



Cavanaugh Macdonald
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State of Mississippi Retirement Systems
Experience Investigation for the
Four-Year Period
Ending June 30, 2020





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CONSULTING, LLC

The experience and dedication you deserve

April 20, 2021

The Board of Trustees
Public Employees' Retirement System of Mississippi
429 Mississippi Street
Jackson, MS 39201

Members of the Board:

We are pleased to submit the results of an investigation of the economic and demographic experience for the Public Employees' Retirement System (PERS), the Highway Safety Patrol Retirement System (HSPRS), the Supplemental Legislative Retirement Plan (SLRP) and the Municipal Retirement Systems (MRS) for the four-year period from July 1, 2016 to June 30, 2020. The study was based on the data submitted by PERS for the annual valuation. In preparing this report, we relied, without audit, on the data provided.

The purpose of the investigation was to assess the reasonability of the current PERS economic assumptions and demographic actuarial assumptions for each 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 division 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.

In order to prepare the results in this report 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.



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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.

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).

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 'Jonathan T. Craven'.

Jonathan T. Craven, ASA, EA, FCA, MAAA
Consulting Actuary

EJK/JTC:mjn



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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. Actuarial valuations of the Mississippi Public Employees' Retirement System (PERS), the Mississippi Highway Safety Patrol Retirement System (HSPRS), the Mississippi Supplemental Legislative Retirement Plan (SLRP) and the Mississippi Municipal Retirement System (MRS) are prepared annually to determine the actuarial contribution rate required to fund them on an actuarial reserve basis, (i.e. the current assets plus future contributions, along with investment earnings will 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 rates of death, termination of employment, retirement age, and salary changes 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 PERS' Board of Trustees purview for the four-year period ending June 30, 2020. This report presents the results, analysis, and resulting recommendations of our study. It is anticipated that the changes, if approved, will first be reflected in the June 30, 2021 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 differs, 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 the same result, 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 the ones that do not materially improve the accuracy of the liability projections.

The following summarizes the findings and recommendations with regard to the assumptions utilized for PERS. 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 continued expectation of lower inflation by forecasters, and the Chief Actuary of the Social Security Administration's view of long-term inflation, **we are recommending a decrease in the price inflation assumption from 2.75% to 2.40%.**



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We are also recommending a 0.75% decrease in the long-term expected return on assets assumption from 7.75% to 7.00%, reflecting the 0.35% decrease in the inflation assumption and a 0.40% decrease in the real rate of return from 5.00% to 4.60%. This will be discussed in detail later in this report, but a real rate of return of 5.00% is no longer supported by the forecasting models developed using the Board's investment consultant's capital market assumptions 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 and the Board's target asset allocation also support this recommendation to decrease the real rate of return to 4.60%.

In the previous experience study, CMC recommended a 7.50% long-term expected return on assets assumption, that consisted of a 4.75% real rate of return and 2.75% inflation assumption.

Based on the Board's funding policy, the long-term investment return assumption adopted by the PERS' Board in conjunction with the experience investigation is 7.75% and will be reduced until it reaches the rate recommended by the actuary in the most recent experience study using net investment gains based on the following parameters:

- 2% Excess return over assumed rate, lower assumption by 5 basis points,
- 5% Excess return over assumed rate, lower assumption by 10 basis points,
- 8% Excess return over assumed rate, lower assumption by 15 basis points,
- 12% Excess return over assumed rate, lower assumption by 20 basis points.

An example of this methodology is if the actual net investment return on a market return basis is 15.00% (excess return of 7.25% over the assumed rate) for the fiscal year ending June 30, 2021, then the investment return assumption will be reduced by 10 basis points from 7.75% to 7.65% for the 2021 valuation. This methodology should continue for each subsequent valuation until the investment return assumption is equal to our recommended rate of 7.00%.

Finally, we are recommending that the general wage inflation (payroll growth) assumption used as the underlying payroll growth for active member and used in the level percent of payroll amortization method be decreased from 3.00% to 2.65%.



The following table summarizes the current and proposed economic assumptions:

Item	Current	Proposed
Price Inflation	2.75%	2.40%
Investment Return*	7.75%	7.00%
Wage Inflation (Payroll Growth)	3.00%	2.65%

* 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 PERS. 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 assumption. The analysis is most commonly performed based on counts, i.e. each member is one exposure as to the probability of the event occurring and one occurrence 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.

In the previous experience investigation, we changed the mortality approach for PERS from a static mortality table with a margin to a generational mortality approach that directly anticipates future improvements in mortality by using a different set of mortality rates for each year of birth, with the rates for later years of birth assuming lower mortality than the rates for earlier years of birth. The varying mortality rates by year of birth create a series of tables that contain “built-in” mortality improvements, e.g., a member who turns age 65 in 2035 has a longer life expectancy than a member who turns age 65 in 2020. When using generational mortality, the A/E ratios for the observed experience are set near 100% as future mortality improvements will be taken into account directly in the actuarial valuation process.

In this experience study, 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 very similar to the Actual to Expected Ratios on a count basis over the past two years.



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The current post-retirement mortality assumption for healthy lives, which we changed in the 2018 experience study, is a generational mortality approach using the Pub-2010 Mortality Tables. These tables, released in 2019, were developed using public pension plan mortality experience only. In the 2018 experience study, we adjusted these tables to better match the mortality experience of the State of Mississippi and the membership of PERS. Since these new tables have been adopted, the gain/loss analysis on post-retirement mortality indicates that these tables provide a reasonable margin, is very credible for the State of Mississippi, and has resulted in very small actuarial losses in the past two actuarial valuations.

Therefore, we have decided to recommend continuation of the Pub-2010 Public Safety Headcount Mortality Tables, with some minor adjustments and refinements for service retirees and beneficiaries as follows:

- **Service Retirees**
 - **Public Safety Healthy Below-Median Mortality Table**
 - **No setback for males or females**
 - **Adjustments in rates at most ages to better match experience of PERS**
 - **Projection scale MP-2020 will be used to project future improvements in life expectancy generationally.**
- **Beneficiaries**
 - **Public Safety Contingent Annuitant Below-Median Mortality Table**
 - **No setback for males or females**
 - **Adjusted 97% at all ages for males and 110% at all ages for females**
 - **Projection scale MP-2020 will be used to project future improvements in life expectancy generationally.**

We also recommend use of the Pub-2010 General Disabled Retiree Mortality Table and the following adjustments for disabled retirees:

- **No setback for males or females**
- **Adjusted 134% of male rates at all ages and 121% of female rates at all ages.**
- **Projection scale MP-2020 will be used to project future improvements in life expectancy generationally.**

More information will be discussed in the demographic section of this report.



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The following is a general list of the other recommended changes to the demographic assumptions for PERS.

- **Retirement:** Extend fixed retirement from age 75 to age 80 and recommend minor adjustments in the rates of retirement to better match experience of the System.
- **Disability:** Decrease rates of disability retirement at all ages.
- **Withdrawal:** Remove the current select and ultimate period method and recommend rates of withdrawal that better match experience of the System based on an age by service matrix table broken down by tier.
- **Merit Salary Scale:** No change in the merit salary at this time. The total salary scale will be lowered by the recommendation to decrease the wage inflation by 0.35%.
- **Pre-Retirement Mortality:** Update the projection scale from MP-2018 to MP-2020.

Section IV of this report will provide more detail to these recommended demographic changes. Sections V-VII provide a summary of the recommended changes for each of the other three Systems.

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 III of this report, we recommend no changes in these actuarial methods at this time.



Other Assumptions

Another assumption that is included in the valuations is the determination of administrative expense component that is added to the total normal cost each year. The current assumption is 0.25% of payroll. **After reviewing the total amount of administrative expenses for the past four years and the percentage of payroll, we are recommending a slight increase in this assumption from 0.25% to 0.28% of payroll.** The following table shows actual percentages over the past four years:

(\$ in Thousands)

Year Ending June 30	Administrative Expenses	Annual Payroll	Percentage
2017	17,056	6,038,229	0.28%
2018	16,264	5,999,231	0.27%
2019	16,905	6,144,916	0.28%
2020	19,757	6,287,441	0.31%

Financial Impact

Although the assumption changes, if approved, will first be reflected in the 2021 valuations, we have provided the following tables which highlight the impact of the recommended changes on the unfunded accrued liabilities (UAL), funding ratios, amortization period and projected funding ratios for each System on the 2020 valuation and projection results.

Change in 2020 Valuation Unfunded Accrued Liability
(\$ in Thousands)

System	Before All Changes	After All Changes at 7.75%	After All Changes at 7.00%
PERS	\$18,725,259	\$19,058,031	\$23,333,807
HSPRS	188,151	178,213	227,117
SLRP	5,013	4,923	6,648

Change in 2020 Valuation Funding Ratio

System	Before All Changes	After All Changes at 7.75%	After All Changes at 7.00%
PERS	60.5%	60.0%	55.1%
HSPRS	66.5%	67.7%	62.2%
SLRP	78.7%	79.0%	73.5%

Change in 2020 Actuarially Determined Employer Contribution

System	Before All Changes	After All Changes at 7.75%	After All Changes at 7.00%
PERS	19.49%	20.59%	25.09%

Change in 2020 Valuation UAL Amortization Period (in years)*

System	Before All Changes	After All Changes at 7.75%	After All Changes at 7.00%
PERS	37.1	47.2	Infinite
HSPRS	21.7	20.0	34.9
SLRP	27.7	28.5	Infinite

* Fixed Contribution Rates (FCR) kept constant.

Change in Projected Funding Ratio in 2047 for PERS and 2042 for HSPRS and SLRP*

System	Before All Changes	After All Changes at 7.75%	After All Changes at 7.00%
PERS	67.6%	63.4%	40.4%
HSPRS	88.3%	94.6%	67.3%
SLRP	88.3%	85.4%	58.5%

* Fixed Contribution Rates (FCR) kept constant.



Section II – Economic Assumptions

There are four economic assumptions used in the actuarial valuations performed for PERS. They are:

- Price Inflation
- Investment Return
- Wage Inflation
- Payroll Growth for Amortization Method

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.

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 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 II – 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 Assumptions	Recommended from 2018 Experience Study	Proposed Assumptions
Price Inflation	2.75%	2.75%	2.40%
Real Rate of Return*	<u>5.00</u>	<u>4.75</u>	<u>4.60</u>
Investment Return	7.75%	7.50%	7.00%
Price Inflation	2.75%	2.75%	2.40%
Real Wage Growth	<u>0.25</u>	<u>0.25</u>	<u>0.25</u>
Wage Inflation	3.00%	3.00%	2.65%
Payroll Growth	3.00%	3.00%	2.65%

* net of investment expenses.

Section II – 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 long-term relationship between price inflation and investment return has long been recognized by economists. The basic principle is that the investor demands a more or less level “real return” – the excess of actual investment return over price inflation. 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, at least in the long run.

The current price inflation assumption is 2.75% per year.

Past Experience

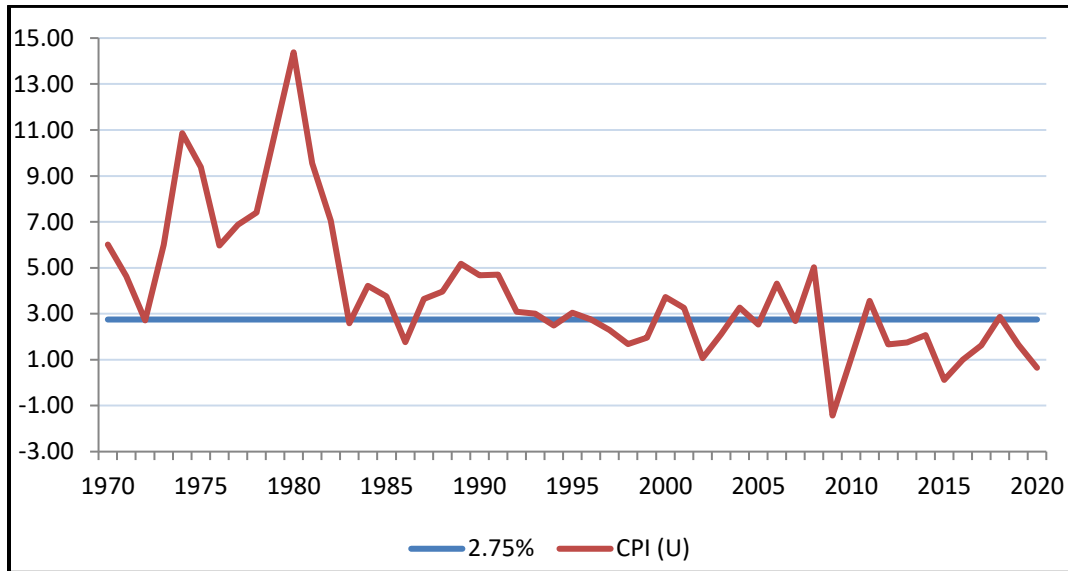
The Consumer Price Index, US City Average, All Urban Consumers, CPI (U), has been used as the basis for reviewing historical levels of price inflation. The table below provides historical annualized rates and annual standard deviation of the CPI-U over periods ending June 30th.

Period	Number of Years	Annualized Rate of Inflation	Annual Standard Deviation
1926 – 2020	94	2.87%	4.05%
1960 – 2020	60	3.67	2.88
1970 – 2020	50	3.86	3.02
1980 – 2020	40	2.88	1.89
1990 – 2020	30	2.31	1.36
2000 – 2020	20	2.03	1.48
2010 - 2020	10	1.69	1.00

Section II – 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 3.00% annual rate currently assumed.

Annual Rate of CPI (U) Increases



Over the last 30 years, the average annual rate of increase in the CPI-U has been below 2.50%. The volatility of the annual rates in the more recent years has been markedly lower as indicated by the significantly lower annual standard deviations.

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.

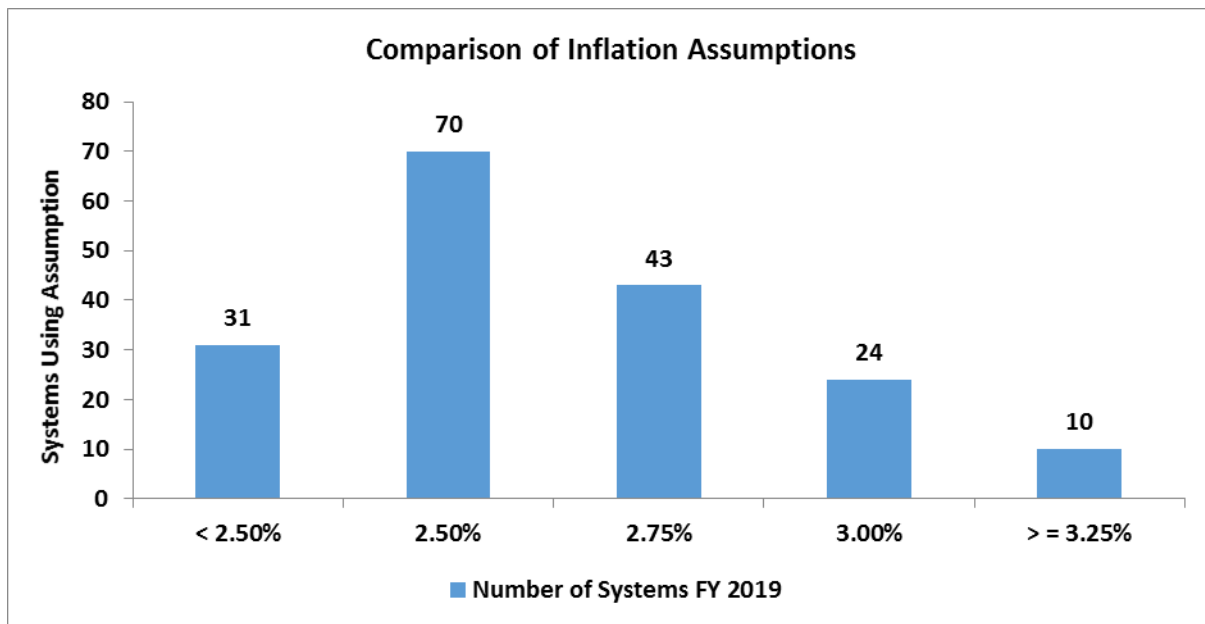
Section II – Economic Assumptions

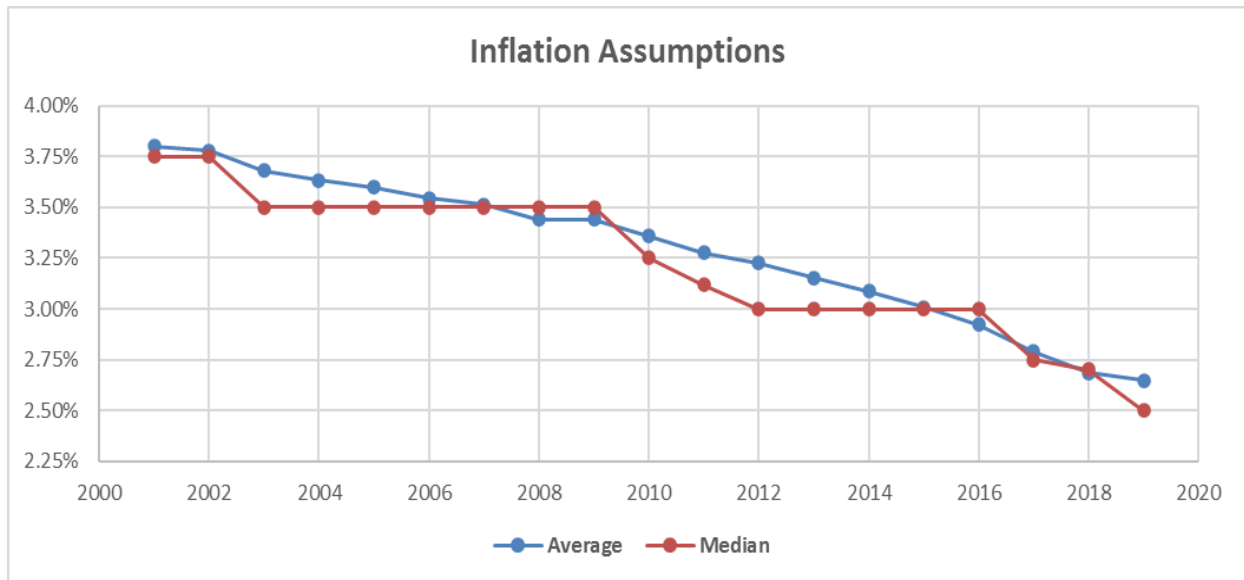
Social Security Administration

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%.

