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PERS
of MISSISSIPPI

State of Mississippi Retirement Systems
Experience Investigation for the
Four-Year Period
Ending June 30, 2016

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April 18, 2017

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, 2012 to June 30, 2016. 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 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.

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,

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President

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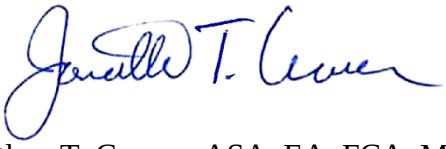
Principal and Consulting Actuary



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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, 2016. 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, 2017 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:

- **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 recent trends of inflation, the market pricing of inflation, and the Chief Actuary of the Social Security Administration's view of

inflation, **we are recommending a continuation of the price inflation assumption of 3.00%**. While some might argue that inflation may be lower in the future, we believe this approach is consistent with our desire to avoid overreacting. The Board lowered the price inflation in 2015 from 3.50% to 3.00% and we feel it is not necessary for another change so quickly.

We are also recommending that the long-term expected return on assets assumption continue at its current rate of 7.75%, reflecting the 3.00% inflation assumption. This will be discussed in detail later in this report, but the real rate of return of 4.75% is supported by the forecasting models developed using 35 sets of capital market assumptions included in the Horizon Actuarial Services, LLC. Survey conducted in 2016 and the Board's target asset allocation.

However, we are recommending that the general wage inflation (payroll growth) assumption be decreased from 3.75% to 3.25%, reflecting historical data that shows PERS continues to experience salary gains on the salary assumption and that the real wage growth in Mississippi has not kept up with the current assumption.

The following table summarizes the current and proposed economic assumptions:

Item	Current	Proposed
Price Inflation	3.00%	3.00%
Investment Return*	7.75%	7.75%
General Wage Inflation	3.75%	3.25%

* 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.

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 some future mortality improvement as part of the mortality assumption.

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

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

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

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

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

The current post-retirement healthy mortality assumption for PERS, which we changed in the 2014 experience study, is the RP-2014 Healthy Annuitant Blue Collar Mortality Table, projected with Scale BB to 2016, with a one year age set-forward for males. This is a static mortality table with margin. The results of the experience analysis indicate that this table provides a reasonable margin for future mortality improvements. In fact, the PERS plan experienced a very small gain due to post-retirement mortality for the 2016 valuation. So, therefore, **we are only recommending a slight adjustment to the current mortality table to accommodate a reasonable margin going forward.**

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

- **Retirement: Increased rates of retirement at younger ages once a member reaches 25 years of service. Minor adjustments at other ages to better match experience.**

- **Disability: Lowered rates of disability for most ages except between the ages of 60 and 64.**

- **Withdrawal: Increased rates of withdrawal at all ages, especially the younger ages and during select period (below 2 years of service).**

- **Merit Salary Scale: No change in merit salary scale.**

Section IV of this report will provide more detail to these recommended changes. Sections V-VII will 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 but do recommend the Board adjust their funding policy to develop an amortization method in order to determine a contribution metric to the fixed contribution rates for each System.

Other Assumptions

Another assumption that is included in the pension valuations is the determination of administrative expense component that is added to the total normal cost each year. The current assumption is 0.23% of payroll. After reviewing the total amount of administrative expenses for the past four years and the percentage of payroll, we are recommending no change in this assumption.

Financial Impact

The following tables highlight the impact of the recommended changes on the unfunded accrued liabilities (UAL), funding ratios, amortization period and projected funding ratios for each System.

Change in 2016 Valuation Unfunded Accrued Liability
($ in Thousands)

System	Before All Changes	After Demographic Changes Only	After All Changes
PERS	$ 16,812,435	$17,069,969	$16,816,332
HSPRS	169,207	171,882	169,034
SLRP	4,812	5,083	4,946
MRS	171,532	172,543	172,519

Change in 2016 Valuation Funding Ratio

System	Before All Changes	After Demographic Changes Only	After All Changes
PERS	60.0%	59.6%	60.0%
HSPRS	65.8%	65.4%	65.8%
SLRP	77.4%	76.4%	76.9%
MRS	48.1%	48.0%	48.0%

Change in 2016 Valuation UAL Amortization Period*

System	Before All Changes	After Demographic Changes Only	After All Changes
PERS	36.6	36.9	39.1
HSPRS	42.9	40.9	39.8
SLRP	22.6	27.7	25.9

* Statutory contribution rates kept constant.

