37%	7.00%	91%	6.72%	95%
35 – 39	6,774	6.82%	6.39%	107%	6.22%	110%
40 – 44	13,312	4.00%	5.43%	74%	4.93%	81%
45 – 49	16,240	2.26%	4.80%	47%	4.63%	49%
50 – 54	16,144	5.20%	4.36%	119%	4.41%	118%
55 – 59	4,076	5.80%	4.21%	138%	4.27%	136%
Total	59,908	4.42%	5.09%	87%	4.91%	90%

Actual Versus Proposed Experience, Benefit-Weighted Basis
Ultimate Termination Rates – Males



Refunds of Contributions

For all but the Judicial Division, the current assumption is that 35% of the vested members who terminate elect to withdraw their contributions and matching employer contributions while the remaining 65% elect to leave their contributions in the plan in order to be eligible for a benefit at their retirement date. For Judicial Division members, the current assumption is that 100% of the vested members who terminate elect to leave their contribution in in the plan in order to be eligible for a benefit at their retirement date. Current active members who are assumed to terminate service and leave their contributions in the Plan in order to be eligible for a benefit at their retirement date are assumed to retire with a reduced benefit, if applicable, at an age based upon benefit structure, Non-Trooper/Trooper, and/or service.

There is very little actual experience from the Judicial Division. **We recommend maintaining the current 100% assumption for this group**.

For all other divisions, we examined actual refund of contribution elections for members during the experience period. The observed election percentage during the experience period is around 33.6%. **We recommend maintaining the current assumption of 35%**.

D. Disability Retirement

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

The current disability rates are based on age and are unisex for all divisions. Rates are the highest for Troopers within the State Division and are the lowest for the School and DPS Divisions (PERA Benefit Structure). Aggregate experience for the period January 1, 2016 to December 31, 2019 resulted in net losses for PERA, although the Judicial Division had no disability retirements during the experience period, which resulted in actuarial gains.

The State and Local Government Divisions have similar disability rates, with minor differences starting at age 35. Actual experience is comparable between these two groups and they have been aggregated for purposes of developing a proposed assumption. Similarly, the School and DPS Divisions (PERA Benefit Structure) have different disability rates than the Judicial Division or members under the DPS Benefit Structure. However, since all of these groups have similar profiles for disability incidence, they were combined for purposes of developing a proposed assumption.

State and Local Government Divisions (Non-Troopers)
All Ages Less Than 65 – Unisex

Age	Exposures (Benefits, in 000's)	Actual Disability Rate	Expected Disability Rate	Ratio of Actual to Expected	Proposed Disability Rate	Ratio of Actual to Proposed
Total	3,334,367	0.1116%	0.1827%	61%	0.1478%	76%

Based on the experience, **we recommend a uniform decrease of 19% applied to the current composite disability retirement rates**.

State and Local Government Divisions (Troopers)
All Ages Less Than 65 – Unisex

Age	Exposures (Benefits, in 000's)	Actual Disability Rate	Expected Disability Rate	Ratio of Actual to Expected	Proposed Disability Rate	Ratio of Actual to Proposed
Total	99,660	0.0646%	0.2191%	30%	0.2191%	30%

There were only two actual disability retirements during the experience study period. Given the limited actual experience and the overall size of this group, **we recommend no changes to the existing disability retirement rates**.

School, DPS and Judicial Divisions
All Ages Less Than 65 – Unisex

Age	Exposures (Benefits, in 000's)	Actual Disability Rate	Expected Disability Rate	Ratio of Actual to Expected	Proposed Disability Rate	Ratio of Actual to Proposed
Total	5,503,785	0.0659%	0.1070%	62%	0.0866%	76%

Based on the experience, **we recommend a uniform decrease of 19% applied to the current composite disability retirement rates**.

E. Spouse Information

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

- 100% of active members (80% for DPS Division) are married
- Male spouses are two years older than female spouses
- 100% of spouses are of the opposite gender

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

IV. Appendix

Appendix A: Proposed Salary Scale

State Division

	State (Non-Troopers)		Troopers	
Age	Current	Proposed	Current	Proposed[15]
20	9.17%	10.90%	9.00%	12.40%
21	8.79%	10.40%	8.65%	11.70%
22	8.40%	9.90%	8.30%	11.00%
23	8.02%	9.40%	7.95%	10.30%
24	7.63%	8.90%	7.60%	9.60%
25	7.25%	8.50%	7.25%	8.90%
26	7.06%	8.00%	7.06%	8.20%
27	6.87%	7.50%	6.87%	7.50%
28	6.68%	7.30%	6.68%	7.30%
29	6.49%	7.00%	6.49%	7.00%
30	6.30%	6.80%	6.30%	6.80%
31	6.15%	6.50%	6.15%	6.50%
32	6.00%	6.30%	6.00%	6.30%
33	5.85%	6.20%	5.85%	6.20%
34	5.60%	6.00%	5.70%	6.00%
35	5.55%	5.90%	5.55%	5.90%
36	5.44%	5.70%	5.44%	5.70%
37	5.33%	5.60%	5.33%	5.60%
38	5.22%	5.50%	5.22%	5.50%
39	5.11%	5.30%	5.11%	5.30%
40	5.00%	5.20%	5.00%	5.20%
41	4.87%	5.00%	4.94%	5.00%
42	4.74%	4.90%	4.88%	4.90%
43	4.61%	4.80%	4.82%	4.80%
44	4.48%	4.70%	4.76%	4.70%
45	4.35%	4.60%	4.70%	4.70%
46	4.28%	4.50%	4.62%	4.60%
47	4.21%	4.40%	4.54%	4.50%
48	4.14%	4.30%	4.46%	4.40%
49	4.07%	4.20%	4.38%	4.30%
50	4.00%	4.10%	4.30%	4.30%