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 and graph show the inflation rate assumptions of 178 plans in the Public Plan Database of the Center for Retirement Research. The assumptions are from actuarial valuation reported in FYE 2019.





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 1.67% is lower than the System's assumed rate of 2.75%, the longer 40-year average of 2.88% is closer to PERS' current rate but it includes the very high rates of inflation from the early 1980s. Those high rates will not be part of the 40-year average for much longer. The reasonableness of PERS' 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% with an intermediate assumption of 2.40% to be the most reasonable and recommend lowering the inflation assumption for PERS from 2.75% to 2.40%.

Price Inflation Assumption	
Current	2.75%
Recommended	2.40%

Section II – 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 7.75%, consisting of a price inflation assumption of 2.75% and a real rate of return assumption of 5.00%.

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 PERS, 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.

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.

Section II – Economic Assumptions

The assets for PERS 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
2016	7.10%	0.53%
2017	8.91	14.51
2018	8.74	9.17
2019	6.79	6.25
2020	6.72	3.11
Average	7.65%	6.74%

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

ASOP 27 provides that the actuary may rely on outside experts in setting economic assumptions. PERS utilizes the services of Callan to assist them in developing investment strategies and providing capital market assumptions for the PERS portfolio. As part of their duties, Callan periodically performs asset-liability studies, along with comprehensive reviews of the expected return of the various asset classes in which the PERS portfolio is invested. We believe it is appropriate to consider the results of Callan's 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 (39 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.

Our forward-looking analysis used the real rates of return in Callan's capital market assumptions for 2021-2030 and PERS' 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 5.17%, but also has a high standard deviation or

Section II – Economic Assumptions

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	5.17%	14.49%	-16.79%	-4.95%	4.27%	14.37%	30.65%
5	4.38%	6.41%	-5.74%	0.04%	4.27%	8.67%	15.33%
10	4.28%	4.52%	-2.91%	1.26%	4.27%	7.36%	11.97%
20	4.24%	3.20%	-0.86%	2.13%	4.27%	6.44%	9.66%
30	4.22%	2.61%	0.06%	2.52%	4.27%	6.04%	8.65%
40	4.21%	2.26%	0.61%	2.75%	4.27%	5.80%	8.05%
50	4.21%	2.02%	0.99%	2.91%	4.27%	5.64%	7.64%

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 -2.91% 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 2.91% and a 25% chance they will be above 5.64%. In other words, there is a 50% chance the real returns will be between 2.91% and 5.64%.

The results of our real return forward looking analysis are very similar to the real rate of return analysis as developed by Callan in their first quarter of 2021 analysis, where they developed a real return expectation of 4.21% over a 10-year horizon.

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 assumption of PERS investment advisor with the following real return results for the 10-year horizon and 20-year horizon:

Horizon Survey 10-year horizon

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5 th	25 th	50 th	75 th	95 th
1	5.21%	13.04%	-14.72%	-3.87%	4.47%	13.54%	27.99%
5	4.57%	5.78%	-4.60%	0.65%	4.47%	8.44%	14.40%
10	4.49%	4.08%	-2.02%	1.76%	4.47%	7.26%	11.40%
20	4.45%	2.88%	-0.16%	2.55%	4.47%	6.44%	9.33%
30	4.44%	2.35%	0.67%	2.90%	4.47%	6.07%	8.42%
40	4.43%	2.04%	1.17%	3.11%	4.47%	5.86%	7.88%
50	4.43%	1.82%	1.52%	3.25%	4.47%	5.71%	7.52%

Horizon Survey 20-year horizon

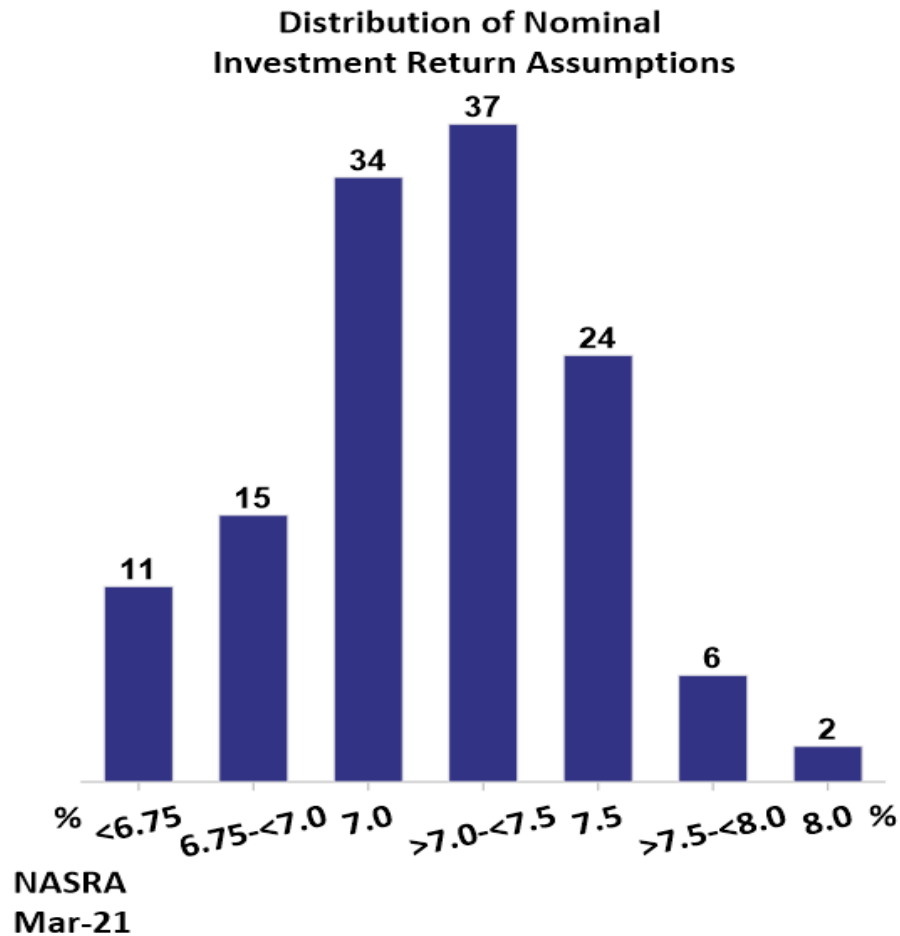
Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5 th	25 th	50 th	75 th	95 th
1	5.91%	13.04%	-14.04%	-3.17%	5.18%	14.25%	28.68%
5	5.27%	5.78%	-3.90%	1.36%	5.18%	9.14%	15.10%
10	5.19%	4.08%	-1.32%	2.46%	5.18%	7.96%	12.10%
20	5.15%	2.88%	0.54%	3.25%	5.18%	7.18%	10.03%
30	5.14%	2.35%	1.37%	3.60%	5.18%	6.78%	9.12%
40	5.13%	2.04%	1.87%	3.81%	5.18%	6.56%	8.58%
50	5.13%	1.82%	2.22%	3.95%	5.18%	6.41%	8.22%

As you can see from the two tables above, setting a real return assumption depends on the time horizon a plan seeks. The 20-year horizon is approximately 0.70% higher at all percentiles than the 10-year horizon. While PERS is a long-term vehicle expected to pay benefits to its retirees for many years in the future, a high percentage of the present value of the benefits is determined within the next ten to fifteen years, so the real return recommendation should fall within the bands shown in the 50th percentile columns in the three tables above.

Section II – Economic Assumptions

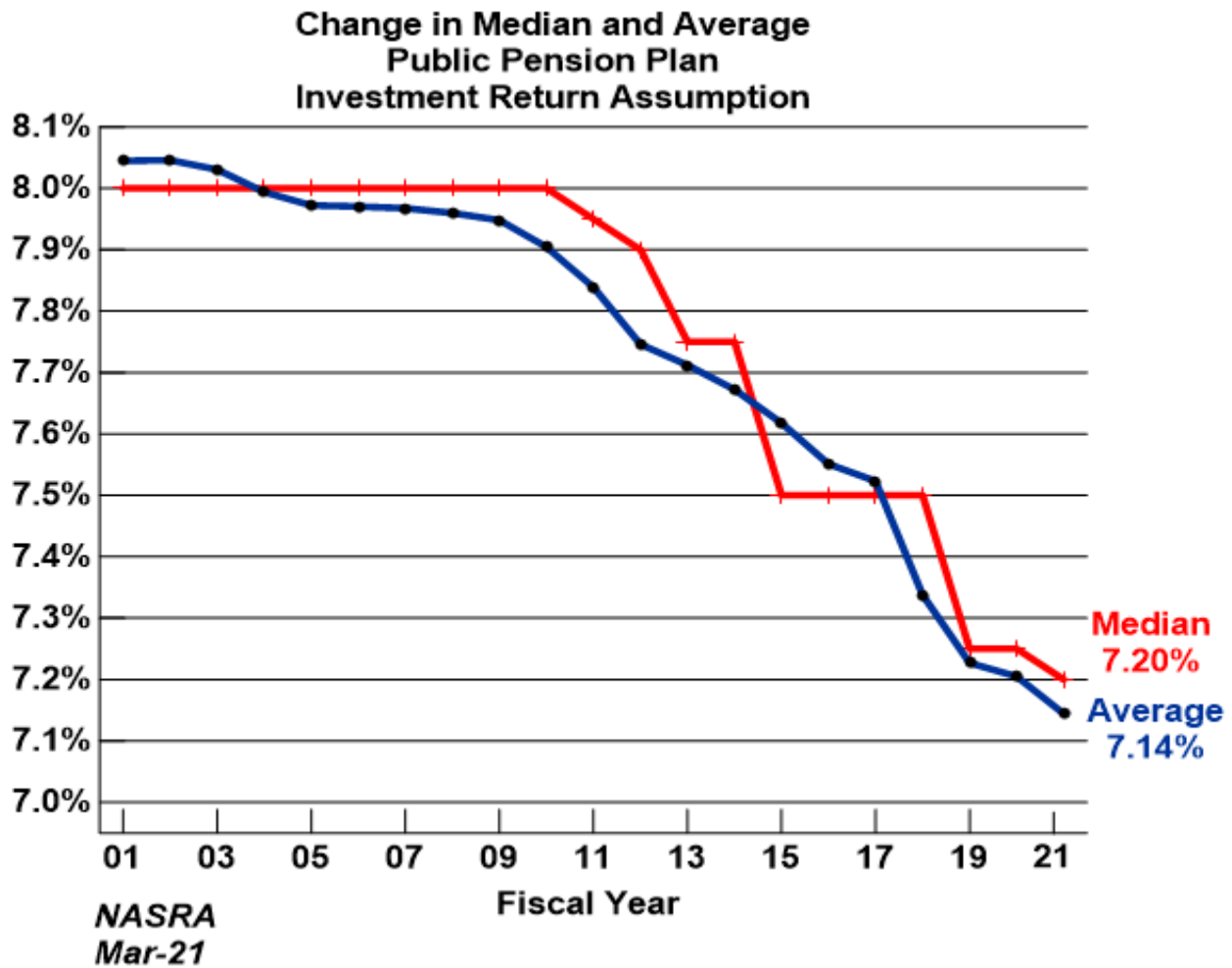
Peer Comparison

The following chart shows the nominal investment return assumptions of 129 plans in the National Association of State Retirement Administrators (NASRA). The assumptions shown below are as of March 2021 and are updated frequently by the NASRA staff.



Section II – 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 II – 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 Callan’s capital market assumptions and the Horizon Survey capital market assumptions, we are recommending a change to the real return assumption from 5.00% to 4.60%. We acknowledge that this real return assumption is above Callan’s anticipated return over the next 10 years of 4.21%, but we do put more weight on a longer time horizon. Based on our recommended inflation assumption of 2.40% and real return assumption of 4.60%, we are recommending a 7.00% expected long term nominal rate of return assumption.

Investment Return Assumption		
	Current	Recommended
Real Rate of Return*	5.00%	4.60%
Inflation	<u>2.75</u>	<u>2.40</u>
Net Investment Return	7.75%	7.00%

* net of investment expenses.

Based on the Board’s funding policy, the long-term investment return assumption adopted by the PERS’ Board in conjunction with the experience investigation is 7.75% and will be reduced until it reaches the rate recommended by the actuary in the most recent experience study using net investment gains based on the following parameters:

- 2% Excess return over assumed rate, lower assumption by 5 basis points,
- 5% Excess return over assumed rate, lower assumption by 10 basis points,
- 8% Excess return over assumed rate, lower assumption by 15 basis points,
- 12% Excess return over assumed rate, lower assumption by 20 basis points.

An example of this methodology is if the actual net investment return on a market return basis is 15.00% (excess return of 7.25% over the assumed rate) for the fiscal year ending June 30, 2021, then the investment return assumption will be reduced by 10 basis points from 7.75% to 7.65% for the 2021 valuation. This methodology should continue for each subsequent valuation until the investment return assumption is equal to our recommended rate of 7.00%.

Section II – 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 dealt with 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 is 3.00% and is composed of a 2.75% rate of inflation assumption and a 0.25% 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. Currently, this wage data is only available through calendar year 2019. 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%	1.75%	1.13%
1999-2019	2.91%	2.14%	0.77%
1989-2019	3.36%	2.40%	0.96%
1979-2019	3.95%	3.07%	0.88%
1969-2019	4.53%	3.91%	0.62%

Thus, over the last 50 years, annual real wage growth has averaged 0.62%.

Section II – 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 April of 2020, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.54%, 1.14% higher than the Social Security intermediate inflation assumption of 2.40% 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 we maintain a 0.25% real wage growth inflation assumption and reduce the wage inflation assumption in total wage inflation growth from 3.00% to 2.65% to account for the similar reduction recommendation in the price inflation assumption.**

Wage Inflation Assumption		
	Current	Recommended
Price Inflation	2.75%	2.40%
Real Wage Growth	<u>0.25%</u>	<u>0.25%</u>
Wage Inflation	3.00%	2.65%

Section II – Economic Assumptions

Payroll Growth

Background

The assumed future rate of payroll growth increase in the total payroll of PERS' active members is an assumption used in the level percentage of payroll amortization method that affects the calculation of the amortization period required to fully amortize the unfunded actuarial accrued liability and the actuarially determined employer contribution. The total payroll growth is impacted by individual member's increases and population growth. The current assumption is 3.00% per year which is comprised of the inflation assumption of 2.75% and real wage growth of 0.25%.

Past Experience

The following table shows the actual PERS' payroll growth experienced over different time periods.

Period	Number of Years	Annual Payroll Growth	Annual Active Membership Growth	Net Payroll Growth
2000 – 2020	20	2.17%	-0.06%	2.24%
2005 – 2020	15	1.84%	-0.31%	2.16%
2010 – 2020	10	0.87%	-0.95%	1.84%
2015 – 2020	5	1.26%	-0.95%	2.24%

Recommendation

The table above shows annual payroll growth has been much lower than assumed and the active membership growth has declined significantly since the financial crisis of 2008/2009. The net growth has been averaging less than the current assumption of 3.00%. **Therefore, we are recommending a payroll growth assumption reduction from 3.00% to 2.65%, which is equal to the recommended wage inflation assumption.**

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 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 PERS.

The rationale of the Entry Age Normal (EAN) cost method is that the cost of each member's benefit is determined to be a level percentage of his salary from date of hire to the end of his employment with the employer. 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 Entry Age Normal 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 Entry Age Normal actuarial accrued liability. The current year's cost to amortize the unfunded actuarial accrued liability is developed by applying an amortization factor.

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 Entry Age Normal 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 PERS.**

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 is 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.

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.**

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 dollar amortization payment method, but the payments increase at a fixed rate each year so that

Section III – Actuarial Methods

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 of the outstanding amortization bases on the valuation date and the UAAL payment is the sum of all of the amortization payments on the existing amortization bases. This approach provides transparency in that the current UAAL is paid off over a fixed period of time 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 PERS Board funding policy, an actuarially determined employer contribution (ADEC) is calculated during each annual valuation and the ADEC is compared to the Fixed Contribution Rate adopted by the Board as one of its Signal Light metrics. 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 Percentage of Payroll
- Amortization Bases – Separate bases for all experience gains and losses, assumption changes or benefit changes

We recommend no changes in these methods.



Section IV – Demographic Assumptions

There are several demographic assumptions used in the actuarial valuations performed for Mississippi PERS. They are:

- Rates of Withdrawal
- Pre-Retirement Mortality
- Rates of Disability Retirement
- Rates of Service Retirement
- Post-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, 2016 through June 30, 2020) 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 considered 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.