Change in Projected Funding Ratio in 2042

System	Before All Changes	After Demographic Changes Only	After All Changes
PERS	62.6%	59.7%	56.7%
HSPRS	51.6%	50.1%	50.2%
SLRP	92.3%	79.8%	82.0%

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

- Price Inflation
- Investment Return
- Wage Inflation

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 was revised in September, 2013 and no longer includes the concept of a "best estimate range". Instead, the revised standard now requires that each economic assumption selected by the actuary should be reasonable which means it has the following characteristics:

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

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

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

Item	Current	Proposed
Price Inflation	3.00%	3.00%
Real Rate of Return*	4.75	4.75
Investment Return	7.75%	7.75%
Price Inflation	3.00%	3.00%
Real Wage Growth	0.75	0.25
Wage Inflation	3.75%	3.25%

* net of investment expenses.

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 3.00% per year.

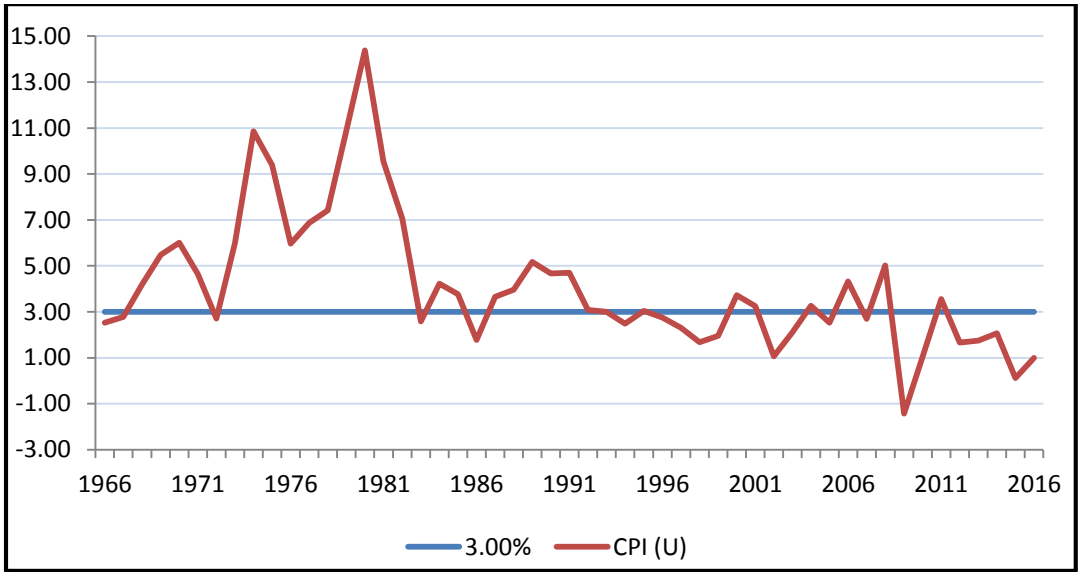
Past Experience

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 – 2016	90	2.92%	4.13%
1956 – 2016	60	3.70	2.87
1966 – 2016	50	4.10	2.97
1976 – 2016	40	3.68	2.93
1986 – 2016	30	2.66	1.48
1996 – 2016	20	2.18	1.48
2006 - 2016	10	1.74	1.79

