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EMPLOYEES'
RETIREMENT SYSTEM
OF GEORGIA

EMPLOYEES' RETIREMENT SYSTEM OF GEORGIA

**EXPERIENCE INVESTIGATION FOR THE
FIVE-YEAR PERIOD ENDING JUNE 30, 2019**





Cavanaugh Macdonald

CONSULTING, LLC

The experience and dedication you deserve

December 18, 2020

Board of Trustees
Employees' Retirement System of Georgia
Two Northside 75, Suite 300
Atlanta, GA 30318

Members of the Board:

We are pleased to submit the results of an investigation of the economic and demographic experience for the Employees' Retirement System of Georgia (ERS) for the five-year period from July 1, 2014 to June 30, 2019. The study was based on the data submitted by ERS for the annual valuation. In preparing this report, we relied, without audit, on the data provided.

The purpose of the investigation is to assess the reasonability of the current ERS economic assumptions and demographic actuarial assumptions for the Retirement System. The results of the investigation indicate that the assumed rates of separation from active service due to withdrawal, disability, death and retirement and rates of post-retirement mortality need revision in order to provide a better fit between the actual and anticipated experience of the Retirement System. As a result of the investigation, it is recommended that revised economic assumptions and demographic tables be adopted by the Board for future use.

All recommended rates of separation, mortality and salary increase at each age for each Plan are shown in the attached tables in Appendix D of this report. In the actuary's judgment, the rates recommended are suitable for use until further experience indicates that modifications are desirable.

We hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices which are consistent with the principles prescribed by the Actuarial Standards Board (ASB) and the Code of Professional Conduct and Qualification Standards for Public Statements of Actuarial Opinion of the American Academy of Actuaries.



Board of Trustees
December 18, 2020
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We further certify that, in our opinion, the assumptions developed in this report satisfy Actuarial Standards of Practice, in particular, No. 27 (Selection of Economic Assumptions for Measuring Pension Obligations) and No. 35 (Selection of Demographic and Other Non-economic Assumptions for Measuring Pension Obligations). In order to prepare the results in this study, we have utilized appropriate actuarial models that were developed for this purpose. These models use assumptions about future contingent events along with recognized actuarial approaches to develop the needed results.

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

Respectfully submitted,

A handwritten signature in blue ink that reads "Edward J. Koebel".

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

A handwritten signature in blue ink that reads "Cathy Turcot".

Cathy Turcot
Principal and Managing Director

A handwritten signature in blue ink that reads "Ben Mobley".

Ben Mobley, ASA, EA, MAAA
Senior Actuary



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Section I - Executive Summary

The purpose of an actuarial valuation is to provide a timely best estimate of the ultimate costs of a retirement system. An actuarial valuation of the Employees' Retirement System of Georgia (ERS) is prepared annually to determine the actuarial contribution rates required to fund it on an actuarial reserve basis, (i.e. the current assets plus future contributions, along with investment earnings are expected to be sufficient to provide the benefits promised by the system). The valuation requires the use of certain assumptions with respect to the occurrence of future events, such as death, termination of employment, retirement, and salary changes (if applicable) to estimate the obligations of the system.

The basic purpose of an experience study is to determine whether the actuarial assumptions currently in use have adequately anticipated the actual emerging experience. This information, along with the professional judgment of system personnel and advisors, is used to evaluate the appropriateness of continued use of the current actuarial assumptions. When analyzing experience and assumptions, it is important to recognize that actual experience is reported in the short term while assumptions are intended to be long-term estimates of experience. Therefore, actual experience is expected to vary from study period to study period, without necessarily indicating a change in assumptions is needed.

Cavanaugh Macdonald Consulting, LLC (CMC) has performed a study of the experience of each of the Plans under the ERS Board of Trustees purview for the five-year period ending June 30, 2019. This report presents the results, analysis, and resulting recommendations of our study for ERS only. Each plan will have its own report. It is anticipated that the changes, if approved, will first be reflected in the June 30, 2020 actuarial valuations.

These assumptions have been developed in accordance with generally recognized and accepted actuarial principles and practices that are consistent with the applicable Actuarial Standards of Practice adopted by the Actuarial Standards Board (ASB). While the recommended assumptions represent our best estimate of future experience, there are other reasonable assumption sets that could be supported by the results of this experience study. Those other sets of reasonable assumptions could produce liabilities and costs that are either higher or lower.

Our Philosophy

Similar to an actuarial valuation, the calculation of actual and expected experience is a fairly mechanical process, and differences between actuaries in this area are generally minor. However, the setting of assumptions is more likely to result in differences between actuaries, as it is more art than science. In this report, we have recommended changes to certain assumptions. To explain our thought process, we offer a brief summary of our philosophy:



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- **Do Not Overreact:** When we see significant changes in experience, we generally do not adjust our rates to reflect the entire difference. We will typically recommend rates somewhere between the old rates and the new experience. If the experience during the next study period shows similar results, we will probably recognize the trend at that point in time or at least move further in the direction of the observed experience. On the other hand, if experience returns closer to its prior level, we will not have overreacted, possibly causing volatility in the actuarial contribution rates.
- **Anticipate Trends:** If there is an identified trend that is expected to continue, we believe that this should be recognized. An example is the retiree mortality assumption. It is an established trend that people are living longer. Therefore, we believe the best estimate of liabilities in the valuation should reflect the expected increase in life expectancy.
- **Simplify:** In general, we attempt to identify which factors are significant and eliminate or ignore those that do not materially improve the accuracy of the liability projections.

The following summarizes the findings and recommendations regarding the assumptions utilized for ERS. Detailed explanations for the recommendations are found in the sections that follow.

Recommended Economic Assumption Changes

Economic assumptions are some of the most visible and significant assumptions used in the valuation process. The items in the broad economy modeled by these assumptions can be very volatile over short periods of time, as clearly seen in the economic downturn in 2008 followed by the rebound in many financial markets in the years following. Our goal is to try to find the emerging long-term trends in the midst of this volatility so that we can then apply reasonable assumptions.

Most of the economic assumptions used by actuaries are developed through a building-block approach. For example, the expected return on assets is based on the expectation for inflation plus the expected real return on assets. At the core of the economic assumptions is the inflation assumption. As we discuss later in the report, based on recent trends of inflation, the market pricing of inflation, and the Chief Actuary of the Social Security Administration's view of inflation, **we are recommending a decrease in the price inflation assumption from 2.75% to 2.50%.**



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We are also recommending a corresponding decrease in the long-term expected return on assets assumption from 7.50% to 7.00%, reflecting the 0.25% decrease in the inflation assumption and a 0.25% decrease in the real rate of return assumption. This will be discussed in detail later in this report, but a real rate of return of 4.50% is supported by the forecasting models developed using the capital market assumptions from Division of Investment Services that oversees ERS’ investments and the Board’s target asset allocation. Further analysis of the 35 sets of capital market assumptions included in the Horizon Actuarial Services, LLC. survey conducted in 2020 also supports this recommendation.

The current ERS funding policy states that the long-term expected return on assets assumption, which was set at 7.50% in the previous experience study, shall be reduced by 0.10% per year from the immediate prior valuation when the actual rate of return for the fiscal year exceeds the assumed rate. The minimum return assumption stated in the funding policy is 7.00%. The asset return assumption used in the most recent actuarial valuation is 7.30%. We concur with the Board policy that will continue to reduce the rate of return used in future valuations until a 7.00% return in achieved so, therefore, the recommended rate change does not have any impact on the valuation results expected in the next few years.

Finally, we are recommending that the general wage inflation assumption used as the underlying payroll growth for active member be decreased from 3.25% to 3.00%, reflecting the 0.25% decrease in the inflation assumption.

The following table summarizes the current and proposed economic assumptions:

Item	Current	Proposed
Price Inflation	2.75%	2.50%
Investment Return*	7.50%	7.00%
Wage Inflation	3.25%	3.00%

* Net of investment expenses only.

Although we have recommended a change in the set of economic assumptions, we recognize there may be other sets of economic assumptions that are also reasonable for purposes of funding ERS. For example, we have typically reflected conservatism to the degree we would classify as moderate. Actuarial Standards of Practice allow for this difference in approaches and perspective, as long, as the assumptions are reasonable and consistent.



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Recommended Demographic Assumption Changes

In the experience study, actual experience for the study period is compared to that expected based on the current actuarial assumptions. The analysis is most commonly performed based on counts, i.e. each member is one exposure to the probability of the event occurring and one count if the event actually occurs. Comparing the actual incidence of the event to what was expected (called the Actual-to-Expected ratio, or A/E ratio) then provides the basis for our analysis.

The issue of future mortality improvement is one that the actuarial profession has become increasingly focused on studying in recent years. This has resulted in changes to the relevant Actuarial Standard of Practice, ASOP 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. This ASOP requires the pension actuary to make and disclose a specific recommendation with respect to future improvements in mortality after the valuation date. There have been significant improvements in longevity in the past, although there are different opinions about future expectations. We believe it is prudent to anticipate that the trend will continue to some degree in the future. Therefore, we believe it is appropriate to reflect future mortality improvement as part of the mortality assumption.

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

- (1) Static table with “margin”
- (2) Generational mortality

The first approach to reflecting mortality improvements is with the use of a static mortality table with “margin.” Under this approach, the A/E ratio is intentionally targeted to be over 100% so that mortality can improve without creating actuarial losses. While there is no formal guidance as to the amount of margin required (how far above 100% is appropriate for the A/E ratio), we typically prefer to have a margin of around 10 to 14% at the core ages of the retired member. The goal is still for the general shape of the curve to be a reasonable fit to the observed experience. Depending on the magnitude and duration of actual mortality improvements in the future, the margin may decrease and eventually become insufficient. If that occurs, the assumption would need to be updated.

Another approach, referred to as generational mortality, directly anticipates future improvements in mortality by using a different set of mortality rates for each year of birth, with the rates for later years of birth assuming lower mortality than the rates for earlier years of birth. The varying mortality rates by year of birth create a series of tables that contain “built-in” mortality improvements, e.g., a member who turns age 65 in 2035 has a longer life expectancy than a member who turns age 65 in 2020. When using generational mortality, the A/E ratios for the



Section I - Executive Summary

observed experience are set near 100% since future mortality improvements will be taken into account directly in the actuarial valuation process.

For the mortality decrements, we also analyzed the experience using a liability-weighted approach. This is approximated by using the member's retirement benefit from the data collected. The exposure and actual occurrences are then multiplied by the benefit level to provide the liability-weighted experience. This approach is particularly insightful when analyzing experience from a non-homogenous group. While we reviewed the mortality experience on both a count and liability-weighted basis, we ultimately decided on the liability-weighted results to evaluate experience and develop a new mortality table.

The current post-retirement mortality assumption for healthy lives is a static table, the RP-2000 Combined Mortality Table projected to 2025 with projection scale BB and set forward 2 years for both males and females. This table is currently used by four of the five pension plans overseen by the ERS Board (The Public School Employees Retirement System uses a different mortality table). The results of the experience analysis indicate that this table provided a very reasonable expectation of mortality for the past 5 years. However, we have decided to adopt a generational mortality approach and have selected the mortality assumptions from the recently published Pub-2010 Public Mortality Plans Mortality Tables. These tables, released in 2019, were developed using public pension plan mortality experience only. The recommended table will be used for ERS, Judicial Retirement System (JRS), Legislative Retirement System (LRS) and Georgia Military Pension Fund (GMPF). More information will be discussed in the demographic section of this report.

Please note that since there are so few Old Plan members, we concentrated our analysis specifically on New Plan and GSEPS members only. Therefore, all Old Plan specific demographic assumptions have no recommended changes. The following is a general list of the other recommended changes to the demographic assumptions specific to the ERS plan.

- **Retirement:**
 - **Non-Police**
 - **Decreased rates of early retirement;**
 - **Decreased rates of normal retirement for members less than age 65;**
 - **Increased rates of normal retirement for members age 65 and older.**
 - **Police**
 - **Increased rates of retirement for members with less than 30 years of service;**
 - **Decreased rates of retirement for members with 30 or more years of service.**



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- **Disability:** Lowered rates of disability retirement for non-Police Officers and increased rates of disability retirement for Police Officers.
- **Withdrawal:** Increased rates of withdrawal at most ages for non-Police Officers and decreased rates of withdrawal at most ages for Police Officers.
- **Merit Salary Scale:** Changed to a service-based table and increased rates at earlier service bands and decreased rates at later service bands.

Section V will provide more detail to these recommended demographic changes.

Actuarial Methods

The basic actuarial methodologies used in the valuation process include the:

- Actuarial Cost Method
- Asset Valuation Method
- Amortization Method

Based on our review, discussed in full detail in Section IV of this report, we recommend no changes in these actuarial methods at this time.



Section I - Executive Summary

Other Assumptions

Another assumption that is included in the valuation is the determination of administrative expense component that is added to the total normal cost each year. The current method used to determine the load for administrative expenses is to use the budgeted expenses provided to us by the System for the applicable fiscal year (currently 0.65% of payroll of ERS). **After reviewing the total administrative expenses for the past five years as a dollar amount and as a percentage of payroll, we are recommending a change in this method to a constant percent of payroll. We recommend a decrease in this assumption from 0.65% to 0.35% of payroll for the next 5-year period.** The following table shows actual percentages over the past five years:

(\$ in Thousands)

Year Ending June 30	Administrative Expenses	Annual Payroll	Percentage
2015	\$7,872	\$2,352,920	0.33%
2016	8,506	2,384,358	0.36%
2017	8,732	2,546,492	0.34%
2018	8,056	2,634,129	0.31%
2019	7,142	2,611,965	0.27%



Section II – Financial Impact

Although the assumption changes, if approved, will first be reflected in the 2020 valuations, we have provided the following table which highlights the impact of the recommended changes on the Unfunded Actuarial Accrued Liability (UAAL), Funding Ratio, Amortization Period and Actuarially Determined Employer Contribution on the 2019 valuation results.

Impact on Principal Valuation Results (\$ in Thousands)		
	Valuation Results 2019	Recommended Assumptions
Unfunded Actuarial Accrued Liability	\$4,348,001	\$4,899,157
Funding Ratio	75.6%	73.3%
Amortization Period (in years)	15.3	19.6
<u>Actuarially Determined Employer Contribution</u>		
Old Plan		
Initial Normal Rate	6.23%	6.48%
Employer Paid on Behalf of Employee	<u>(4.75)</u>	<u>(4.75)</u>
Normal Rate	1.48%	1.73%
Accrued Liability Rate	<u>18.40</u>	<u>18.27</u>
Total	19.88%	20.00%
New Plan		
Normal Rate	6.23%	6.48%
Accrued Liability Rate	<u>18.40</u>	<u>18.27</u>
Total	24.63%	24.75%
GSEPs		
Normal Rate	3.17%	3.30%
Accrued Liability Rate	<u>18.40</u>	<u>18.27</u>
Total	21.57%	21.57%



Section III – Economic Assumptions

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

- Price Inflation
- Investment Return
- Wage Inflation

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

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

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



Section III – Economic Assumptions

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

Item	Current	Proposed
Price Inflation	2.75%	2.50%
Real Rate of Return*	<u>4.75</u>	<u>4.50</u>
Investment Return	7.50%	7.00%
Price Inflation	2.75%	2.50%
Real Wage Growth	<u>0.50%</u>	<u>0.50%</u>
Wage Inflation	3.25%	3.00%

* Net of investment expenses

Note that future price inflation has an indirect impact on the results of the actuarial valuation through the development of the assumptions for investment return and wage inflation. However, it is not directly used in the valuation process.



Section III – Economic Assumptions

Price Inflation

Background

As can be seen from the table on the previous page, assumed price inflation is used as the basis for both the investment return assumption and the wage inflation assumption. These latter two assumptions will be discussed in detail in the following sections.

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

The relationship between price inflation and investment return has long been recognized by economists. The basic principle is that the investor demands a relatively level “real return” – the excess of actual investment return over price inflation. Over the long-term, if inflation rates are expected to be high, investment return rates are also expected to be high, while low inflation rates are expected to result in lower expected investment returns.

The current price inflation assumption is 2.75% per year.

Past Experience

The Consumer Price Index, US City Average, All Urban Consumers, CPI (U), has been used as the basis for reviewing historical levels of price inflation. The table below provides historical annualized rates and annual standard deviation of the CPI-U over periods ending June 30th.

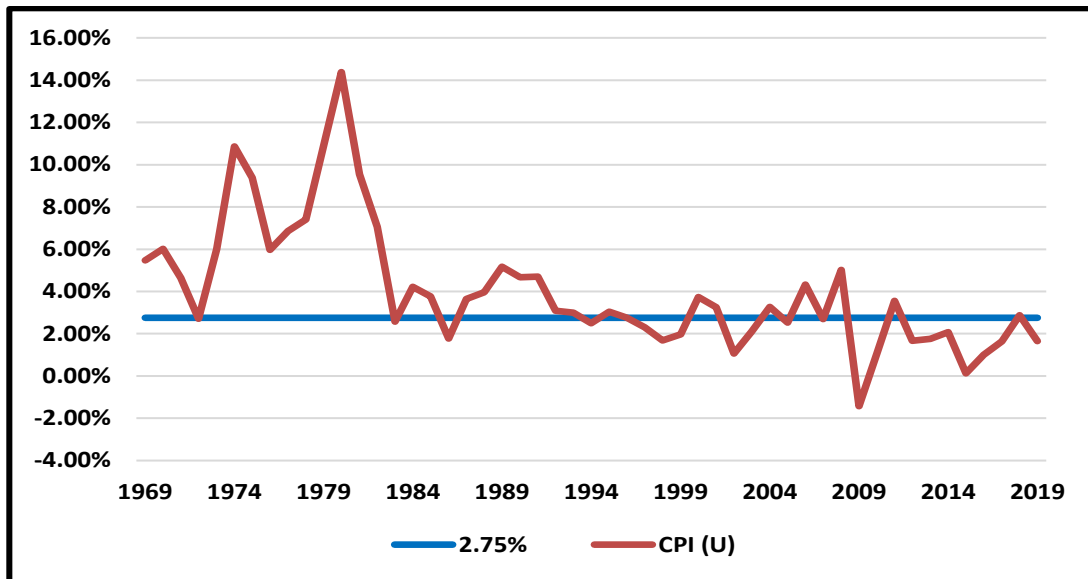
Period	Number of Years	Annualized Rate of Inflation	Annual Standard Deviation
1926 – 2019	93	2.90%	4.06%
1959 – 2019	60	3.69	2.87
1969 – 2019	50	3.97	3.00
1979 – 2019	40	3.21	2.59
1989 – 2019	30	2.44	1.38
1999 – 2019	20	2.19	1.49
2009 - 2019	10	1.73	0.96



Section III – Economic Assumptions

The following graph illustrates the historical levels of price inflation measured as of June 30th of each of the last 50 years and compared to the current 2.75% annual rate currently assumed.

Annual Rate of CPI (U) Increases



Over the last 50 years, the average annual rate of increase in the CPI-U has been just below 4.00%. The period of high inflation from 1973 to 1982 has a significant impact on the averages over periods which include these rates. The volatility of the annual rates in the more recent years has been markedly lower as indicated by the significantly lower annual standard deviations. Many experts attribute the lower average annual rates and lower volatility to the increased efforts of the Federal Reserve since the early 1980's to stabilize price inflation.

Forecasts

Based upon information contained in the “Survey of Professional Forecasters” for the fourth quarter of 2020 as published by the Philadelphia Federal Reserve Bank, the median expected annual rate of inflation for the next ten years is 2.12%. Although 10 years of future expectation is too short of a period for the basis of our inflation assumption, the information does provide some evidence that the consensus expectations of these experts are for rates of inflation lower than our current assumption of 2.75% for the near-term future.



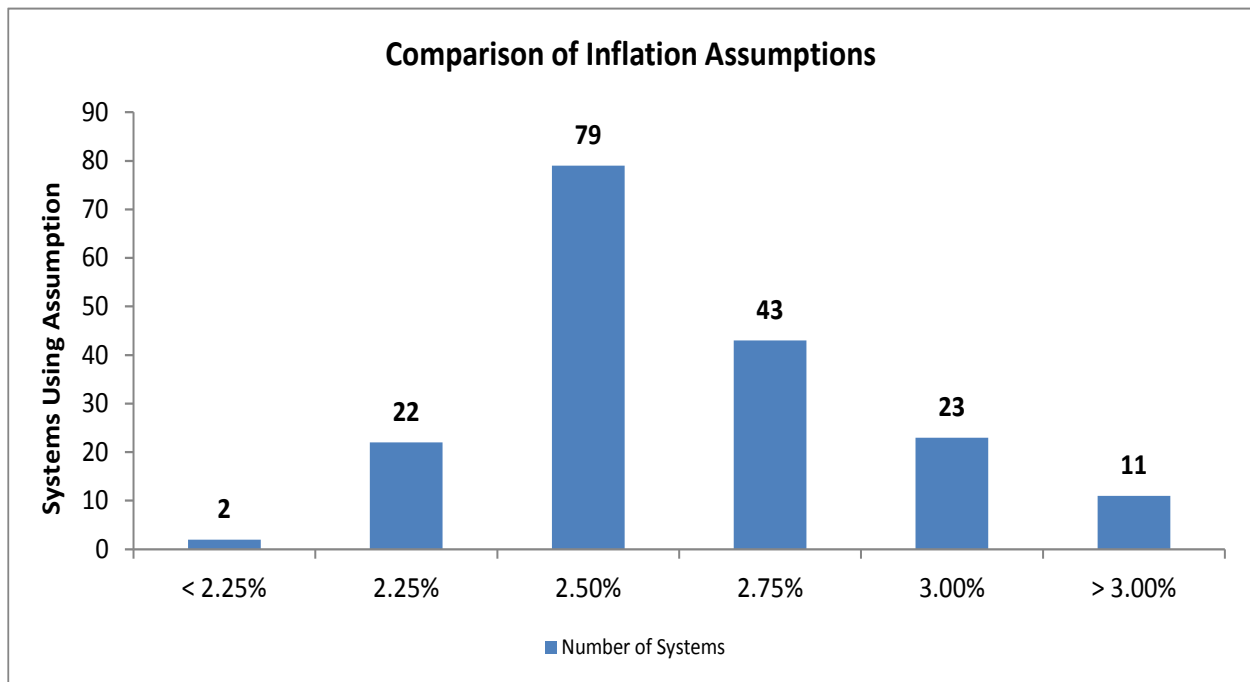
Section III – Economic Assumptions

Social Security Administration

Although many economists forecast lower inflation than the assumption used by most retirement plans, they are generally looking at a shorter time horizon than is appropriate for a pension valuation. To consider a longer, similar time frame, we looked at the expected increase in the CPI by the Office of the Chief Actuary for the Social Security Administration. In the 2020 annual report, the projected ultimate average annual increase in the CPI over the next 75 years was estimated to be 2.40%, under the intermediate (best estimate) cost assumption. The range of inflation assumptions used in the Social Security 75-year modeling, which includes a low and high cost scenario, in addition to the intermediate cost projection, was 1.80% to 3.00%. This is a decline of 0.20% in the CPI forecasts from the Social Security Administration from their 2019 annual report.