PUBLIC EMPLOYEES' RETIREMENT SYSTEM

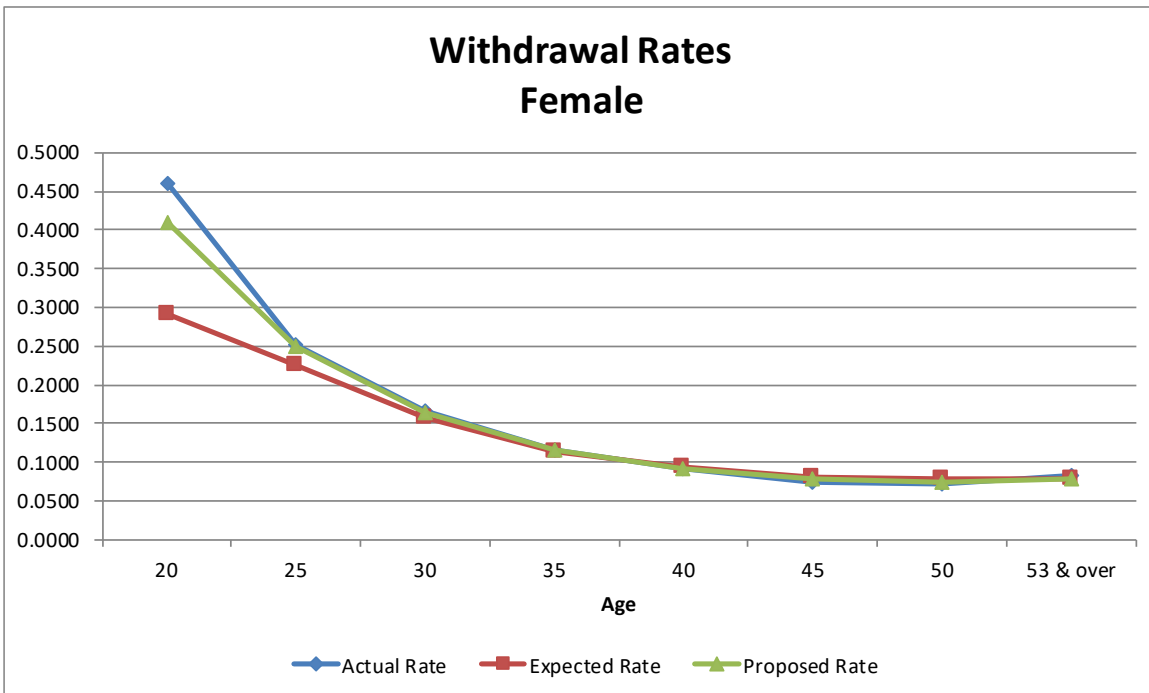
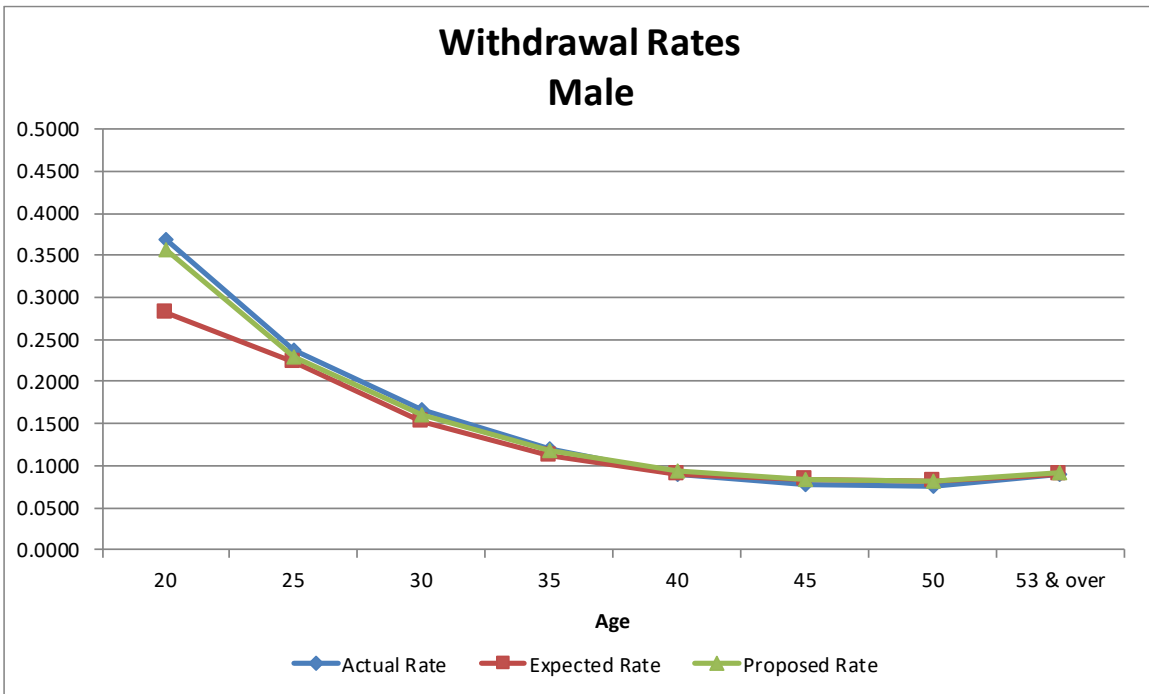
RATES OF WITHDRAWAL

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

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
20	1,025	781	1.312	992	628	1.580
25	3,789	3,569	1.062	6,330	5,673	1.116
30	3,785	3,478	1.088	6,564	6,212	1.057
35	2,968	2,774	1.070	5,443	5,364	1.015
40	2,364	2,409	0.981	4,711	4,781	0.985
45	2,187	2,303	0.950	3,972	4,248	0.935
50	1,834	2,031	0.903	3,405	3,618	0.941
53 & over	3,689	3,669	1.005	5,614	5,401	1.039
TOTAL	21,641	21,014	1.030	37,031	35,925	1.031

The following graphs show a comparison of the present, actual and proposed rates of withdrawal.

PUBLIC EMPLOYEES' RETIREMENT SYSTEM
RATES OF WITHDRAWAL FOR ACTIVE MEMBERS



Section IV – Demographic Assumptions

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 results of our four-year study indicate that, in aggregate, the actual number of withdrawals was more than expected at younger age groups and less than expected at most older age groups.

The current rates of withdrawal are broken down by a select and ultimate period based on service. There are three bands of the select and ultimate period. The last band is the ultimate period, which includes all years of service after two years. However, when we dug further into the actual experience of withdrawal, we found that there was a better correlation of actual to expected withdrawal rates when we extended the number of years of service and included age as a factor. **Therefore, we recommend eliminating the current select and ultimate period basis and utilize an age by service matrix table for the rates of withdrawal in the future.** We hope this new table will eliminate the actuarial losses that we continue to see in the annual actuarial valuation reports for withdrawal.

The following tables show a comparison between the current withdrawal rates and a sample of the proposed withdrawal rates.

COMPARATIVE RATES OF WITHDRAWAL*

AGE	CURRENT RATES OF WITHDRAWAL	
	MALES	FEMALES
20	26.50%	32.50%
25	18.50	18.50
30	11.75	12.00
35	8.50	8.75
40	6.75	7.00
45	6.25	6.00
50	6.25	6.00
55	6.25	6.00
60	6.25	6.00
65	6.25	6.00
70	6.25	6.00
74	6.25	6.00

* For all ages, rates of 33.5% during the first year of employment and 24.0% during the second year.

AGE	PROPOSED RATES OF WITHDRAWAL FOR MALES (Tiers 1-3)								
	SERVICE								
	0	1	2	3	4	5	10	15	20
20	40.00	35.00	28.00	28.00	18.00	13.00	-	-	-
25	34.50	25.50	21.00	17.50	16.00	13.00	9.00	-	-
30	34.00	25.00	20.00	15.00	13.00	12.00	6.50	5.00	-
35	33.75	24.50	19.00	14.00	12.50	12.00	6.50	4.00	4.00
40	33.50	24.00	17.00	13.00	11.50	9.50	6.00	4.00	4.00
45	32.00	23.50	17.00	11.50	11.00	9.50	5.50	4.00	4.00
50	28.00	20.00	15.00	11.50	11.00	9.50	5.50	4.00	4.00
53+	25.00	19.00	14.00	11.50	11.00	9.50	5.50	4.00	4.00

AGE	PROPOSED RATES OF WITHDRAWAL FOR FEMALES (Tiers 1-3)								
	SERVICE								
	0	1	2	3	4	5	10	15	20
20	45.00	40.00	32.00	27.00	20.00	14.00	-	-	-
25	37.00	27.50	22.00	18.00	17.50	12.50	9.00	-	-
30	35.00	26.50	20.00	15.00	13.00	12.50	6.50	5.00	-
35	30.00	24.00	18.75	13.75	10.00	12.00	6.25	4.25	3.50
40	28.00	23.00	16.75	12.75	8.00	9.50	6.00	4.25	3.50
45	27.50	20.00	16.75	12.75	6.50	9.50	5.75	4.25	3.50
50	27.50	20.00	14.00	12.75	6.50	9.50	5.75	4.25	3.50
53+	25.00	19.00	14.00	12.75	6.50	9.50	5.75	4.25	3.50

AGE	PROPOSED RATES OF WITHDRAWAL FOR MALES (Tier 4)									
	SERVICE									
	0	1	2	3	4	5	10	15	20	25
20	40.00	35.00	28.00	28.00	18.00	13.00	-	-	-	-
25	34.50	25.50	21.00	17.50	16.00	13.00	9.00	-	-	-
30	34.00	25.00	20.00	15.00	13.00	12.00	6.50	5.00	-	-
35	33.75	24.50	19.00	14.00	12.50	12.00	6.50	4.00	4.00	-
40	33.50	24.00	17.00	13.00	11.50	9.50	6.00	4.00	4.00	4.00
45	32.00	23.50	17.00	11.50	11.00	9.50	5.50	4.00	4.00	4.00
50	28.00	20.00	15.00	11.50	11.00	9.50	5.50	4.00	4.00	4.00
53+	25.00	19.00	14.00	11.50	11.00	9.50	5.50	4.00	4.00	4.00

AGE	PROPOSED RATES OF WITHDRAWAL FOR FEMALES (Tier 4)									
	SERVICE									
	0	1	2	3	4	5	10	15	20	25
20	45.00	40.00	32.00	27.00	20.00	14.00	-	-	-	-
25	37.00	27.50	22.00	18.00	17.50	12.50	9.00	-	-	-
30	35.00	26.50	20.00	15.00	13.00	12.50	6.50	5.00	-	-
35	30.00	24.00	18.75	13.75	10.00	12.00	6.25	4.25	3.50	-
40	28.00	23.00	16.75	12.75	8.00	9.50	6.00	4.25	3.50	3.50
45	27.50	20.00	16.75	12.75	6.50	9.50	5.75	4.25	3.50	3.50
50	27.50	20.00	14.00	12.75	6.50	9.50	5.75	4.25	3.50	3.50
53+	25.00	19.00	14.00	12.75	6.50	9.50	5.75	4.25	3.50	3.50

**COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS
FROM ACTIVE SERVICE BASED ON PROPOSED RATES**

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
20	1,025	992	1.034	992	881	1.126
25	3,789	3,777	1.003	6,330	6,241	1.014
30	3,785	3,646	1.038	6,564	6,492	1.011
35	2,968	2,947	1.007	5,443	5,480	0.993
40	2,364	2,396	0.987	4,711	4,739	0.994
45	2,187	2,230	0.981	3,972	4,165	0.954
50	1,834	1,883	0.974	3,405	3,457	0.985
53 & over	3,689	3,679	1.003	5,614	5,308	1.058
TOTAL	21,641	21,550	1.004	37,031	36,763	1.007

PUBLIC EMPLOYEES' RETIREMENT SYSTEM

RATES OF PRE-RETIREMENT MORTALITY

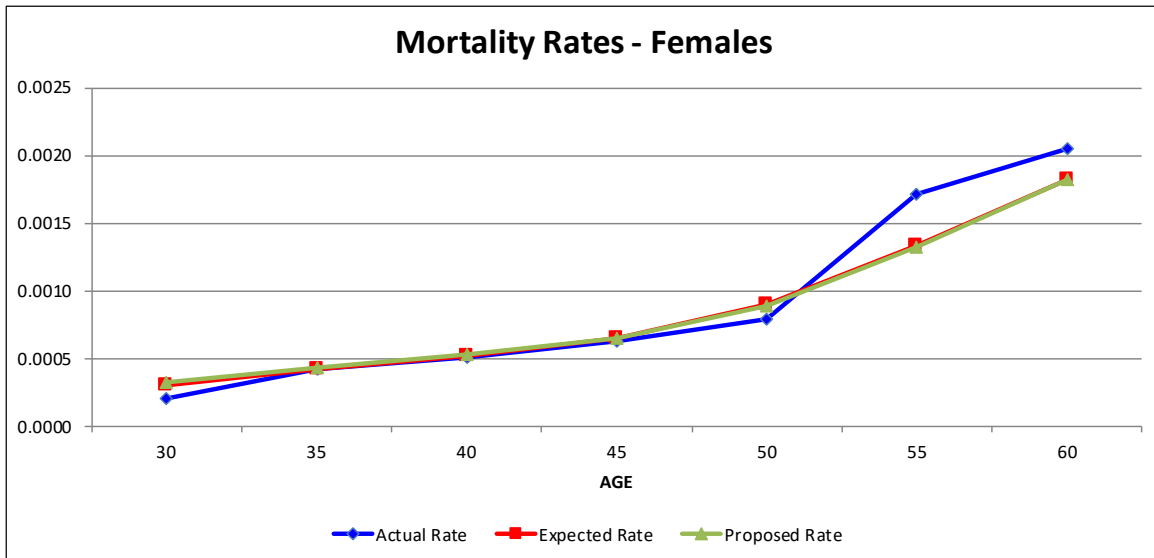
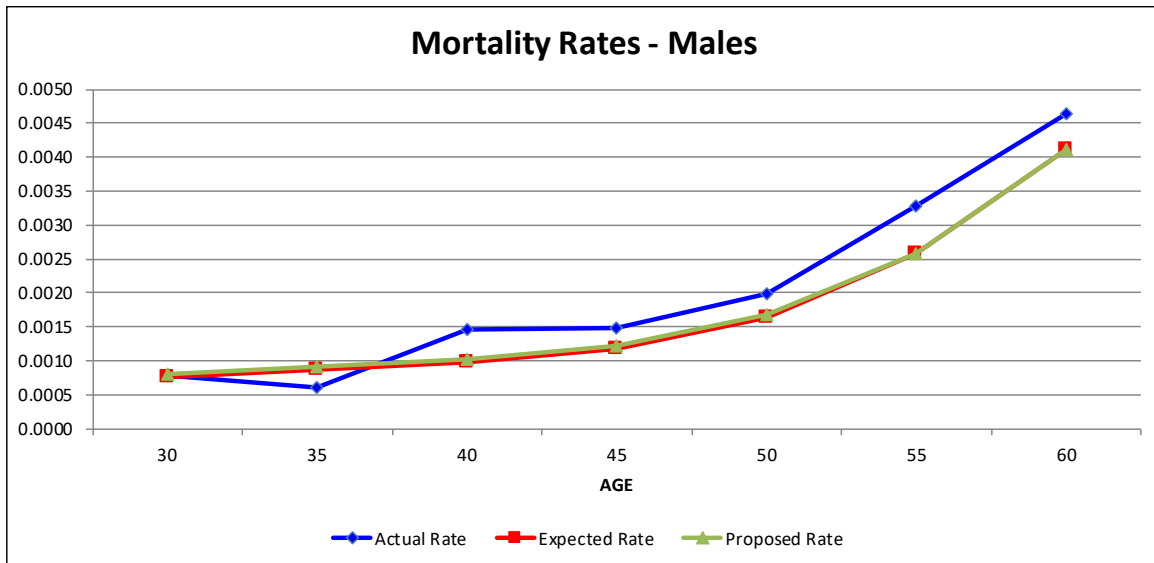
The active member mortality assumption models eligibility for death benefits prior to retirement. Therefore, it has a much smaller impact on the valuation results than the post-retirement mortality assumption.

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 sometimes this 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.

COMPARISON OF ACTUAL AND EXPECTED PRE-RETIREMENT DEATHS

CENTRAL AGE OF GROUP	NUMBER OF DEATHS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
30	18	17	1.059	8	12	0.667
35	15	22	0.682	20	20	1.000
40	39	26	1.500	26	27	0.963
45	42	34	1.235	34	35	0.971
50	56	46	1.217	42	47	0.894
55	87	68	1.279	85	66	1.288
60	110	98	1.122	85	75	1.133
63 & over	170	170	1.000	62	70	0.886
TOTAL	537	481	1.116	362	352	1.028

The following graphs show a comparison of the present, actual, and proposed rates of pre-retirement mortality.