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



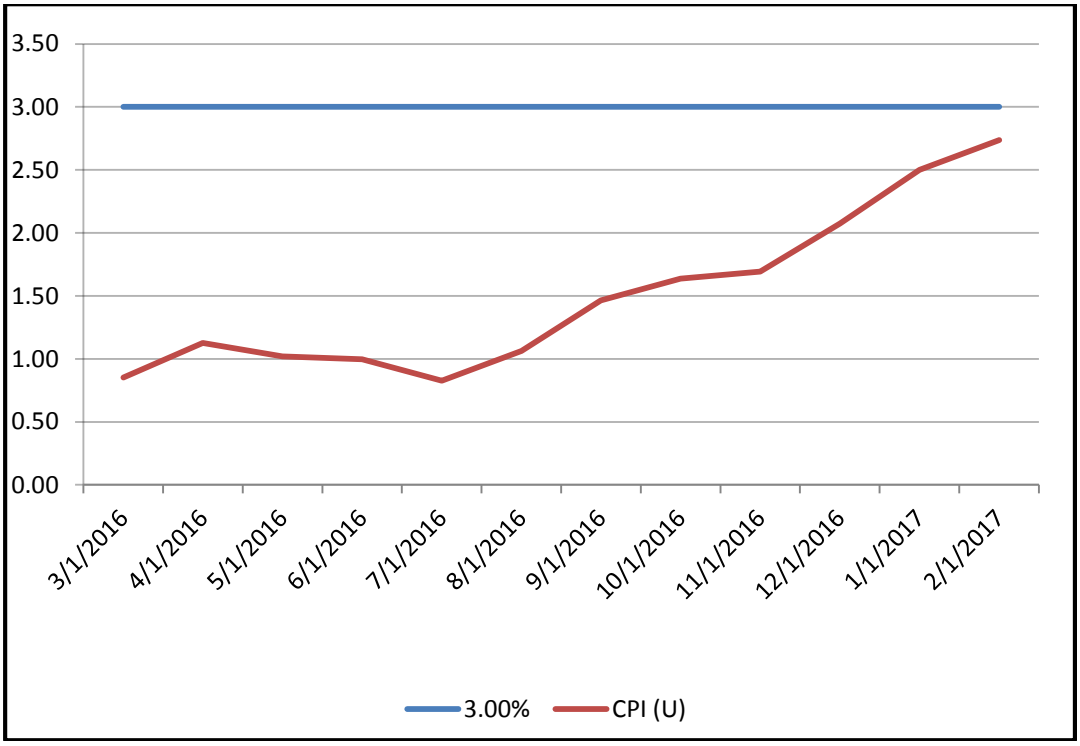
Over the last 30 years, the average annual rate of increase in the CPI-U has been below 3.00%. The period of high inflation from 1973 to 1982 has a significant impact on the averages over periods which include these rates. The volatility of the annual rates in the more recent years has been markedly lower as indicated by the significantly lower annual standard deviations. Many experts attribute the lower average annual rates and lower volatility to the increased efforts of the Federal Reserve since the early 1980's to stabilize price inflation.

Forecasts

Based upon information contained in the "Survey of Professional Forecasters" for the first quarter of 2017 as published by the Philadelphia Federal Reserve Bank, the median expected annual rate of inflation for the next ten years is 2.3%. 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 lower rates of inflation for the near term future.

Interestingly, the most recent inflation data shows an acceleration in the rate which is approaching the current assumption of 3.0%. This recent surge in the inflation rate supports the Federal Reserve forecast of multiple increases in the federal funds this year.