Peer Comparison

While we do not recommend the selection of any assumption based on what other systems use, it does provide another set of relevant information to consider. The following chart shows the inflation rate assumptions of 180 plans in the Public Plan Database of the Center for Retirement Research. The assumptions are from actuarial valuation reported in FYE 2019.





Section III – Economic Assumptions

Recommendation

It is difficult to predict inflation accurately. Inflation’s short-term volatility is illustrated by comparing its average rate over the last 10 and 50 years. Although the 10-year average of 1.73% is lower than the System’s assumed rate of 2.75%, the longer 50-year averages of 3.97% is somewhat higher than ERS’ current rate. The reasonableness of ERS’ assumption is, therefore, dependent upon the emphasis one assigns to the short and long-terms.

Current economic forecasts suggest lower inflation but are generally looking at a shorter time period than appropriate for our purposes. We consider the range included in the Social Security Administration of 1.80% to 3.00% to be reasonable and recommend lowering the inflation assumption for ERS from 2.75% to 2.50%.

Price Inflation Assumption	
Current	2.75%
Recommended	2.50%



Section III – Economic Assumptions

Investment Return

Background

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

The current assumption is 7.50%, consisting of a price inflation assumption of 2.75% and a real rate of return assumption of 4.75%. The current ERS funding policy states that the long-term expected return on assets assumption, which was set at 7.50% in the previous experience study, shall be reduced by 0.10% per year from the immediate prior valuation when the actual rate of return for the fiscal year exceeds the assumed rate. The minimum return assumption stated in the funding policy is 7.00%. The asset return assumption used in the most recent actuarial valuation is 7.30%.

Long Term Perspective

Because the economy is constantly changing, assumptions about what may occur in the near term are volatile. Asset managers and investment consultants usually focus on this near-term horizon in order to make prudent choices regarding how to invest the trust funds. For actuarial calculations, we typically consider very long periods of time. For example, a newly hired employee who is 25 years old may work for 35 years, to age 60, and live another 30 years, to age 90 (or longer). The retirement system would receive contributions for the first 35 years and then pay out benefits for the next 30 years. During the entire 65-year period, the system is investing assets related to the member. For such a typical career employee, more than one-half of the investment income earned on assets accumulated to pay benefits is received after the employee retires. In addition, in an open, ongoing system like ERS, the stream of benefit payments is continually increasing as new hires replace current members who leave covered employment due to death, termination of employment, and retirement. This difference in the time horizon used by actuaries and investment consultants is frequently a source of debate and confusion when setting economic assumptions.



Section III – Economic Assumptions

Past Experience

One of the inherent problems with analyzing historical data is that the results can look significantly different depending on the timeframe used, especially if the year-to-year results vary widely. In addition, the asset allocation can also impact the investment returns, so comparing results over long periods when different asset allocations were in place may not be meaningful.

The assets for ERS are valued using a widely accepted asset-smoothing methodology that fully recognizes the expected investment income and also recognizes 20% of each year's investment gain or loss (the difference between actual and expected investment income). The recent experience over the last five years is shown in the table below.

Year Ending 6/30	Actuarial Value	Market Value
2015	9.16%	3.68
2016	7.43	1.12
2017	7.89	12.30
2018	8.43	9.17
2019	6.47	6.65
Average	7.87%	6.58%

While important to review and analyze, historical returns over such a short time period are not credible for the purpose of setting the long-term assumed future rate of return.

Future Expectation Analysis

The Division of Investment Services (DIS) assists the ERS Board with developing investment strategies and providing capital market assumptions for the ERS portfolio. As part of their duties, DIS periodically performs asset-liability studies, along with comprehensive reviews of the expected return of the various asset classes in which the ERS portfolio is invested. We believe it is appropriate to consider the results of DIS' work as one factor in assessing expected future returns.

We also recognize that there can be differences of opinion among investment professionals regarding future return expectations. Horizon Actuarial Services prepares an annual study in which they survey various investment advisors (35 were included in the 2020 study with a 10-year horizon) and provide ranges of results as well as averages. This information provides an additional perspective on what a broad group of investment experts anticipate for future investment returns.



Section III – Economic Assumptions

Our forward-looking analysis used the real rates of return in the DIS capital market assumptions and the ERS target asset allocation. Using statistical projections that assume investment returns approximately follow a lognormal distribution with no correlation between years, produces an expected range of real rates of return over a 50-year time horizon. Looking at one year’s results produces a mean real return of 6.18%, but also has a high standard deviation or measurement of volatility. By expanding the time horizon, the real return does not change, but the volatility declines significantly. The table below provides a summary of results.

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5 th	25 th	50 th	75 th	95 th
1	6.18%	13.90%	-15.04%	-3.58%	5.28%	14.95%	30.46%
5	5.46	6.15	-4.35	1.22	5.28	9.50	15.87
10	5.37	4.35	-1.62	2.39	5.28	8.25	12.66
20	5.32	3.07	0.35	3.23	5.28	7.37	10.45
30	5.31	2.51	1.24	3.60	5.28	6.98	9.48
40	5.30	2.17	1.77	3.82	5.28	6.75	8.91
50	5.30	1.94	2.13	3.98	5.28	6.59	8.52

The percentile results are the percentages of random returns over the time span shown that are expected to be less than the amount indicated. For example, for the 10-year time span, 5% of the resulting real rates of return will be below -1.62% and 95% will be above that. As the time span increases, the results begin to converge. Over a 50-year time span, the results indicate there will be a 25% chance that real returns will be below 3.98% and a 25% chance they will be above 6.59%. In other words, there is a 50% chance the real returns will be between 3.98% and 6.59%.

For a broader view of expected returns, we also reviewed the 2020 Survey of Capital Market Assumptions produced by Horizon Actuarial Services, LLC to see what other investment professionals are currently using for capital market assumptions. The Horizon survey includes both 10-year horizon and 20-year horizon capital market assumptions. We applied the same statistical analysis to these survey results as we did the capital market assumptions of DIS with the following real return results for the 20-year horizon:



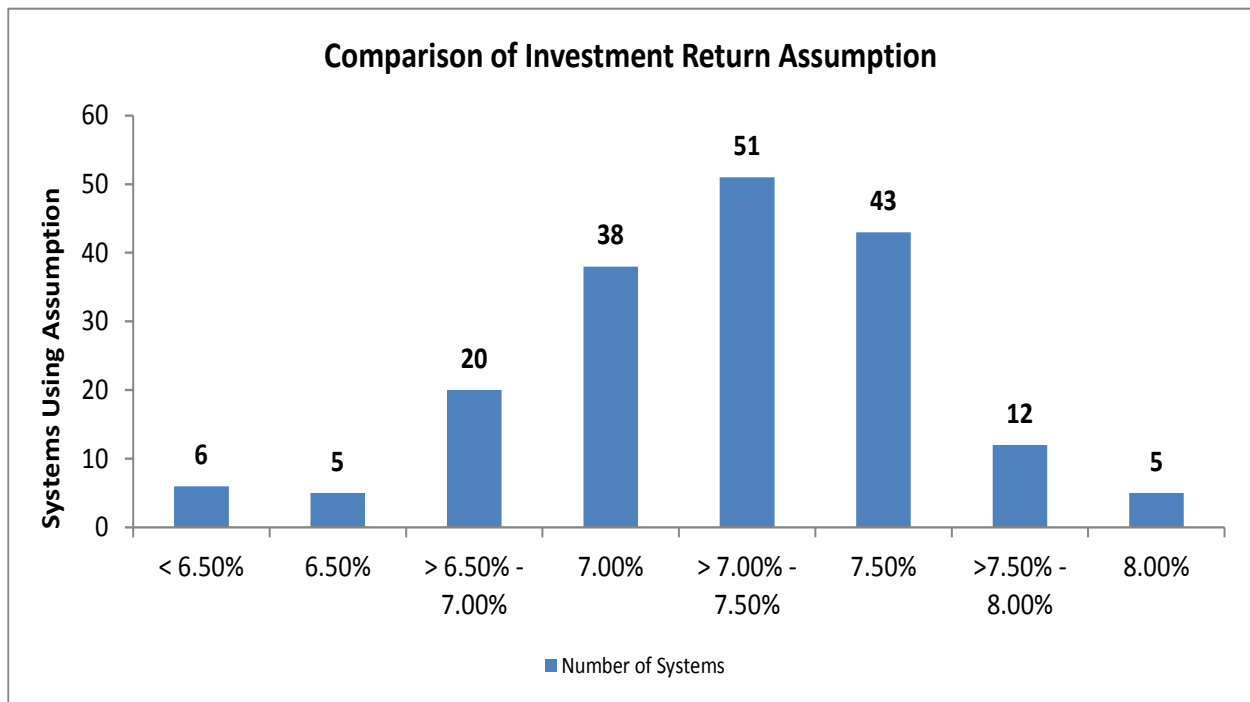
Section III – Economic Assumptions

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5 th	25 th	50 th	75 th	95 th
1	4.85%	11.49%	-12.92%	-3.18%	4.22%	12.19%	24.74%
5	4.35	5.10	-3.82	0.84	4.22	7.71	12.94
10	4.28	3.60	-1.54	1.82	4.22	6.68	10.32
20	4.25	2.55	0.12	2.52	4.22	5.95	8.50
30	4.24	2.08	0.86	2.83	4.22	5.63	7.70
40	4.24	1.80	1.30	3.01	4.22	5.44	7.23
50	4.23	1.61	1.61	3.14	4.22	5.31	6.90

As can be seen from the Horizon survey analysis, the forecast shows that over a 50-year time span, there is a 50% chance that real returns will be between 3.14% and 5.31%. This is slightly lower than the results from DIS’ analysis.

Peer Comparison

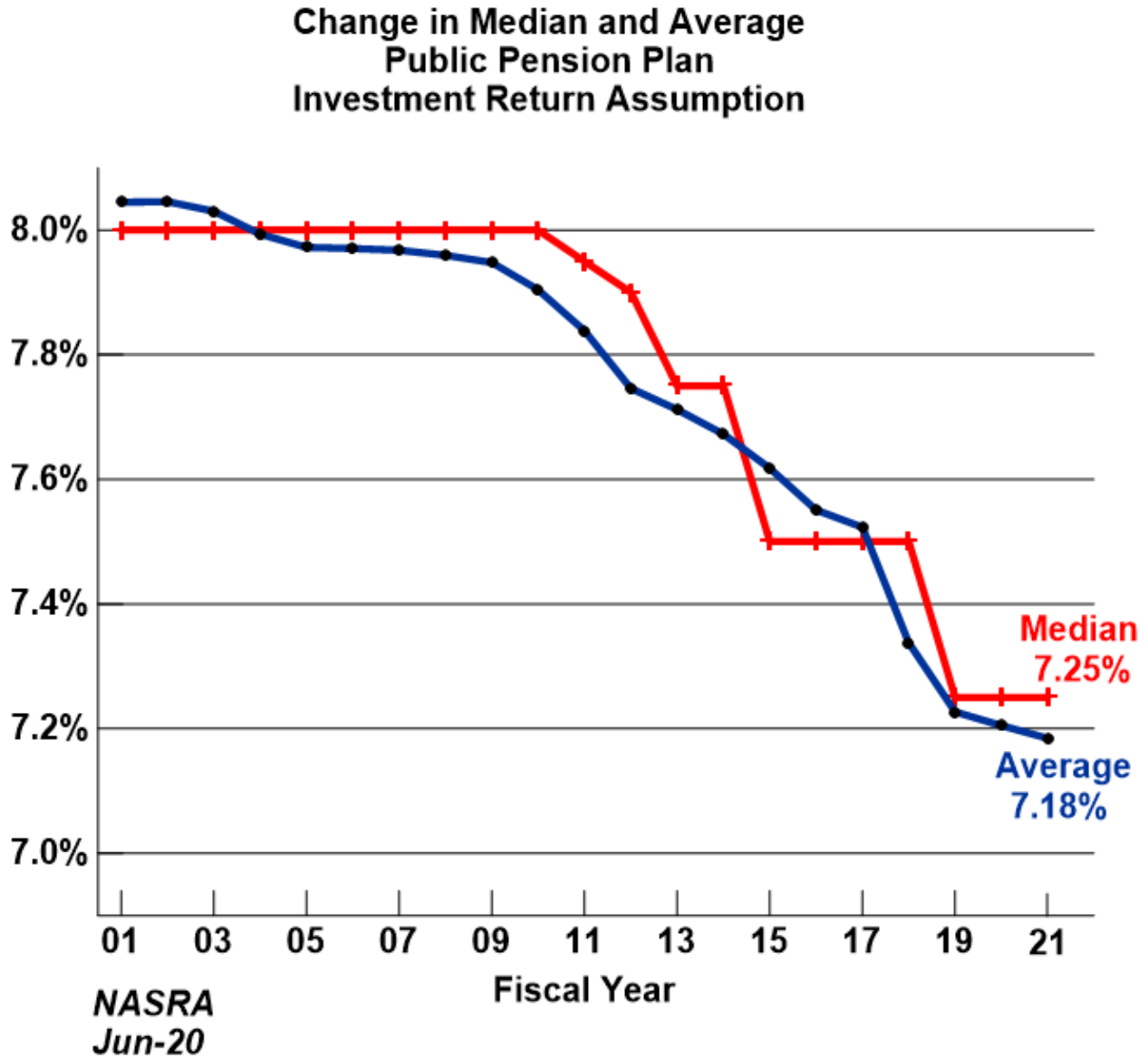
The following chart shows the nominal investment return assumptions of 180 plans in the Public Plan Database of the Center for Retirement Research. The assumptions are from FYE 2019 reporting.





Section III – Economic Assumptions

The following chart shows the changes in expected investment return assumption from the NASRA public plan survey over the last 20 years from 2001.





Section III – Economic Assumptions

Recommendation

By actuarial standards, we are required to maintain a long-term perspective in setting all assumptions, including the investment return assumption. Therefore, we believe we must be careful not to let recent experience or the short-term expectations impact our judgment regarding the appropriateness of the current assumption over the long term.

Based on our analysis of the DIS’ capital market assumptions and the Horizon Survey capital market assumptions, we are recommending a reduction in the real return assumption from 4.75% to 4.50%. Based on our recommended inflation assumption of 2.50%, we are recommending a 7.00% expected long term nominal rate of return assumption.

Investment Return Assumption		
	Current*	Recommended
Real Rate of Return**	4.75%	4.50%
Inflation	<u>2.75</u>	<u>2.50</u>
Net Investment Return	7.50%	7.00%

* actual assumption for the 2019 valuation is 7.30% based on the Board funding policy

** net of investment expenses.



Section III – Economic Assumptions

Wage Inflation

Background

The wage inflation assumption is composed of the price inflation assumption and an assumption for the real rate of wage increases. The salary increase assumption combines the wage inflation assumption with an assumption for promotion and longevity, often called merit increases. Merit assumptions are generally age and or service related and will be discussed in the demographic assumption section of the report. The excess of wage growth over price inflation is also considered the increase in productivity that labor provides.

The current wage inflation assumption of 3.25% is composed of a 2.75% rate of inflation assumption and a 0.50% real rate of wage inflation.

Past Experience

The Social Security Administration publishes data on wage growth in the United States (see Appendix C). While this is the most comprehensive data available, it is based on all wage earners in the country so it can be influenced by the mix of jobs as well as by changes in certain sectors of the workforce that may not be seen by all segments.

As with our analysis of inflation, we provide below wage inflation and a comparison with price inflation over various time periods. We remove the rate of price inflation for each year from the data to result in the historical real rate of wage inflation.

Period	Wage Inflation	Price Inflation	Real Wage Growth
2009-2019	2.88%	1.73%	1.15%
1999-2019	2.91%	2.19%	0.72%
1989-2019	3.36%	2.44%	0.92%
1979-2019	3.95%	3.21%	0.74%
1969-2019	4.53%	3.97%	0.56%

The chart indicates that over the last 50 years, annual real wage growth has averaged 0.56%.



Section III – Economic Assumptions

Social Security Administration

The wage index used for the historical analysis is projected forward by the Office of the Chief Actuary of the Social Security Administration in their 75-year projections. In June of 2020, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.5%, 1.1% higher than the Social Security intermediate inflation assumption of 2.4% per year. The range of the assumed real wage inflation in the 2020 Trustees report was 0.52% to 1.76% per year.

Recommendation

The data the Social Security Administration collects is nationwide and predominantly from the private sector which includes many collectively bargained employees. It is questionable whether public sector employees can match the productivity rates of the private sector. **Therefore, we recommend a decrease in the total wage inflation growth from 3.25% to 3.00%, in conjunction with the recommendation of lowering the price inflation assumption by 0.25%.**

Wage Inflation Assumption		
	Current	Recommended
Price Inflation	2.75%	2.50%
Real Wage Growth	<u>0.50%</u>	<u>0.50%</u>
Wage Inflation	3.25%	3.00%

Payroll Growth Assumption: The current amortization method is level dollar amortization. **We recommend continued use of this amortization method.**



Section IV – Actuarial Methods

Actuarial Cost Method

There are various actuarial cost methods, each of which has different characteristics, advantages and disadvantages. However, Governmental Accounting Standard Board (GASB) Statement Numbers 67 and 68 require that the Entry Age Normal (EAN) cost method be used for financial reporting. Most systems do not want to use a different actuarial cost method for funding and financial reporting. In addition, the Entry Age Normal method has been the most common funding method for public systems for many years. This is the cost method currently used by ERS.

The rationale of the (EAN funding method is that the cost of each member's benefit is determined to be a level percentage of salary from date of hire to the end of employment. This level percentage multiplied by the member's annual salary is referred to as the normal cost and is that portion of the total cost of the employee's benefit that is allocated to the current year. The portion of the present value of future benefits allocated to the future is determined by multiplying this percentage times the present value of the member's assumed earnings for all future years including the current year. The EAN actuarial accrued liability is then developed by subtracting from the present value of future benefits that portion of costs allocated to the future. To determine the unfunded actuarial accrued liability, the value of plan assets is subtracted from the EAN actuarial accrued liability. The current year's cost to amortize the unfunded actuarial accrued liability is developed by applying an amortization factor based on the funding policy.

It is to be expected that future events will not occur exactly as anticipated by the actuarial assumptions in each year. Actuarial gains/losses from experience under this actuarial cost method can be directly calculated and are reflected as a decrease/increase in the unfunded actuarial accrued liability. Consequently, the gain/loss results in a decrease/increase in the amortization payment, and therefore the contribution rate.

Considering that the EAN cost method is the most commonly used cost method by public plans, that it develops a normal cost rate that tends to be stable and less volatile, and is the required cost method under calculations required by GASB Numbers 67 and 68, **we recommend the Entry Age Normal actuarial cost method be retained for ERS.**



Section IV – Actuarial Methods

Actuarial Value of Assets

In preparing an actuarial valuation, the actuary must assign a value to the assets of the fund. An adjusted market value is often used to smooth out the volatility that is reflected in the market value of assets. This is because most employers would rather have annual costs remain relatively smooth, as a percentage of payroll or in actual dollars, as opposed to a cost pattern that may be extremely volatile.

The actuary does not have complete freedom in assigning this value. The Actuarial Standards Board also has basic principles regarding the calculation of a smoothed asset value, Actuarial Standard of Practice No. 44 (ASOP 44), *Selection and Use of Asset Valuation Methods for Pension Valuations*.

ASOP 44 provides that the asset valuation method should bear a reasonable relationship to the market value. Furthermore, the asset valuation method should be likely to satisfy both of the following:

- Produce values within a reasonable range around market value, AND
- Recognize differences from market value in a reasonable amount of time.

In lieu of both of the above, the standard will be met if either of the following requirements is satisfied:

- There is a sufficiently narrow range around the market value, OR
- The method recognizes differences from market value in a sufficiently short period.

These rules or principles prevent the asset valuation methodology from being used to manipulate annual funding patterns. No matter what asset valuation method is used, it is important to note that, like a cost method or actuarial assumptions, the asset valuation method does not affect the true cost of the plan; it only impacts the incidence of cost. The 5-year phase-in methodology that ERS currently uses meets these rules and is, in fact, the most commonly used methodology for plans similar to ERS.

Currently, the actuarial value of assets recognizes a portion of the difference between the market value of assets and the expected market value of assets, based on the assumed valuation rate of return. The amount recognized each year is 20% of the difference between market value and expected market value. **We recommend no change in this methodology.**



Section IV – Actuarial Methods

Amortization of the Unfunded Actuarial Accrued Liability

The actuarial accrued liability is the portion of the actuarial present value of future benefits that are not included in future normal costs. Thus, it represents the liability that, in theory, should have been funded through normal costs for past service. Unfunded actuarial accrued liability (UAAL) exists when the actuarial accrued liability exceeds the actuarial value of plan assets. These deficiencies can result from:

- (i) plan improvements that have not been completely paid for,
- (ii) experience that is less favorable than expected,
- (iii) assumption changes that increase liabilities, or
- (iv) contributions that are less than the actuarial contribution rate.