As can be seen from the table on the previous page, the pre-retirement mortality experience was very close to expected. Therefore, we believe the current pre-retirement mortality table is working well and we only recommend a minor adjustment to the projection scale as follows:

<u>Membership Table</u>	<u>Set Forward (+)/ Setback (-)</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubS.H-2010(B) Employee	None	Male: 105%, Female: 70%	MP-2020 (was MP-2018)

**COMPARISON OF ACTUAL AND EXPECTED PRE-RETIREMENT DEATHS
BASED ON PROPOSED RATES**

CENTRAL AGE OF GROUP	NUMBER OF DEATHS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
30	18	18	1.000	8	13	0.615
35	15	23	0.652	20	20	1.000
40	39	27	1.444	26	27	0.963
45	42	35	1.200	34	35	0.971
50	56	47	1.191	42	47	0.894
55	87	69	1.261	85	66	1.288
60	110	98	1.122	85	75	1.133
63 & over	170	192	0.885	62	76	0.816
TOTAL	537	509	1.055	362	359	1.008

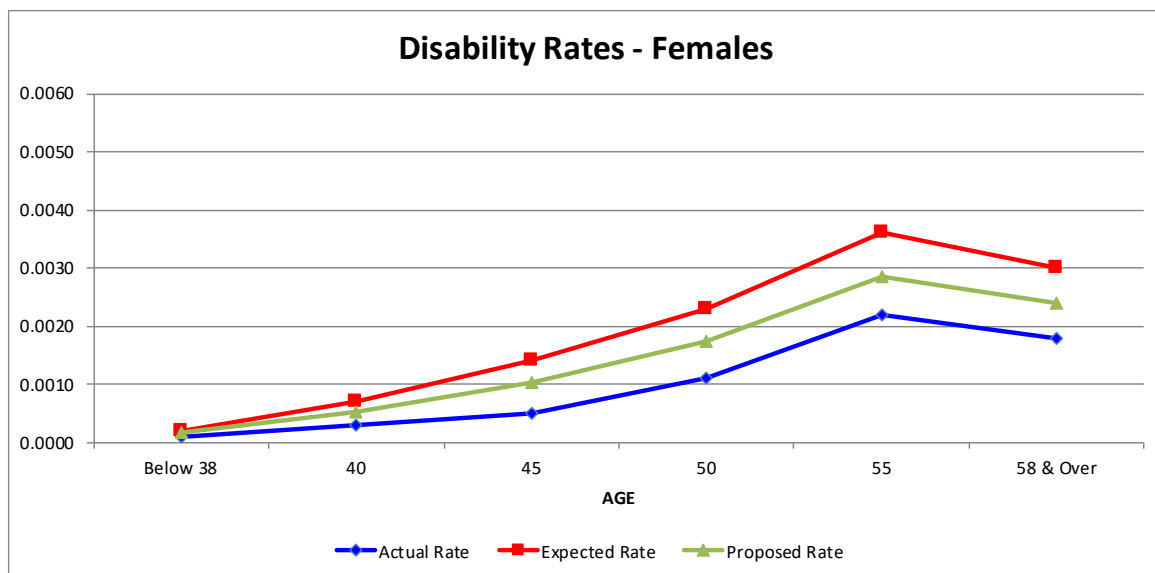
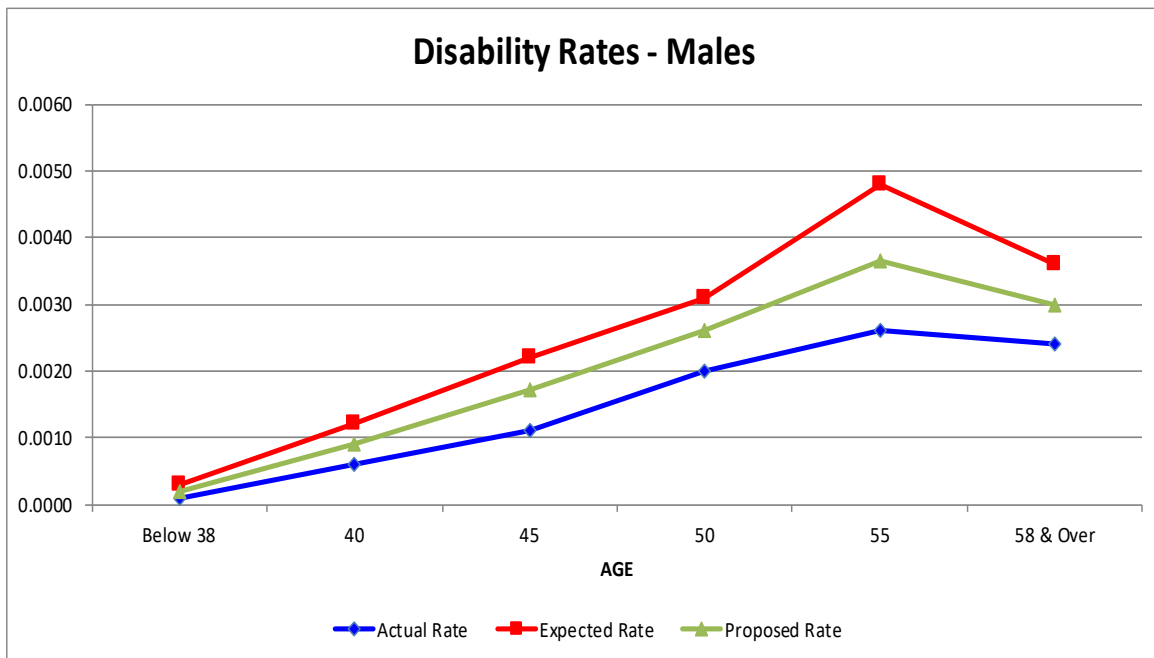
PUBLIC EMPLOYEES' RETIREMENT SYSTEM

RATES OF DISABILITY RETIREMENT

COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS

CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Below 38	8	18	0.444	10	20	0.500
40	17	31	0.548	18	37	0.486
45	31	64	0.484	29	77	0.377
50	55	86	0.640	60	121	0.496
55	69	127	0.543	111	180	0.617
58 & over	106	160	0.663	118	197	0.599
TOTAL	286	486	0.588	346	632	0.547

The following graphs show a comparison of the present and actual rates of disability retirements.



As can be seen from the table on the previous page, the actual rates of disability retirement are less than expected for both males and females at all ages. The number of disabilities has significantly declined during the last four years of this study period. **Therefore, we recommend a decrease in the rates of disability retirement to better match experience.**

COMPARATIVE RATES OF DISABILITY RETIREMENTS

AGE	RATES OF DISABILITY			
	MALES		FEMALES	
	Present	Proposed	Present	Proposed
20	0.010%	0.006%	0.009%	0.006%
25	0.012	0.011	0.011	0.011
30	0.017	0.016	0.014	0.016
35	0.036	0.020	0.017	0.020
40	0.110	0.090	0.070	0.050
45	0.230	0.170	0.140	0.100
50	0.290	0.260	0.220	0.170
55	0.500	0.370	0.380	0.290
60	0.530	0.310	0.410	0.250

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

CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Below 38	8	13	0.615	10	21	0.476
40	17	24	0.708	18	27	0.667
45	31	49	0.633	29	56	0.518
50	55	73	0.753	60	92	0.652
55	69	97	0.711	111	141	0.787
58 & over	106	108	0.981	118	132	0.894
TOTAL	286	364	0.786	346	469	0.738

PUBLIC EMPLOYEES' RETIREMENT SYSTEM

RATES OF RETIREMENT

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

Retirements with less than 25 years of service

AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
60	296	264	1.121	634	645	0.983
61	245	230	1.065	459	490	0.937
62	445	434	1.025	710	723	0.982
63	271	308	0.880	560	545	1.028
64	225	224	1.004	453	446	1.016
65	333	315	1.057	614	581	1.057
66	242	225	1.076	410	372	1.102
67	163	159	1.025	237	230	1.030
68	155	120	1.292	174	158	1.101
69	113	123	0.919	134	123	1.089
70	103	106	0.972	109	115	0.948
71	83	78	1.064	63	77	0.818
72	72	68	1.059	68	61	1.115
73	49	43	1.140	40	44	0.909
74	38	39	0.974	36	37	0.973
Subtotal	2,833	2,736	1.035	4,701	4,647	1.012
75 & Over	213	945	0.225	138	567	0.243
GRAND TOTAL	3,046	3,681	0.827	4,839	5,214	0.928

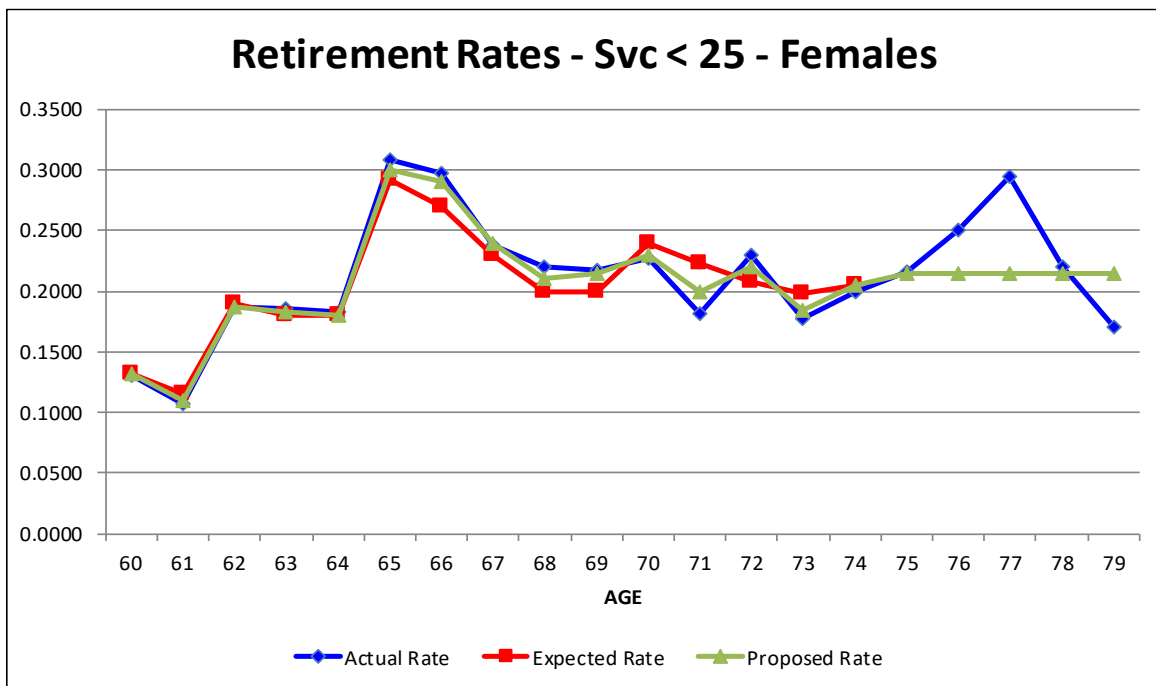
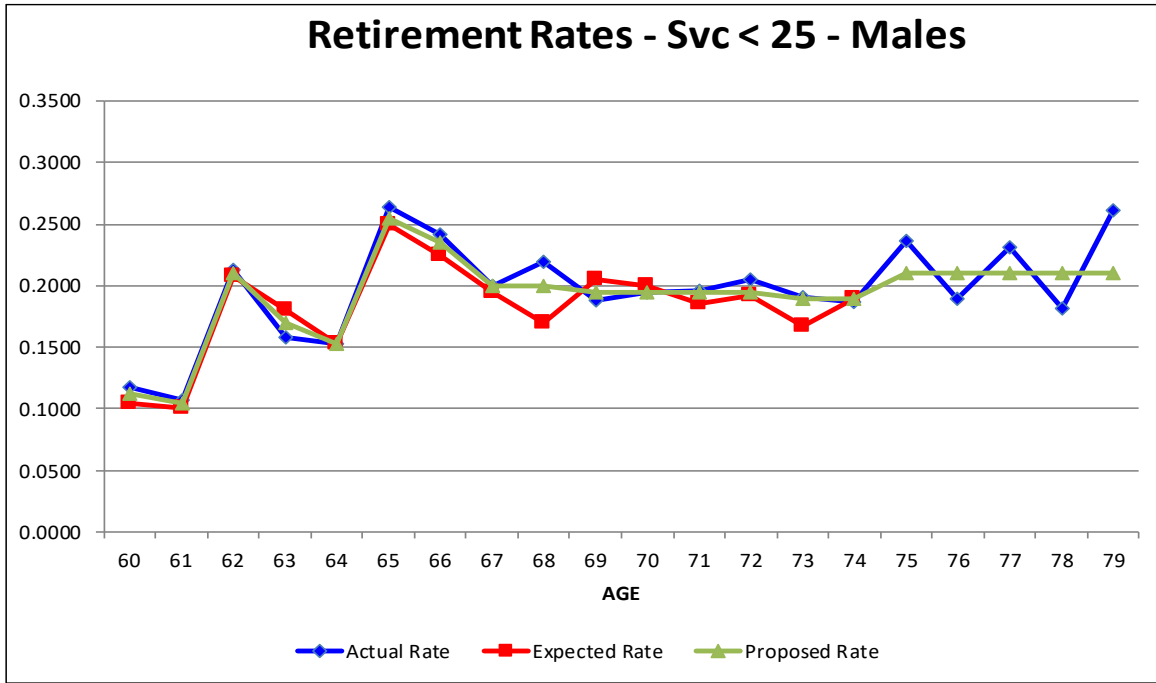
COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

Retirements with 25 or more years of service

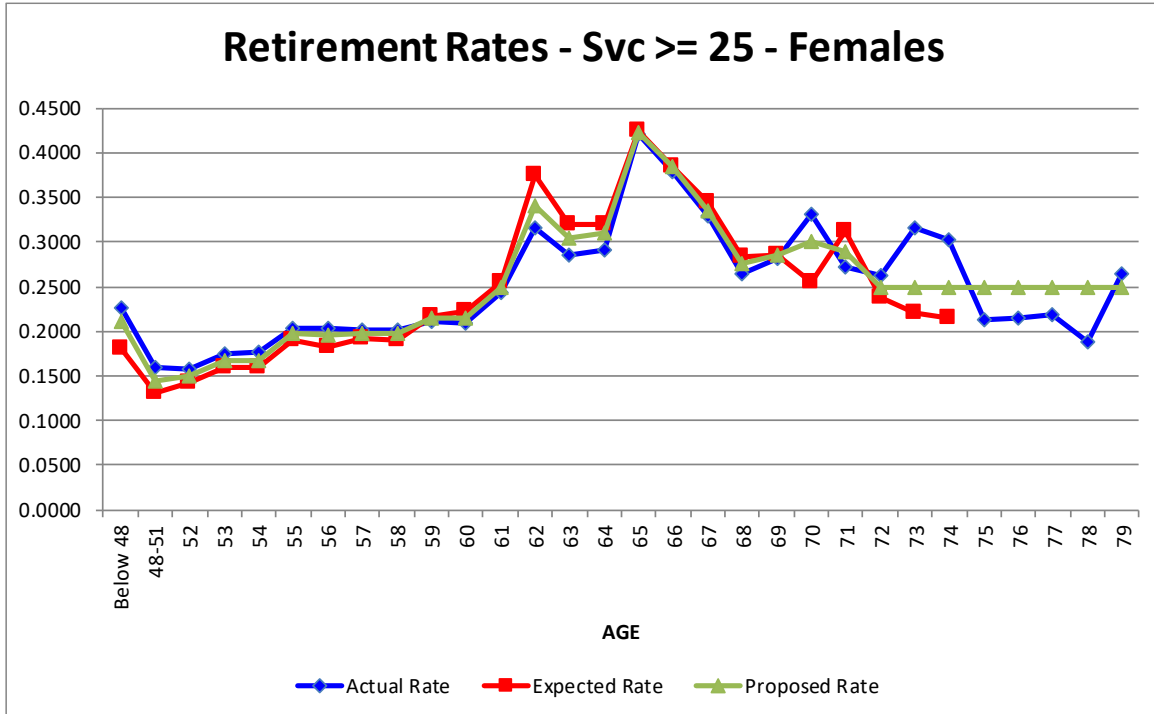
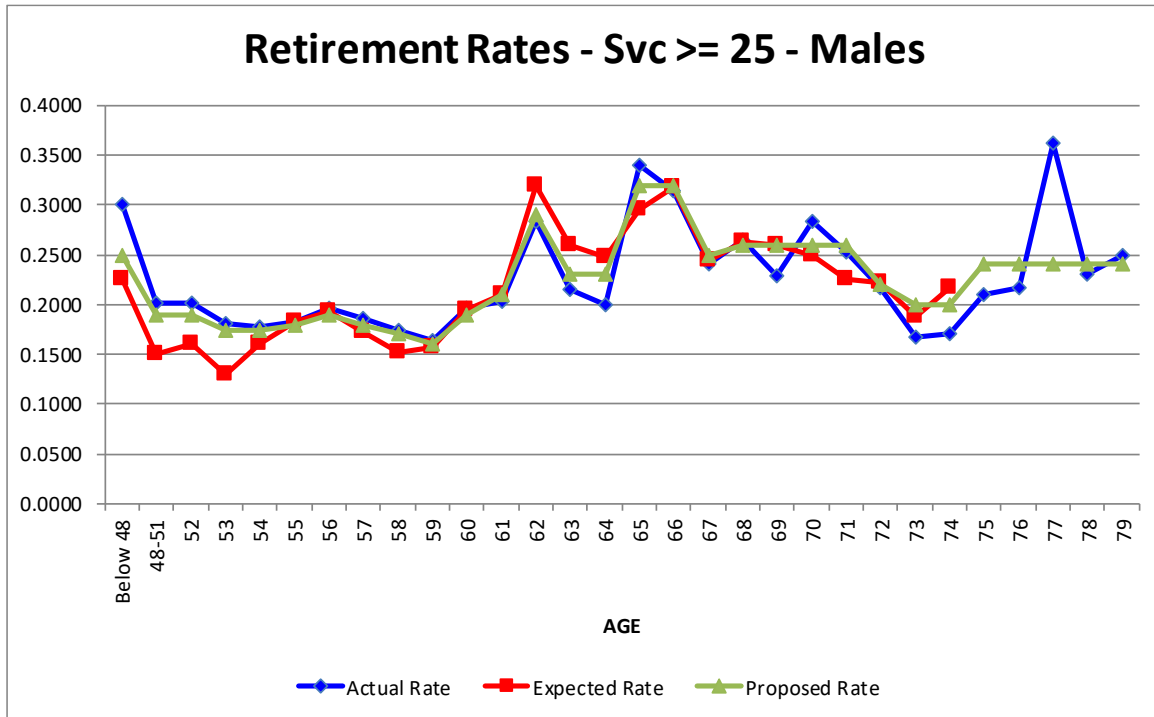
AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Below 48	178	133	1.338	131	104	1.260
48-51	528	393	1.344	766	624	1.228
52	170	135	1.259	229	207	1.106
53	158	113	1.398	260	239	1.088
54	167	151	1.106	279	252	1.107
55	179	178	1.006	332	310	1.071
56	184	180	1.022	336	301	1.116
57	172	159	1.082	336	321	1.047
58	158	138	1.145	341	321	1.062
59	144	138	1.043	356	368	0.967
60	167	166	1.006	341	364	0.937
61	168	173	0.971	381	400	0.953
62	227	256	0.887	452	537	0.842
63	144	174	0.828	309	346	0.893
64	116	144	0.806	268	295	0.908
65	184	160	1.150	312	316	0.987
66	121	123	0.984	185	188	0.984
67	69	70	0.986	105	110	0.955
68	60	60	1.000	62	66	0.939
69	43	49	0.878	53	54	0.981
70	50	44	1.136	52	40	1.300
71	31	28	1.107	34	39	0.872
72	20	20	1.000	27	24	1.125
73	15	17	0.882	25	17	1.471
74	15	19	0.789	16	11	1.455
Subtotal	3,468	3,221	1.077	5,988	5,854	1.023
75 & Over	89	346	0.257	56	243	0.230
GRAND TOTAL	3,557	3,567	0.997	6,044	6,097	0.991

The following graphs show a comparison of the present, actual, and proposed rates of service retirements.