[15] Proposed assumptions for active members eligible for Trooper benefits within the State and Local Government Divisions.

	State (Non-Troopers)		Troopers	
Age	Current	Proposed	Current	Proposed*
51	3.92%	4.00%	4.22%	4.20%
52	3.84%	3.90%	4.14%	4.10%
53	3.76%	3.80%	4.06%	4.00%
54	3.68%	3.80%	3.98%	4.00%
55	3.60%	3.70%	3.90%	3.90%
56	3.58%	3.70%	3.82%	3.90%
57	3.56%	3.60%	3.74%	3.80%
58	3.54%	3.60%	3.66%	3.70%
59	3.52%	3.50%	3.58%	3.70%
60	3.50%	3.50%	3.50%	3.60%
61	3.50%	3.40%	3.50%	3.60%
62	3.50%	3.40%	3.50%	3.50%
63	3.50%	3.40%	3.50%	3.40%
64	3.50%	3.40%	3.50%	3.40%
65	3.50%	3.30%	3.50%	3.30%
66	3.50%	3.30%	3.50%	3.30%
67 and over	3.50%	3.30%	3.50%	3.20%

School and Denver Public Schools Divisions

	School		Denver Public Schools	
Age	Current[16]	Proposed[17]	Current[18]	Proposed[19]
20	9.70%	11.00%	7.00%	11.50%
21	9.28%	10.50%	7.00%	11.10%
22	8.86%	10.00%	7.00%	10.70%
23	8.44%	9.50%	7.00%	10.30%
24	8.02%	9.10%	7.00%	9.90%
25	7.60%	8.60%	7.00%	9.40%
26	7.37%	8.20%	7.00%	9.00%
27	7.14%	7.70%	7.00%	8.60%
28	6.91%	7.50%	6.90%	8.30%
29	6.68%	7.20%	6.80%	8.00%
30	6.45%	7.00%	6.70%	7.80%
31	6.36%	6.70%	6.60%	7.50%
32	6.27%	6.50%	6.50%	7.20%
33	6.18%	6.40%	6.42%	7.10%
34	6.09%	6.30%	6.34%	7.00%
35	6.00%	6.30%	6.26%	6.90%
36	5.89%	6.20%	6.18%	6.80%
37	5.78%	6.10%	6.10%	6.70%
38	5.67%	6.00%	5.94%	6.50%
39	5.56%	5.90%	5.78%	6.40%
40	5.45%	5.70%	5.62%	6.20%
41	5.33%	5.60%	5.46%	6.10%
42	5.21%	5.50%	5.20%	5.90%
43	5.09%	5.40%	5.08%	5.80%
44	4.97%	5.30%	4.96%	5.60%
45	4.85%	5.10%	4.84%	5.50%
46	4.74%	5.00%	4.72%	5.30%
47	4.63%	4.90%	4.60%	5.20%
48	4.52%	4.80%	4.50%	5.10%
49	4.41%	4.70%	4.40%	5.00%
50	4.30%	4.60%	4.30%	5.00%
51	4.21%	4.50%	4.20%	4.90%
52	4.12%	4.40%	4.10%	4.80%
53	4.03%	4.30%	4.04%	4.70%
54	3.94%	4.20%	3.98%	4.70%

[16] Current assumptions for active members under the PERA Benefit Structure within the School and DPS Divisions.
[17] Proposed assumptions for all active members within the School Division.
[18] Current assumptions for active members under the DPS Benefit Structure regardless of division.
[19] Proposed assumptions for all active members within the DPS Division.