There are a variety of different methods that can be used to amortize the UAAL. Each method results in a different payment stream and, therefore, has cost implications. For each methodology, there are three characteristics:

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

Amortization Period: The amortization period can be either closed or open. If it is a closed amortization period, the number of years remaining in the amortization period declines by one in each future valuation. Alternatively, if the amortization period is an open or rolling period, the amortization period does not decline but is reset to the same number each year. This approach essentially “refinances” the System’s debt (UAAL) every year.

Amortization Payment: The level dollar amortization method is similar to the method in which a homeowner pays off a mortgage. The liability, once calculated, is financed by a constant fixed dollar amount, based on the amortization period until the liability is extinguished. This results in the liability steadily decreasing while the payments, though remaining level in dollar terms, in all probability decrease as a percentage of payroll. (Even if a plan sponsor’s population is not growing, inflationary salary increases will usually be sufficient to increase the aggregate covered payroll).

The rationale behind the level percentage of payroll amortization method is that since normal costs are calculated to be a constant percentage of pay, the unfunded actuarial accrued liability should be paid off in the same manner. When this method of amortizing the unfunded actuarial accrued liability is adopted, the initial amortization payments are lower than they would be under a level



Section IV – Actuarial Methods

dollar amortization payment method, but the payments increase at a fixed rate each year so that ultimately the annual payment far exceeds the level dollar payment. The expectation is that total payroll will increase at the same rate so that the amortization payments will remain constant, as a percentage of payroll. In the initial years, the level percentage of payroll amortization payment is often less than the interest accruing on the unfunded actuarial accrued liability meaning that even if there are no experience losses, the dollar amount of the unfunded actuarial accrued liability will grow (called negative amortization). This is particularly true if the plan sponsor is paying off the unfunded actuarial accrued liability over a long period, such as 20 or more years.

Amortization Bases: The UAAL can be amortized either as one single amount or as components or “layers”, each with a separate amortization base, payment and period. If the UAAL is amortized as one amount, the UAAL is recalculated each year in the valuation and experience gains/losses or other changes in the UAAL are folded into the single UAAL amortization base. The amortization payment is then the total UAAL divided by an amortization factor for the applicable amortization period.

If separate amortization bases are maintained, the UAAL is composed of multiple amortization bases, each with its own payment schedule and remaining amortization period. In each valuation, the unexpected change in the UAAL is established as a new amortization base over the appropriate amortization period beginning on that valuation date. The UAAL is then the sum of all the outstanding amortization bases on the valuation date and the UAAL payment is the sum of all the amortization payments on the existing amortization bases. This approach provides transparency in that the current UAAL is paid off over a fixed period and the remaining components of the UAAL are clearly identified. Adjustments to the UAAL in future years are also separately identified in each future year. One downside of this approach is that it can create some discontinuities in contribution rates when UAAL layers/components are fully paid off. If this occurs, it likely would be far in the future, with adequate time to address any adjustments needed.

Recommendation

In the current ERS Board funding policy, an actuarially determined employer contribution (ADEC) is calculated during each annual valuation. The methodology in calculating the ADEC is as follows:

- Amortization Period – Closed period with maximum period of 25 years for new bases
- Amortization Payment – Level dollar
- Amortization Bases – Separate bases for all experience gains and losses, assumption changes or benefit changes

We recommend no changes in these methods.



Section V – Demographic Assumptions

There are several demographic assumptions used in the actuarial valuations performed for Georgia ERS. They are:

- Rates of Withdrawal
- Rates of Disability Retirement
- Rates of Service Retirement
- Post-Retirement Mortality
- Pre-Retirement Mortality
- Rates of Merit Salary Increase

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

The purpose of a study of demographic experience is to compare what actually happened to the membership during the study period (July 1, 2014 through June 30, 2019) with what was expected to happen based on the assumptions used in the most recent Actuarial Valuations.

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

If the actual experience differs significantly from the overall expected results, or if the pattern of actual decrements, or rates of decrement, by age, gender, or service does not follow the expected pattern, new assumptions are recommended. Recommended changes usually do not follow the exact actual experience during the observation period. Judgment is required to extrapolate future experience from past trends and current member behavior. In addition, non-recurring events, such as early retirement windows, need to be taken into account in determining the weight to give to recent experience.

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



Section V – Demographic Assumptions

RATES OF WITHDRAWAL

**COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS
FROM ACTIVE SERVICE**

NON-POLICE

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	Current Rates					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Withdrawals with less than 5 years of service						
20	1,030	811.3	1.270	801	588.9	1.360
25	2,666	2,308.0	1.155	4,088	3,531.5	1.158
30	1,908	1,723.2	1.107	3,538	3,209.1	1.102
35	1,149	1,040.8	1.104	2,354	2,213.1	1.064
40	773	733.2	1.054	1,638	1,645.8	0.995
45	780	689.9	1.131	1,353	1,290.9	1.048
50	567	534.7	1.060	1,054	910.2	1.158
53 & OVER	906	849.0	1.067	1,466	1,337.0	1.096
TOTAL	9,779	8,690.1	1.125	16,292	14,726.5	1.106
Withdrawals with at least 5 but less than 10 years of service						
25	105	87.2	1.204	81	76.8	1.055
30	342	293.0	1.167	558	551.8	1.011
35	328	292.3	1.122	631	667.4	0.945
40	213	200.9	1.060	437	496.8	0.880
45	187	207.4	0.902	399	392.8	1.016
50	174	160.9	1.081	327	303.1	1.079
53 & OVER	455	413.5	1.100	777	697.4	1.114
TOTAL	1,804	1,655.2	1.090	3,210	3,186.1	1.008
Withdrawals with 10 or more years of service						
30	58	48.6	1.193	51	43.2	1.181
35	204	181.9	1.121	369	312.5	1.181
40	253	254.4	0.994	551	507.9	1.085
45	300	298.0	1.007	553	529.0	1.045
50	286	263.3	1.086	553	514.4	1.075
53 & OVER	449	385.2	1.166	800	718.5	1.113
TOTAL	1,550	1,431.4	1.083	2,877	2,625.5	1.096



Section V – Demographic Assumptions

POLICE

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS		
	Current Rates		
	Actual	Expected	Ratio of Actual to Expected
	Withdrawals with less than 10 years of service		
20	2	4.1	0.488
25	37	28.9	1.280
30	41	51.8	0.792
35	27	27.7	0.975
40	16	15.3	1.046
45	6	10.8	0.556
50	6	5.9	1.017
53 & OVER	5	2.3	2.174
TOTAL	140	146.8	0.954
	Withdrawals with 10 or more years of service		
30	2	5.4	0.370
35	10	16.9	0.592
40	20	23.4	0.855
45	20	24.7	0.810
50	27	16.8	1.607
53 & OVER	13	2.9	4.483
TOTAL	92	90.1	1.021

The rates of withdrawal adopted by the Board are used to determine the expected number of separations from active service which will occur as a result of resignation or dismissal. The experience indicates that during the period studied, for Non-Police members, there were more withdrawals than expected overall at most age groups for all service categories.

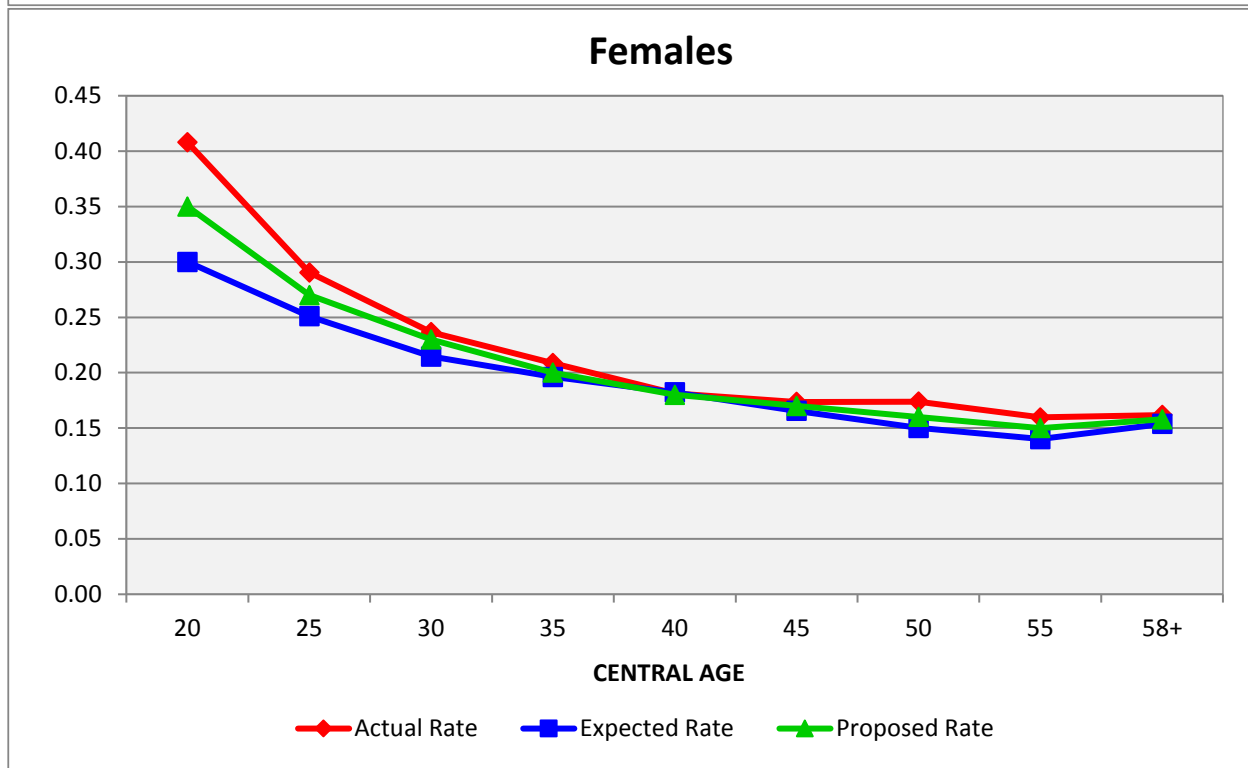
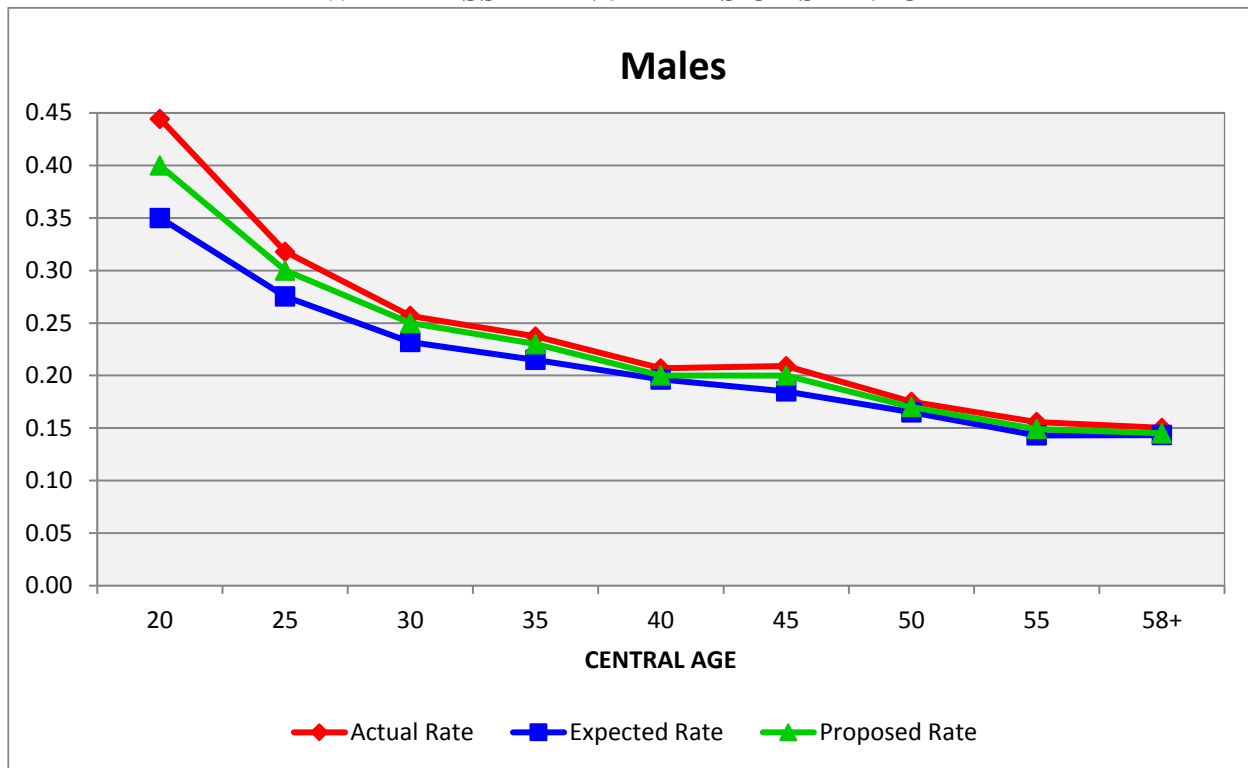
For Police members, the current rates of withdrawal matched the actual experience very close in aggregate. We recommend slight changes at certain age bands to more closely reflect the actual experience but not change the aggregate results.

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



Section V – Demographic Assumptions

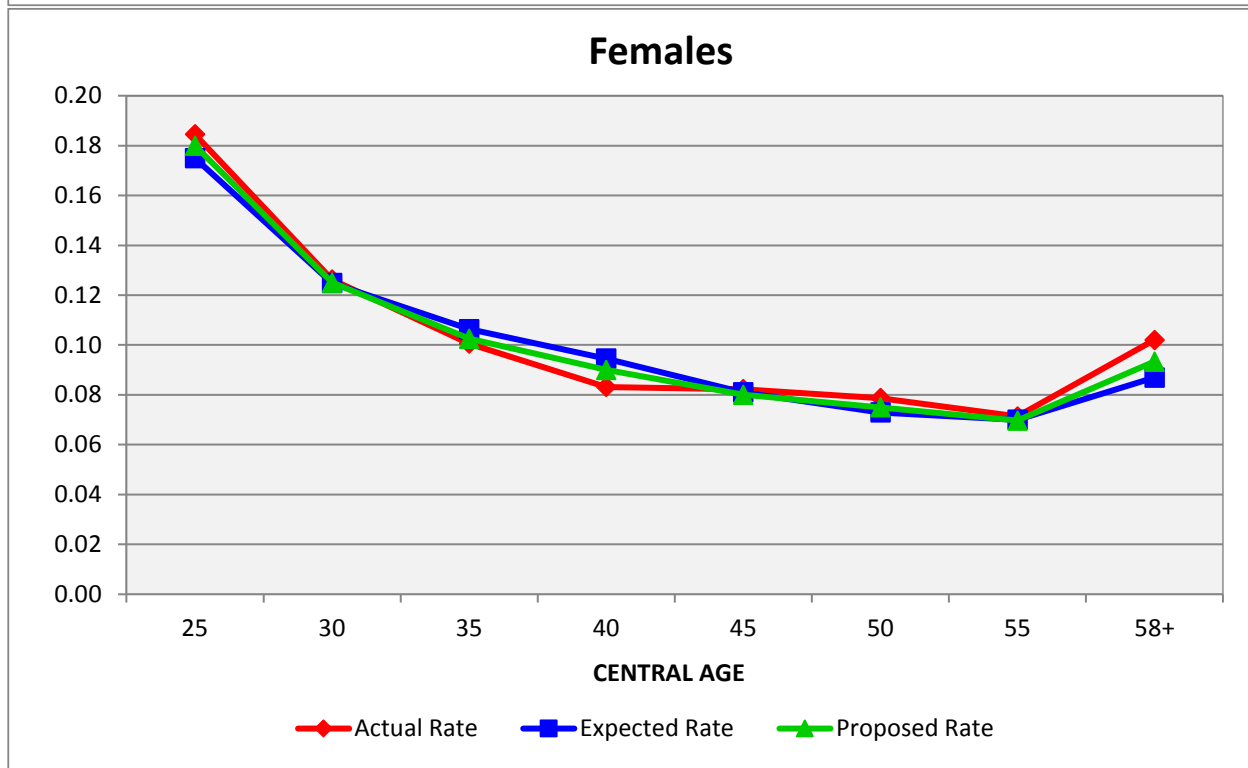
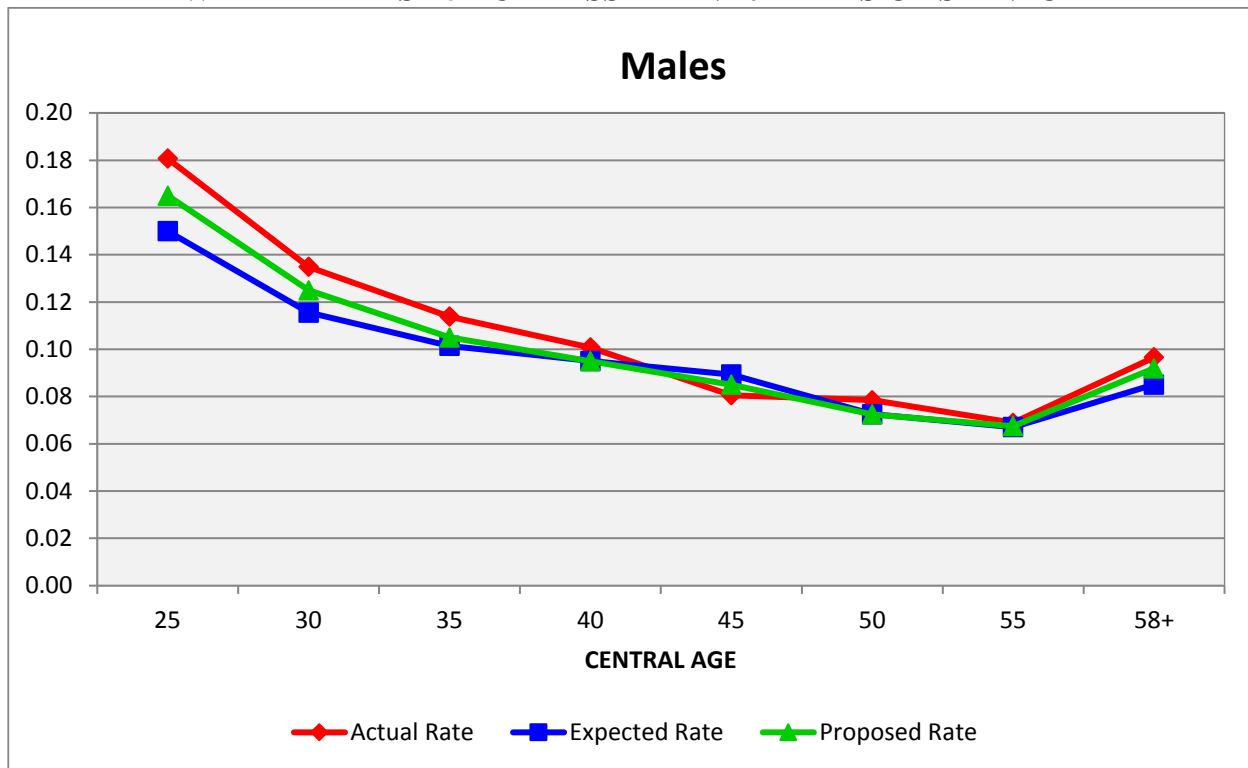
RATES OF WITHDRAWAL FOR NON-POLICE ACTIVE MEMBERS WITH LESS THAN 5 YEARS OF SERVICE