**RATES OF RETIREMENT FOR ACTIVE MEMBERS
WITH LESS THAN 25 YEARS OF SERVICE**



**RATES OF RETIREMENT FOR ACTIVE MEMBERS
WITH 25 OR MORE YEARS OF SERVICE**



Section IV – Demographic Assumptions

As can be seen from the previous 4 pages, the actual rates of service retirement, for both under 25 years and over 25 years are reasonably close to expected at most ages. **However, we do recommend some slight adjustments in the rates of retirement, especially at the earlier ages, to better match anticipated experience going forward. We also recommend an extension of the fixed retirement from age 75 to age 80, as the census data demonstrates more and more active members are working longer in the System.**

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

COMPARATIVE RATES OF RETIREMENT

AGE	RATES OF SERVICE RETIREMENT*							
	MALES				FEMALES			
	Under 25 Years of Service		25 Years of Service and Over		Under 25 Years of Service		25 Years of Service and Over	
	Present	Proposed	Present	Proposed	Present	Proposed	Present	Proposed
45			22.50%	25.00%			18.00%	21.00%
50			15.00	19.00			13.00	14.50
55			18.25	18.00			19.00	19.75
60	10.50%	11.25%	19.50	19.00	13.25%	13.25%	22.25	21.50
62	20.75	21.00	32.00	29.00	19.00	18.75	37.50	34.00
65	25.00	25.50	29.50	32.00	29.25	30.00	42.50	42.25
70	20.00	19.50	25.00	26.00	24.00	23.00	25.50	30.00
75	100.00	22.00	100.00	24.00	100.00	21.50	100.00	25.00
80		100.00		100.00		100.00		100.00

* The proposed changes shown above are used for Tier 4 service retirements as well, except the 25 years of service is 30 years of service for these members.

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

Retirements with less than 25 years of service

AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
60	296	283	1.046	634	645	0.983
61	245	241	1.017	459	469	0.979
62	445	440	1.011	710	713	0.996
63	271	291	0.931	560	552	1.014
64	225	224	1.004	453	446	1.016
65	333	322	1.034	614	596	1.030
66	242	235	1.030	410	392	1.046
67	163	163	1.000	237	240	0.988
68	155	141	1.099	174	166	1.048
69	113	117	0.966	134	132	1.015
70	103	103	1.000	109	110	0.991
71	83	83	1.000	63	69	0.913
72	72	68	1.059	68	65	1.046
73	49	49	1.000	40	42	0.952
74	38	39	0.974	36	38	0.947
75	47	44	1.068	30	30	1.000
76	31	36	0.861	27	23	1.174
77	30	29	1.034	23	17	1.353
78	19	23	0.826	13	13	1.000
79	23	19	1.211	8	10	0.800
Subtotal	2,983	2,950	1.011	4,802	4,768	1.007
80 & Over	63	259	0.243	37	136	0.272
GRAND TOTAL	3,046	3,209	0.949	4,839	4,904	0.987

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS BASED ON PROPOSED RATES

Retirements with 25 or more years of service

AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Below 48	178	148	1.203	131	121	1.083
48-51	528	498	1.060	766	696	1.101
52	170	161	1.056	229	218	1.050
53	158	152	1.039	260	250	1.040
54	167	165	1.012	279	264	1.057
55	179	176	1.017	332	323	1.028
56	184	178	1.034	336	322	1.043
57	172	166	1.036	336	330	1.018
58	158	154	1.026	341	334	1.021
59	144	141	1.021	356	364	0.978
60	167	162	1.031	341	352	0.969
61	168	173	0.971	381	392	0.972
62	227	232	0.978	452	487	0.928
63	144	154	0.935	309	329	0.939
64	116	134	0.866	268	286	0.937
65	184	173	1.064	312	314	0.994
66	121	124	0.976	185	188	0.984
67	69	72	0.958	105	107	0.981
68	60	59	1.017	62	64	0.969
69	43	49	0.878	53	54	0.981
70	50	46	1.087	52	47	1.106
71	31	32	0.969	34	38	0.895
72	20	20	1.000	27	26	1.038
73	15	18	0.833	25	20	1.250
74	15	18	0.833	16	13	1.231
75	17	19	0.895	10	12	0.833
76	13	14	0.929	9	11	0.818
77	17	11	1.545	7	8	0.875
78	6	6	1.000	6	8	0.750
79	5	5	1.000	6	6	1.000
Subtotal	3,526	3,460	1.019	6,026	5,984	1.007
80 & Over	31	112	0.277	18	68	0.265
GRAND TOTAL	3,557	3,572	0.996	6,044	6,052	0.999

PUBLIC EMPLOYEES' RETIREMENT SYSTEM

RATES OF POST-RETIREMENT 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.



Section IV – Demographic Assumptions

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 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.

In the previous experience investigation, we changed the mortality approach for PERS from a static mortality table with a margin to a generational mortality approach that directly anticipates future improvements in mortality by using a different set of mortality rates for each year of birth, with the rates for later years of birth assuming lower mortality than the rates for earlier years of birth. The varying mortality rates by year of birth create a series of tables that contain “built-in” mortality improvements, e.g., a member who turns age 65 in 2035 has a longer life expectancy than a member who turns age 65 in 2020. When using generational mortality, the A/E ratios for the observed experience are set near 100% as future mortality improvements will be 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 ten to fifteen years, this method has become quite common as computing power has increased.

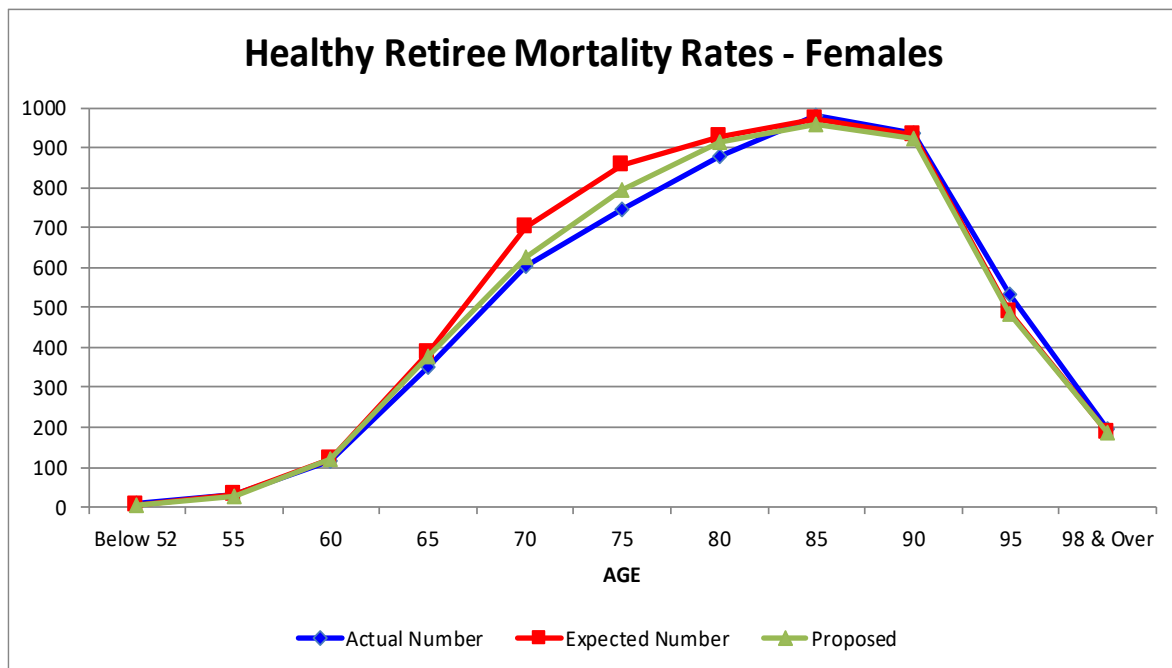
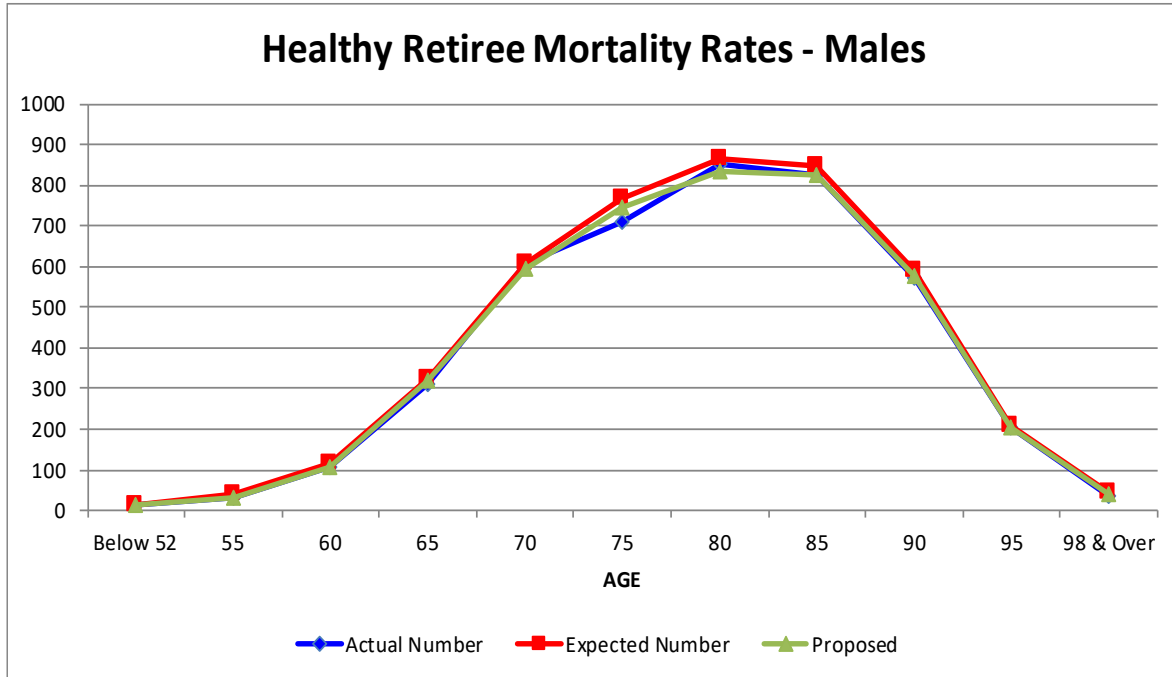
In this experience study, we also analyzed recent experience on a benefit-weighted basis where the exposures and deaths are multiplied by the monthly retirement benefit amount. This helps to reflect any differences that arise from better mortality experience among those with larger benefits. Because 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 very similar to the Actual to Expected Ratios on a count basis over the past two years.

COMPARISON OF ACTUAL AND EXPECTED CASES OF POST-RETIREMENT DEATHS

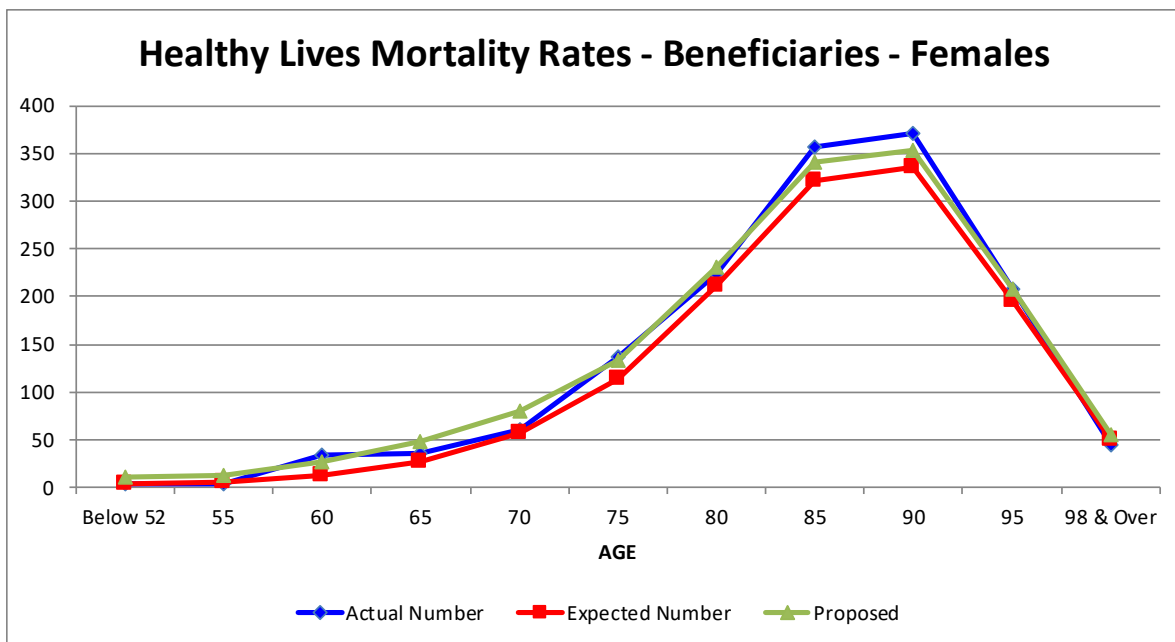
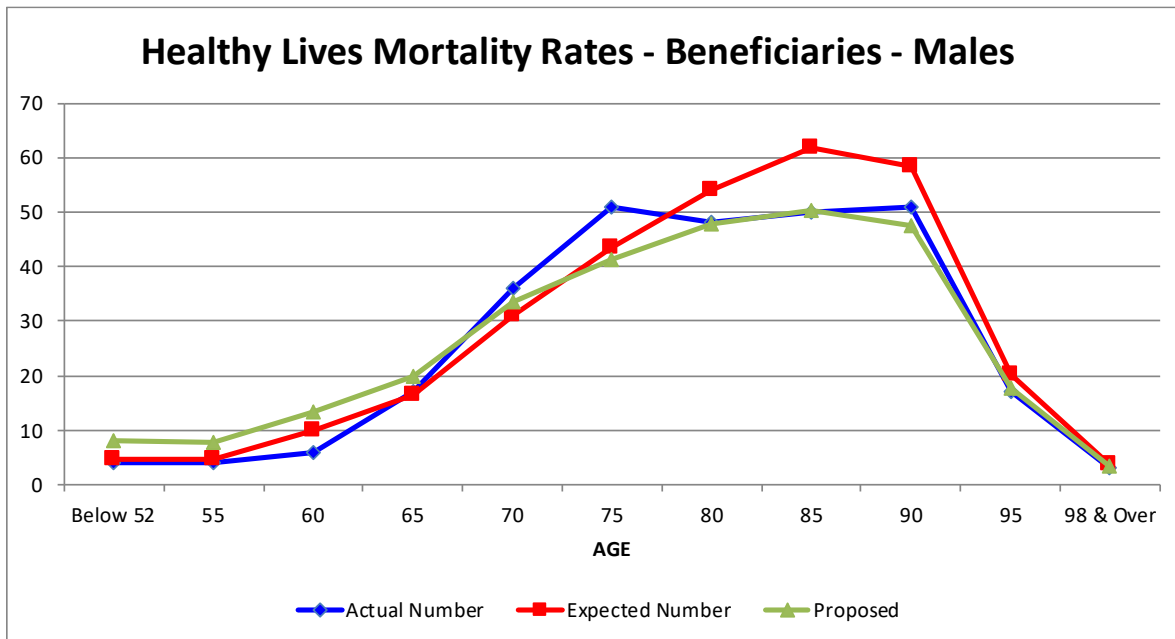
CENTRAL AGE OF GROUP	NUMBER OF POST-RETIREMENT DEATHS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	SERVICE RETIREMENTS					
Below 53	12	13	0.923	10	5	2.000
55	32	38	0.842	31	29	1.069
60	107	116	0.922	117	121	0.967
65	313	326	0.960	352	386	0.912
70	610	607	1.005	603	701	0.860
75	711	767	0.927	745	857	0.869
80	854	866	0.986	878	927	0.947
85	826	849	0.973	980	972	1.008
90	571	592	0.965	938	934	1.004
95	203	209	0.971	534	488	1.094
98 & over	38	43	0.884	195	187	1.043
TOTAL	4,277	4,426	0.966	5,383	5,607	0.960
BENEFICIARIES						
Below 53	4	5	0.800	4	3	1.333
55	4	5	0.800	4	5	0.800
60	6	10	0.600	33	12	2.750
65	17	16	1.063	35	27	1.296
70	36	31	1.161	60	58	1.034
75	51	43	1.186	136	115	1.183
80	48	54	0.889	223	211	1.057
85	50	62	0.806	356	321	1.109
90	51	59	0.864	371	335	1.107
95	17	20	0.850	207	194	1.067
98 & over	3	4	0.750	44	50	0.880
TOTAL	287	309	0.929	1,473	1,331	1.107
DISABILITY RETIREMENTS						
Below 48	8	9	0.889	14	8	1.750
50	18	20	0.900	20	19	1.053
55	41	46	0.891	47	46	1.022
60	71	84	0.845	80	75	1.067
65	99	110	0.900	90	86	1.047
70	107	94	1.138	86	80	1.075
75	59	56	1.054	69	61	1.131
80	41	38	1.079	41	53	0.774
85	17	17	1.000	38	33	1.152
88 & over	9	8	1.125	18	21	0.857
TOTAL	470	482	0.975	503	482	1.044

The following graphs show a comparison of the present, actual and proposed number of post-retirement deaths.