	School		Denver Public Schools	
Age	Current	Proposed	Current	Proposed
55	3.85%	4.20%	3.92%	4.60%
56	3.78%	4.10%	3.86%	4.60%
57	3.71%	4.00%	3.80%	4.50%
58	3.64%	3.90%	3.70%	4.40%
59	3.57%	3.90%	3.70%	4.30%
60	3.50%	3.80%	3.70%	4.30%
61	3.50%	3.80%	3.70%	4.20%
62	3.50%	3.70%	3.70%	4.10%
63	3.50%	3.60%	3.70%	4.00%
64	3.50%	3.60%	3.70%	4.00%
65	3.50%	3.50%	3.50%	3.90%
66	3.50%	3.50%	3.50%	3.90%
67 and over	3.50%	3.40%	3.50%	3.80%

Local Government Division (Non-Troopers)

Age	Current	Proposed
20	10.45%	11.30%
21	9.92%	10.80%
22	9.40%	10.30%
23	8.86%	9.80%
24	8.33%	9.20%
25	7.80%	8.70%
26	7.47%	8.10%
27	7.14%	7.60%
28	6.80%	7.30%
29	6.47%	7.00%
30	6.14%	6.80%
31	5.95%	6.50%
32	5.77%	6.20%
33	5.59%	6.10%
34	5.41%	6.00%
35	5.22%	5.80%
36	5.12%	5.70%
37	5.02%	5.60%
38	4.93%	5.50%
39	4.83%	5.40%
40	4.73%	5.20%
41	4.68%	5.10%
42	4.63%	5.00%
43	4.59%	4.90%

Age	Current	Proposed
44	4.54%	4.90%
45	4.49%	4.80%
46	4.45%	4.80%
47	4.41%	4.70%
48	4.37%	4.60%
49	4.33%	4.60%
50	4.29%	4.50%
51	4.25%	4.50%
52	4.21%	4.40%
53	4.18%	4.30%
54	4.14%	4.30%
55	4.10%	4.20%
56	4.03%	4.20%
57	3.96%	4.10%
58	3.89%	4.00%
59	3.82%	4.00%
60	3.75%	3.90%
61	3.70%	3.90%
62	3.65%	3.80%
63	3.60%	3.70%
64	3.55%	3.60%
65	3.50%	3.40%
66	3.50%	3.30%
67 and over	3.50%	3.20%

Judicial Division

Current Age Based		Proposed Service Based	
Age	Current	Service	Proposed
30	5.00%	0	5.30%
31	5.00%	1	5.30%
32	5.00%	2	5.30%
33	5.00%	3	5.20%
34	5.00%	4	5.10%
35	5.00%	5	5.00%
36	4.82%	6	4.90%
37	4.67%	7	4.80%
38	4.50%	8	4.70%
39	4.33%	9	4.60%
40	4.17%	10	4.50%
41	4.14%	11	4.40%
42	4.09%	12	4.30%

Current Age Based		Proposed Service Based	
Age	**Current**	**Service**	**Proposed**
43	4.07%	13	4.30%
44	4.03%	14	4.20%
45 and over	4.00%	15	4.20%
		16	4.10%
		17	4.10%
		18	4.00%
		19	4.00%
		20	3.90%
		21	3.90%
		22	3.80%
		23	3.80%
		24	3.70%
		25	3.70%
		26	3.60%
		27	3.60%
		28	3.50%
		29	3.50%
		30	3.40%
		31	3.40%
		32	3.30%
		33	3.30%
		34	3.20%
		35	3.20%
		36	3.10%
		37	3.10%
		38	2.90%
		39	3.00%
		40	2.80%

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

State Division (Non-Troopers)

Age	Unreduced Retirement[20]				Reduced Retirement			
	Female		Male		Female		Male	
	Current Rate	Proposed Rate	Current Rate	Proposed Rate	Current Rate	Proposed Rate	Current Rate	Proposed Rate
50	55.00%	48.00%	60.00%	56.00%	10.00%	9.00%	9.50%	9.50%
51	40.00%	35.00%	50.00%	43.00%	10.00%	8.00%	9.50%	11.00%
52	36.00%	34.00%	42.00%	38.00%	10.00%	8.00%	9.50%	11.00%
53	34.00%	28.00%	38.00%	34.00%	10.00%	9.00%	9.50%	12.00%
54	26.00%	30.00%	32.00%	33.00%	10.00%	12.00%	9.50%	12.00%
55	25.00%	25.00%	25.00%	26.00%	10.00%	15.00%	9.50%	12.00%
56	24.00%	20.00%	20.00%	19.00%	10.00%	11.00%	9.50%	9.50%
57	20.00%	19.00%	20.00%	18.00%	10.00%	12.00%	9.50%	15.00%
58	18.00%	18.00%	18.00%	17.00%	10.00%	15.00%	9.50%	15.00%
59	18.00%	18.00%	20.00%	20.00%	10.00%	35.00%	9.50%	35.00%
60	21.00%	21.00%	20.00%	20.00%	10.00%	8.00%	9.50%	7.50%
61	18.00%	18.00%	18.00%	19.00%	10.00%	8.00%	9.50%	7.50%
62	19.00%	20.00%	22.00%	23.00%	10.00%	9.00%	9.50%	7.50%
63	19.00%	18.00%	20.00%	20.00%	10.00%	9.00%	9.50%	7.50%
64	19.00%	21.00%	20.00%	22.00%	10.00%	9.00%	9.50%	7.50%
65	22.00%	27.00%	24.00%	27.00%				
66	26.00%	27.00%	26.00%	29.00%				
67	24.00%	25.00%	25.00%	28.00%				
68	25.00%	24.00%	22.00%	24.00%				
69	24.00%	24.00%	22.00%	24.00%				
70	25.00%	24.00%	25.00%	24.00%				
71	25.00%	24.00%	25.00%	24.00%				
72	25.00%	24.00%	25.00%	24.00%				
73	25.00%	24.00%	25.00%	24.00%				
74	25.00%	24.00%	25.00%	24.00%				
75	100.00%	100.00%	100.00%	100.00%				

[20] Additional increase in rates during the first 5 years of unreduced retirement for ages 55 to 64. For females, the rates are 20%, 9%, 9%, 9%, and 9%. For males, the rates are 30%, 13%, 13%, 13%, and 13%.