Month over Month Annual Inflation Rate
March 2016 through February 2017

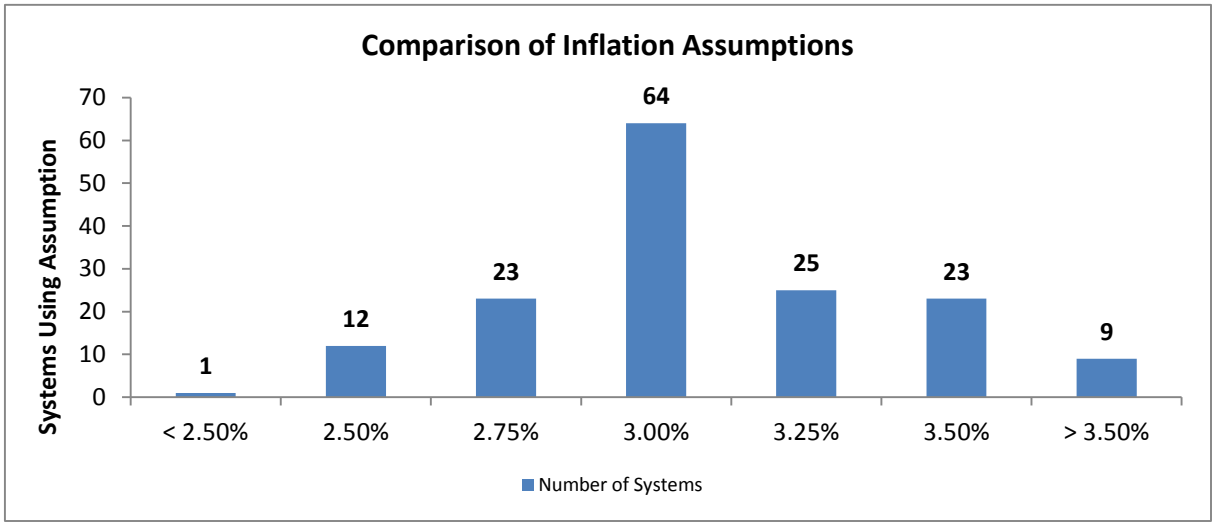


Social Security Administration

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 most recent report (June 2016), the projected ultimate average annual increase in the CPI over the next 75 years was estimated to be 2.60%, 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 2.00% to 3.20%.

Peer Comparison

While we do not recommend the selection of any assumption based on what other systems use, it does provide another set of relevant information to consider. The following chart shows the inflation rate assumptions of 157 plans in the Public Plan Database of the Center for Retirement Research. The assumptions are from the last actuarial valuation reported to the center (ranging from 6/30/2013 to 1/1/2015).



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 1.74% is lower than the System's assumed rate of 3.00%, the longer 50-year averages of 3.68% is somewhat higher than PERS' current rate. 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 2.00% to 3.20% to be reasonable and since the inflation assumption for PERS was lowered from 3.50% to 3.00% two years ago, we still view 3.00% as reasonable and recommend no change to the assumption at this time.

Price Inflation Assumption	
Current	3.00%
Recommended	3.00%

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 3.00% and a real rate of return assumption of 4.75%.

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.

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	Actual Market Value Returns
2012	1.60%	0.60%
2013	5.88	13.40
2014	13.88	18.60
2015	12.21	3.40
2016	7.19	1.15
Average	8.06%	7.19%

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 (35 were included in the 2016 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 from the fourth quarter of 2016 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 5.41%, but also has a high standard

deviation or measurement of volatility. By expanding the time horizon, the real return does not change, but the volatility declines significantly. The table below provides a summary of results.

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	5.41%	15.43%	-17.91%	-5.46%	4.30%	15.06%	32.52%
5	4.52%	6.81%	-6.30%	-0.18%	4.30%	8.98%	16.09%
10	4.41%	4.81%	-3.31%	1.11%	4.30%	7.59%	12.50%
20	4.35%	3.40%	-1.14%	2.03%	4.30%	6.61%	10.03%
30	4.33%	2.77%	-0.16%	2.44%	4.30%	6.18%	8.96%
40	4.32%	2.40%	0.42%	2.69%	4.30%	5.93%	8.32%
50	4.32%	2.15%	0.82%	2.86%	4.30%	5.76%	7.89%

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 -3.31% 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 2.86% and a 25% chance they will be above 5.76%. In other words, there is a 50% chance the real returns will be between 2.86% and 5.76%.

The results of our real return forward looking analysis of 4.30% at the 50th percentile match the real rate of return analysis as developed by Callan and presented to the Board in March, 2017. When we reviewed this analysis two years ago using Callan's then capital market assumptions, we developed a rate of 4.90% at the 50th percentile. This represents a 0.60% decrease in the expected portfolio return over a two-year period.

For a broader view of expected returns, we also reviewed the 2016 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. Using the current PERS target asset allocation, 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:

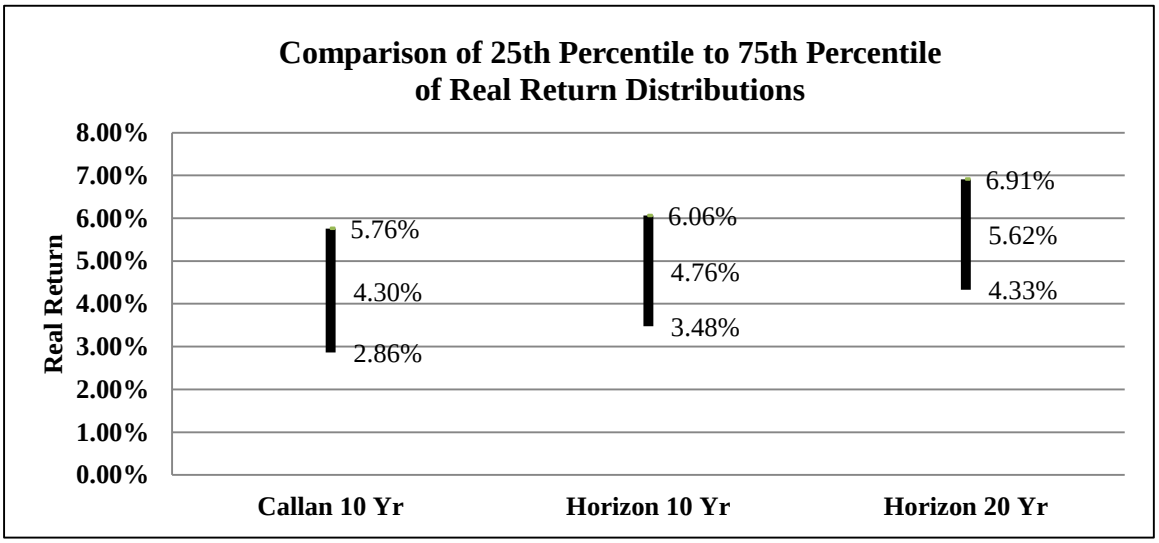
Mean Real Return Projection based on the PERS Asset Allocation and the Capital Market Assumptions from the 10-year Horizon Actuarial Services Survey

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	5.64%	13.70%	-15.29%	-3.98%	4.76%	14.30%	29.57%
5	4.94%	6.07%	-4.73%	0.76%	4.76%	8.93%	15.21%
10	4.85%	4.28%	-2.04%	1.92%	4.76%	7.69%	12.05%
20	4.81%	3.03%	-0.10%	2.74%	4.76%	6.83%	9.86%
30	4.79%	2.47%	0.78%	3.11%	4.76%	6.44%	8.91%
40	4.79%	2.14%	1.30%	3.33%	4.76%	6.22%	8.34%
50	4.78%	1.91%	1.66%	3.48%	4.76%	6.06%	7.96%

The results for the 20-year horizon are contained in the following table:

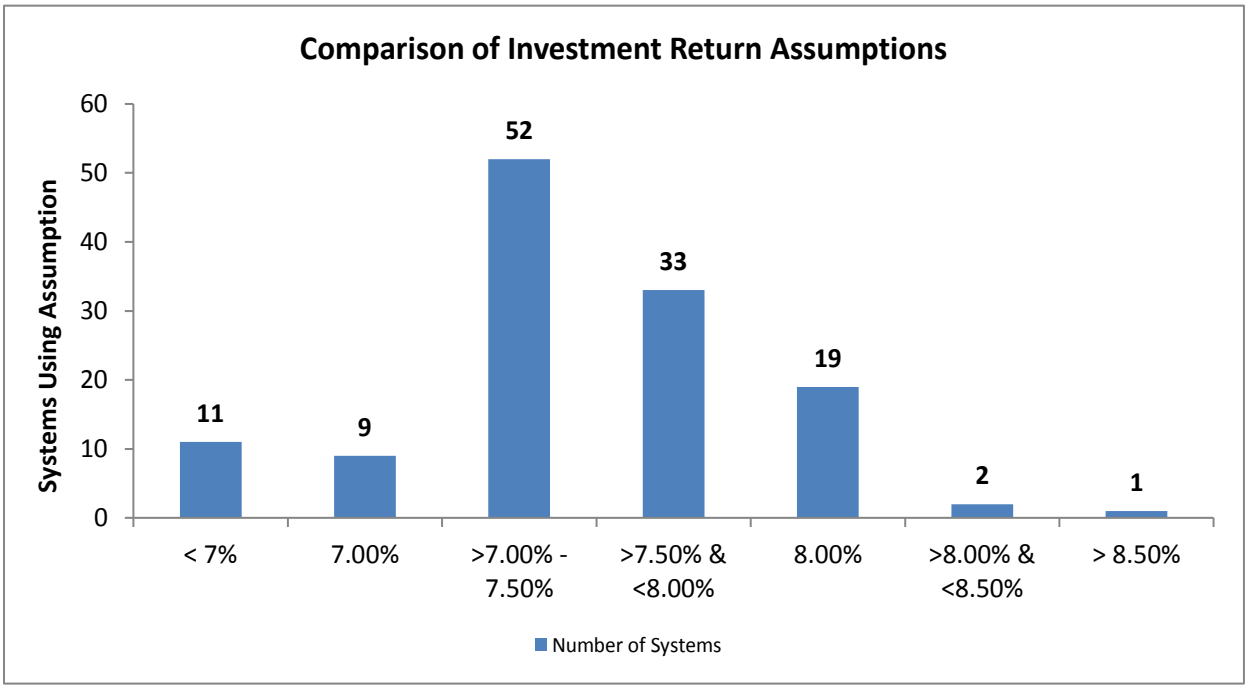
Mean Real Return Projection based on the PERS Asset Allocation and the Capital Market Assumptions from the 20-year Horizon Actuarial Services Survey