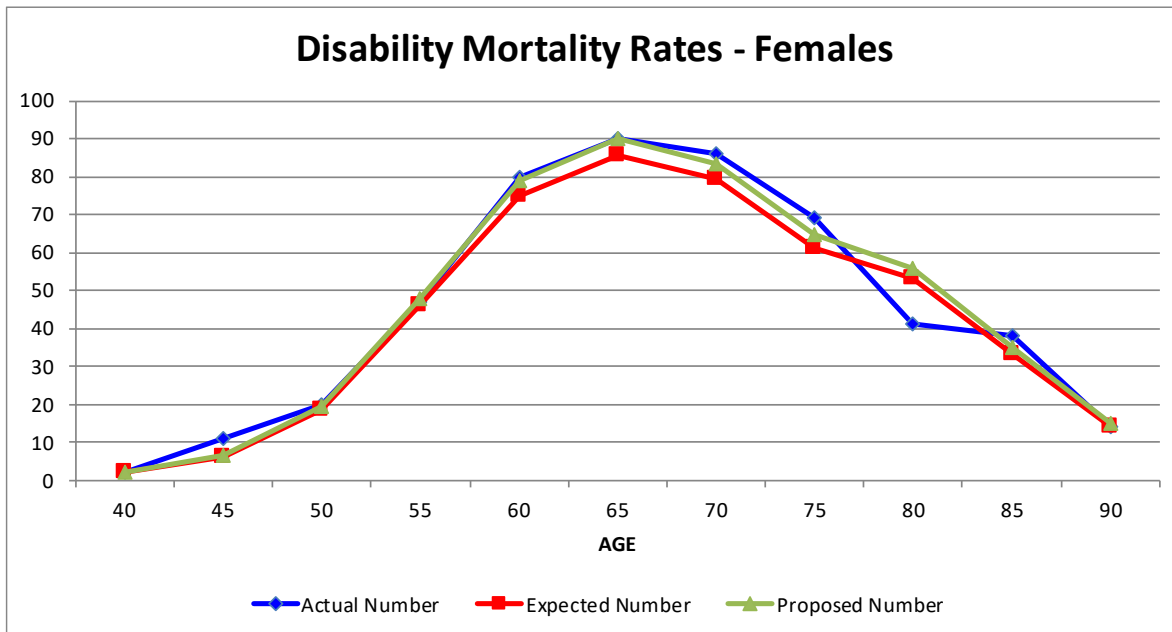
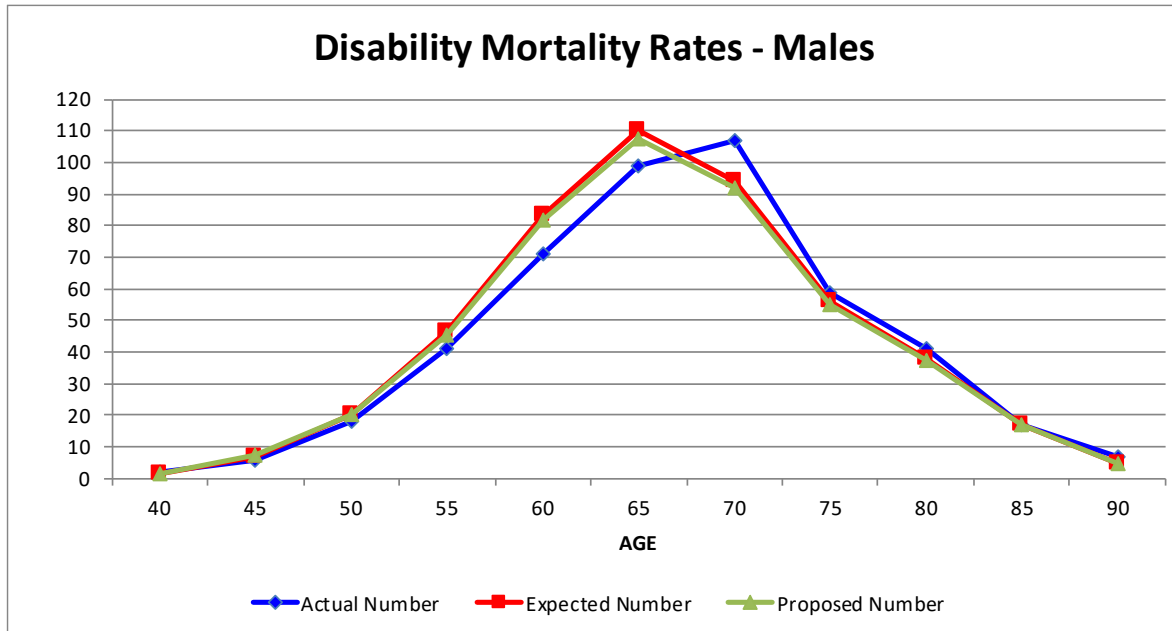
**POST-RETIREMENT DEATHS
SERVICE RETIREMENTS**



POST-RETIREMENT DEATHS BENEFICIARIES



**POST-RETIREMENT DEATHS
DISABILITY RETIREMENTS**





Section IV – Demographic Assumptions

The ratio of actual to expected experience shown on page 52 and the actuarial gain/loss analysis performed during the 2019 and 2020 valuations for PERS has indicated that the current mortality table that was adopted after the last experience study fits nicely into the actual mortality experience of PERS' service retirees, beneficiaries, and disabled retirees. The ratios are fairly close to the 100% that is preferred under a generational mortality approach and the gain/loss analysis has only shown a total loss of \$22.5 million over the past two valuation cycles which is less than 0.06% of the total retiree liability of PERS.

We do note that as we are preparing this experience investigation report, the world is in the midst of a pandemic. We have considered available information, including applying a COVID-19 load to the mortality table, but we do not believe that there is any credible reason to warrant the modification of the mortality table at this time due to the COVID-19 pandemic. The impact of the virus for the 2021 fiscal year will fall into the gain/loss analysis in the June 30, 2021 valuation results. We will continue to monitor the situation and advise the Board in the future of any adjustments that we believe would be appropriate.

Therefore, we are only recommending a slight change in the mortality table for service retirees as follows:

Service Retirees (Prior Table)*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubS.H-2010(B) Retiree	Male: 112% to age 75 and 105% for ages above 79 Female: 85% to age 65 and 102% for ages above 75	MP-2018

Service Retirees (Recommended Table)*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubS.H-2010(B) Retiree	Male: 95% up to age 60, 110% for ages 61 to 75, and 101% for ages above 77 Female: 84% up to age 72, 100% for ages above 76	MP-2020

* Please note that none of the previous or recommended tables have any setbacks or setforwards.



Section IV – Demographic Assumptions

The results of our study indicate that overall, the mortality assumption works better for retirees than contingent annuitants or survivors. Therefore, we have decided to use a distinct assumption for each group of retirees. It is not uncommon for widows or widowers to die sooner than otherwise would be expected after the death of their spouse. This phenomenon is captured in mortality tables for surviving spouses only and we have adopted such a table for contingent annuitants or survivors at PERS:

Contingent Annuitants (Prior Table)*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubS.H-2010(B) Retiree	Male: 112% to age 75 and 105% for ages above 79 Female: 85% to age 65 and 102% for ages above 75	MP-2018

Contingent Annuitants (Recommended Table)*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubS.H-2010(B) Contingent Annuitant	Male: 97% for all ages Female: 110% for all ages	MP-2020

* Please note that none of the previous or recommended tables have any setbacks or setforwards.

We also recommend a small adjustment in the mortality for disabled retirees as follows:

Disabled Retirees (Prior Table)*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubG.H-2010 Disabled	Male: 137% for all ages Female: 115% for all ages	MP-2018

Disabled Retirees (Recommended Table)*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubG.H-2010 Disabled	Male: 134% for all ages Female: 121% for all ages	MP-2020

* Please note that none of the previous or recommended tables have any setbacks or setforwards.

The following shows a comparison of the actual and expected post-retirement deaths based on new revised rates of mortality.

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

CENTRAL AGE OF GROUP	NUMBER OF POST-RETIREMENT DEATHS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	SERVICE RETIREMENTS					
Below 53	12	12	1.000	10	5	2.000
55	32	33	0.970	31	29	1.069
60	107	107	1.000	117	120	0.975
65	313	319	0.981	352	375	0.939
70	610	593	1.029	603	627	0.962
75	711	747	0.952	745	794	0.938
80	854	832	1.026	878	913	0.962
85	826	825	1.001	980	959	1.022
90	571	576	0.991	938	924	1.015
95	203	204	0.995	534	484	1.103
98 & over	38	41	0.927	195	184	1.060
TOTAL	4,277	4,289	0.997	5,383	5,414	0.994
BENEFICIARIES						
Below 53	4	8	0.500	4	11	0.364
55	4	8	0.500	4	13	0.308
60	6	13	0.462	33	27	1.222
65	17	20	0.850	35	48	0.729
70	36	33	1.091	60	80	0.750
75	51	41	1.244	136	133	1.023
80	48	48	1.000	223	230	0.970
85	50	50	1.000	356	341	1.044
90	51	48	1.063	371	354	1.048
95	17	18	0.944	207	208	0.995
98 & over	3	4	0.750	44	55	0.800
TOTAL	287	291	0.986	1,473	1,500	0.982
DISABILITY RETIREMENTS						
Below 48	8	10	0.800	14	9	1.556
50	18	20	0.900	20	19	1.053
55	41	45	0.911	47	48	0.979
60	71	82	0.866	80	79	1.013
65	99	108	0.917	90	90	1.000
70	107	92	1.163	86	84	1.024
75	59	55	1.073	69	65	1.062
80	41	37	1.108	41	56	0.732
85	17	17	1.000	38	35	1.086
88 & over	9	8	1.125	18	23	0.783
TOTAL	470	474	0.992	503	508	0.990

PUBLIC EMPLOYEES' RETIREMENT SYSTEM

RATES OF SALARY INCREASE

**COMPARISON OF ACTUAL AND EXPECTED SALARIES
OF ACTIVE MEMBERS**

SERVICE OF GROUP	SALARIES AT END OF YEAR (\$1,000's)		
	MALES AND FEMALES		
	Actual	Expected	Ratio of Actual to Expected
0	\$506,415	\$493,706	1.026
1	1,391,182	1,401,159	0.993
2	1,275,557	1,285,951	0.992
3	1,205,379	1,207,087	0.999
4	1,120,881	1,121,214	1.000
5-9	4,595,540	4,594,441	1.000
10-14	4,169,881	4,182,628	0.997
15-19	3,527,724	3,552,113	0.993
20-24	2,579,076	2,600,630	0.992
25-29	1,260,796	1,269,663	0.993
30-34	492,302	496,402	0.992
35 & Over	226,210	229,270	0.987
TOTAL	\$22,350,943	\$22,434,264	0.996

Over the past four years, actual rates of salary increase have been less than expected at almost all service breakdowns. In the economic section of this experience study report, we are recommending the wage inflation assumption be reduced from 3.00% to 2.65% (see page 24). As the wage inflation assumption is part of our building block approach to determining the salary scale, the total salary scale will be reduced by 0.35% at all service intervals. **Therefore, we recommend no change in the merit salary scale at this time.**



Section IV – Demographic Assumptions

The following table shows a comparison between the present and proposed rates of the total salary increase.

SERVICE OF GROUP	SALARY INCREASE RATES	
	MALES AND FEMALES	
	Present	Proposed
0	18.25%	17.90%
1	8.25%	7.90%
2	5.75%	5.40%
3	4.75%	4.40%
4	4.25%	3.90%
5-7	3.75%	3.40%
8-27	3.25%	2.90%
28 and Over	3.00%	2.65%

**COMPARISON OF ACTUAL AND EXPECTED SALARIES
OF ACTIVE MEMBERS
BASED ON PROPOSED RATES**

SERVICE OF GROUP	SALARIES AT END OF YEAR (\$1,000's)		
	MALES AND FEMALES		
	Actual	Expected	Ratio of Actual to Expected
0	\$506,415	\$492,246	1.029
1	1,391,182	1,396,629	0.996
2	1,275,557	1,281,694	0.995
3	1,205,379	1,203,055	1.002
4	1,120,881	1,117,450	1.003
5-9	4,595,540	4,578,910	1.004
10-14	4,169,881	4,168,449	1.000
15-19	3,527,724	3,540,070	0.997
20-24	2,579,076	2,591,814	0.995
25-29	1,260,796	1,265,356	0.996
30-34	492,302	494,714	0.995
35 & Over	226,210	228,492	0.990
TOTAL	\$22,350,943	\$22,358,879	1.000

PUBLIC EMPLOYEES' RETIREMENT SYSTEM

OTHER ASSUMPTIONS

DEFERRED VESTEDS: Currently, the valuation assumes 60% of participants that leave the System as deferred vested will receive a deferred benefit upon attaining the eligibility requirements for retirement. During the last two investigation periods, the plan experienced an estimated 57% and 62% assumption, respectively. **Therefore, we believe the 60% assumption is very close to actual experience and recommend no change at this time.**

LINE OF DUTY DEATH ASSUMPTION: Currently, it is assumed that 6% of active member deaths are in the line of duty and 94% of active member deaths are not in the line of duty. During the last four years of this experience investigation period, approximately 2.7% of the active member deaths were in the line of duty. For the previous four-year period (from 2012 to 2016), the approximate rate was 5.7%. **We definitely see a downward trend in this experience and, therefore, recommend a change in this assumption to 4% at this time.**

LINE OF DUTY DISABILITY ASSUMPTION: Currently, it is assumed that 9% of active member disabilities are in the line of duty and 91% of active member disabilities are not in the line of duty. During the experience investigation period, an average of about 14% of disabilities each year were in the line of duty. During the last experience study, the average for the period was 11%. **Therefore, we recommend that the assumption be increased so that 12% of active member disabilities are assumed to be in the line of duty and 88% of active member disabilities are assumed to be not in the line of duty.**

PERCENT MARRIED: Currently, 85% of active members are assumed to be married and elect a joint & survivor payment form. We are not provided with marital status on the census data. **However, we believe the current assumption is fairly conservative and recommend no change at this time.**

SPOUSE AGE DIFFERENCE: Currently, for married members, it is assumed a male is three years older than his spouse. **We have reviewed this assumption and recommend no change at this time.**

UNUSED LEAVE: Currently, we assume that participants will have on average 0.50 years of unused leave (sick and personal) at retirement. We reviewed this assumption for those participants who retired during this four-year period and the average number of years of unused leave was 0.55 years. **We recommend no change at this time.**



Section IV – Demographic Assumptions

FINAL AVERAGE COMPENSATION: We compared the actual final average compensation used to determine retiree benefits with the compensation predicted by our pension software. Based on our findings, **we recommend a continuation of the 0.25% load on the final average compensation produced by our valuation software.**

MILITARY SERVICE: Currently, we assume that participants will have on average 0.25 years of military service at retirement. We reviewed this assumption for those participants who retired during this four-year period and the average number of years of military service was 0.22 years. **Therefore, we recommend no change at this time.**

ASSUMED INTEREST RATE ON EMPLOYEE CONTRIBUTIONS: 2.00%

OTHER ASSUMPTION LOADS: Varying loads for pre-retirement dependent children option and for disability dependent child's options.

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

HIGHWAY SAFETY PATROL RETIREMENT SYSTEM

SUMMARY OF RESULTS

Over the period of this investigation, we have noted the following observations:

- There were 39 actual withdrawals versus 35 expected withdrawals over the four-year period of this investigation. In the prior investigation, the number of actual withdrawals was approximately the same as the number of expected withdrawals and no change was made to the rates of withdrawal. **At this time, we recommend slight changes in the rates of withdrawal to better match experience.**
- There were 75 actual retirements versus 102 expected retirements over the four-year period of this investigation. In the prior investigation, we experience similar results. Although there are numerous members eligible to retire as of the 2020 valuation, **we recommend a change in the retirement decrements to better match experience. One of those recommendations is an extension of fixed retirement from age 60 to age 63 as more and more officers are working past age 60.**
- There were no deaths while in active service over the four-year period of this investigation and there was one death in the prior study. **We recommend updating the pre-retirement mortality assumption to be consistent with our change to PERS.**
- There were no disability retirements over the four-year period of this investigation compared to one in the prior study. **We recommend a decrease in the rates of disability at this time.**



Section V – HSPRS Summary of Results

- Actual rates of salary increase were higher than expected over the four-year period, but this was only during the last year of the period. **Since we are recommending a decrease in the wage inflation assumption from 3.00% to 2.65%, we are recommending that merit salary increases be increased by 0.35% to maintain the current total salary increase assumption.**
- Since the HSPRS does not have enough mortality data by itself to warrant credible data, we recommend that each of the Systems have the same mortality table. As mentioned in the PERS section of this report, we recommend that the rates of mortality for post-retirements be revised to match the PERS mortality tables as outlined in below:

Service Retirees*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubS.H-2010(B) Retiree	Male: 95% up to age 60, 110% for ages 61 to 75, and 101% for ages above 77 Female: 84% up to age 72, 100% for ages above 76	MP-2020

Contingent Annuitants*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubS.H-2010(B) Contingent Annuitant	Male: 97% for all ages Female: 110% for all ages	MP-2020

Disabled Retirees*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubG.H-2010 Disabled	Male: 134% for all ages Female: 121% for all ages	MP-2020

* Please note that none of the recommended tables have any setbacks or setforwards.

SUPPLEMENTAL LEGISLATIVE RETIREMENT PLAN

SUMMARY OF RESULTS

Over the period of this investigation, we have noted the following observations:

- During the four-year period of the investigation, there were 21 actual withdrawals and we expected 20 withdrawals. This would appear that our current assumptions are correct. However, when we reviewed the withdrawal rates for both non-election years and election years separately, we found differences. The actual number of withdrawals during non-election years was 8 (versus none expected) and during election years, it was 14 (versus 20 expected). **Therefore, we recommend changes in the rates of withdrawal for both election and non-election years to better match experience.**
- We also reviewed the service retirements rates for both non-election years and election years and saw similar results. There were 11 actual service retirements (versus none expected) during non-election years and 22 actual service retirements (versus 25 expected) during election years. **Therefore, we recommend a small change in the rates of retirements during non-election years and no change in the retirement rates during election years.**
- There were no deaths while in active service over the four-year period of this investigation compared with 3 expected. **We recommend updating the mortality assumption to be consistent with our change to PERS.**
- There were no disability retirements over the four-year period of this investigation. In fact, there were no disability retirements during the prior four-year period as well. However, the current rates for disability are extremely low, so therefore, **we recommend no change at this time.**



Section VI – SLRP Summary of Results

- Actual salary increases were about 97% of what was expected. In conjunction with the recommended decrease in the wage inflation assumption, **we recommend that the salary scale be reduced to 2.65% for all ages.**
- Since the SLRP does not have enough mortality data by itself to warrant credible data, we recommend that each of the Systems have the same mortality table. As mentioned in the PERS section of this report, we recommend that the rates of mortality for post-retirements be revised to match the PERS mortality tables as outlined in below:

Service Retirees*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubS.H-2010(B) Retiree	Male: 95% up to age 60, 110% for ages 61 to 75, and 101% for ages above 77 Female: 84% up to age 72, 100% for ages above 76	MP-2020

Contingent Annuitants*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubS.H-2010(B) Contingent Annuitant	Male: 97% for all ages Female: 110% for all ages	MP-2020

Disabled Retirees*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubG.H-2010 Disabled	Male: 134% for all ages Female: 121% for all ages	MP-2020

* Please note that none of the recommended tables have any setbacks or setforwards.