State and Local Government Divisions (Troopers)

Age	Unreduced Retirement[21]		Reduced Retirement	
	Unisex		Unisex	
	Current Rate	Proposed Rate	Current Rate	Proposed Rate
50	40.00%	40.00%	10.00%	10.00%
51	32.00%	28.00%	10.00%	10.00%
52	32.00%	28.00%	10.00%	10.00%
53	32.00%	28.00%	10.00%	10.00%
54	32.00%	28.00%	10.00%	10.00%
55	32.00%	28.00%	5.00%	5.00%
56	32.00%	28.00%	5.00%	5.00%
57	32.00%	28.00%	5.00%	5.00%
58	32.00%	28.00%	5.00%	5.00%
59	32.00%	28.00%	5.00%	5.00%
60	32.00%	28.00%	10.00%	10.00%
61	32.00%	28.00%	10.00%	10.00%
62	32.00%	28.00%	10.00%	10.00%
63	32.00%	28.00%	10.00%	10.00%
64	32.00%	28.00%	10.00%	10.00%
65	100.00%	100.00%		
66	100.00%	100.00%		
67	100.00%	100.00%		
68	100.00%	100.00%		
69	100.00%	100.00%		
70	100.00%	100.00%		
71	100.00%	100.00%		
72	100.00%	100.00%		
73	100.00%	100.00%		
74	100.00%	100.00%		
75	100.00%	100.00%		

[21] An additional 20% increase in rates during the first year of unreduced retirement eligibility at ages 55 to 64

School and Denver Public Schools Divisions (PERA Benefit Structure)

Age	Unreduced Retirement[22]				Reduced Retirement			
	Female		Male		Female		Male	
	Current Rate	Proposed Rate	Current Rate	Proposed Rate	Current Rate	Proposed Rate	Current Rate	Proposed Rate
50	60.00%	55.00%	55.00%	52.00%	8.00%	7.00%	8.00%	8.00%
51	54.00%	45.00%	48.00%	43.00%	8.00%	7.00%	8.00%	8.00%
52	48.00%	41.00%	46.00%	41.00%	8.00%	8.00%	8.00%	9.00%
53	42.00%	37.00%	42.00%	39.00%	8.00%	10.00%	8.00%	9.00%
54	40.00%	34.00%	40.00%	37.00%	10.00%	14.00%	10.00%	12.00%
55	29.00%	28.00%	28.00%	27.00%	10.00%	12.00%	10.00%	9.00%
56	25.00%	24.00%	25.00%	22.00%	11.00%	12.00%	10.00%	9.00%
57	25.00%	23.00%	25.00%	21.00%	11.00%	12.00%	10.00%	9.00%
58	22.00%	22.00%	22.00%	19.00%	11.00%	16.00%	10.00%	12.00%
59	22.00%	22.00%	22.00%	21.00%	11.00%	34.00%	10.00%	24.00%
60	25.00%	24.00%	25.00%	25.00%	11.00%	9.00%	10.00%	8.00%
61	24.00%	23.00%	25.00%	24.00%	11.00%	9.00%	12.00%	9.00%
62	27.00%	26.00%	24.00%	22.00%	11.00%	10.00%	12.00%	10.00%
63	24.00%	24.00%	24.00%	22.00%	11.00%	10.00%	12.00%	10.00%
64	24.00%	24.00%	24.00%	26.00%	11.00%	10.00%	12.00%	10.00%
65	26.00%	31.00%	27.00%	28.00%				
66	28.00%	29.00%	28.00%	31.00%				
67	25.00%	26.00%	25.00%	25.00%				
68	22.00%	25.00%	24.00%	26.00%				
69	22.00%	25.00%	24.00%	26.00%				
70	25.00%	28.00%	22.00%	24.00%				
71	23.00%	23.00%	22.00%	24.00%				
72	23.00%	23.00%	22.00%	24.00%				
73	23.00%	23.00%	22.00%	24.00%				
74	23.00%	23.00%	22.00%	24.00%				
75	100.00%	100.00%	100.00%	100.00%				

[22] Additional increase in rates during the first 5 years of unreduced retirement for ages 55 to 64. For females, the rates are 28%, 10%, 10%, 10%, and 10%. For males, the rates are 28%, 4%, 4%, 4%, and 4%.