Section V – Demographic Assumptions

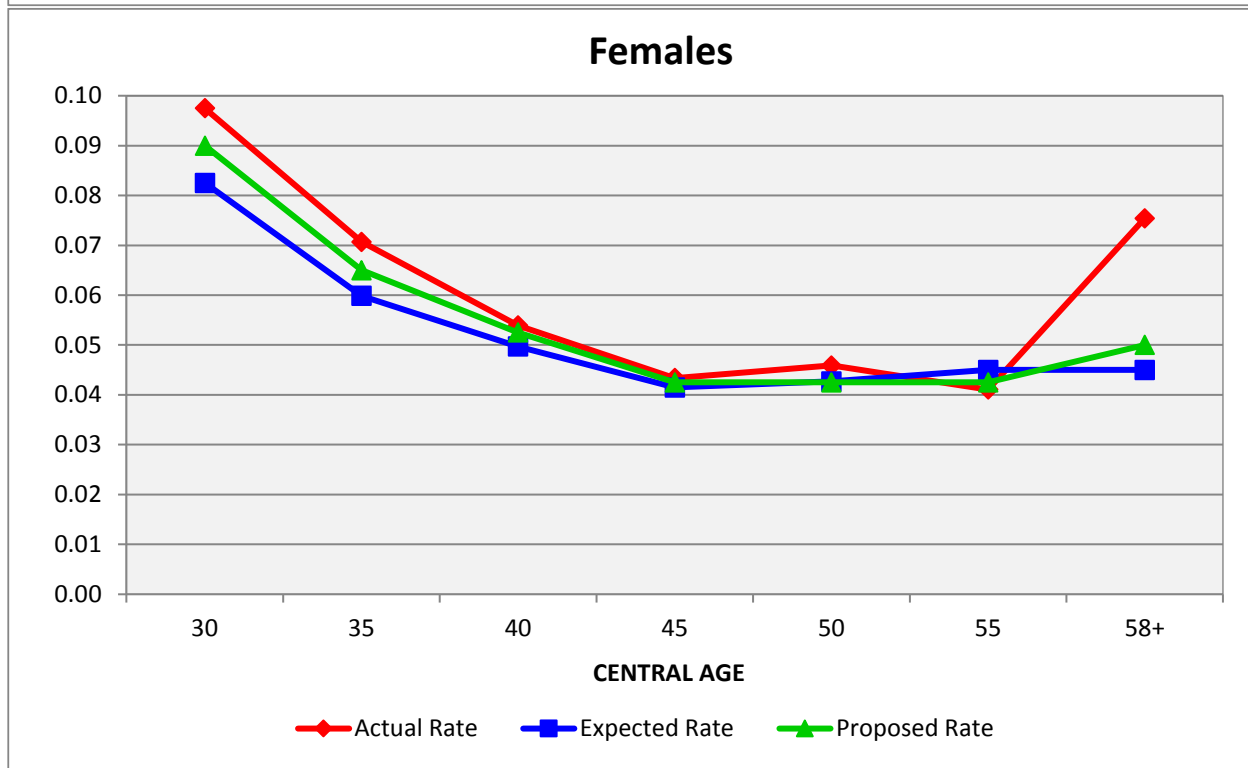
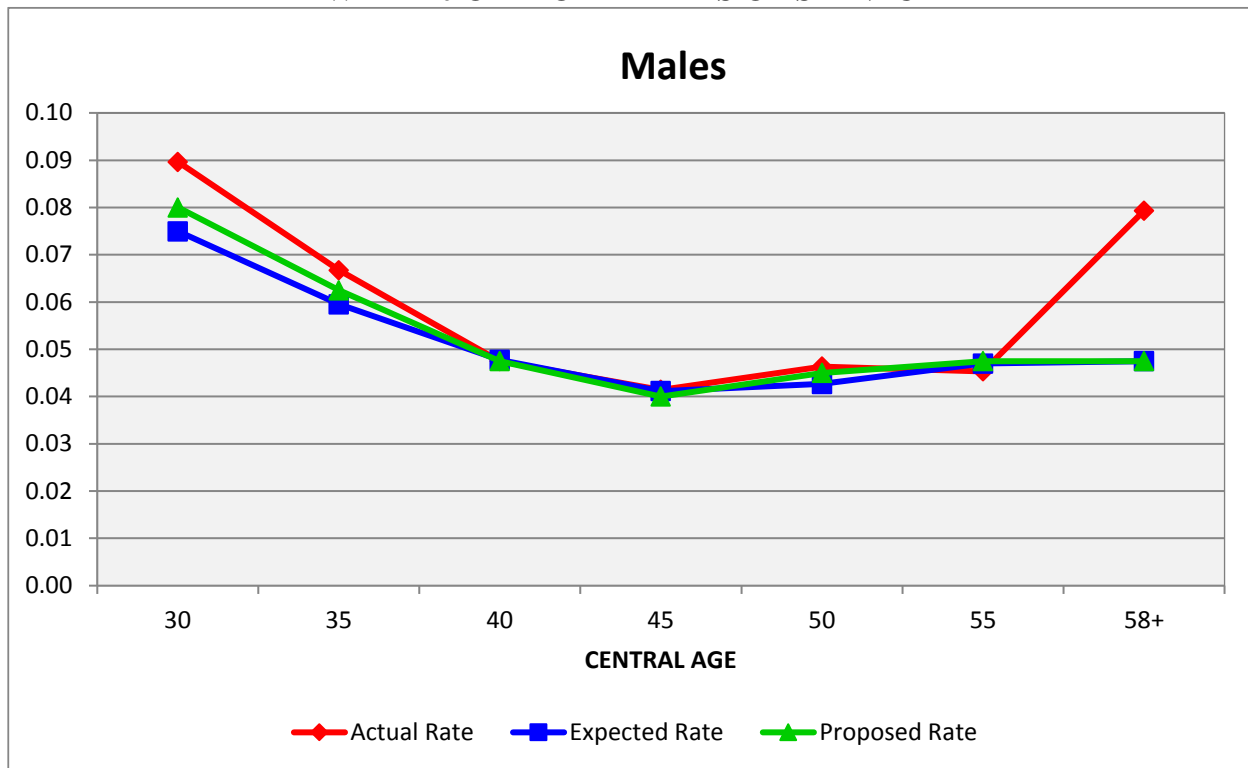
RATES OF WITHDRAWAL FOR NON-POLICE ACTIVE MEMBERS WITH AT LEAST 5 BUT LESS THAN 10 YEARS OF SERVICE





Section V – Demographic Assumptions

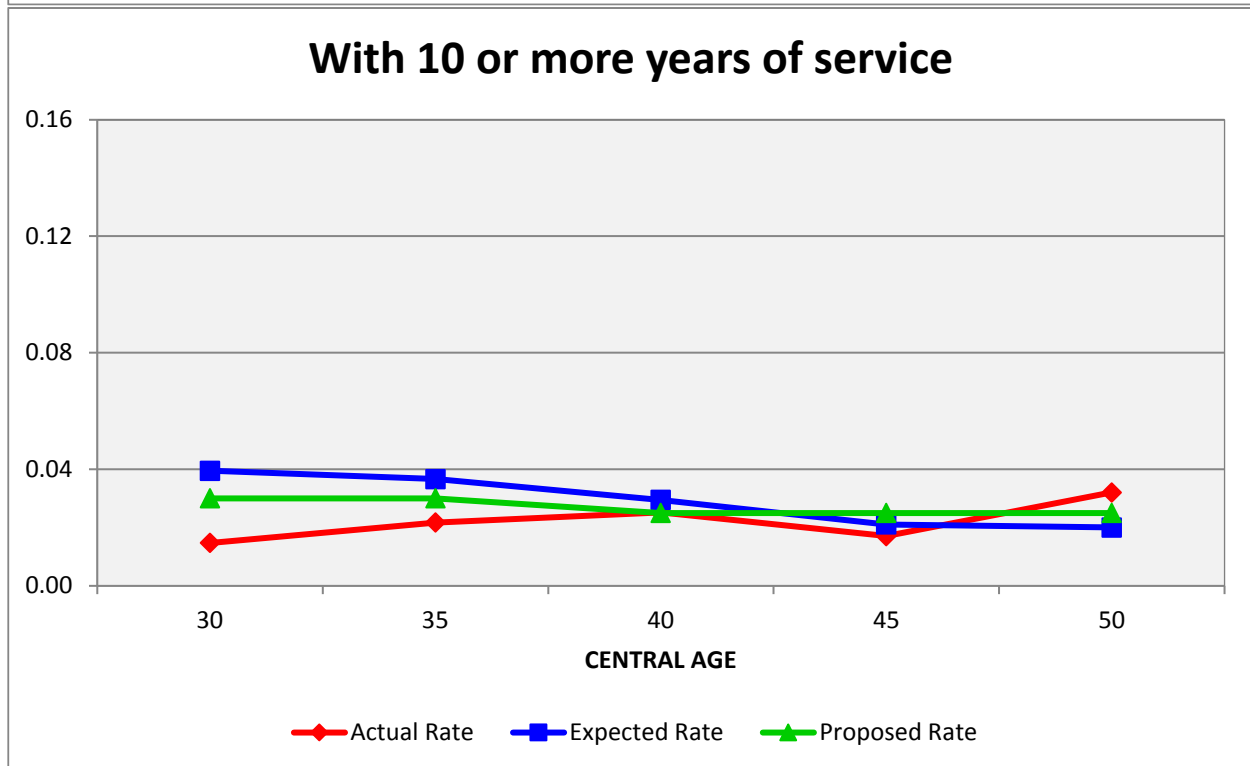
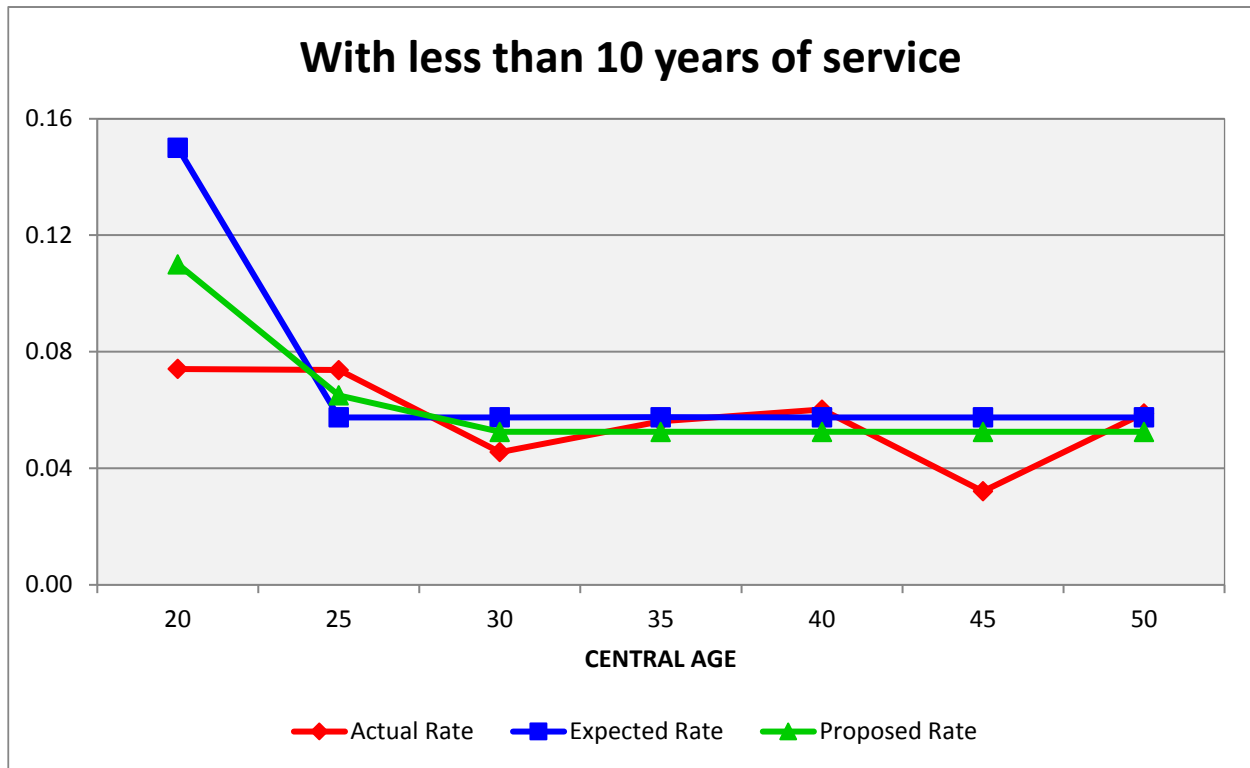
RATES OF WITHDRAWAL FOR NON-POLICE ACTIVE MEMBERS WITH 10 OR MORE YEARS OF SERVICE





Section V – Demographic Assumptions

RATES OF WITHDRAWAL FOR POLICE ACTIVE MEMBERS





Section V – Demographic Assumptions

The charts below provide our recommended changes to this assumption.

**COMPARATIVE RATES OF WITHDRAWAL
FROM ACTIVE SERVICE**

NON-POLICE

AGE	RATES OF WITHDRAWAL					
	CURRENT			PROPOSED		
	Years of Service			Years of Service		
	0 – 4	5 – 9	10+	0 – 4	5 – 9	10+
	Males					
20	35.00%			40.00%		
25	27.50	15.00%		30.00	16.25%	
30	23.00	11.50	7.50%	25.00	12.50	8.00%
35	21.50	10.00	6.00	23.00	10.50	6.25
40	19.50	9.50	4.75	20.00	9.50	4.75
45	18.60	9.00	4.00	20.00	8.50	4.00
50	16.60	7.25	4.25	17.00	7.25	4.50
55	14.50	7.00	4.75	15.00	6.75	4.75
Females						
20	30.00%			35.00%		
25	25.00	17.50%		27.00	18.00%	
30	21.50	12.50	8.25%	23.00	12.50	9.00%
35	19.50	10.50	6.00	20.00	10.25	6.50
40	18.25	9.50	5.00	18.00	9.00	5.25
45	16.50	8.00	4.00	17.00	8.00	4.25
50	15.00	7.25	4.25	16.00	7.50	4.25
55	14.00	7.00	4.50	15.00	7.25	4.25



Section V – Demographic Assumptions

POLICE

AGE	RATES OF WITHDRAWAL			
	CURRENT		PROPOSED	
	Years of Service		Years of Service	
	0 – 9	10+	0 – 9	10+
20	15.00%		11.00%	
25	5.75		6.50	
30	5.75	4.00	5.25	3.00
35	5.75	3.75	5.25	3.00
40	5.75	3.00	5.25	2.50
45	5.75	2.00	5.25	2.50
50	5.75	2.00	5.25	2.50
55	0.00	0.00	0.00	0.00

The following tables show a comparison of the actual and expected withdrawals from active service based on the new proposed rates of withdrawal and the resulting A/E (actual to expected) ratio.



Section V – Demographic Assumptions

**COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS
BASED ON PROPOSED RATES**

NON-POLICE

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	Proposed Rates					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	Withdrawals with less than 5 years of service					
20	1,030	927.2	1.111	801	687.1	1.166
25	2,666	2,522.4	1.057	4,088	3,810.3	1.073
30	1,908	1,864.2	1.023	3,538	3,448.5	1.026
35	1,149	1,115.6	1.030	2,354	2,260.0	1.042
40	773	747.4	1.034	1,638	1,626.5	1.007
45	780	746.2	1.045	1,353	1,325.5	1.021
50	567	552.3	1.027	1,054	970.2	1.086
53 & OVER	906	871.0	1.040	1,466	1,403.0	1.045
TOTAL	9,779	9,346.3	1.046	16,292	15,531.1	1.049
	Withdrawals with at least 5 but less than 10 years of service					
25	105	94.4	1.112	81	79.0	1.025
30	342	315.0	1.086	558	550.5	1.014
35	328	305.2	1.075	631	647.3	0.975
40	213	201.1	1.059	437	475.2	0.920
45	187	196.4	0.952	399	391.2	1.020
50	174	162.0	1.074	327	311.8	1.049
53 & OVER	455	437.0	1.041	777	719.4	1.080
TOTAL	1,804	1,711.1	1.054	3,210	3,174.4	1.011
	Withdrawals with 10 or more years of service					
30	58	51.8	1.120	51	47.1	1.083
35	204	188.5	1.082	369	337.3	1.094
40	253	254.4	0.994	551	533.9	1.032
45	300	298.8	1.004	553	551.4	1.003
50	286	279.6	1.023	553	512.0	1.080
53 & OVER	449	388.2	1.157	800	710.0	1.127
TOTAL	1,550	1,461.3	1.061	2,877	2,691.7	1.069



Section V – Demographic Assumptions

**COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS
BASED ON PROPOSED RATES**

POLICE

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS		
	Proposed Rates		
	Actual	Expected	Ratio of Actual to Expected
Withdrawals with less than 10 years of service			
20	2	3.0	0.667
25	37	32.7	1.131
30	41	47.3	0.867
35	27	25.3	1.067
40	16	14.0	1.143
45	6	9.8	0.612
50	6	5.4	1.111
53 & OVER	5	2.0	2.500
TOTAL	140	139.5	1.004
Withdrawals with 10 or more years of service			
30	2	4.1	0.488
35	10	13.8	0.725
40	20	19.8	1.010
45	20	29.2	0.685
50	27	21.1	1.280
53 & OVER	13	3.6	3.611
TOTAL	92	91.6	1.004



Section V – Demographic Assumptions

RATES OF DISABILITY RETIREMENT

COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS

NON-POLICE

CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS					
	Current Rates					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
35	7	19.0	0.368	4	14.1	0.284
40	16	28.7	0.557	19	26.7	0.712
45	61	67.7	0.901	62	67.3	0.921
50	94	105.2	0.894	103	119.8	0.860
55	108	145.7	0.741	143	185.3	0.772
58 & OVER	59	63.4	0.931	72	84.3	0.854
TOTAL	345	429.7	0.803	403	497.5	0.810

POLICE

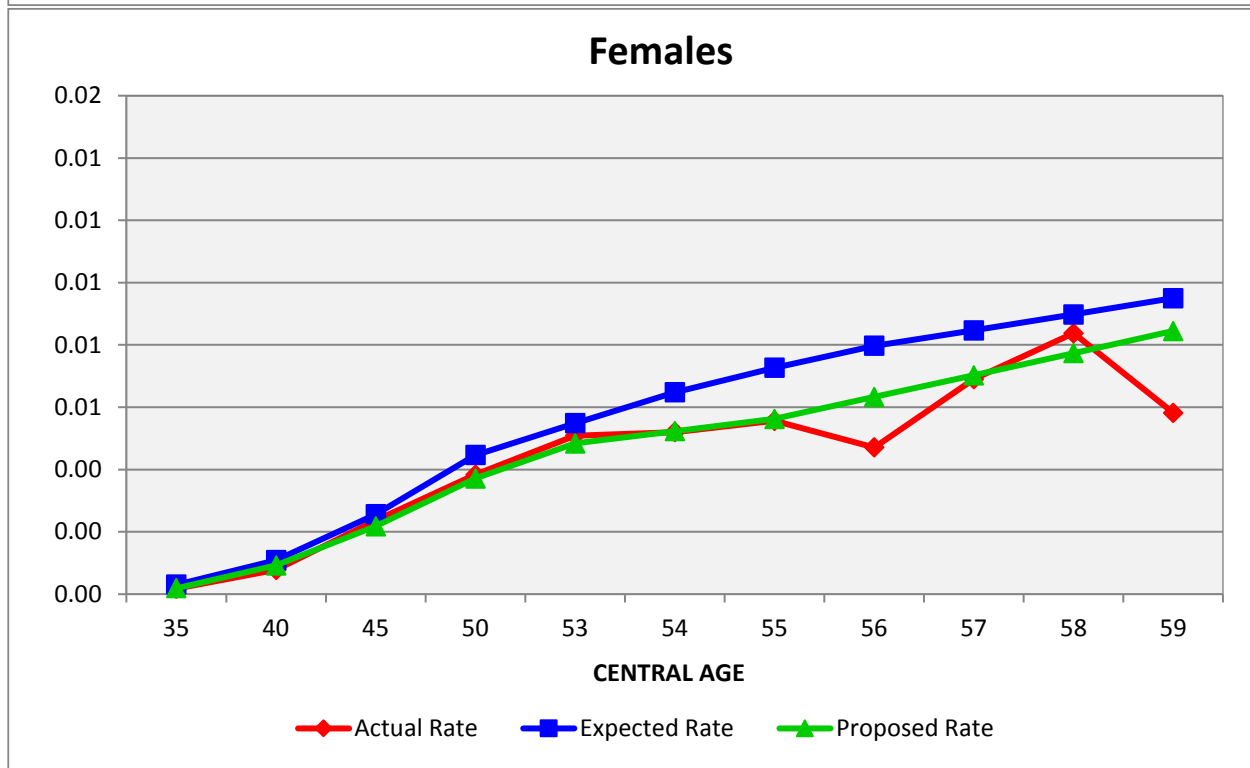
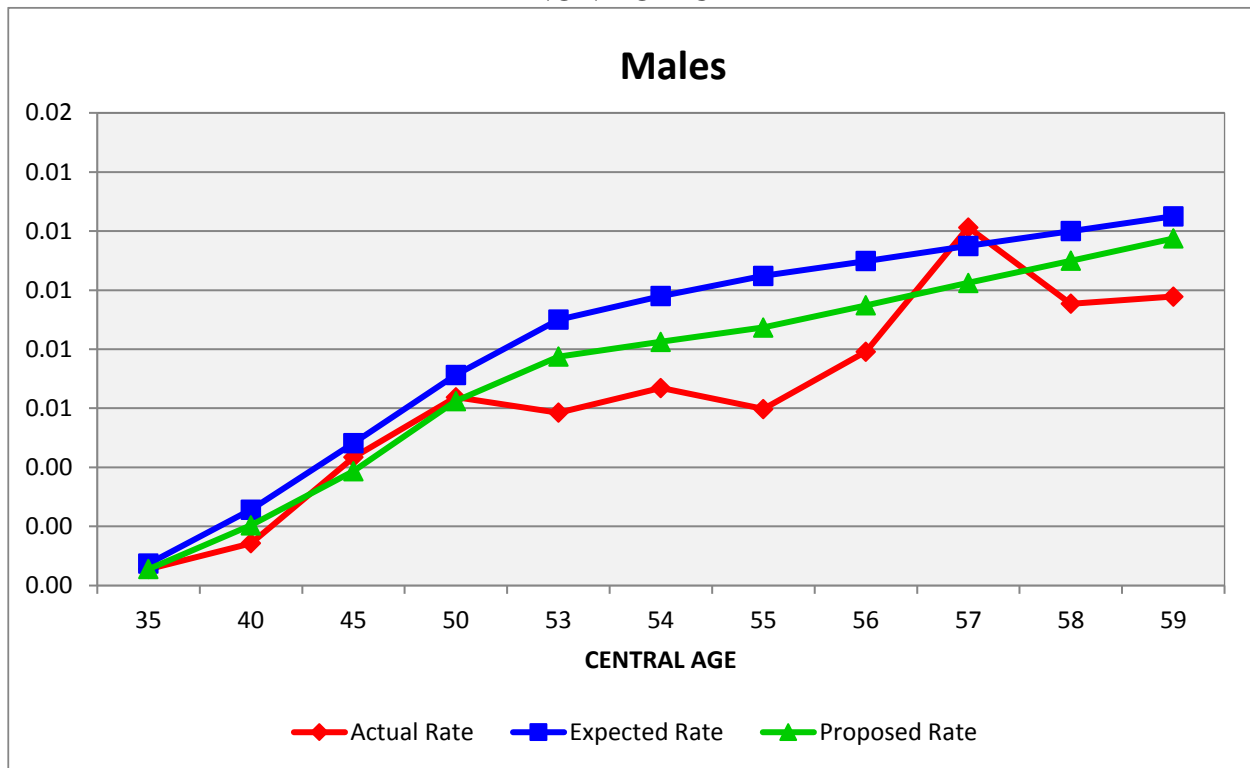
CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS		
	Current Rates		
	Actual	Expected	Ratio of Actual to Expected
35	2	3.4	0.588
40	22	8.9	2.472
45	41	19.2	2.135
50	54	19.5	2.769
53 & OVER	23	11.6	1.983
TOTAL	142	62.6	2.268

During the period under investigation, the actual rates of disability retirement for Non-Police members were less than expected over all age groups. On the contrary, for Police members the disability retirements were significantly more than expected over most age groups. Therefore, we recommend the rates of disability retirement be decreased for Non-Police members and increased for Police members to partially reflect the experience of the System. The following graphs show a comparison of the current expected, actual, and proposed rates of disability retirements for actives.