MUNICIPAL RETIREMENT SYSTEMS

SUMMARY OF RESULTS

Since this is a closed System with very few actives remaining, we have not investigated the active decrements, but have concentrated on the post-retirement mortality experience. Over the period of this investigation, we have found the following observations:

- Since the MRS does not have enough mortality data by itself to warrant credible data, we recommend that each of the Systems have the same mortality table. As mentioned in the PERS section of this report, we recommend that the rates of mortality for post-retirements be revised to match the PERS mortality tables as outlined in below:

Service Retirees*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubS.H-2010(B) Retiree	Male: 95% up to age 60, 110% for ages 61 to 75, and 101% for ages above 77 Female: 84% up to age 72, 100% for ages above 76	MP-2020

Contingent Annuitants*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubS.H-2010(B) Contingent Annuitant	Male: 97% for all ages Female: 110% for all ages	MP-2020

Disabled Retirees*

<u>Membership Table</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
PubG.H-2010 Disabled	Male: 134% for all ages Female: 121% for all ages	MP-2020

* Please note that none of the recommended tables have any setbacks or setforwards.



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



**Callan's Capital Market Assumptions and
PERS' Board of Trustees Asset Allocation**

Geometric Real Rates of Return and Standard Deviations by Asset Class

Asset Class	Expected Real Rate of Return	Standard Deviation
Domestic Equity	4.60%	17.95%
International Equity	4.50	19.90
Global Equity	4.80	20.70
Fixed Income	(0.25)	3.75
Real Estate	3.75	14.10
Private Equity	6.00	27.80
Cash Equivalents	(1.00)	0.90

Asset Allocation Targets

Asset Class	Asset Allocation
Domestic Equity	28.24%
International Equity	22.58
Global Equity	12.09
Fixed Income	18.24
Real Estate	8.67
Private Equity	9.40
Cash Equivalents	0.78



Appendix C – Social Security Administration Wage Index

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



TABLE 1(a)
PUBLIC EMPLOYEES' RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE – MALES

AGE	RATES OF DEATH*	RATES OF DISABILITY	RATES OF RETIREMENT	
			LESS THAN 25 YRS OF SERVICE**	25 OR MORE YEARS OF SERVICE**
20	0.000483	0.00006		
21	0.000515	0.00007		
22	0.000536	0.00008		
23	0.000546	0.00009		
24	0.000557	0.00010		
25	0.000567	0.00011		
26	0.000578	0.00012		
27	0.000588	0.00013		
28	0.000609	0.00014		
29	0.000620	0.00015		
30	0.000630	0.00016		
31	0.000651	0.00017		
32	0.000662	0.00018		
33	0.000683	0.00019		
34	0.000693	0.00020		
35	0.000714	0.00020		
36	0.000746	0.00034		
37	0.000767	0.00048		
38	0.000809	0.00062		
39	0.000840	0.00076		
40	0.000893	0.00090		0.2500
41	0.000935	0.00106		0.2500
42	0.000997	0.00122		0.2500
43	0.001061	0.00138		0.2500
44	0.001134	0.00154		0.2500
45	0.001218	0.00170		0.2500
46	0.001302	0.00188		0.2500
47	0.001407	0.00206		0.2500
48	0.001512	0.00224		0.1900
49	0.001638	0.00242		0.1900
50	0.001764	0.00260		0.1900
51	0.001901	0.00282		0.1900
52	0.002058	0.00304		0.1900
53	0.002216	0.00350		0.1750
54	0.002394	0.00370		0.1750
55	0.002594	0.00370		0.1800
56	0.002804	0.00370		0.1900
57	0.003045	0.00365		0.1800
58	0.003329	0.00350		0.1700
59	0.003633	0.00330		0.1600
60	0.003980	0.00310	0.1125	0.1900
61	0.004358	0.00300	0.1050	0.2100
62	0.004788	0.00300	0.2100	0.2900
63	0.005261	0.00300	0.1700	0.2300
64	0.005775	0.00290	0.1525	0.2300
65	0.006353	0.00280	0.2550	0.3200
66	0.007172	0.00200	0.2350	0.3200
67	0.008096	0.00200	0.2000	0.2500
68	0.009146	0.00200	0.2000	0.2600
69	0.010322	0.00200	0.1950	0.2600
70	0.011655	0.00200	0.1950	0.2600
71	0.013157	0.00200	0.1950	0.2600
72	0.014858	0.00200	0.1950	0.2200
73	0.016779	0.00200	0.1900	0.2000
74	0.018942	0.00200	0.1900	0.2000
75	0.021389	0.00200	0.2200	0.2400
76	0.024150	0.00200	0.2200	0.2400
77	0.027258	0.00200	0.2200	0.2400
78	0.030776	0.00200	0.2200	0.2400
79	0.034755	0.00200	0.2200	0.2400
80	0.039239	0.00000	1.0000	1.0000

* Adjusted Base rates

**For Tier 4 members, 30 years of service.

Appendix D – Recommended Rates

TABLE 1(b)
PUBLIC EMPLOYEES' RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE – MALES (continued)

RATES OF WITHDRAWAL - MALES*																										
AGE	SERVICE																									
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>=25
15	0.4000	0.3500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.4000	0.3500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.4000	0.3500	0.2800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	0.4000	0.3500	0.2800	0.2800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	0.4000	0.3500	0.2800	0.2800	0.1800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.4000	0.3500	0.2800	0.2800	0.1800	0.1300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	0.4000	0.3500	0.2800	0.2800	0.1800	0.1300	0.1250	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.4000	0.3500	0.2800	0.2800	0.1800	0.1300	0.1250	0.0800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.3450	0.2550	0.2100	0.1750	0.1600	0.1300	0.1250	0.0800	0.0800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	0.3450	0.2550	0.2100	0.1750	0.1600	0.1300	0.1250	0.0800	0.0800	0.0800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	0.3450	0.2550	0.2100	0.1750	0.1600	0.1300	0.1250	0.0800	0.0800	0.0800	0.0900	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	0.3450	0.2550	0.2100	0.1750	0.1600	0.1300	0.1250	0.0800	0.0800	0.0800	0.0900	0.0650	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	0.3450	0.2550	0.2100	0.1750	0.1600	0.1300	0.1250	0.0800	0.0800	0.0800	0.0900	0.0650	0.0600	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	0.3400	0.2500	0.2000	0.1500	0.1300	0.1200	0.1050	0.0800	0.0800	0.0800	0.0650	0.0650	0.0600	0.0550	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	0.3400	0.2500	0.2000	0.1500	0.1300	0.1200	0.1050	0.0800	0.0800	0.0800	0.0650	0.0650	0.0600	0.0550	0.0550	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	0.3400	0.2500	0.2000	0.1500	0.1300	0.1200	0.1050	0.0800	0.0800	0.0800	0.0650	0.0650	0.0600	0.0550	0.0550	0.0500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31	0.3400	0.2500	0.2000	0.1500	0.1300	0.1200	0.1050	0.0800	0.0800	0.0800	0.0650	0.0650	0.0600	0.0550	0.0550	0.0500	0.0500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32	0.3400	0.2500	0.2000	0.1500	0.1300	0.1200	0.1050	0.0800	0.0800	0.0800	0.0650	0.0650	0.0600	0.0550	0.0550	0.0500	0.0500	0.0400	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
33	0.3375	0.2450	0.1900	0.1400	0.1250	0.1200	0.0950	0.0800	0.0750	0.0750	0.0650	0.0600	0.0550	0.0550	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
34	0.3375	0.2450	0.1900	0.1400	0.1250	0.1200	0.0950	0.0800	0.0750	0.0750	0.0650	0.0600	0.0550	0.0550	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
35	0.3375	0.2450	0.1900	0.1400	0.1250	0.1200	0.0950	0.0800	0.0750	0.0750	0.0650	0.0600	0.0550	0.0550	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000	0.0000	0.0000	0.0000	0.0000
36	0.3375	0.2450	0.1900	0.1400	0.1250	0.1200	0.0950	0.0800	0.0750	0.0750	0.0650	0.0600	0.0550	0.0550	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000	0.0000	0.0000	0.0000
37	0.3375	0.2450	0.1900	0.1400	0.1250	0.1200	0.0950	0.0800	0.0750	0.0750	0.0650	0.0600	0.0550	0.0550	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000	0.0000	0.0000
38	0.3350	0.2400	0.1700	0.1300	0.1150	0.0950	0.0800	0.0800	0.0750	0.0750	0.0600	0.0550	0.0500	0.0550	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000	0.0000
39	0.3350	0.2400	0.1700	0.1300	0.1150	0.0950	0.0800	0.0800	0.0750	0.0750	0.0600	0.0550	0.0500	0.0550	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000
40	0.3350	0.2400	0.1700	0.1300	0.1150	0.0950	0.0800	0.0800	0.0750	0.0750	0.0600	0.0550	0.0500	0.0550	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000
41	0.3350	0.2400	0.1700	0.1300	0.1150	0.0950	0.0800	0.0800	0.0750	0.0750	0.0600	0.0550	0.0500	0.0550	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000
42	0.3350	0.2400	0.1700	0.1300	0.1150	0.0950	0.0800	0.0800	0.0750	0.0750	0.0600	0.0550	0.0500	0.0550	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000
43-47	0.3200	0.2350	0.1700	0.1150	0.1100	0.0950	0.0800	0.0750	0.0750	0.0600	0.0550	0.0525	0.0500	0.0450	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000
48-52	0.2800	0.2000	0.1500	0.1150	0.1100	0.0950	0.0750	0.0750	0.0700	0.0600	0.0550	0.0525	0.0475	0.0450	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000
53-79	0.2500	0.1900	0.1400	0.1150	0.1100	0.0950	0.0750	0.0750	0.0700	0.0600	0.0550	0.0500	0.0450	0.0450	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0400	0.0000
80	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

*Rates stop at eligibility for retirement. For Tier 4, rates at 24 years of service are extended out to 29 years of service.



TABLE 2(a)
PUBLIC EMPLOYEES' RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE – FEMALES

AGE	RATES OF DEATH*	RATES OF DISABILITY	RATES OF RETIREMENT	
			LESS THAN 25 YRS OF SERVICE**	25 OR MORE YEARS OF SERVICE**
20	0.000126	0.00006		
21	0.000140	0.00007		
22	0.000154	0.00008		
23	0.000161	0.00009		
24	0.000175	0.00010		
25	0.000189	0.00011		
26	0.000203	0.00012		
27	0.000210	0.00013		
28	0.000224	0.00014		
29	0.000238	0.00015		
30	0.000259	0.00016		
31	0.000273	0.00017		
32	0.000287	0.00018		
33	0.000308	0.00019		
34	0.000329	0.00020		
35	0.000350	0.00020		
36	0.000371	0.00026		
37	0.000399	0.00032		
38	0.000420	0.00038		
39	0.000448	0.00044		
40	0.000483	0.00050		0.2100
41	0.000511	0.00060		0.2100
42	0.000546	0.00070		0.2100
43	0.000581	0.00080		0.2100
44	0.000623	0.00090		0.2100
45	0.000665	0.00100		0.2100
46	0.000707	0.00114		0.2100
47	0.000756	0.00128		0.2100
48	0.000805	0.00142		0.1450
49	0.000861	0.00156		0.1450
50	0.000917	0.00170		0.1450
51	0.000980	0.00194		0.1450
52	0.001043	0.00218		0.1500
53	0.001113	0.00260		0.1675
54	0.001190	0.00290		0.1675
55	0.001274	0.00290		0.1975
56	0.001358	0.00290		0.1950
57	0.001449	0.00290		0.1975
58	0.001540	0.00270		0.1975
59	0.001645	0.00260		0.2150
60	0.001757	0.00250	0.1325	0.2150
61	0.001876	0.00240	0.1100	0.2500
62	0.002002	0.00240	0.1875	0.3400
63	0.002135	0.00240	0.1825	0.3050
64	0.002275	0.00230	0.1800	0.3100
65	0.002429	0.00220	0.3000	0.4225
66	0.002779	0.00150	0.2850	0.3850
67	0.003171	0.00150	0.2400	0.3350
68	0.003626	0.00150	0.2100	0.2750
69	0.004144	0.00150	0.2150	0.2850
70	0.004739	0.00150	0.2300	0.3000
71	0.005418	0.00150	0.2000	0.3000
72	0.006195	0.00150	0.2200	0.2500
73	0.007077	0.00150	0.1850	0.2500
74	0.008092	0.00150	0.2100	0.2500
75	0.009247	0.00150	0.2150	0.2500
76	0.010570	0.00150	0.2150	0.2500
77	0.012082	0.00150	0.2150	0.2500
78	0.013811	0.00150	0.2150	0.2500
79	0.015785	0.00150	0.2150	0.2500
80	0.018046	0.00000	1.0000	1.0000

*Adjusted Base Rates

**For Tier 4 members, 30 years of service.

Appendix D – Recommended Rates

TABLE 2(b)
PUBLIC EMPLOYEES' RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE – FEMALES (Continued)

RATES OF WITHDRAWAL - FEMALES*																										
AGE	SERVICE																									
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>=25
15	0.4500	0.4000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.4500	0.4000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.4500	0.4000	0.3200	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	0.4500	0.4000	0.3200	0.2700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	0.4500	0.4000	0.3200	0.2700	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.4500	0.4000	0.3200	0.2700	0.2000	0.1400	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	0.4500	0.4000	0.3200	0.2700	0.2000	0.1400	0.1250	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.4500	0.4000	0.3200	0.2700	0.2000	0.1400	0.1250	0.0950	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.3700	0.2750	0.2200	0.1800	0.1750	0.1250	0.1250	0.0950	0.0850	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	0.3700	0.2750	0.2200	0.1800	0.1750	0.1250	0.1250	0.0950	0.0850	0.0800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	0.3700	0.2750	0.2200	0.1800	0.1750	0.1250	0.1250	0.0950	0.0850	0.0800	0.0900	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	0.3700	0.2750	0.2200	0.1800	0.1750	0.1250	0.1250	0.0950	0.0850	0.0800	0.0900	0.0650	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	0.3700	0.2750	0.2200	0.1800	0.1750	0.1250	0.1250	0.0950	0.0850	0.0800	0.0900	0.0650	0.0600	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	0.3500	0.2650	0.2000	0.1500	0.1300	0.1250	0.1050	0.0800	0.0750	0.0750	0.0650	0.0650	0.0600	0.0550	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	0.3500	0.2650	0.2000	0.1500	0.1300	0.1250	0.1050	0.0800	0.0750	0.0750	0.0650	0.0650	0.0600	0.0550	0.0550	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	0.3500	0.2650	0.2000	0.1500	0.1300	0.1250	0.1050	0.0800	0.0750	0.0750	0.0650	0.0650	0.0600	0.0550	0.0550	0.0500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31	0.3500	0.2650	0.2000	0.1500	0.1300	0.1250	0.1050	0.0800	0.0750	0.0750	0.0650	0.0650	0.0600	0.0550	0.0550	0.0500	0.0450	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32	0.3500	0.2650	0.2000	0.1500	0.1300	0.1250	0.1050	0.0800	0.0750	0.0750	0.0650	0.0650	0.0600	0.0550	0.0550	0.0500	0.0450	0.0400	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
33	0.3000	0.2400	0.1875	0.1375	0.1000	0.1200	0.0950	0.0800	0.0750	0.0750	0.0625	0.0600	0.0550	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
34	0.3000	0.2400	0.1875	0.1375	0.1000	0.1200	0.0950	0.0800	0.0750	0.0750	0.0625	0.0600	0.0550	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
35	0.3000	0.2400	0.1875	0.1375	0.1000	0.1200	0.0950	0.0800	0.0750	0.0750	0.0625	0.0600	0.0550	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0350	0.0000	0.0000	0.0000	0.0000	0.0000
36	0.3000	0.2400	0.1875	0.1375	0.1000	0.1200	0.0950	0.0800	0.0750	0.0750	0.0625	0.0600	0.0550	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0350	0.0350	0.0000	0.0000	0.0000	0.0000
37	0.3000	0.2400	0.1875	0.1375	0.1000	0.1200	0.0950	0.0800	0.0750	0.0750	0.0625	0.0600	0.0550	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0350	0.0350	0.0350	0.0000	0.0000	0.0000
38	0.2800	0.2300	0.1675	0.1275	0.0800	0.0950	0.0900	0.0750	0.0750	0.0700	0.0600	0.0550	0.0500	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000	0.0000
39	0.2800	0.2300	0.1675	0.1275	0.0800	0.0950	0.0900	0.0750	0.0750	0.0700	0.0600	0.0550	0.0500	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
40	0.2800	0.2300	0.1675	0.1275	0.0800	0.0950	0.0900	0.0750	0.0750	0.0700	0.0600	0.0550	0.0500	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
41	0.2800	0.2300	0.1675	0.1275	0.0800	0.0950	0.0900	0.0750	0.0750	0.0700	0.0600	0.0550	0.0500	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
42	0.2800	0.2300	0.1675	0.1275	0.0800	0.0950	0.0900	0.0750	0.0750	0.0700	0.0600	0.0550	0.0500	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
43-47	0.2750	0.2000	0.1675	0.1275	0.0650	0.0950	0.0800	0.0750	0.0750	0.0600	0.0575	0.0550	0.0500	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
48-52	0.2750	0.2000	0.1400	0.1275	0.0650	0.0950	0.0750	0.0750	0.0700	0.0600	0.0575	0.0550	0.0475	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
53-79	0.2500	0.1900	0.1400	0.1275	0.0650	0.0950	0.0750	0.0750	0.0700	0.0600	0.0575	0.0550	0.0450	0.0450	0.0450	0.0425	0.0425	0.0400	0.0375	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
80	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

*Rates stop at eligibility for retirement. For Tier 4, rates at 24 years of service are extended out to 29 years of service.