Local Government Division (Non-Troopers)

Age	Unreduced Retirement[23]				Reduced Retirement			
	Female		Male		Female		Male	
	Current Rate	Proposed Rate	Current Rate	Proposed Rate	Current Rate	Proposed Rate	Current Rate	Proposed Rate
50	60.00%	48.00%	60.00%	56.00%	9.00%	9.00%	8.00%	9.50%
51	52.00%	35.00%	46.00%	43.00%	9.00%	8.00%	8.00%	11.00%
52	40.00%	34.00%	30.00%	38.00%	9.00%	8.00%	8.00%	11.00%
53	40.00%	28.00%	25.00%	34.00%	9.00%	9.00%	8.00%	12.00%
54	40.00%	30.00%	22.00%	33.00%	9.00%	12.00%	8.00%	12.00%
55	28.00%	25.00%	22.00%	26.00%	12.00%	15.00%	8.00%	12.00%
56	30.00%	20.00%	25.00%	19.00%	12.00%	11.00%	8.00%	9.50%
57	21.00%	19.00%	22.00%	18.00%	12.00%	12.00%	8.00%	15.00%
58	21.00%	18.00%	20.00%	17.00%	12.00%	15.00%	8.00%	15.00%
59	21.00%	18.00%	20.00%	20.00%	11.50%	35.00%	10.00%	35.00%
60	21.00%	21.00%	22.00%	20.00%	11.50%	8.00%	11.00%	7.50%
61	20.00%	18.00%	22.00%	19.00%	11.50%	8.00%	11.00%	7.50%
62	27.00%	20.00%	24.00%	23.00%	11.50%	9.00%	11.00%	7.50%
63	22.00%	18.00%	25.00%	20.00%	11.50%	9.00%	11.00%	7.50%
64	22.00%	21.00%	25.00%	22.00%	11.50%	9.00%	11.00%	7.50%
65	25.00%	27.00%	25.00%	27.00%				
66	25.00%	27.00%	30.00%	29.00%				
67	30.00%	25.00%	20.00%	28.00%				
68	20.00%	24.00%	25.00%	24.00%				
69	20.00%	24.00%	25.00%	24.00%				
70	24.00%	24.00%	25.00%	24.00%				
71	24.00%	24.00%	25.00%	24.00%				
72	24.00%	24.00%	25.00%	24.00%				
73	24.00%	24.00%	25.00%	24.00%				
74	24.00%	24.00%	25.00%	24.00%				
75	100.00%	100.00%	100.00%	100.00%				

[23] Additional increase in rates during the first 5 years of unreduced retirement for ages 55 to 64. For females, the rates are 20%, 9%, 9%, 9% and 9%. For males, the rates are 30%, 13%, 13%, 13%, and 13%.

Judicial Division

Age	Unreduced Retirement				Reduced Retirement			
	Female		Male		Female		Male	
	Current Rate	Proposed Rate	Current Rate	Proposed Rate	Current Rate	Proposed Rate	Current Rate	Proposed Rate
50	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
51	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
52	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
53	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
54	6.00%	10.00%	6.00%	10.00%	6.00%	10.00%	6.00%	10.00%
55	6.00%	10.00%	6.00%	10.00%	6.00%	10.00%	6.00%	10.00%
56	6.00%	10.00%	6.00%	10.00%	6.00%	10.00%	6.00%	10.00%
57	6.00%	10.00%	6.00%	10.00%	6.00%	10.00%	6.00%	10.00%
58	6.00%	8.00%	6.00%	8.00%	6.00%	8.00%	6.00%	8.00%
59	6.00%	8.00%	6.00%	8.00%	6.00%	8.00%	6.00%	8.00%
60	8.00%	10.00%	8.00%	10.00%	8.00%	10.00%	8.00%	10.00%
61	8.00%	10.00%	8.00%	10.00%	8.00%	10.00%	8.00%	10.00%
62	8.00%	10.00%	8.00%	10.00%	8.00%	10.00%	8.00%	10.00%
63	8.00%	10.00%	8.00%	10.00%	8.00%	10.00%	8.00%	10.00%
64	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
65	15.00%	20.00%	15.00%	20.00%				
66	15.00%	20.00%	15.00%	20.00%				
67	15.00%	20.00%	15.00%	20.00%				
68	15.00%	20.00%	15.00%	20.00%				
69	15.00%	20.00%	15.00%	20.00%				
70	40.00%	40.00%	40.00%	40.00%				
71	40.00%	40.00%	40.00%	40.00%				
72	40.00%	40.00%	40.00%	40.00%				
73	40.00%	40.00%	40.00%	40.00%				
74	40.00%	40.00%	40.00%	40.00%				
75	100.00%	100.00%	100.00%	100.00%				

All Divisions (DPS Benefit Structure)