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	6.49%	13.70%	-14.46%	-3.13%	5.62%	15.15%	30.40%
5	5.79%	6.07%	-3.89%	1.61%	5.62%	9.78%	16.06%
10	5.70%	4.28%	-1.20%	2.77%	5.62%	8.54%	12.90%
20	5.66%	3.03%	0.75%	3.59%	5.62%	7.68%	10.71%
30	5.64%	2.47%	1.63%	3.96%	5.62%	7.30%	9.76%
40	5.64%	2.14%	2.15%	4.18%	5.62%	7.07%	9.20%
50	5.63%	1.91%	2.51%	4.33%	5.62%	6.91%	8.81%



Peer Comparison

The following chart shows the nominal investment return assumptions of the 127 plans from the National Association of State Retirement Administrators (NASRA) Issue Brief entitled, "Public Pension Plan Investment Return Assumptions", updated February, 2017. The median nominal investment return from this survey is 7.50%.



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.

This is a particularly challenging time to develop a recommendation for the investment return assumption. We need to recognize that there is no right answer to the question as no one knows what the future holds. The capital market assumptions of the Board's investment consultant have declined significantly from the last experience study two years ago. These assumptions have a 10 year horizon which is much shorter than the benefit payment period of the System. The capital market assumptions of investment consultants that provide them for longer time horizons as seen in the Horizon Survey are much higher. As this assumption is reviewed every two years and the Board lowered the assumption in 2016, we are recommending no change to the investment return assumption at this time.

Investment Return Assumption		
	Current	**Recommended**
Real Rate of Return*	4.75%	4.75%
Inflation	3.00	3.00
Net Investment Return	7.75%	7.75%

* net of investment expenses.

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 3.75%, and is composed of a 3.00% rate of inflation assumption and a 0.75% real rate of wage inflation.