Section V – Demographic Assumptions

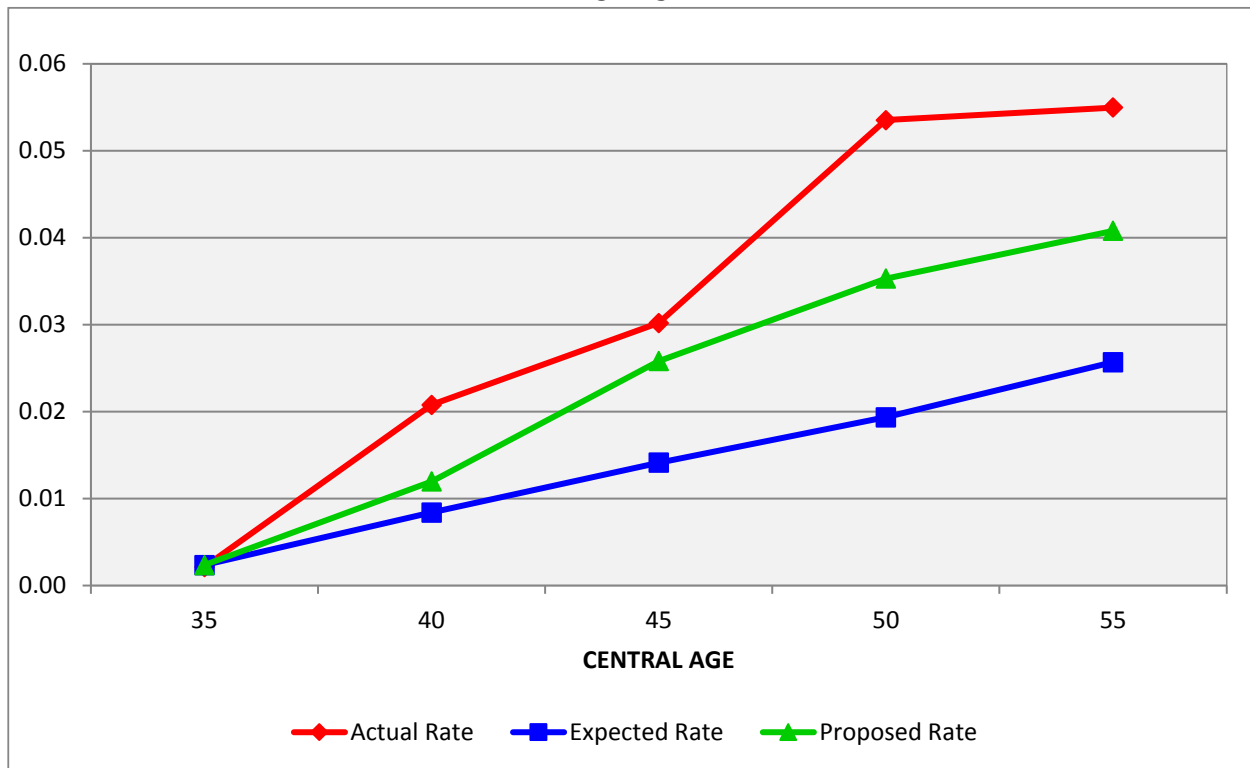
RATES OF DISABILITY RETIREMENT NON-POLICE





Section V – Demographic Assumptions

**RATES OF DISABILITY RETIREMENT
POLICE**



The following tables show a comparison between the present disability retirement rates and the proposed rates.

**COMPARATIVE RATES OF DISABILITY RETIREMENTS
NON-POLICE**

AGE	RATES OF DISABILITY			
	MALES		FEMALES	
	Current	Proposed	Current	Proposed
30	0.050%	0.010%	0.020%	0.005%
35	0.050	0.040	0.020	0.010
40	0.250	0.200	0.100	0.085
45	0.480	0.375	0.250	0.215
50	0.700	0.625	0.450	0.365
55	1.050	0.875	0.730	0.565



Section V – Demographic Assumptions

**COMPARATIVE RATES OF DISABILITY RETIREMENTS
POLICE**

AGE	RATES OF DISABILITY	
	Current	Proposed
30	0.080%	0.050%
35	0.160	0.125
40	0.850	1.125
45	1.400	2.625
50	2.000	3.625
55	2.700	4.125

The following table shows a comparison of the actual and expected disability retirements based on the new proposed rates of disability and the resulting A/E (actual to expected) ratio.

**COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS
BASED ON PROPOSED RATES**

NON-POLICE

CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS					
	Proposed Rates					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
35	7	7.0	1.000	4	5.0	0.800
40	16	22.8	0.702	19	22.6	0.841
45	61	54.4	1.121	62	57.2	1.084
50	94	92.1	1.021	103	99.7	1.033
55	108	125.1	0.863	143	151.0	0.947
58 & OVER	59	58.9	1.002	72	73.8	0.976
TOTAL	345	360.3	0.958	403	409.3	0.985



Section V – Demographic Assumptions

**COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS
BASED ON PROPOSED RATES**

POLICE

CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS		
	Proposed Rates		
	Actual	Expected	Ratio of Actual to Expected
35	1	3.5	0.286
40	18	12.5	1.440
45	22	17.1	1.287
50	24	13.8	1.739
53 & OVER	12	9.0	1.333
TOTAL	77	55.9	1.377



Section V – Demographic Assumptions

RATES OF RETIREMENT

**COMPARISON OF ACTUAL AND EXPECTED
EARLY RETIREMENTS**

NEW PLAN AND GSEPS NON-POLICE

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS					
	Current Rates					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
45	21	36.1	0.582	12	20.9	0.574
50	77	145.5	0.529	102	145.5	0.701
53	32	31.0	1.032	21	37.5	0.560
54	27	29.6	0.912	38	43.0	0.884
55	12	28.8	0.417	33	44.4	0.743
56	26	26.7	0.974	25	44.7	0.559
57	15	27.4	0.547	41	49.0	0.837
58	22	28.8	0.764	36	52.8	0.682
59	22	30.5	0.721	44	66.0	0.667
TOTAL	254	384.4	0.661	352	503.8	0.699

**COMPARISON OF ACTUAL AND EXPECTED
NORMAL RETIREMENTS**

NEW PLAN AND GSEPS NON-POLICE

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS					
	Current Rates					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
52 & UNDER	283	335.4	0.844	261	296.4	0.881
55	440	625.3	0.704	585	784.5	0.746
60	1,131	1,303.5	0.868	2,001	2,339.7	0.855
65	752	859.4	0.875	1,240	1,295.5	0.957
68 & OVER	375	459.2	0.817	405	473.0	0.856
TOTAL	2,981	3,582.8	0.832	4,492	5,189.1	0.866



Section V – Demographic Assumptions

**COMPARISON OF ACTUAL AND EXPECTED
NORMAL RETIREMENTS**

POLICE

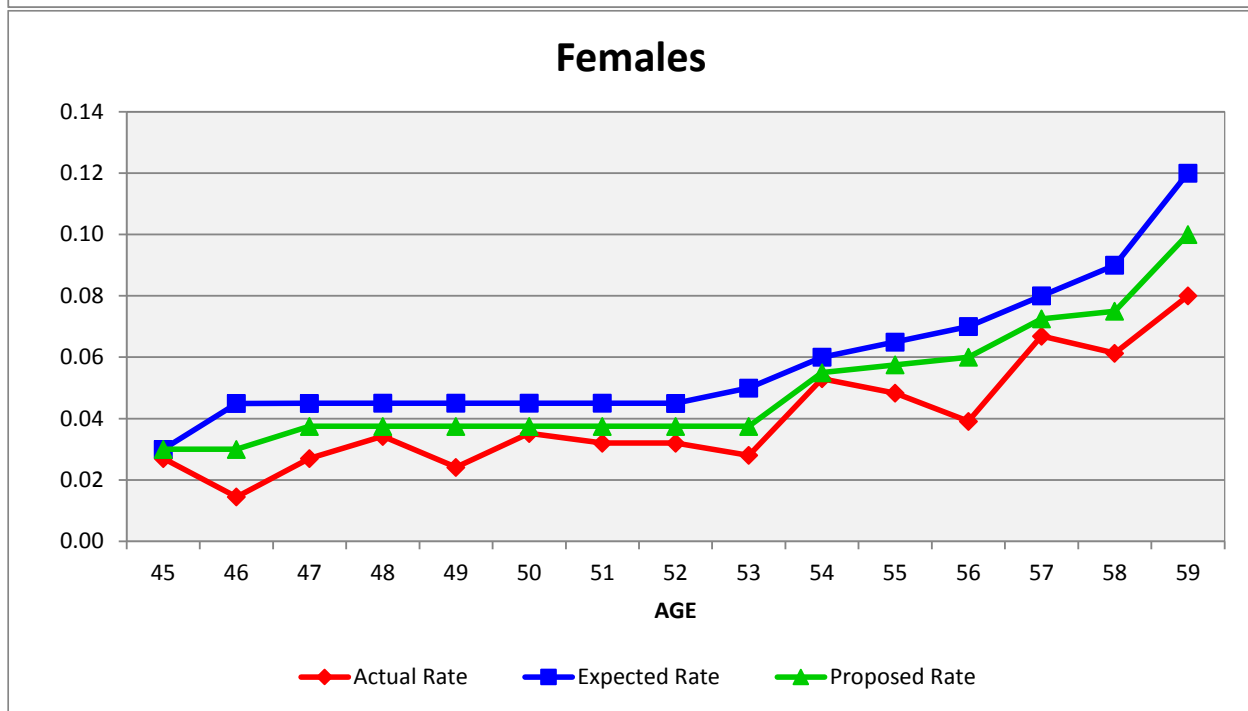
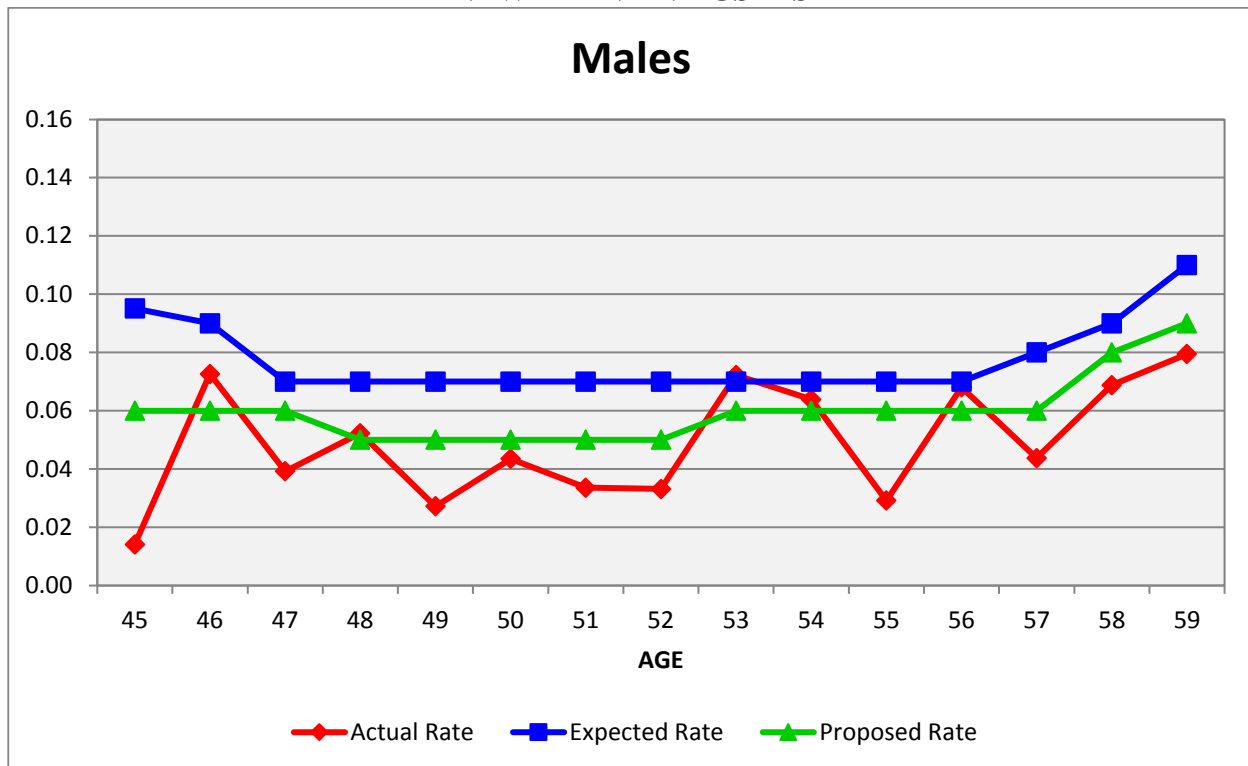
AGE	NUMBER OF SERVICE RETIREMENTS		
	Current Rates		
	Actual	Expected	Ratio of Actual to Expected
< 55	48	68.3	0.703
55	7	13.4	0.522
56	8	5.9	1.356
57	6	5.4	1.111
58	8	4.7	1.702
59	6	3.1	1.935
60	6	5.7	1.053
61	3	2.1	1.429
62	3	3.2	0.938
63	1	0.8	1.250
64	3	1.3	2.308
65 & OVER	2	1.5	1.333
TOTAL	101	115.4	0.875

The analysis of the experience reflects that actual rates of early retirement and normal retirement were less than expected at most ages for non-Police. For Police, in aggregate, the actual rates of retirement were less than expected but those were mostly at younger ages. We recommend an increase in the non-Police rates of retirement at most ages and adjustments to the Police retirement rates at all ages to reflect the experience as well as maintain a reasonable degree of margin. The following graphs show a comparison of the present, actual, and proposed rates of service retirements.



Section V – Demographic Assumptions

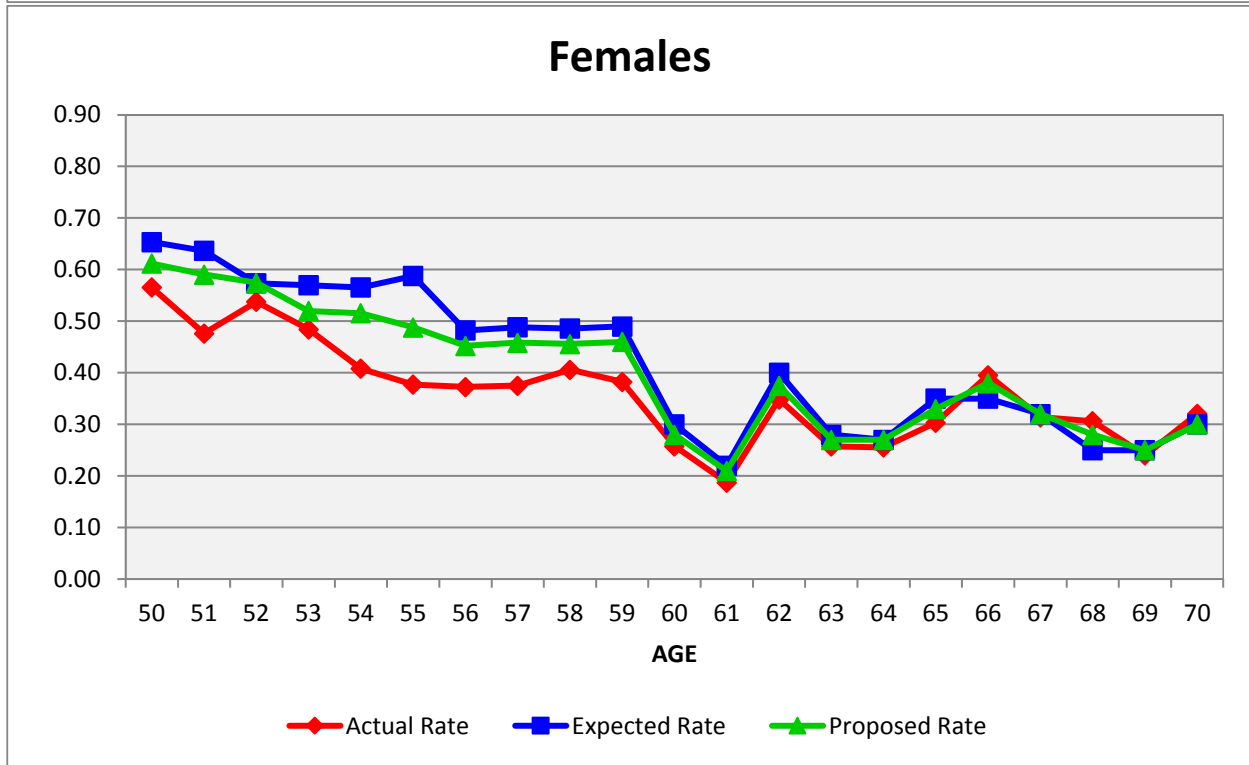
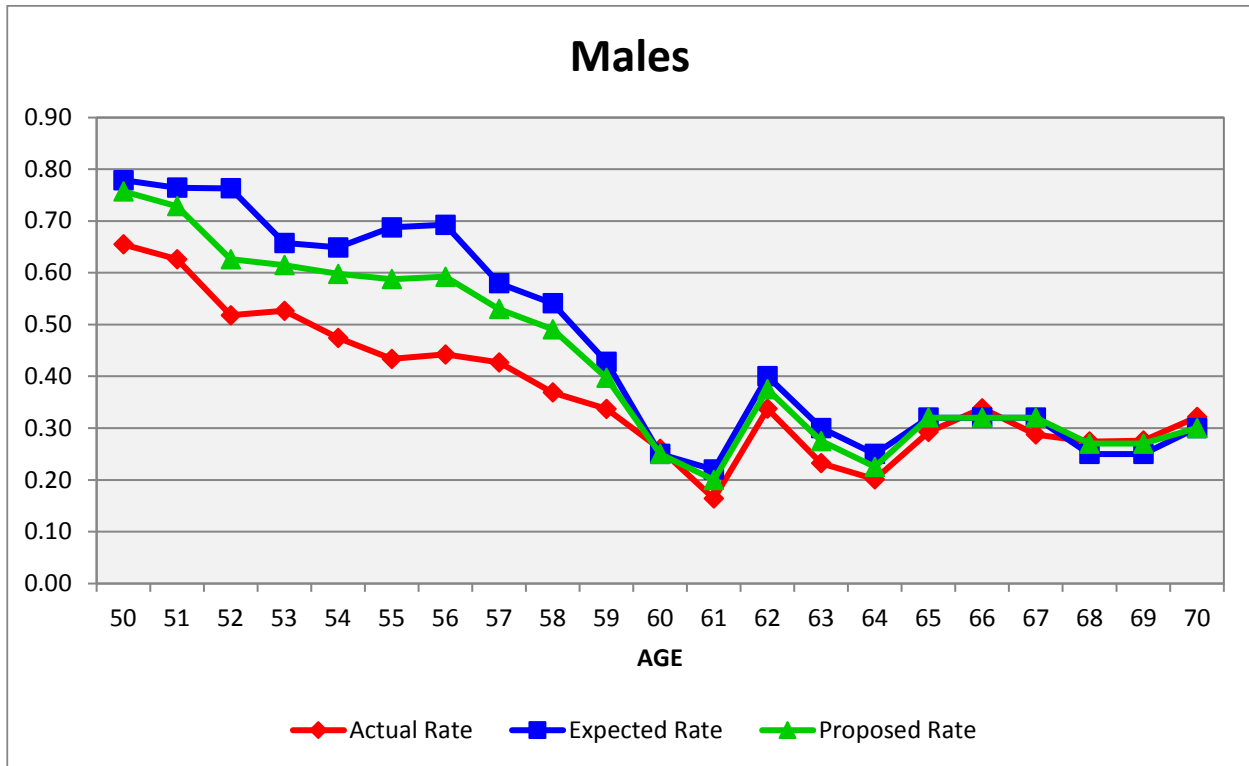
RATES OF EARLY RETIREMENT NEW PLAN AND GSEPS





Section V – Demographic Assumptions

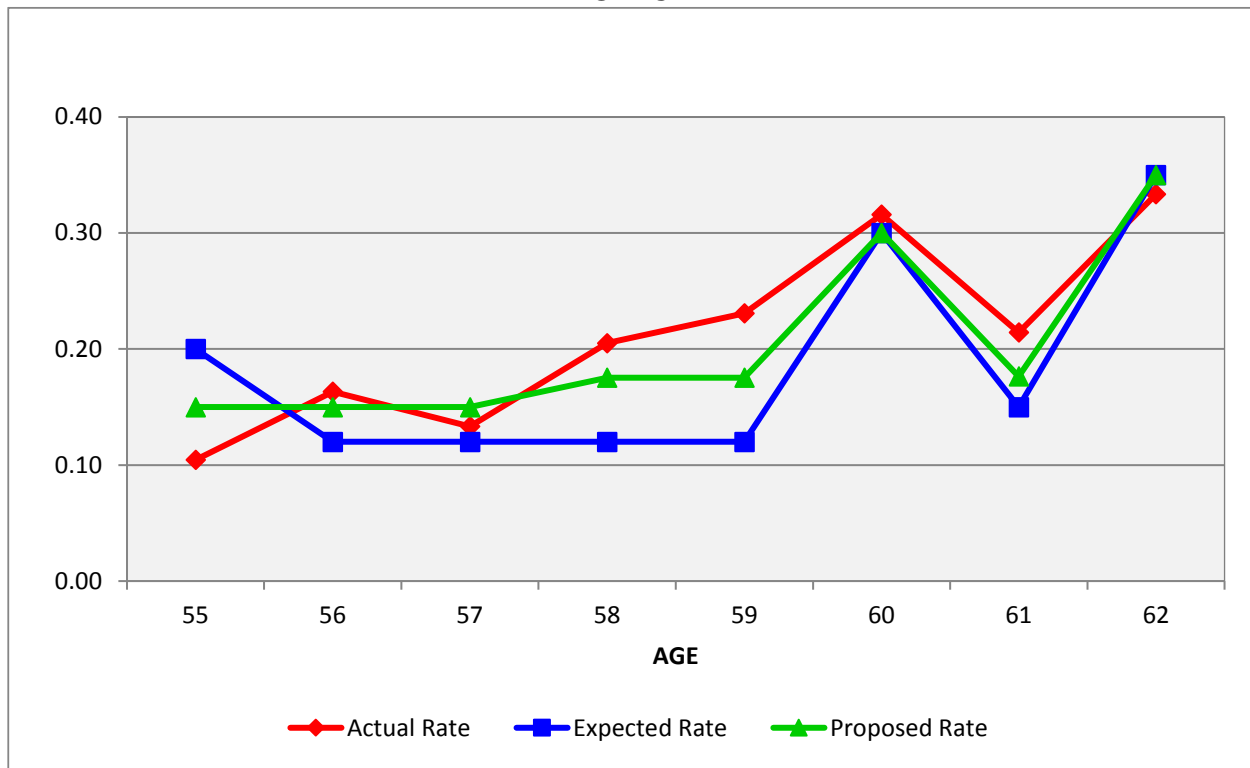
RATES OF NORMAL RETIREMENT
NEW PLAN AND GSEPS





Section V – Demographic Assumptions

RATES OF RETIREMENT POLICE



The following tables show a comparison of the present and proposed rates of service retirement.