Age	Unreduced Retirement				Reduced Retirement			
	Female		Male		Female		Male	
	Current Rate	Proposed Rate	Current Rate	Proposed Rate	Current Rate	Proposed Rate	Current Rate	Proposed Rate
50	40.00%	40.00%	40.00%	35.00%	5.00%	5.00%	8.00%	8.00%
51	40.00%	40.00%	40.00%	35.00%	5.00%	7.00%	8.00%	8.00%
52	30.00%	30.00%	35.00%	30.00%	5.00%	10.00%	8.00%	8.00%
53	30.00%	30.00%	35.00%	30.00%	10.00%	10.00%	8.00%	10.00%
54	30.00%	30.00%	30.00%	25.00%	10.00%	10.00%	11.00%	10.00%
55	30.00%	34.00%	30.00%	30.00%	10.00%	10.00%	11.00%	10.00%
56	25.00%	24.00%	20.00%	20.00%	10.00%	10.00%	11.00%	10.00%
57	25.00%	25.00%	24.00%	26.00%	10.00%	10.00%	11.00%	10.00%
58	20.00%	20.00%	22.00%	22.00%	10.00%	10.00%	11.00%	10.00%
59	24.00%	28.00%	25.00%	26.00%	12.00%	14.00%	15.00%	15.00%
60	30.00%	25.00%	22.00%	26.00%	15.00%	17.00%	15.00%	15.00%
61	28.00%	28.00%	20.00%	18.00%	15.00%	17.00%	17.00%	16.00%
62	30.00%	30.00%	25.00%	27.00%	15.00%	17.00%	17.00%	16.00%
63	30.00%	31.00%	40.00%	40.00%	15.00%	17.00%	17.00%	16.00%
64	30.00%	42.00%	20.00%	24.00%	15.00%	17.00%	17.00%	16.00%
65	35.00%	38.00%	30.00%	38.00%				
66	35.00%	35.00%	30.00%	30.00%				
67	32.00%	32.00%	30.00%	30.00%				
68	30.00%	27.00%	30.00%	30.00%				
69	30.00%	29.00%	30.00%	30.00%				
70	30.00%	28.00%	30.00%	30.00%				
71	30.00%	30.00%	30.00%	30.00%				
72	30.00%	30.00%	30.00%	30.00%				
73	30.00%	30.00%	30.00%	30.00%				
74	30.00%	30.00%	30.00%	30.00%				
75	100.00%	100.00%	100.00%	100.00%				

Appendix C: Proposed Termination Rates

State Division (Non-Troopers) – Select Table

	Female		Male	
Years from Hire	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
0	41.50%	34.00%	41.50%	34.00%
1	21.50%	21.00%	20.50%	21.00%
2	16.00%	16.00%	14.50%	16.00%
3	13.00%	12.00%	11.50%	12.00%
4	11.50%	10.00%	9.50%	10.00%

State Division (Non-Troopers) – Ultimate Table

	Female		Male	
Age	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
20	20.00%	16.45%	30.00%	30.00%
21	18.90%	15.35%	26.00%	26.00%
22	17.80%	14.25%	22.00%	22.00%
23	16.70%	13.60%	18.00%	19.20%
24	15.60%	12.95%	14.00%	16.40%
25	14.50%	12.30%	10.00%	13.60%
26	13.60%	11.65%	9.40%	10.80%
27	12.70%	11.00%	8.80%	8.00%
28	11.80%	10.50%	8.20%	7.70%
29	10.90%	10.00%	7.60%	7.40%
30	10.00%	9.50%	7.00%	7.10%
31	9.50%	9.00%	6.80%	6.80%
32	9.00%	8.50%	6.60%	6.50%
33	8.50%	8.10%	6.40%	6.30%
34	8.00%	7.70%	6.20%	6.10%
35	7.50%	7.30%	6.00%	5.90%
36	7.35%	6.90%	6.00%	5.70%
37	7.20%	6.50%	5.75%	5.50%
38	7.05%	6.25%	5.50%	5.25%
39	6.90%	6.00%	5.25%	5.00%
40	6.75%	5.75%	5.00%	4.75%
41	6.50%	5.50%	4.85%	4.50%
42	6.25%	5.25%	4.70%	4.25%
43	6.00%	5.15%	4.55%	4.15%
44	5.75%	5.05%	4.40%	4.05%

	Female		Male	
Age	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
45	5.50%	4.75%	4.25%	3.95%
46	5.45%	4.70%	4.25%	3.85%
47	5.40%	4.65%	4.25%	3.75%
48	5.35%	4.60%	4.25%	3.72%
49	5.30%	4.55%	4.25%	3.69%
50	5.25%	4.50%	4.25%	3.66%
51	5.25%	4.75%	4.25%	3.63%
52	5.25%	4.70%	4.25%	3.60%
53	5.25%	4.70%	4.25%	3.58%
54	5.25%	4.70%	4.25%	3.56%
55	5.25%	4.70%	4.25%	3.54%
56	5.25%	4.70%	4.25%	3.52%
57+	5.25%	4.70%	4.25%	3.50%

State and Local Government Divisions (Troopers)