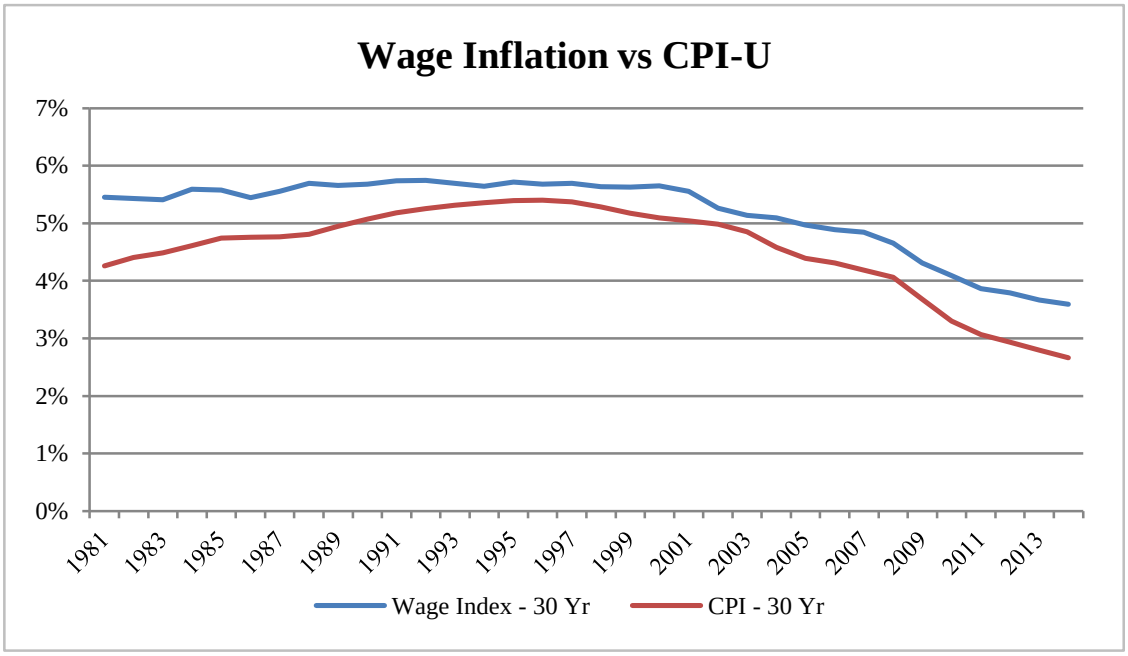
Past Experience

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 2015. 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
2005-2015	2.67%	1.86%	0.81%
1995-2005	4.11%	2.52%	1.59%
1985-1995	3.92%	3.45%	0.47%
1975-1985	6.90%	7.01%	(0.11)%
1965-1975	6.36%	5.73%	0.63%
1995-2015	3.39%	2.19%	1.20%
1985-2015	3.56%	2.61%	0.95%
1975-2015	4.39%	3.69%	0.70%
1965-2015	4.78%	4.09%	0.69%

Thus over the last 50 years, annual real wage growth has averaged 0.69%.



Social Security Administration

The wage index used for the historical analysis is projected forward by the Office of the Chief Actuary of the Social Security Administration in their 75-year projections. In June of 2016, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.8%, 1.2% higher than the Social Security intermediate inflation assumption of 2.6% per year. The range of the assumed real wage inflation in the 2016 Trustees report was 0.5% to 1.8% 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. PERS continues to experience gains on the salary assumption (i.e. actual increases in salary are less than expected) and real wage growth has not kept up with the current assumption of 0.75%. Therefore, we recommend a decrease in the real wage assumption from 0.75% to 0.25%. Not only will this recommended assumption lower projected salaries in the future, but it will also lower projected liabilities for active members.

Wage Inflation Assumption		
	Current	Recommended
Price Inflation	3.00%	3.00%
Real Wage Growth	0.75%	0.25%
Wage Inflation	3.75%	3.25%

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 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.

Current PERS Actuarial Amortization Method: Based on the current PERS Board funding policy, contributions to the PERS System is set at 15.75% of payroll and the amortization of the UAAL is determined by taking the difference in the 15.75% and the employer normal cost rate as a percentage of payroll for the valuation. Then this rate is used in the development of an "open" amortization period using the level percentage of payroll method. While the 15.75% of payroll is the current contribution to the PERS plan, **we recommend the Board consider adding to their current funding policy criteria for a contribution metric for each System using a "closed" amortization period, level percentage of payroll amortization payment, and separate layered amortization bases for the current UAAL and any future gains or losses of the System. This metric will be calculated during each valuation cycle to provide the Board with additional information as to how the current contribution compares to a contribution aimed at reaching a 100% funding ratio. This would replace the current Annual Required Contribution (ARC) rate we currently show in the valuation report.**

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

- Rates of Withdrawal
- Pre-retirement Mortality
- Rates of Disability Retirement
- Rates of Service Retirement
- Post-retirement Mortality
- Rates of 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, 2012 through June 30, 2016) with what was expected to happen based on the assumptions used in the most recent Actuarial Valuations.