Section V – Demographic Assumptions

**COMPARATIVE RATES OF RETIREMENT
NEW PLAN AND GSEPS**

AGE	EARLY RETIREMENT			
	MALES		FEMALES	
	Present	Proposed	Present	Proposed
45	9.50%	6.00%	3.00%	3.00%
50	7.00	5.00	4.50	3.75
55	7.00	6.00	6.50	5.75
59	11.00	9.00	12.00	10.00

AGE	NORMAL RETIREMENT			
	MALES		FEMALES	
	Present*	Proposed*	Present**	Proposed**
50	70.0%	60.0%	50.0%	42.0%
55	60.0	50.0	50.0	40.0
60	25.0	25.0	30.0	28.0
62	40.0	37.5	40.0	37.5
64	25.0	22.5	27.0	27.0
65	32.0	32.0	35.0	33.0
66	32.0	32.0	35.0	38.0
67	32.0	32.0	32.0	32.0
68	25.0	27.0	25.0	28.0
69	25.0	27.0	25.0	25.0
70	30.0	30.0	30.0	30.0
75	100.0	100.0	100.0	100.0

* An additional 20% are assumed to retire in the first year eligible for unreduced retirement with 30 years of service before age 60.

** An additional 25% for ages below 53 and 20% for ages 53 to 59 are assumed to retire in the first year eligible for unreduced retirement with 30 years of service before age 60.



Section V – Demographic Assumptions

**COMPARATIVE RATES OF RETIREMENT
POLICE**

AGE	RATES OF RETIREMENT			
	Less than 30 years of service		30 or more years of service	
	Current	Proposed	Current	Proposed
45			100.0%	100.0%
46			100.0	100.0
47			100.0	100.0
48			100.0	90.0
49			100.0	90.0
50			100.0	75.0
51			75.0	60.0
52			75.0	60.0
53			75.0	60.0
54			75.0	60.0
55	20.0%	15.0%	20.0	15.0
56	12.0	15.0	12.0	15.0
57	12.0	15.0	12.0	15.0
58	12.0	17.5	12.0	17.5
59	12.0	17.5	12.0	17.5
60	30.0	30.0	30.0	30.0
61	15.0	17.5	15.0	17.5
62	35.0	35.0	35.0	35.0
63	25.0	35.0	25.0	35.0
64	25.0	35.0	25.0	35.0
65	25.0	25.0	25.0	25.0
66	25.0	25.0	25.0	25.0
67	25.0	25.0	25.0	25.0
68	25.0	25.0	25.0	25.0
69	25.0	25.0	25.0	25.0
70 & OVER	100.0	100.0	100.0	100.0



Section V – Demographic Assumptions

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

NEW PLAN AND GSEPS

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS					
	Proposed Rates					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
45	21	26.4	0.795	12	16.9	0.710
50	77	103.9	0.741	102	121.1	0.842
53	32	26.6	1.203	21	28.1	0.747
54	27	25.4	1.063	38	39.5	0.962
55	12	24.7	0.486	33	39.3	0.840
56	26	22.9	1.135	25	38.3	0.653
57	15	20.6	0.728	41	44.4	0.923
58	22	25.6	0.859	36	44.0	0.818
59	22	24.9	0.884	44	55.0	0.800
TOTAL	254	301.0	0.844	352	426.6	0.825

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

NEW PLAN AND GSEPS

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS					
	Proposed Rates					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
52 & UNDER	283	318.2	0.889	261	288.2	0.906
55	440	559.0	0.787	585	708.6	0.826
60	1,131	1,236.0	0.915	2,001	2,198.0	0.910
65	752	822.1	0.915	1,240	1,285.5	0.965
68 & OVER	375	489.5	0.766	405	495.3	0.818
TOTAL	2,981	3,424.8	0.870	4,492	4,975.6	0.903



Section V – Demographic Assumptions

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

POLICE

AGE	NUMBER OF SERVICE RETIREMENTS		
	Proposed Rates		
	Actual	Expected	Ratio of Actual to Expected
< 55	48	55.1	0.871
55	7	10.1	0.693
56	8	7.4	1.081
57	6	6.8	0.882
58	8	6.8	1.176
59	6	4.6	1.304
60	6	5.7	1.053
61	3	2.5	1.200
62	3	3.2	0.938
63	1	1.1	0.909
64	3	1.8	1.667
65 & OVER	2	1.5	1.333
TOTAL	101	106.6	0.947



Section V – Demographic Assumptions

RATES OF MORTALITY

One of the most important demographic assumptions in the valuation is mortality because it projects how long benefit payments will be made. The longer members live, the greater the true cost of future benefit obligations will be.

For many years, rates of mortality have been declining, meaning people, in general, are living longer. Consequently, we anticipate that mortality tables will need to be updated periodically. Because of potential differences in mortality, we break down our study by gender (males and females) and by status (healthy retirees, beneficiaries, disabled retirees, and active members).

Because of the substantial amount of data required to construct a mortality table, actuaries usually rely on standard tables published by the Society of Actuaries. Actuaries then use various adjustments such as age or scaling adjustments to the standard, published mortality tables in order to better match the observed mortality rates of a specific group.

The first of these adjustments is an age adjustment that can be either a “setback” or a “set forward”. A one-year age setback treats all members as if they were one year younger than they truly are when applying the rates in the mortality table. For example, a one year set back would treat a 61-year old retiree as if he will exhibit the mortality of a 60-year old in the standard mortality table.

The second adjustment that can be used to adjust the mortality rates in a standard table to better fit actual experience is to “scale” a mortality table by multiplying the probabilities of death by factors less than one (to reflect better mortality) or factors greater than one (to reflect poorer mortality). Scaling factors can be applied to an entire table or a portion of the table. Of course, if needed, actuaries may use both of these methods to develop an appropriate table to model the mortality of the specific plan population.

In 2019, the Society of Actuaries released a family of mortality tables named the Pub-2010 tables. While prior pension mortality tables have been based solely on private corporate and union retirement plans, these new tables are based entirely on public sector plan data. These tables are split by three membership types: Safety, Teachers, and General to reflect the observed differences in mortality patterns related to the three groups. Tables are further split for healthy retirees, disabled retirees, contingent beneficiaries, and employees. There are still other breakdowns in these tables for at, above or below median annuity values. We anticipate that this family of tables will be a good starting point in developing a recommended mortality assumption.

The issue of future mortality improvement is one that the actuarial profession has become increasingly focused on studying and monitoring. This has resulted in changes to the relevant Actuarial Standard of Practice, ASOP 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. This ASOP requires the pension actuary to make



Section V – Demographic Assumptions

and disclose a specific recommendation with respect to future improvements in mortality after the valuation date, although it does not require that an actuary assume there will be future improvements. There have been significant improvements in longevity in the past, although there are different opinions about future expectations, and thus there is a subjective component in the estimation of future mortality improvement. We believe it is prudent to anticipate that the trend will continue to some degree in the future and that it is appropriate to reflect some future mortality improvement as part of the mortality assumption.

There are two, widely-used ways to reflect future improvements in mortality:

- (1) Static table with “margin”
- (2) Generational mortality

The first approach to reflecting mortality improvements is through the use of a static mortality table with “margin.” Under this approach, the Actual to Expected Ratio is intentionally targeted to be over 100% so that mortality can improve without creating actuarial losses. This has been the approach used historically by many other systems because of its computational simplicity.

Another approach, referred to as generational mortality, directly anticipates future improvements in mortality by using a different set of mortality rates based on each year of birth, with the rates for later years of birth assuming lower mortality than the rates for earlier years of birth. The varying mortality rates by year of birth create a series of tables that contain “built-in” mortality improvements, e.g., a member who turns age 65 in 2035 has a longer life expectancy than a member who turns age 65 in 2020. When using generational mortality, the Actual to Expected Ratios for the observed experience are set near 100% as future mortality improvements will be taken into account directly in the actuarial valuation process. The generational approach is our preferred method for recognizing future mortality improvements in the valuation process because it is more direct and results in longer life expectancy for members who are younger, consistent with what we believe is more likely to occur. Over the last 10-15 years, this method has become quite common as computing power has increased.



Section V – Demographic Assumptions

MORTALITY – Healthy Retirees

The valuation currently uses the same mortality assumption for all healthy members, including service retirees and beneficiaries. This table is divided for male and female members. The current underlying mortality table is from the Society of Actuaries RP-2000 table projected statically to 2025. For this study, we have reviewed service retirees separately from beneficiaries.

We also analyzed recent experience on a benefit-weighted basis where the exposures and deaths are multiplied by the monthly retirement benefit amount. This helps to reflect any differences that arise from better mortality experience among those with larger benefits. Because a valuation is designed to measure the amount and timing of future benefit payments (liability) rather than simply the number of retirees leaving pay status, this benefit-weighted approach is an important factor in valuing plan obligations. The Actual to Expected Ratios on the benefit-weighted basis were different from the Actual to Expected Ratios on a count basis, confirming that members with higher benefits also tend to have better mortality. Please note that we are not saying that larger benefits definitely lead to better mortality, but simply that there is a correlation between the two.

The Actual to Expected Ratios on a benefit-weighted basis are summarized and compared to those on a count basis in the following table. The fact that the ratios are lower on a weighted basis than on a count basis is an indication that individuals with larger benefits do indeed have slightly better mortality on average, as was anticipated. (Note that most mortality tables used by actuaries are developed on a weighted basis.)

The results of the experience study for healthy retirees ages 60 to 90, on a count and liability-weighted basis, are summarized in the following chart.

Healthy Retiree Deaths		
A/E Ratio		
	Count Basis	Liability-Weighted Basis
Male	108%	95%
Female	95%	90%



Section V – Demographic Assumptions

In order to more closely anticipate future liability experience, we believe that assigning more credibility to the benefit-weighted analysis is the better approach. Based on the observations summarized in the table above, we believe that mortality assumption changes are appropriate for ERS. We believe the new Pub-2010 tables would be a good choice and we recommend changing the mortality basis for all of the groups so that all of ERS can share a common family of tables. We also recommend the mortality improvement scale, MP-2019, be used to anticipate future mortality improvements in the valuation process through at least the next experience study.

Therefore, our recommended mortality assumption for service retirees is based on the Pub-2010 healthy annuitant tables, with adjustments as outlined below to better fit actual experience, projected generationally with the MP-2019 scale.

<u>Group</u>	<u>Membership Table</u>	<u>Set Forward (+)/ Setback (-)</u>	<u>Adjustment to Rates</u>
Service Retirees	General	Male: +1, Female: +1	Male: 105%, Female: 108%

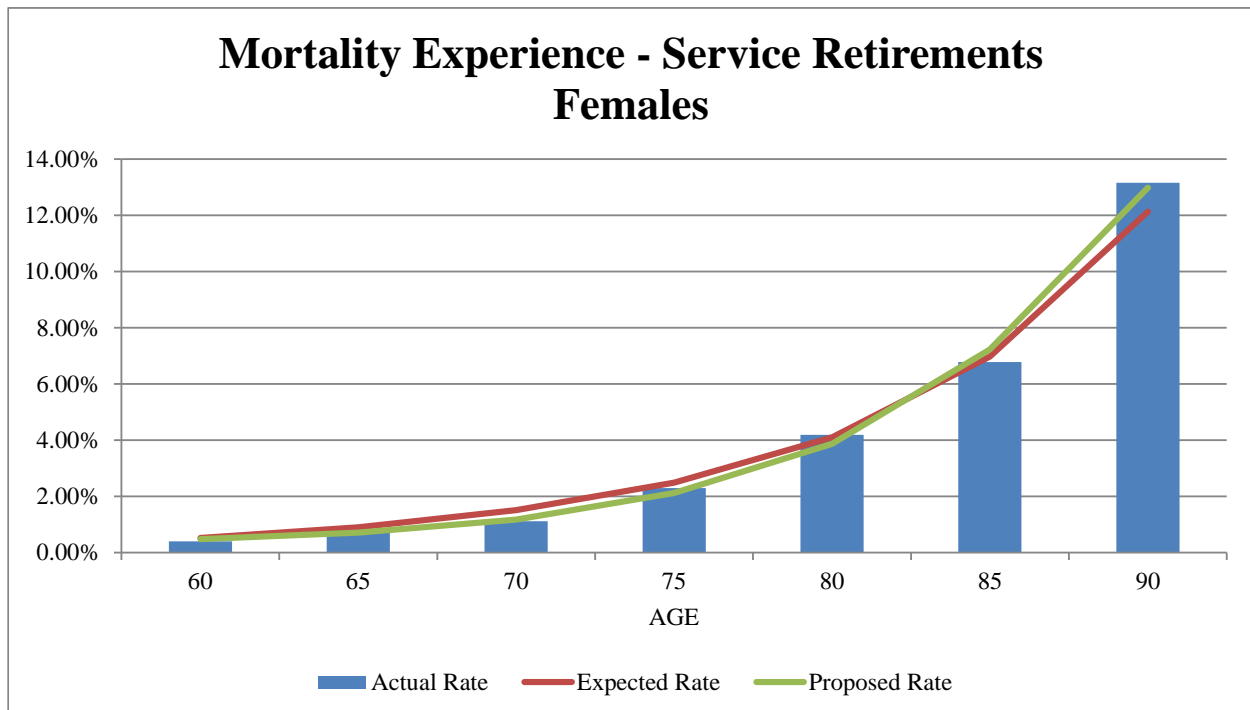
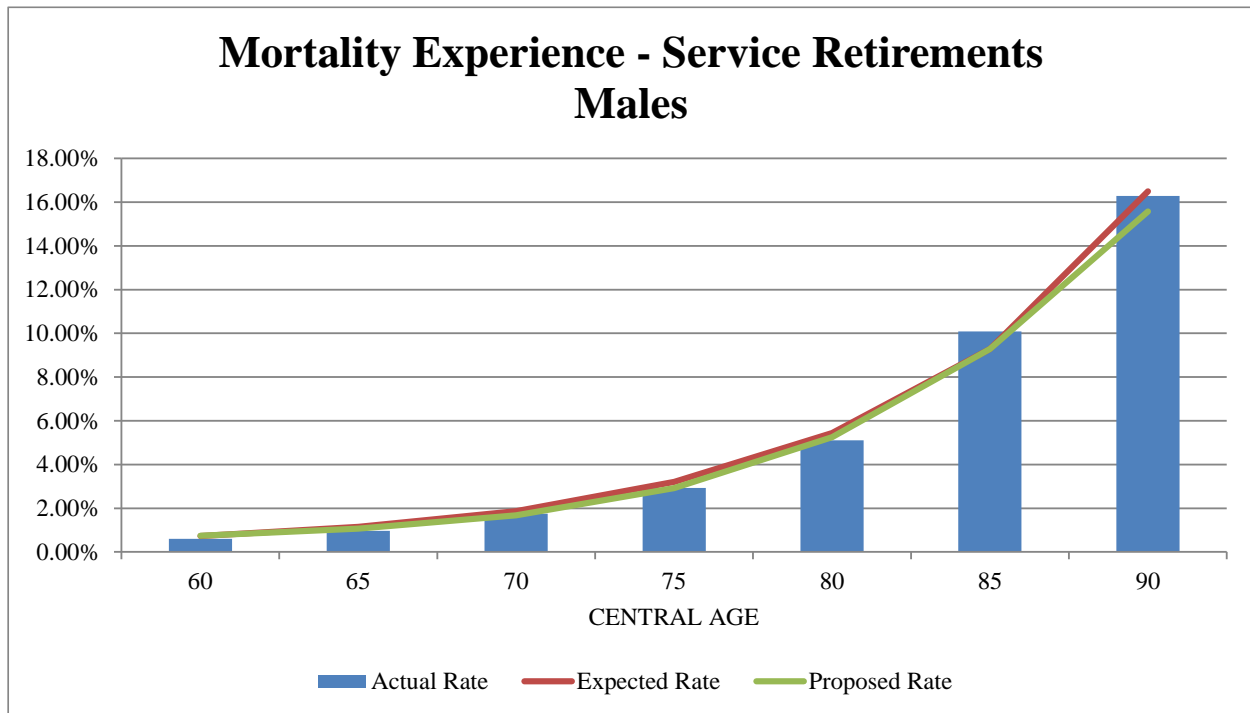
The resulting Actual to Expected Ratios, based on the proposed assumption for ages 60 to 90, are shown in the following table.

Healthy Mortality A/E Ratios (Liability Weighted)		
	<u>Current</u>	<u>Proposed</u>
Male	95%	100%
Female	90	100



Section V – Demographic Assumptions

The resulting comparisons of rates of mortality are shown in the following graphs





Section V – Demographic Assumptions

MORTALITY – Beneficiaries

The mortality of beneficiaries applies to the survivors of members who retired with a joint and survivor option. There are fewer members receiving survivor benefits under the joint and survivor options, but we do believe that the data is still somewhat credible. The results are summarized in the following table:

Beneficiary Mortality A/E Ratios (Weighted)		
	<u>Current</u>	<u>Proposed</u>
Male	123%	100%
Female	113	100

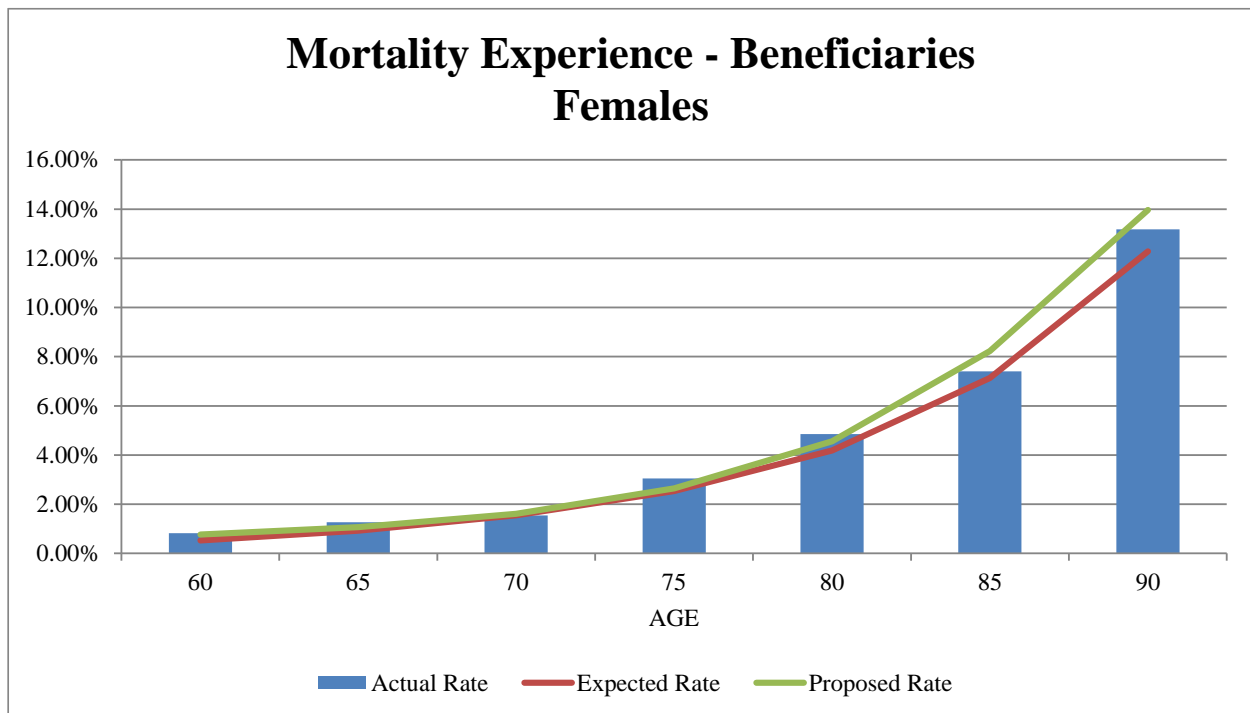
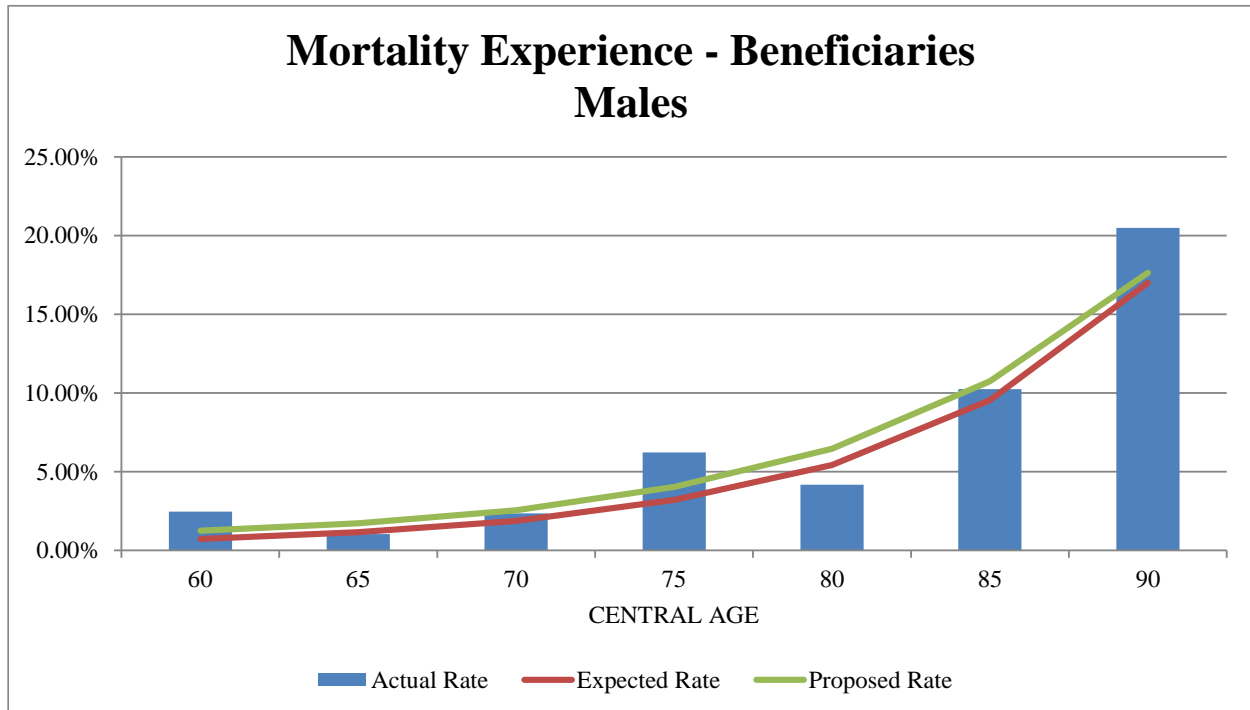
We recommend the Pub-2010 Contingent Survivors Table be used with adjustments as outlined below to better fit actual experience, projected generationally with the MP-2019 scale.