TABLE 3

**HIGHWAY SAFETY PATROL RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE**

AGE	RATES OF WITHDRAWAL		RATES OF DEATH* MALES	RATES OF DEATH* FEMALES	RATES OF DISABILITY	SERVICE	RATES OF RETIREMENT**
	Less than 20 Years of Service	20 or More Years of Service					
20	0.10000	0.05000	0.000483	0.000126	0.000338	0	0.000
21	0.10000	0.05000	0.000515	0.000140	0.000338	1	0.000
22	0.10000	0.05000	0.000536	0.000154	0.000338	2	0.000
23	0.10000	0.05000	0.000546	0.000161	0.000383	3	0.000
24	0.08500	0.04250	0.000557	0.000175	0.000383	4	0.000
25	0.07000	0.03500	0.000567	0.000189	0.000383	5	0.075
26	0.05000	0.02500	0.000578	0.000203	0.000383	6	0.075
27	0.04500	0.02250	0.000588	0.000210	0.000450	7	0.075
28	0.04500	0.02250	0.000609	0.000224	0.000450	8	0.075
29	0.04250	0.02125	0.000620	0.000238	0.000473	9	0.075
30	0.04000	0.02000	0.000630	0.000259	0.000518	10	0.075
31	0.03750	0.01875	0.000651	0.000273	0.000540	11	0.075
32	0.03500	0.01750	0.000662	0.000287	0.000608	12	0.075
33	0.03250	0.01625	0.000683	0.000308	0.000675	13	0.075
34	0.03000	0.01500	0.000693	0.000329	0.000698	14	0.075
35	0.02750	0.01375	0.000714	0.000350	0.000765	15	0.075
36	0.02500	0.01250	0.000746	0.000371	0.000788	16	0.075
37	0.02250	0.01125	0.000767	0.000399	0.000855	17	0.075
38	0.02000	0.01000	0.000809	0.000420	0.000900	18	0.075
39	0.02000	0.01000	0.000840	0.000448	0.000945	19	0.075
40	0.02000	0.01000	0.000893	0.000483	0.001013	20	0.075
41	0.02000	0.01000	0.000935	0.000511	0.001058	21	0.100
42	0.02000	0.01000	0.000998	0.000546	0.001148	22	0.100
43	0.02000	0.01000	0.001061	0.000581	0.001193	23	0.100
44	0.02000	0.01000	0.001134	0.000623	0.001283	24	0.100
45	0.02000	0.01000	0.001218	0.000665	0.001350	25	0.200
46	0.02000	0.01000	0.001302	0.000707	0.001485	26	0.100
47	0.02000	0.01000	0.001407	0.000756	0.001620	27	0.100
48	0.02000	0.01000	0.001512	0.000805	0.001733	28	0.150
49	0.02000	0.01000	0.001638	0.000861	0.001913	29	0.150
50	0.02000	0.01000	0.001764	0.000917	0.002070	30	0.150
51	0.00500	0.00250	0.001901	0.000980	0.002273	31	0.350
52	0.00500	0.00250	0.002058	0.001043	0.002520	32	0.350
53	0.00500	0.00250	0.002216	0.001113	0.002813	33	0.350
54	0.00500	0.00250	0.002394	0.001190	0.003083	34	0.350
55	0.00000	0.00000	0.002594	0.001274	0.003488	35	0.350
56			0.002804	0.001358	0.004005	36	0.350
57			0.003045	0.001449	0.004500	37	0.500
58			0.003329	0.001540	0.005085	38	0.500
59			0.003633	0.001645	0.005828	39	0.500
60			0.003980	0.001757	0.005828	40+	1.000
61			0.004358	0.001876	0.000000		

*Adjusted Base Rates

**The annual rate of service retirement is 100% at age 63.

TABLE 4
SUPPLEMENTAL LEGISLATIVE RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE

AGE	ADJUSTED BASE RATES OF DEATH		RATES OF DISABILITY
	MALES	FEMALES	
20	0.000483	0.000126	0.0004
21	0.000515	0.000140	0.0004
22	0.000536	0.000154	0.0005
23	0.000546	0.000161	0.0005
24	0.000557	0.000175	0.0005
25	0.000567	0.000189	0.0005
26	0.000578	0.000203	0.0006
27	0.000588	0.000210	0.0006
28	0.000609	0.000224	0.0007
29	0.000620	0.000238	0.0007
30	0.000630	0.000259	0.0007
31	0.000651	0.000273	0.0008
32	0.000662	0.000287	0.0009
33	0.000683	0.000308	0.0010
34	0.000693	0.000329	0.0011
35	0.000714	0.000350	0.0011
36	0.000746	0.000371	0.0012
37	0.000767	0.000399	0.0013
38	0.000809	0.000420	0.0014
39	0.000840	0.000448	0.0016
40	0.000893	0.000483	0.0017
41	0.000935	0.000511	0.0018
42	0.000998	0.000546	0.0019
43	0.001061	0.000581	0.0021
44	0.001134	0.000623	0.0022
45	0.001218	0.000665	0.0023
46	0.001302	0.000707	0.0025
47	0.001407	0.000756	0.0026
48	0.001512	0.000805	0.0027
49	0.001638	0.000861	0.0028
50	0.001764	0.000917	0.0030
51	0.001901	0.000980	0.0031
52	0.002058	0.001043	0.0032
53	0.002216	0.001113	0.0033
54	0.002394	0.001190	0.0034
55	0.002594	0.001274	0.0035
56	0.002804	0.001358	0.0036
57	0.003045	0.001449	0.0037
58	0.003329	0.001540	0.0038
59	0.003633	0.001645	0.0039
60	0.003980	0.001757	0.0040
61	0.004358	0.001876	0.0041
62	0.004788	0.002002	0.0042
63	0.005261	0.002135	0.0044
64	0.005775	0.002275	0.0045
65	0.006353	0.002429	0.0000
66	0.007172	0.002779	0.0000
67	0.008096	0.003171	0.0000
68	0.009146	0.003626	0.0000
69	0.010322	0.004144	0.0000
70	0.011655	0.004739	0.0000
71	0.013157	0.005418	0.0000
72	0.014858	0.006195	0.0000
73	0.016779	0.007077	0.0000
74	0.018942	0.008092	0.0000
75	0.021389	0.009247	0.0000
76	0.024150	0.010570	0.0000
77	0.027258	0.012082	0.0000
78	0.030776	0.013811	0.0000
79	0.034755	0.015785	0.0000
80	0.039239	0.018046	0.0000

- Withdrawal and Vesting: 15% in an election year, 2% in a non-election year.
- Service Retirement: 30% in an election year, 2.5% in a non-election year. All members assumed to retire no later than age 80.

TABLE 5
RATES OF ANTICIPATED SALARY INCREASES*
(For Both Males and Females)

SERVICE	PERS	AGE	HSPRS	SLRP
0	0.1790	20	0.08564	0.0265
1	0.0790	21	0.08180	0.0265
2	0.0540	22	0.06780	0.0265
3	0.0440	23	0.06380	0.0265
4	0.0390	24	0.05948	0.0265
5	0.0340	25	0.05309	0.0265
6	0.0340	26	0.04990	0.0265
7	0.0340	27	0.04891	0.0265
8	0.0290	28	0.04493	0.0265
9	0.0290	29	0.04493	0.0265
10	0.0290	30	0.04493	0.0265
11	0.0290	31	0.04493	0.0265
12	0.0290	32	0.04493	0.0265
13	0.0290	33	0.04493	0.0265
14	0.0290	34	0.04493	0.0265
15	0.0290	35	0.04493	0.0265
16	0.0290	36	0.04493	0.0265
17	0.0290	37	0.04493	0.0265
18	0.0290	38	0.04493	0.0265
19	0.0290	39	0.04493	0.0265
20	0.0290	40	0.04493	0.0265
21	0.0290	41	0.04493	0.0265
22	0.0290	42	0.04493	0.0265
23	0.0290	43	0.03995	0.0265
24	0.0290	44	0.03995	0.0265
25	0.0290	45	0.03995	0.0265
26	0.0290	46	0.03995	0.0265
27	0.0290	47	0.03995	0.0265
28	0.0265	48	0.03498	0.0265
29	0.0265	49	0.03498	0.0265
30	0.0265	50	0.03498	0.0265
31	0.0265	51	0.03498	0.0265
32	0.0265	52	0.03498	0.0265
33	0.0265	53	0.03498	0.0265
34	0.0265	54	0.03498	0.0265
35	0.0265	55	0.03498	0.0265
36	0.0265	56	0.03498	0.0265
37	0.0265	57	0.03498	0.0265
38	0.0265	58	0.03498	0.0265
39	0.0265	59	0.03498	0.0265
40	0.0265	60	0.03000	0.0265
		61	0.03000	0.0265
		62	0.03000	0.0265
		63	0.03000	0.0265
		64	0.03000	0.0265
		65	0.03000	0.0265
		66	0.03000	0.0265
		67	0.03000	0.0265
		68	0.03000	0.0265
		69	0.03000	0.0265
		70	0.03000	0.0265
		71	0.03000	0.0265
		72	0.03000	0.0265
		73	0.03000	0.0265
		74	0.03000	0.0265
		75	0.03000	0.0265

* Includes wage inflation of 2.65%



TABLE 6

ALL SYSTEMS

BASE RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF SERVICE*

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.000409	0.000134	71	0.024431	0.014171
20	0.000437	0.000151	72	0.027467	0.015700
21	0.000466	0.000168	73	0.030833	0.018026
22	0.000485	0.000185	74	0.034507	0.020664
23	0.000494	0.000193	75	0.038566	0.023659
24	0.000504	0.000210	76	0.041901	0.027354
25	0.000513	0.000227	77	0.045531	0.031250
26	0.000523	0.000244	78	0.049520	0.034630
27	0.000532	0.000252	79	0.055631	0.038370
28	0.000551	0.000269	80	0.062640	0.042530
29	0.000561	0.000286	81	0.070589	0.047310
30	0.000570	0.000311	82	0.079447	0.052770
31	0.000589	0.000328	83	0.089153	0.058860
32	0.000599	0.000344	84	0.099586	0.065660
33	0.000618	0.000370	85	0.110605	0.073240
34	0.000627	0.000395	86	0.122220	0.081690
35	0.000646	0.000420	87	0.134512	0.091120
36	0.000675	0.000445	88	0.147601	0.101640
37	0.000694	0.000479	89	0.161661	0.113380
38	0.000732	0.000504	90	0.176902	0.126470
39	0.000760	0.000538	91	0.192435	0.140070
40	0.000808	0.000580	92	0.207797	0.153730
41	0.000846	0.000613	93	0.222846	0.167350
42	0.000903	0.000655	94	0.237693	0.182910
43	0.000960	0.000697	95	0.252611	0.199300
44	0.001026	0.000748	96	0.267973	0.216490
45	0.002983	0.000983	97	0.284133	0.234570
46	0.003221	0.001084	98	0.301374	0.253620
47	0.003458	0.001201	99	0.319796	0.273590
48	0.003705	0.001336	100	0.339269	0.294360
49	0.003952	0.001478	101	0.359328	0.315620
50	0.004190	0.001638	102	0.379063	0.336900
51	0.004389	0.001814	103	0.398344	0.358000
52	0.004579	0.002016	104	0.417029	0.378730
53	0.004760	0.002226	105	0.434997	0.398920
54	0.004950	0.002470	106	0.452157	0.418410
55	0.005197	0.002738	107	0.468428	0.437060
56	0.005501	0.003032	108	0.483750	0.454770
57	0.005919	0.003360	109	0.498102	0.471450
58	0.006451	0.003730	110	0.505000	0.487050
59	0.007068	0.004133	111	0.505000	0.500000
60	0.007771	0.004578	112	0.505000	0.500000
61	0.009867	0.005074	113	0.505000	0.500000
62	0.010725	0.005620	114	0.505000	0.500000
63	0.011561	0.006233	115	0.505000	0.500000
64	0.012375	0.006905	116	0.505000	0.500000
65	0.013211	0.007652	117	0.505000	0.500000
66	0.014399	0.008476	118	0.505000	0.500000
67	0.015785	0.009391	119	0.505000	0.500000
68	0.017446	0.010408	120	1.000000	1.000000
69	0.019437	0.011542			
70	0.021758	0.012785			

*Adjusted Base Rates



TABLE 7

ALL SYSTEMS

BASE RATES OF MORTALITY FOR BENEFICIARIES OF DECEASED MEMBERS*

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.000417	0.000176	71	0.026248	0.021571
20	0.000446	0.000198	72	0.028615	0.023342
21	0.000475	0.000220	73	0.031244	0.025344
22	0.000495	0.000242	74	0.034105	0.027566
23	0.000504	0.000253	75	0.037209	0.030052
24	0.000514	0.000275	76	0.040575	0.032802
25	0.000524	0.000297	77	0.044222	0.035849
26	0.000534	0.000319	78	0.048219	0.039248
27	0.000543	0.000330	79	0.052671	0.043032
28	0.000563	0.000352	80	0.057734	0.047289
29	0.000572	0.000374	81	0.063351	0.052074
30	0.000582	0.000407	82	0.069568	0.057486
31	0.000601	0.000429	83	0.076417	0.063613
32	0.000611	0.000451	84	0.083963	0.070587
33	0.000631	0.000484	85	0.092228	0.078562
34	0.000640	0.000517	86	0.101258	0.087670
35	0.000660	0.000550	87	0.111104	0.097922
36	0.000689	0.000583	88	0.121813	0.109274
37	0.000708	0.000627	89	0.133424	0.121561
38	0.000747	0.000660	90	0.146577	0.134530
39	0.000776	0.000704	91	0.161728	0.148423
40	0.000825	0.000759	92	0.177510	0.163405
41	0.000863	0.000803	93	0.193573	0.179575
42	0.000922	0.000858	94	0.209801	0.196977
43	0.000980	0.000913	95	0.227484	0.215611
44	0.001048	0.000979	96	0.246787	0.235422
45	0.007692	0.005104	97	0.266517	0.256311
46	0.007779	0.005269	98	0.286422	0.278124
47	0.007886	0.005500	99	0.306248	0.300696
48	0.008032	0.005907	100	0.325833	0.323796
49	0.008235	0.006270	101	0.345097	0.347182
50	0.008837	0.006556	102	0.364051	0.370590
51	0.009070	0.006776	103	0.382568	0.393800
52	0.009312	0.007007	104	0.400513	0.416603
53	0.009555	0.007260	105	0.417769	0.438812
54	0.009816	0.007535	106	0.434250	0.460251
55	0.010156	0.007843	107	0.449876	0.480766
56	0.010534	0.008195	108	0.464591	0.500247
57	0.010932	0.008602	109	0.478375	0.518595
58	0.011378	0.009075	110	0.485000	0.535755
59	0.011863	0.009581	111	0.485000	0.550000
60	0.012397	0.010131	112	0.485000	0.550000
61	0.012998	0.010780	113	0.485000	0.550000
62	0.013677	0.011528	114	0.485000	0.550000
63	0.014434	0.012353	115	0.485000	0.550000
64	0.015297	0.013233	116	0.485000	0.550000
65	0.016286	0.014157	117	0.485000	0.550000
66	0.017518	0.015169	118	0.485000	0.550000
67	0.018925	0.016236	119	0.485000	0.550000
68	0.020486	0.017369	120	1.000000	1.000000
69	0.022232	0.018612			
70	0.024153	0.019998			

*Adjusted Base Rates



TABLE 8
ALL SYSTEMS

BASE RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF DISABILITY*

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.005641	0.002965	71	0.061144	0.040438
20	0.005521	0.002819	72	0.064441	0.043028
21	0.005172	0.002602	73	0.068072	0.045895
22	0.004797	0.002347	74	0.072132	0.049102
23	0.004516	0.002154	75	0.076661	0.052683
24	0.004315	0.002093	76	0.081713	0.056676
25	0.004261	0.002142	77	0.087328	0.061117
26	0.004476	0.002323	78	0.093559	0.066078
27	0.004690	0.002529	79	0.100473	0.071608
28	0.004918	0.002759	80	0.108125	0.077779
29	0.005172	0.003001	81	0.116526	0.084615
30	0.005427	0.003267	82	0.125705	0.092202
31	0.005695	0.003545	83	0.135662	0.100587
32	0.005976	0.003848	84	0.146368	0.109808
33	0.006285	0.004175	85	0.157785	0.119947
34	0.006620	0.004538	86	0.169925	0.130571
35	0.006995	0.004925	87	0.182856	0.141461
36	0.007397	0.005360	88	0.196658	0.152508
37	0.007866	0.005820	89	0.211412	0.163761
38	0.008402	0.006340	90	0.227224	0.175353
39	0.009005	0.006945	91	0.244175	0.187490
40	0.009688	0.007611	92	0.264034	0.200412
41	0.010465	0.008337	93	0.285246	0.214388
42	0.011336	0.009123	94	0.306672	0.229670
43	0.012315	0.009983	95	0.328488	0.246513
44	0.013427	0.010914	96	0.350933	0.265051
45	0.014660	0.011919	97	0.374235	0.285391
46	0.016026	0.012983	98	0.398556	0.307497
47	0.017527	0.014121	99	0.423909	0.331201
48	0.019162	0.015331	100	0.450119	0.356176
49	0.020917	0.016613	101	0.476732	0.381900
50	0.022780	0.017956	102	0.502915	0.407649
51	0.024160	0.018574	103	0.528496	0.433180
52	0.025567	0.019203	104	0.553286	0.458263
53	0.027001	0.019844	105	0.577125	0.482693
54	0.028435	0.020473	106	0.599891	0.506276
55	0.029855	0.021078	107	0.621479	0.528843
56	0.031249	0.021732	108	0.641806	0.550272
57	0.032575	0.022433	109	0.660848	0.570455
58	0.033862	0.023147	110	0.670000	0.589331
59	0.035148	0.023898	111	0.670000	0.605000
60	0.036475	0.024684	112	0.670000	0.605000
61	0.037909	0.025531	113	0.670000	0.605000
62	0.039503	0.026439	114	0.670000	0.605000
63	0.041285	0.027443	115	0.670000	0.605000
64	0.043269	0.028532	116	0.670000	0.605000
65	0.045426	0.029730	117	0.670000	0.605000
66	0.047731	0.031061	118	0.670000	0.605000
67	0.050156	0.032549	119	0.670000	0.605000
68	0.052689	0.034207	120	1.000000	1.000000
69	0.055329	0.036058			
70	0.058129	0.038127			

*Adjusted Base Rates