	Unisex	
Age	Current Rate of Termination	Proposed Rate of Termination
20	8.00%	7.30%
21	7.60%	6.90%
22	7.20%	6.50%
23	6.80%	6.05%
24	6.40%	5.60%
25	6.00%	5.15%
26	5.60%	4.70%
27	5.20%	4.25%
28	4.80%	4.05%
29	4.40%	3.85%
30	4.00%	3.65%
31	3.95%	3.45%
32	3.90%	3.25%
33	3.85%	3.16%
34	3.80%	3.07%
35	3.75%	2.98%
36	3.60%	2.89%
37	3.45%	2.80%
38	3.30%	2.74%
39	3.15%	2.68%
40	3.00%	2.62%
41	3.00%	2.56%
42+	3.00%	2.50%

School Division – Select Table

	Female		Male	
Years from Hire	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
0	34.00%	30.00%	37.00%	30.00%
1	20.00%	18.00%	21.00%	18.00%
2	15.00%	14.00%	16.00%	14.00%
3	12.00%	11.00%	12.00%	11.00%
4	11.00%	10.00%	11.00%	10.00%

School Division – Ultimate Table

	Female		Male	
Age	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
20	14.50%	17.00%	20.00%	20.00%
21	14.00%	16.50%	18.00%	18.00%
22	13.50%	16.00%	16.00%	16.00%
23	13.00%	14.52%	14.00%	14.42%
24	12.50%	13.04%	12.00%	12.84%
25	12.00%	11.56%	10.00%	11.26%
26	11.20%	10.08%	9.30%	9.68%
27	10.40%	8.60%	8.60%	8.10%
28	9.60%	8.18%	7.90%	7.58%
29	8.80%	7.76%	7.20%	7.06%
30	8.00%	7.34%	6.50%	6.54%
31	7.70%	6.92%	6.25%	6.02%
32	7.40%	6.50%	6.00%	5.50%
33	7.10%	6.17%	5.75%	5.20%
34	6.80%	5.84%	5.50%	4.90%
35	6.50%	5.51%	5.25%	4.60%
36	6.20%	5.18%	5.05%	4.30%
37	5.90%	4.85%	4.85%	4.00%
38	5.60%	4.68%	4.65%	3.88%
39	5.30%	4.51%	4.45%	3.76%
40	5.00%	4.34%	4.25%	3.64%
41	5.00%	4.17%	4.20%	3.52%
42	5.00%	4.00%	4.15%	3.40%
43	5.00%	4.00%	4.10%	3.38%
44	5.00%	4.00%	4.05%	3.36%
45	5.00%	4.00%	4.00%	3.34%
46	5.00%	4.00%	4.00%	3.32%

	Female		Male	
Age	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
47	5.00%	4.00%	4.00%	3.30%
48	5.00%	4.00%	4.00%	3.28%
49	5.00%	4.00%	4.00%	3.26%
50	5.00%	4.00%	4.00%	3.24%
51	5.00%	4.00%	4.00%	3.22%
52+	5.00%	4.00%	4.00%	3.20%

Local Government Division (Non-Troopers) – Select Table

	Female		Male	
Years from Hire	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
0	39.00%	34.00%	41.00%	34.00%
1	23.00%	21.00%	24.00%	21.00%
2	18.00%	16.00%	17.00%	16.00%
3	14.00%	12.00%	12.00%	12.00%
4	11.00%	10.00%	10.00%	10.00%

Local Government Division (Non-Troopers) – Ultimate Table

	Female		Male	
Age	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
20	16.00%	16.45%	13.00%	30.00%
21	16.00%	15.35%	12.80%	26.00%
22	16.00%	14.25%	12.60%	22.00%
23	16.00%	13.60%	12.40%	19.20%
24	16.00%	12.95%	12.20%	16.40%
25	16.00%	12.30%	12.00%	13.60%
26	15.00%	11.65%	11.20%	10.80%
27	14.00%	11.00%	10.40%	8.00%
28	13.00%	10.50%	9.60%	7.70%
29	12.00%	10.00%	8.80%	7.40%
30	11.00%	9.50%	8.00%	7.10%
31	10.60%	9.00%	7.60%	6.80%
32	10.20%	8.50%	7.20%	6.50%
33	9.80%	8.10%	6.80%	6.30%
34	9.40%	7.70%	6.40%	6.10%
35	9.00%	7.30%	6.00%	5.90%
36	8.50%	6.90%	5.85%	5.70%
37	8.00%	6.50%	5.70%	5.50%
38	7.50%	6.25%	5.55%	5.25%
39	7.00%	6.00%	5.40%	5.00%
40	6.50%	5.75%	5.25%	4.75%
41	6.50%	5.50%	5.10%	4.50%
42	6.50%	5.25%	4.95%	4.25%
43	6.50%	5.15%	4.80%	4.15%
44	6.50%	5.05%	4.65%	4.05%
45	6.50%	4.75%	4.50%	3.95%
46	6.40%	4.70%	4.50%	3.85%

	Female		Male	
Age	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
47	6.30%	4.65%	4.50%	3.75%
48	6.20%	4.60%	4.50%	3.72%
49	6.10%	4.55%	4.50%	3.69%
50	6.00%	4.50%	4.50%	3.66%
51	6.00%	4.75%	4.50%	3.63%
52	6.00%	4.70%	4.50%	3.60%
53	6.00%	4.70%	4.50%	3.58%
54	6.00%	4.70%	4.50%	3.56%
55	6.00%	4.70%	4.50%	3.54%
56	6.00%	4.70%	4.50%	3.52%
57+	6.00%	4.70%	4.50%	3.50%