<u>Group</u>	<u>Membership Table</u>	<u>Set Forward (+)/ Setback (-)</u>	<u>Adjustment to Rates</u>
Beneficiaries	General	Male: +2, Female: +2	Male: 106%, Female: 105%



Section V – Demographic Assumptions

The resulting comparisons of rates of mortality are shown in the following graphs





Section V – Demographic Assumptions

MORTALITY – Disabled Retirees

The valuation assumes that disabled members, in general, will not live as long as retired members who met the regular service retirement eligibility. There tends to be more fluctuation in disabled mortality than healthy mortality because of differences in the types of disabilities. In addition, the smaller number of exposures makes the results more volatile. The results are summarized in the following table:

Disabled Mortality A/E Ratios (Weighted)		
	<u>Current</u>	<u>Proposed</u>
Male	86%	101%
Female	97	101

We recommend the Pub-2010 General Disabled Table be used with adjustments as outlined below to better fit actual experience, projected generationally with the MP-2019 scale.

<u>Group</u>	<u>Membership Table</u>	<u>Set Forward (+)/ Setback (-)</u>	<u>Adjustment to Rates</u>
Disabled Retirees	General	Male: -3, Female: 0	Male: 103%, Female: 106%

MORTALITY – Actives

The active member mortality assumption models eligibility for death benefits prior to retirement. Therefore, it has a much smaller impact on the valuation results than the post-retirement mortality assumption.

It is difficult to isolate the mortality for active members as it may be impacted by active members first terminating or moving to disabled status before death. The data collection methods used in this study do not fully capture known deaths, and so can be misleading. Finally, the probability of active death is very small so volatility is not uncommon. Consequently, we prefer to set this assumption by utilizing the more reliable analysis performed on the retiree data.

Our recommended mortality assumption is based on the Pub-2010 General Employee table, with no adjustments, projected generationally with the MP-2019 scale.



Section V – Demographic Assumptions

RATES OF SALARY INCREASE

Estimates of future salaries for each member are based on assumptions for two types of increases:

- Increases in each individual's salary due to promotion or longevity (often called merit scale), and
- Increases in the general wage increase of the membership, which is directly related to price and wage inflation.

Earlier in this report, we recommended using a 3.00% wage inflation assumption (2.50% price inflation and 0.50% real wage growth). Therefore, the merit scale will be added to the applicable wage inflation assumption to develop the total individual salary increase assumption.

Analysis of the merit salary scale is complicated by the fact that only total salary is reported to ERS, which includes both the general wage inflation component of salary increases and the merit salary scale. Furthermore, there is often a delay in actual price inflation compared to when it has an impact on salary increases. As a result, it is difficult to isolate the merit scale for purposes of measuring the actual salary experience. One technique we used to help reduce the effect of inflation was to look at the individual salary increases for each of the five years in the study period and adjust the results so that the longer service individuals had increases of approximately 3.00%. This allows us to focus on the shape of the increases and determine the reasonableness of a possible salary merit scale. In addition, salary increases for governmental employees during this study period have been lower than those observed in corporate America. Consequently, the selection of a merit scale has a significant component of professional judgment.

Lastly, the current rates of salary increase for active members are based on the member's age. We have studied rates of salary increase for many statewide plans over the past five years and determined that rates of salary increase for active members are better correlated to the member's service, rather than age. Therefore, we recommend that ERS change to a service-based table for rates of salary increase for active members.



Section V – Demographic Assumptions

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

SERVICE OF GROUP	RATES OF SALARY INCREASE		
	CURRENT RATES		
	Actual	Expected	Ratio of Actual to Expected
1	8.91%	4.77%	1.869
2	6.65%	4.63%	1.437
3	6.10%	4.49%	1.358
4	5.51%	4.37%	1.262
5	5.65%	4.27%	1.325
6-9	4.71%	4.07%	1.158
10-19	4.37%	3.88%	1.127
20-29	3.87%	3.65%	1.060
30+	3.09%	3.41%	0.905
TOTAL	5.49%	4.11%	1.337

The current assumed rates of salary increase were less than the actual rates of increase averaged over the study period for most service categories. We recommend a slight increase to the long-term current salary increase assumption.

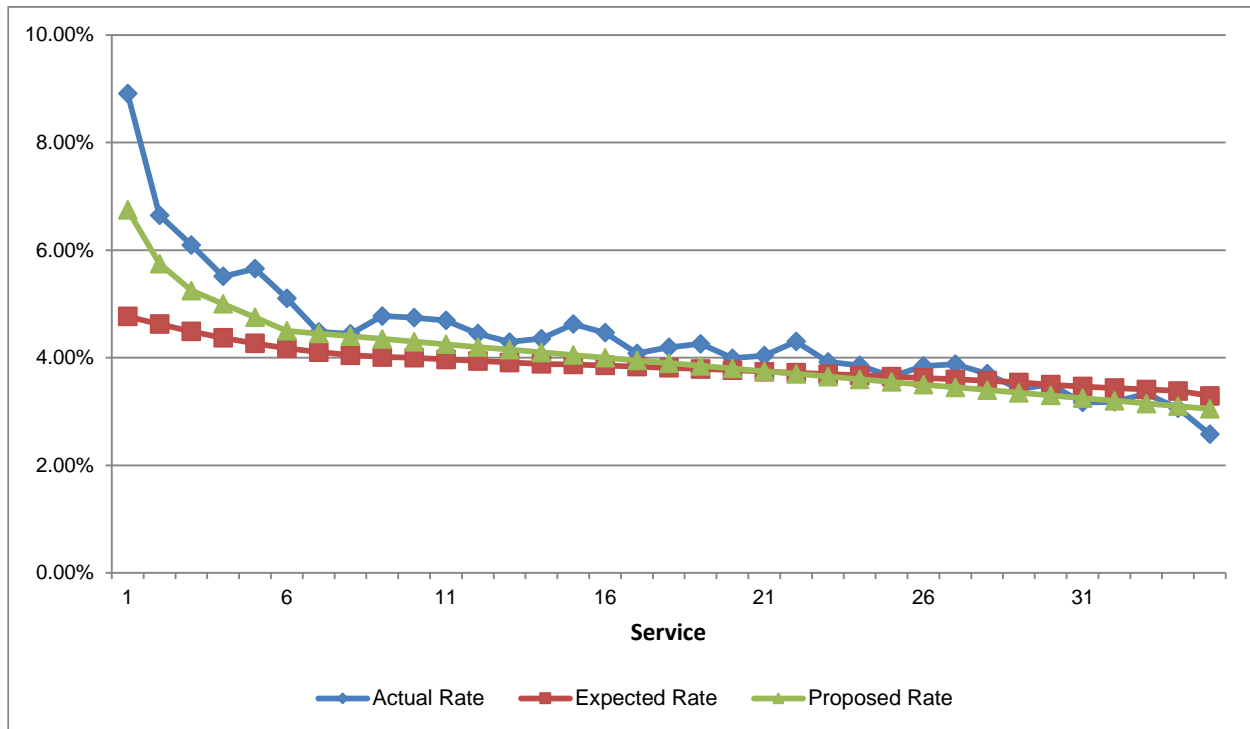
The rates of salary increase assumption will use the 3.00% rate of wage inflation (inflation plus the real rate of salary increase assumption) as the base rate of increase at all years of service and add the merit/promotion component which varies by age. The table below provides the analysis concerning the development of the merit component of this assumption.



Section V – Demographic Assumptions

CENTRAL SERVICE OF GROUP	RATES OF SALARY INCREASE		
	CURRENT RATES		
	Proposed Rate of Increase	Less Expected Wage Inflation	Proposed Merit Scale
1	6.75%	3.00%	3.75%
2	5.75%	3.00%	2.75%
3	5.25%	3.00%	2.25%
4	5.00%	3.00%	2.00%
5	4.75%	3.00%	1.75%
6-9	4.40%	3.00%	1.40%
10-19	4.05%	3.00%	1.05%
20-29	3.55%	3.00%	0.55%
30+	3.20%	3.00%	0.20%

The proposed assumed rates of merit increases are added to the assumed rate of wage inflation (3.00%) for each year of service. The following graph shows the actual, expected, and proposed rates of salary increase.





Section VI – Other Assumptions and Methods

ADMINISTRATIVE EXPENSES: Currently, budgeted administrative expenses for the fiscal year are added to the normal cost. **We recommend that a rate of 0.35% of payroll be added to normal cost.**

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

SICK LEAVE: We currently assume a load on service for the practice of allowing members to convert forfeited sick leave to service at retirement. We assume one year of additional service for retirement eligibility purposes and **we continue to recommend this assumption.**

In addition, we assume a load on liabilities as follows:

- Old Plan members who retire with 34 years of service – 4.00%
- Old Plan members who retire on normal retirement – 2.00%
- Old Plan members who retire on early retirement – 1.50%
- All New Plan and GSEPS Retirements – 3.00%
- All Police Retirements – 5.00%

We reviewed the data over the last five-year period and recommend an increase in this assumption for New Plan and GSEPS members as follows:

- All New Plan and GSEPS Retirements – 3.25%
- All Police Retirements – 7.00%

ASSUMPTION FOR ACTIVE VESTED MEMBERS TERMINATION BENEFITS: Currently, we assume that 50% of active members who terminate with ten or more years of service before retirement will receive a benefit beginning at age 60 and 50% will receive a refund of member contributions. We reviewed this assumption and find that more than 50% of members as terminated vested elect to wait and receive their benefit at age 60. **Therefore, we recommend a change in this assumption to 75% of active members who terminate with ten or more years of service before retirement will receive a benefit beginning at age 60 and 25% will receive a refund of member contributions.**



Section VII – Special Contribution Rates

We have also determined the impact of the recommended new assumptions on the special employer contribution rates as follows:

Groups that have Age 55 Retirement and Line-of-Duty Disability Benefits:

- Public Safety #466
- Revenue Agents #474
- DNR Conservation Rangers #462
- GBI Officers/Agents #471

PLAN	Additional Rate	Total Rate
New Plan	7.27%	32.02%
GSEPS	2.58%	24.15%

Groups that have Line-of-Duty Disability Benefits:

- Deputy DNR Conservation Rangers #462
- Probation Officers #467
- Parole Officers – Pardons and Paroles #465
- Dept of Community Supervision #477

PLAN	Additional Rate	Total Rate
New Plan	0.02%	24.77%
GSEPS	0.03%	21.60%

Group that has Age 55 Retirement:

- Special Investigators Department of Revenue #474

PLAN	Additional Rate	Total Rate
New Plan	7.07%	31.82%
GSEPS	2.38%	23.95%

Appellate Court Judges: Total rate equal to 48.68% of payroll



Section VII – Special Contribution Rates

Group Term Life Insurance Plan Results

The following table highlights the impact of the recommended changes on the Group Term Life Insurance Plan for pre-retirement benefits.

Pre-Retirement Benefits

Impact on Principal Valuation Results (\$ in Thousands)		
	Valuation Results 2019	Recommended Assumptions
Unfunded Actuarial Accrued Liability	\$(291,794)	\$(313,165)
Funding Ratio	2,171.9%	3,437.9%
<u>Actuarially Determined Employer Contribution</u>		
Total Normal Rate	0.15%	0.11%
Employee Rates		
Old Plan Members	0.05%*	0.05%*
New Plan, LRS and JRS Members	0.02%	0.02%
Employer Normal Rate	0.14%	0.09%
Accrued Liability Rate	<u>(0.14)%</u>	<u>(0.09)%</u>
Total Employer Rate	0.00%	0.00%

* 0.03% paid by employer.



Section VII – Special Contribution Rates

The following table highlights the impact of the recommended changes on the Group Term Life Insurance Plan for post-retirement benefits.

Post-Retirement Benefits

Impact on Principal Valuation Results (\$ in Thousands)		
	Valuation Results 2019	Recommended Assumptions
Unfunded Actuarial Accrued Liability	\$(287,118)	\$(392,462)
Funding Ratio	130.3%	144.3%
<u>Actuarially Determined Employer Contribution</u>		
Total Normal Rate	0.34%	0.33%
Employee Rates		
Old Plan Members	0.45%*	0.45%*
New Plan, LRS and JRS Members	0.23%	0.23%
Employer Normal Rate	0.11%	0.10%
Accrued Liability Rate	<u>(0.11)%</u>	<u>(0.10)%</u>
Total Employer Rate	0.00%	0.00%

* 0.22% paid by employer.



Appendix A – Historical June CPI(U) Index

Year	CPI (U)	Year	CPI (U)
1961	29.8	1991	136.0
1962	30.2	1992	140.2
1963	30.6	1993	144.4
1964	31.0	1994	148.0
1965	31.6	1995	152.5
1966	32.4	1996	156.7
1967	33.3	1997	160.3
1968	35.7	1998	163.0
1969	34.7	1999	166.2
1970	38.8	2000	172.4
1971	40.6	2001	178.0
1972	41.7	2002	179.9
1973	44.2	2003	183.7
1974	49.0	2004	189.7
1975	53.6	2005	194.5
1976	56.8	2006	202.9
1977	60.7	2007	208.352
1978	65.2	2008	218.815
1979	72.3	2009	215.693
1980	82.7	2010	217.965
1981	90.6	2011	225.722
1982	97.0	2012	229.478
1983	99.5	2013	233.504
1984	103.7	2014	238.343
1985	107.6	2015	238.638
1986	109.5	2016	241.018
1987	113.5	2017	244.955
1988	118.0	2018	251.989
1989	124.1	2019	256.143
1990	129.9	2020	257.797



Appendix B – Capital Market Assumptions and Asset Allocation

As Provided by the System

Arithmetic Rates of Return and Standard Deviations by Asset Class

Asset Class	Expected Rate of Return*	Standard Deviation
Fixed Income	1.4%	2.3%
US Large Stocks	12.1%	19.8%
US Small Stocks	16.3%	31.5%
Int'l Developed Mkt Stocks	12.1%	21.8%
Int'l Emerging Mkt Stocks	13.3%	31.7%
Alternatives	13.5%	27.9%

*Includes 2.90% assumed inflation

Asset Class Correlation Coefficients

Asset Class	Fixed Income	US Large Stocks	US Small Stocks	Int'l Dev Mkt Stocks	Int'l EM Mkt Stocks	Alts
Fixed Income	1.00					
US Large Stocks	0.01	1.00				
US Small Stocks	(0.09)	0.79	1.00			
Int'l Developed Mkt Stocks	(0.11)	0.67	0.51	1.00		
Int'l Emerging Mkt Stocks	(0.11)	0.67	0.51	0.72	1.00	
Alternatives	0.31	0.74	0.74	0.64	0.62	1.00

Asset Allocation Targets

Asset Class	Asset Allocation
Fixed Income	30.0%
US Large Stocks	46.4%
US Small Stocks	1.1%
Int'l Developed Mkt Stocks	11.7%
Int'l Emerging Mkt Stocks	5.8%
Alternatives	5.0%



Appendix B – Capital Market Assumptions and Asset Allocation

**As Determined by the 2020 Horizon Actuarial Services, LLC.
Survey of Capital Market Assumptions (20-year Horizon)**

Arithmetic Rates of Return and Standard Deviations by Asset Class

Asset Class	Expected Rate of Return*	Standard Deviation
Fixed Income	2.28%	1.78%
US Large Stocks	8.36%	16.22%
US Small Stocks	9.54%	20.22%
Int'l Developed Mkt Stocks	9.09%	18.05%
Int'l Emerging Mkt Stocks	11.33%	24.23%
Alternatives (Private Equity)	12.54%	21.99%

*Includes 2.17% assumed inflation

Asset Class Correlation Coefficients

Asset Class	Fixed Income	US Large Stocks	US Small Stocks	Int'l Dev Mkt Stocks	Int'l EM Mkt Stocks	Alts
Fixed Income	1.00					
US Large Stocks	(0.08)	1.00				
US Small Stocks	(0.08)	0.89	1.00			
Int'l Developed Mkt Stocks	(0.07)	0.84	0.76	1.00		
Int'l Emerging Mkt Stocks	(0.06)	0.73	0.69	0.80	1.00	
Alternatives (Private Equity)	(0.06)	0.73	0.71	0.67	0.59	1.00



Appendix C – Social Security Administration Wage Index

Year	Wage Index	Annual Increase	Year	Wage Index	Annual Increase
1960	\$4,007.12	3.92%	1991	\$21,811.60	3.73%
1961	4,086.76	1.99	1992	22,935.42	5.15
1962	4,291.40	5.01	1993	23,132.67	0.86
1963	4,396.64	2.45	1994	23,753.53	2.68
1964	4,576.32	4.09	1995	24,705.66	4.01
1965	4,658.72	1.80	1996	25,913.90	4.89
1966	4,938.36	6.00	1997	27,426.00	5.84
1967	5,213.44	5.57	1998	28,861.44	5.23
1968	5,571.76	6.87	1999	30,469.84	5.57
1969	5,893.76	5.78	2000	32,154.82	5.53
1970	6,186.24	4.96	2001	32,921.92	2.39
1971	6,497.08	5.02	2002	33,252.09	1.00
1972	7,133.80	9.80	2003	34,064.95	2.44
1973	7,580.16	6.26	2004	35,648.55	4.65
1974	8,030.76	5.94	2005	36,952.94	3.66
1975	8,630.92	7.47	2006	38,651.41	4.60
1976	9,226.48	6.90	2007	40,405.48	4.54
1977	9,779.44	5.99	2008	41,334.97	2.30
1978	10,556.03	7.94	2009	40,711.61	-1.51
1979	11,479.46	8.75	2010	41,673.83	2.36
1980	12,513.46	9.01	2011	42,979.61	3.13
1981	13,773.10	10.07	2012	44,321.67	3.12
1982	14,531.34	5.51	2013	44,888.16	1.28
1983	15,239.24	4.87	2014	46,481.52	3.55
1984	16,135.07	5.88	2015	48,098.63	3.48
1985	16,822.51	4.26	2016	48,642.15	1.13
1986	17,321.82	2.97	2017	50,321.89	3.45
1987	18,426.51	6.38	2018	52,145.80	3.62
1988	19,334.04	4.93	2019	54,099.99	3.75
1989	20,099.55	3.96			
1990	21,027.98	4.62			



Appendix D – Recommended Rates

TABLE 1
RATES OF SEPARATION FROM ACTIVE SERVICE – MALES (NON-POLICE)

AGE	RATES OF WITHDRAWAL			RATES OF DEATH*	RATES OF DISABILITY
	YEARS OF SERVICE				
	0 – 4	5 – 9	10+		
19	0.4000			0.000380	0.000000
20	0.4000			0.000370	0.000000
21	0.4000			0.000360	0.000000
22	0.4000			0.000330	0.000000
23	0.3300	0.1625		0.000310	0.000000
24	0.3150	0.1625		0.000290	0.000000
25	0.3000	0.1625		0.000280	0.000000
26	0.2900	0.1625		0.000300	0.000000
27	0.2800	0.1625		0.000310	0.000000
28	0.2600	0.1350	0.0800	0.000330	0.000000
29	0.2550	0.1300	0.0800	0.000340	0.000000
30	0.2500	0.1250	0.0800	0.000360	0.000100
31	0.2450	0.1210	0.0800	0.000380	0.000160
32	0.2400	0.1160	0.0800	0.000400	0.000220
33	0.2350	0.1120	0.0742	0.000420	0.000280
34	0.2325	0.1080	0.0683	0.000440	0.000340
35	0.2300	0.1050	0.0625	0.000470	0.000400
36	0.2275	0.1020	0.0575	0.000500	0.000720
37	0.2250	0.1010	0.0550	0.000530	0.001040
38	0.2000	0.0990	0.0525	0.000570	0.001360
39	0.2000	0.0970	0.0500	0.000610	0.001680
40	0.2000	0.0950	0.0475	0.000660	0.002000
41	0.2000	0.0930	0.0460	0.000710	0.002350
42	0.2000	0.0910	0.0445	0.000770	0.002700
43	0.2000	0.0890	0.0425	0.000830	0.003050
44	0.2000	0.0870	0.0410	0.000900	0.003400
45	0.2000	0.0850	0.0400	0.000980	0.003750
46	0.2000	0.0825	0.0410	0.001070	0.004250
47	0.2000	0.0800	0.0420	0.001160	0.004750
48	0.1900	0.0775	0.0430	0.001270	0.005250
49	0.1800	0.0750	0.0440	0.001380	0.005750
50	0.1700	0.0725	0.0450	0.001490	0.006250
51	0.1600	0.0700	0.0475	0.001620	0.006750
52	0.1500	0.0700	0.0475	0.001750	0.007250
53	0.1500	0.0675	0.0475	0.001890	0.007750
54	0.1500	0.0675	0.0475	0.002030	0.008250
55	0.1500	0.0675	0.0475	0.002190	0.008750
56	0.1500	0.0675	0.0475	0.002360	0.009500
57	0.1450	0.0675	0.0475	0.002550	0.010250
58	0.1450	0.0650	0.0475	0.002750	0.011000
59	0.1450	0.0550	0.0475	0.002960	0.011750
60	0.1450	0.0550	0.0475	0.003190	0.000000
61	0.1450	0.0850	0.0475	0.003440	0.000000
62	0.1450	0.1000	0.0475	0.003710	0.000000
63	0.1450	0.1000	0.0475	0.004010	0.000000
64	0.1450	0.1000	0.0475	0.004330	0.000000
65	0.1450	0.1250	0.0475	0.004680	0.000000
66	0.1450	0.1250	0.0475	0.005060	0.000000
67	0.1450	0.1250	0.0475	0.005480	0.000000
68	0.1450	0.1250	0.0475	0.005940	0.000000
69	0.1450	0.1250	0.0475	0.006460	0.000000
70	0.1450	0.1250	0.0475	0.007030	0.000000



Appendix D – Recommended Rates

TABLE 2
RATES OF SEPARATION FROM ACTIVE SERVICE – MALES (NON-POLICE)
(Continued)

AGE	RATES OF SERVICE RETIREMENT					
	OLD PLAN				NEW PLAN AND GSEPS	
	EARLY RETIREMENT	AGE 60 OR 30 YEARS	34 YEARS	MORE THAN 34 YEARS	EARLY RETIREMENT	NORMAL RETIREMENT*
49	0.020	0.075	1.000	0.900	0.050	0.700
50	0.020	0.075	1.000	0.900	0.050	0.600
51	0.020	0.075	1.000	0.900	0.050	0.600
52	0.020	0.075	1.000	0.900	0.050	0.500
53	0.020	0.075	1.000	0.900	0.060	0.500
54	0.020	0.075	1.000	0.750	0.060	0.500
55	0.030	0.075	1.000	0.750	0.060	0.500
56	0.030	0.075	1.000	0.700	0.060	0.500
57	0.030	0.105	1.000	0.700	0.060	0.450
58	0.045	0.140	0.975	0.700	0.080	0.400
59	0.060	0.175	0.975	0.700	0.090	0.300
60		0.150	0.975	0.400		0.250
61		0.200	0.975	0.400		0.200
62		0.320	0.975	0.400		0.375
63		0.200	0.900	0.400		0.275
64		0.200	0.900	0.150		0.225
65		0.350	0.350	0.350		0.320
66		0.350	0.350	0.350		0.320
67		0.350	0.350	0.350		0.320
68		0.350	0.350	0.350		0.270
69		0.350	0.350	0.350		0.270
70		0.350	0.350	0.350		0.300
71		0.350	0.350	0.350		0.300
72		0.350	0.350	0.350		0.300
73		0.350	0.350	0.350		0.300
74		0.350	0.350	0.350		0.300
75		1.000	1.000	1.000		1.000

* An additional 20% are assumed to retire in the first year eligible for unreduced retirement with 30 years of service before age 60.



Appendix D – Recommended Rates

**TABLE 3
RATES OF SEPARATION FROM ACTIVE SERVICE – FEMALES (NON-POLICE)**

AGE	RATES OF WITHDRAWAL			RATES OF DEATH*	RATES OF DISABILITY
	YEARS OF SERVICE				
	0 – 4	5 – 9	10+		
19	0.3500			0.000130	0.000000
20	0.3500			0.000130	0.000000
21	0.3500			0.000120	0.000000
22	0.3500			0.000110	0.000000
23	0.3100	0.1800		0.000100	0.000000
24	0.2900	0.1800		0.000090	0.000000
25	0.2700	0.1800		0.000090	0.000000
26	0.2600	0.1800		0.000100	0.000000
27	0.2500	0.1800		0.000110	0.000000
28	0.2400	0.1400	0.0900	0.000120	0.000000
29	0.2300	0.1350	0.0900	0.000130	0.000000
30	0.2300	0.1250	0.0900	0.000150	0.000050
31	0.2300	0.1210	0.0900	0.000160	0.000060
32	0.2200	0.1160	0.0900	0.000180	0.000070
33	0.2100	0.1100	0.0750	0.000190	0.000080
34	0.2000	0.1050	0.0700	0.000210	0.000090
35	0.2000	0.1025	0.0650	0.000230	0.000100
36	0.2000	0.1000	0.0625	0.000250	0.000250
37	0.1900	0.0975	0.0600	0.000280	0.000400
38	0.1800	0.0950	0.0575	0.000300	0.000550
39	0.1800	0.0925	0.0550	0.000330	0.000700
40	0.1800	0.0900	0.0525	0.000360	0.000850
41	0.1800	0.0880	0.0500	0.000400	0.001110
42	0.1800	0.0860	0.0480	0.000430	0.001370
43	0.1700	0.0840	0.0450	0.000470	0.001630
44	0.1700	0.0820	0.0438	0.000510	0.001890
45	0.1700	0.0800	0.0425	0.000560	0.002150
46	0.1700	0.0790	0.0425	0.000610	0.002450
47	0.1700	0.0780	0.0425	0.000660	0.002750
48	0.1600	0.0770	0.0425	0.000710	0.003050
49	0.1600	0.0760	0.0425	0.000770	0.003350
50	0.1600	0.0750	0.0425	0.000830	0.003650
51	0.1600	0.0740	0.0425	0.000900	0.004050
52	0.1600	0.0730	0.0425	0.000970	0.004450
53	0.1500	0.0725	0.0425	0.001050	0.004850
54	0.1500	0.0725	0.0425	0.001130	0.005250
55	0.1500	0.0725	0.0425	0.001230	0.005650
56	0.1500	0.0650	0.0425	0.001330	0.006350
57	0.1500	0.0650	0.0425	0.001440	0.007050
58	0.1550	0.0600	0.0500	0.001560	0.007750
59	0.1550	0.0700	0.0500	0.001700	0.008450
60	0.1550	0.0700	0.0500	0.001860	0.000000
61	0.1550	0.0850	0.0500	0.002030	0.000000
62	0.1550	0.1100	0.0500	0.002220	0.000000
63	0.1650	0.1100	0.0500	0.002440	0.000000
64	0.1650	0.1200	0.0500	0.002690	0.000000
65	0.1650	0.1200	0.0500	0.002960	0.000000
66	0.1650	0.1200	0.0500	0.003270	0.000000
67	0.1650	0.1200	0.0500	0.003620	0.000000
68	0.1650	0.1200	0.0500	0.004000	0.000000
69	0.1650	0.1200	0.0500	0.004420	0.000000
70	0.1650	0.1200	0.0500	0.004890	0.000000



Appendix D – Recommended Rates

**TABLE 4
RATES OF SEPARATION FROM ACTIVE SERVICE – FEMALES (NON-POLICE)
(Continued)**

AGE	RATES OF SERVICE RETIREMENT					
	OLD PLAN				NEW PLAN AND GSEPS	
	EARLY RETIREMENT	AGE 60 OR 30 YEARS	34 YEARS	MORE THAN 34 YEARS	EARLY RETIREMENT	NORMAL RETIREMENT*
49	0.020	0.060	1.000	0.900	0.038	0.420
50	0.020	0.060	1.000	1.000	0.038	0.420
51	0.020	0.060	1.000	1.000	0.038	0.420
52	0.020	0.060	1.000	1.000	0.038	0.420
53	0.020	0.060	1.000	1.000	0.038	0.400
54	0.020	0.075	1.000	0.900	0.055	0.400
55	0.035	0.100	1.000	0.900	0.058	0.400
56	0.050	0.100	1.000	0.700	0.060	0.370
57	0.050	0.100	1.000	0.700	0.073	0.370
58	0.050	0.140	1.000	0.650	0.075	0.370
59	0.050	0.160	0.950	0.650	0.100	0.370
60		0.200	0.950	0.550		0.280
61		0.200	0.950	0.550		0.210
62		0.400	0.950	0.650		0.375
63		0.250	0.950	0.500		0.270
64		0.250	0.900	0.500		0.270
65		0.400	0.400	0.400		0.330
66		0.400	0.400	0.400		0.380
67		0.350	0.350	0.350		0.320
68		0.250	0.250	0.250		0.280
69		0.250	0.250	0.250		0.250
70		0.350	0.350	0.350		0.300
71		0.350	0.350	0.350		0.300
72		0.350	0.350	0.350		0.300
73		0.350	0.350	0.350		0.300
74		0.350	0.350	0.350		0.300
75		1.000	1.000	1.000		1.000

* An additional 25% for ages below 53 and 20% for ages 53 to 59 are assumed to retire in the first year eligible for unreduced retirement with 30 years of service before age 60.



Appendix D – Recommended Rates

TABLE 5

RATES OF SEPARATION FROM ACTIVE SERVICE - POLICE

AGE	RATES OF WITHDRAWAL		DEATH*		DISABILITY	RETIREMENT
	With less than 10 years of service	With 10 or more years of service	MALE	FEMALE		
19	0.1100		0.000380	0.000130	0.00000	
20	0.1100		0.000370	0.000130	0.00000	
21	0.1100		0.000360	0.000120	0.00000	
22	0.1100		0.000330	0.000110	0.00000	
23	0.0650		0.000310	0.000100	0.00000	
24	0.0650		0.000290	0.000090	0.00000	
25	0.0650	0.0300	0.000280	0.000090	0.00000	
26	0.0650	0.0300	0.000300	0.000100	0.00000	
27	0.0650	0.0300	0.000310	0.000110	0.00000	
28	0.0525	0.0300	0.000330	0.000120	0.00000	
29	0.0525	0.0300	0.000340	0.000130	0.00000	
30	0.0525	0.0300	0.000360	0.000150	0.00050	
31	0.0525	0.0300	0.000380	0.000160	0.00065	
32	0.0525	0.0300	0.000400	0.000180	0.00080	
33	0.0525	0.0300	0.000420	0.000190	0.00095	
34	0.0525	0.0300	0.000440	0.000210	0.00110	
35	0.0525	0.0300	0.000470	0.000230	0.00125	
36	0.0525	0.0300	0.000500	0.000250	0.00325	
37	0.0525	0.0300	0.000530	0.000280	0.00525	
38	0.0525	0.0250	0.000570	0.000300	0.00725	
39	0.0525	0.0250	0.000610	0.000330	0.00925	
40	0.0525	0.0250	0.000660	0.000360	0.01125	
41	0.0525	0.0250	0.000710	0.000400	0.01425	
42	0.0525	0.0250	0.000770	0.000430	0.01725	
43	0.0525	0.0250	0.000830	0.000470	0.02025	
44	0.0525	0.0250	0.000900	0.000510	0.02325	
45	0.0525	0.0250	0.000980	0.000560	0.02625	1.000
46	0.0525	0.0250	0.001070	0.000610	0.02825	1.000
47	0.0525	0.0250	0.001160	0.000660	0.03025	1.000
48	0.0525	0.0250	0.001270	0.000710	0.03225	0.900
49	0.0525	0.0250	0.001380	0.000770	0.03425	0.900
50	0.0525	0.0250	0.001490	0.000830	0.03625	0.750
51	0.0525	0.0250	0.001620	0.000900	0.03725	0.600
52	0.0525	0.0250	0.001750	0.000970	0.03825	0.600
53	0.0525	0.0250	0.001890	0.001050	0.03925	0.600
54	0.0525	0.0250	0.002030	0.001130	0.04025	0.600
55			0.002190	0.001230	0.04125	0.150
56			0.002360	0.001330	0.04225	0.150
57			0.002550	0.001440	0.04325	0.150
58			0.002750	0.001560	0.04425	0.175
59			0.002960	0.001700	0.04525	0.175
60			0.003190	0.001860		0.300
61			0.003440	0.002030		0.175
62			0.003710	0.002220		0.350
63			0.004010	0.002440		0.350
64			0.004330	0.002690		0.350
65			0.004680	0.002960		0.250
66			0.005060	0.003270		0.250
67			0.005480	0.003620		0.250
68			0.005940	0.004000		0.250
69			0.006460	0.004420		0.250
70			0.007030	0.004890		1.000



TABLE 6
RATES OF ANTICIPATED SALARY INCREASES
(For Both Males and Females)

SERVICE	SALARY INCREASES
1	0.0675
2	0.0575
3	0.0525
4	0.0500
5	0.0475
6	0.0450
7	0.0445
8	0.0440
9	0.0435
10	0.0430
11	0.0425
12	0.0420
13	0.0415
14	0.0410
15	0.0405
16	0.0400
17	0.0395
18	0.0390
19	0.0385
20	0.0380
21	0.0375
22	0.0370
23	0.0365
24	0.0360
25	0.0355
26	0.0350
27	0.0345
28	0.0340
29	0.0335
30	0.0330
31	0.0325
32	0.0320
33	0.0315
34	0.0310
35	0.0305
>35	0.0300



Appendix D – Recommended Rates

TABLE 7

RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF SERVICE*

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.000389	0.000140	71	0.019992	0.014418
20	0.000378	0.000130	72	0.022355	0.016168
21	0.000347	0.000119	73	0.025032	0.018133
22	0.000326	0.000108	74	0.028046	0.020336
23	0.000305	0.000097	75	0.031448	0.022799
24	0.000294	0.000097	76	0.035291	0.025574
25	0.000315	0.000108	77	0.039638	0.028706
26	0.000326	0.000119	78	0.044552	0.032249
27	0.000347	0.000130	79	0.050127	0.036288
28	0.000357	0.000140	80	0.056427	0.040900
29	0.000378	0.000162	81	0.063546	0.046181
30	0.000399	0.000173	82	0.071516	0.052207
31	0.000420	0.000194	83	0.080388	0.059119
32	0.000441	0.000205	84	0.090206	0.067014
33	0.000462	0.000227	85	0.100958	0.076043
34	0.000494	0.000248	86	0.112697	0.086260
35	0.000525	0.000270	87	0.125444	0.097697
36	0.000557	0.000302	88	0.139230	0.110333
37	0.000599	0.000324	89	0.154056	0.124060
38	0.000641	0.000356	90	0.169785	0.138596
39	0.000693	0.000389	91	0.186323	0.153781
40	0.000746	0.000432	92	0.203616	0.169582
41	0.000809	0.000464	93	0.221624	0.186062
42	0.000872	0.000508	94	0.240324	0.203310
43	0.000945	0.000551	95	0.259676	0.221454
44	0.001029	0.000605	96	0.279657	0.240602
45	0.001124	0.000659	97	0.300184	0.260788
46	0.001218	0.000713	98	0.321153	0.282020
47	0.001334	0.000767	99	0.342395	0.304128
48	0.001449	0.000832	100	0.363678	0.326862
49	0.003129	0.002398	101	0.384720	0.349726
50	0.003371	0.002516	102	0.405342	0.372535
51	0.003633	0.002657	103	0.425376	0.395075
52	0.003906	0.002797	104	0.444696	0.417150
53	0.004211	0.002938	105	0.463187	0.438577
54	0.004526	0.003089	106	0.480753	0.459205
55	0.004861	0.003251	107	0.497322	0.478883
56	0.005219	0.003434	108	0.512852	0.497524
57	0.005597	0.003629	109	0.525000	0.515052
58	0.006017	0.003866	110	0.525000	0.531414
59	0.006458	0.004147	111	0.525000	0.540000
60	0.006941	0.004493	112	0.525000	0.540000
61	0.007487	0.004903	113	0.525000	0.540000
62	0.008085	0.005400	114	0.525000	0.540000
63	0.008778	0.005962	115	0.525000	0.540000
64	0.009587	0.006620	116	0.525000	0.540000
65	0.010532	0.007366	117	0.525000	0.540000
66	0.011634	0.008208	118	0.525000	0.540000
67	0.012905	0.009169	119	1.000000	1.000000
68	0.014364	0.010260	120	1.000000	1.000000
69	0.016023	0.011480			
70	0.017882	0.012863			

*Base mortality rates as of 2010 before application of the improvement scale



Appendix D – Recommended Rates

TABLE 8

RATES OF MORTALITY FOR BENEFICIARIES OF DECEASED MEMBERS*

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.000382	0.000126	71	0.029797	0.018659
20	0.000350	0.000116	72	0.032690	0.020507
21	0.000329	0.000105	73	0.035849	0.022586
22	0.000307	0.000095	74	0.039284	0.024896
23	0.000297	0.000095	75	0.043036	0.027500
24	0.000318	0.000105	76	0.047170	0.030429
25	0.000329	0.000116	77	0.051728	0.033747
26	0.000350	0.000126	78	0.056816	0.037517
27	0.000360	0.000136	79	0.062508	0.041843
28	0.000382	0.000157	80	0.068879	0.046778
29	0.000403	0.000168	81	0.075991	0.052437
30	0.000424	0.000189	82	0.083899	0.058916
31	0.000445	0.000200	83	0.092676	0.066318
32	0.000466	0.000221	84	0.102375	0.074781
33	0.000498	0.000242	85	0.113049	0.084315
34	0.000530	0.000263	86	0.124741	0.094931
35	0.000562	0.000294	87	0.137567	0.106533
36	0.000604	0.000315	88	0.152831	0.118955
37	0.000647	0.000347	89	0.169038	0.132258
38	0.000700	0.000378	90	0.186083	0.146496
39	0.000753	0.000420	91	0.203902	0.161711
40	0.000816	0.000452	92	0.222452	0.177933
41	0.000880	0.000494	93	0.241680	0.195195
42	0.000954	0.000536	94	0.261544	0.213486
43	0.000954	0.000536	95	0.281971	0.232775
44	0.006063	0.002866	96	0.302884	0.252987
45	0.006318	0.002982	97	0.324159	0.274019
46	0.006583	0.003108	98	0.345655	0.295680
47	0.006848	0.003234	99	0.367142	0.317782
48	0.007431	0.003360	100	0.388384	0.340011
49	0.007674	0.003591	101	0.409202	0.362187
50	0.007918	0.003843	102	0.429427	0.384101
51	0.008173	0.004106	103	0.448931	0.405563
52	0.008448	0.004379	104	0.467598	0.426395
53	0.008734	0.004683	105	0.485332	0.446450
54	0.009052	0.004998	106	0.502058	0.465581
55	0.009402	0.005334	107	0.517736	0.483704
56	0.009794	0.005702	108	0.530000	0.500745
57	0.010229	0.006101	109	0.530000	0.516652
58	0.010727	0.006531	110	0.530000	0.525000
59	0.011310	0.007004	111	0.530000	0.525000
60	0.011978	0.007529	112	0.530000	0.525000
61	0.012741	0.008106	113	0.530000	0.525000
62	0.013632	0.008747	114	0.530000	0.525000
63	0.014670	0.009440	115	0.530000	0.525000
64	0.015868	0.010217	116	0.530000	0.525000
65	0.017257	0.011057	117	0.530000	0.525000
66	0.018826	0.012002	118	1.000000	1.000000
67	0.020596	0.013041	119	1.000000	1.000000
68	0.022567	0.014207	120	1.000000	1.000000
69	0.024751	0.015519			
70	0.027157	0.017000			

*Base mortality rates as of 2010 before application of the improvement scale



Appendix D – Recommended Rates

TABLE 9

RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF DISABILITY*

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.000237	0.002597	71	0.036297	0.032213
20	0.000319	0.00247	72	0.038172	0.034333
21	0.004151	0.002279	73	0.040180	0.036718
22	0.004336	0.002056	74	0.042364	0.039411
23	0.004244	0.001866	75	0.044743	0.042432
24	0.003976	0.001738	76	0.047370	0.045813
25	0.003626	0.001738	77	0.050264	0.049587
26	0.003255	0.001897	78	0.053478	0.053795
27	0.002977	0.002078	79	0.057031	0.058480
28	0.002863	0.002279	80	0.060986	0.063674
29	0.003008	0.002491	81	0.065374	0.069430
30	0.003152	0.002724	82	0.070267	0.075790
31	0.003306	0.002979	83	0.075684	0.082797
32	0.003471	0.003254	84	0.081669	0.090482
33	0.003646	0.003562	85	0.088220	0.098909
34	0.003832	0.003890	86	0.095368	0.107728
35	0.004027	0.004251	87	0.103103	0.116748
36	0.004233	0.004643	88	0.111395	0.125907
37	0.004470	0.005077	89	0.120283	0.135224
38	0.004717	0.005554	90	0.129831	0.144849
39	0.005006	0.006084	91	0.140111	0.154940
40	0.005335	0.006667	92	0.153068	0.165731
41	0.005717	0.007303	93	0.167406	0.177444
42	0.006149	0.007992	94	0.182114	0.190323
43	0.006644	0.008745	95	0.196998	0.204559
44	0.007210	0.009561	96	0.212056	0.220310
45	0.007859	0.010441	97	0.227403	0.237906
46	0.008590	0.011374	98	0.243255	0.256796
47	0.009435	0.012370	99	0.259828	0.277031
48	0.010372	0.013430	100	0.277317	0.298496
49	0.011423	0.014554	101	0.295847	0.320809
50	0.012576	0.015720	102	0.315427	0.343249
51	0.013823	0.016271	103	0.335873	0.365636
52	0.015141	0.016822	104	0.356751	0.387759
53	0.016531	0.017384	105	0.377392	0.409425
54	0.017634	0.017935	106	0.397621	0.430455
55	0.018725	0.018465	107	0.417274	0.450701
56	0.019786	0.018963	108	0.436226	0.470015
57	0.020806	0.019430	109	0.454364	0.488310
58	0.021774	0.019864	110	0.471596	0.505514
59	0.022670	0.020288	111	0.487849	0.521573
60	0.023484	0.020734	112	0.503083	0.530000
61	0.024257	0.021200	113	0.515000	0.530000
62	0.025008	0.021741	114	0.515000	0.530000
63	0.025781	0.022366	115	0.515000	0.530000
64	0.026615	0.023087	116	0.515000	0.530000
65	0.027573	0.023914	117	0.515000	0.530000
66	0.028686	0.024868	118	0.515000	0.530000
67	0.029952	0.025970	119	0.515000	0.530000
68	0.031353	0.027231	120	1.000000	1.000000
69	0.032888	0.028684			
70	0.034536	0.030337			

*Base mortality rates as of 2010 before application of the improvement scale