Judicial Division

	Unisex	
Age	Current Rate of Termination	Proposed Rate of Termination
For all ages	1.65%	1.50%

Denver Public Schools Division (PERA Benefit Structure) – Select Table

	Female		Male	
Years from Hire	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
0	34.00%	26.00%	37.00%	26.00%
1	20.00%	19.00%	21.00%	19.00%
2	15.00%	14.00%	16.00%	14.00%
3	12.00%	12.00%	12.00%	12.00%
4	11.00%	10.00%	11.00%	10.00%

Denver Public Schools Division (PERA Benefit Structure) – Ultimate Table

	Female		Male	
Age	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
20	14.50%	12.80%	20.00%	19.20%
21	14.00%	12.40%	18.00%	17.60%
22	13.50%	12.00%	16.00%	16.00%
23	13.00%	11.60%	14.00%	14.40%
24	12.50%	11.20%	12.00%	12.80%
25	12.00%	10.80%	10.00%	11.20%
26	11.20%	10.40%	9.30%	9.60%
27	10.40%	10.00%	8.60%	8.00%
28	9.60%	9.80%	7.90%	7.90%
29	8.80%	9.60%	7.20%	7.80%
30	8.00%	9.40%	6.50%	7.70%
31	7.70%	9.20%	6.25%	7.60%
32	7.40%	9.00%	6.00%	7.50%
33	7.10%	8.60%	5.75%	7.20%
34	6.80%	8.20%	5.50%	6.90%
35	6.50%	7.80%	5.25%	6.60%
36	6.20%	7.40%	5.05%	6.30%
37	5.90%	7.00%	4.85%	6.00%
38	5.60%	6.80%	4.65%	6.00%
39	5.30%	6.60%	4.45%	6.00%
40	5.00%	6.40%	4.25%	6.00%
41	5.00%	6.20%	4.20%	6.00%
42	5.00%	6.00%	4.15%	6.00%
43	5.00%	6.00%	4.10%	6.00%
44	5.00%	6.00%	4.05%	6.00%
45	5.00%	6.00%	4.00%	6.00%
46	5.00%	6.00%	4.00%	6.00%

	Female		Male	
Age	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
47	5.00%	6.00%	4.00%	6.00%
48	5.00%	5.80%	4.00%	6.00%
49	5.00%	5.60%	4.00%	6.00%
50	5.00%	5.40%	4.00%	6.00%
51	5.00%	5.20%	4.00%	6.00%
52+	5.00%	5.00%	4.00%	6.00%

All Divisions (DPS Benefit Structure)

	Female		Male	
Age	Current Rate of Termination	Proposed Rate of Termination	Current Rate of Termination	Proposed Rate of Termination
20	10.00%	10.00%	8.00%	8.00%
21	10.00%	10.00%	8.00%	8.00%
22	10.00%	10.00%	8.00%	8.00%
23	10.00%	9.60%	8.00%	7.80%
24	10.00%	9.20%	8.00%	7.60%
25	10.00%	8.80%	8.00%	7.40%
26	9.80%	8.40%	7.80%	7.20%
27	9.60%	8.00%	7.60%	7.00%
28	9.40%	7.90%	7.40%	6.95%
29	9.20%	7.80%	7.20%	6.90%
30	9.00%	7.70%	7.00%	6.85%
31	8.80%	7.60%	7.00%	6.80%
32	8.60%	7.50%	7.00%	6.75%
33	8.40%	7.40%	7.00%	6.70%
34	8.20%	7.30%	7.00%	6.65%
35	8.00%	7.20%	7.00%	6.60%
36	7.70%	7.10%	6.75%	6.55%
37	7.40%	7.00%	6.50%	6.50%
38	7.10%	6.65%	6.25%	6.15%
39	6.80%	6.30%	6.00%	5.80%
40	6.50%	5.95%	5.75%	5.45%
41	6.10%	5.60%	5.60%	5.10%
42	5.70%	5.25%	5.45%	4.75%
43	5.30%	4.97%	5.30%	4.73%
44	4.90%	4.69%	5.15%	4.71%
45	4.50%	4.41%	5.00%	4.69%
46	4.50%	4.13%	4.90%	4.67%
47	4.50%	3.85%	4.80%	4.65%
48	4.50%	3.85%	4.70%	4.60%
49	4.50%	3.85%	4.60%	4.55%
50	4.50%	3.85%	4.50%	4.55%
51	4.50%	3.85%	4.45%	4.45%
52	4.50%	3.85%	4.40%	4.40%
53	4.50%	3.85%	4.35%	4.37%
54	4.50%	3.85%	4.30%	4.34%
55	4.50%	3.85%	4.25%	4.31%
56	4.50%	3.85%	4.25%	4.28%
57+	4.50%	3.85%	4.25%	4.25%

END OF REPORT