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

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

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

PUBLIC EMPLOYEES' RETIREMENT SYSTEM

RATES OF WITHDRAWAL

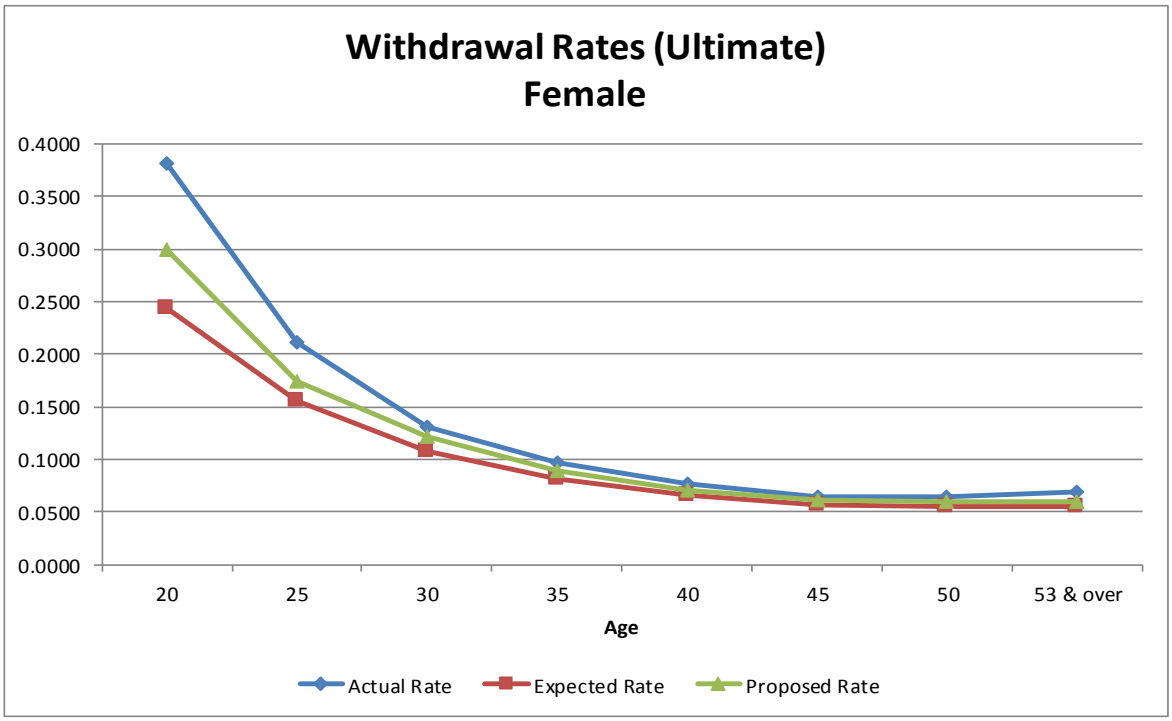
COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS FROM ACTIVE SERVICE

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	Withdrawals with more than 2 years of service					
20	158	108	1.463	135	86	1.570
25	1,848	1,357	1.362	2,878	2,116	1.360
30	2,529	2,006	1.261	4,512	3,734	1.208
35	2,198	1,783	1.233	4,115	3,451	1.192
40	1,910	1,581	1.208	3,542	3,023	1.172
45	1,706	1,544	1.105	3,261	2,839	1.149
50	1,581	1,340	1.180	2,929	2,476	1.183
53 & over	2,665	2,075	1.284	4,355	3,433	1.269
TOTAL	**14,595**	**11,794**	**1.237**	**25,727**	**21,158**	**1.216**

The following graphs show a comparison of the present, actual and proposed rates of withdrawal for withdrawals with more than 2 years of service.

PUBLIC EMPLOYEES' RETIREMENT SYSTEM

RATES OF WITHDRAWAL FOR ACTIVE MEMBERS WITH MORE THAN 2 YEARS OF SERVICE



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 study indicate that for members with more than 2 years of service, the actual number of withdrawals was more at all age groups than expected over the four year period, especially at the youngest ages. Therefore, we recommend increasing the rates for both males and females to partially reflect the higher numbers of terminations experience over the last four years.

Furthermore the actual rates of withdrawal during the select period (first 2 years of employment) indicate that both male and female members are withdrawing at a slightly greater rate during the select period than currently expected. We recommend increasing the rate from 32.00% to 32.50% during the first year of employment and from 23.00% to 23.50 % during the second year of employment.

The following table shows a comparison between the present withdrawal rates and the proposed withdrawal rates for members with more than 2 years of service.

COMPARATIVE RATES OF WITHDRAWAL

AGE	RATES OF WITHDRAWAL			
	MALES		FEMALES	
	Present	Proposed	Present	Proposed
20	23.00%	25.00%	28.00%	30.00%
25	16.00	18.00	16.50	18.25
30	10.00	11.50	10.50	12.00
35	7.50	8.50	8.00	8.75
40	6.25	6.75	6.50	7.00
45	5.75	6.25	5.50	6.00
50	5.75	6.25	5.50	6.00
55	5.75	6.25	5.50	6.00
60	5.75	6.25	5.50	6.00
65	5.75	6.25	5.50	6.00
70	5.75	6.25	5.50	6.00
74	5.75	6.25	5.50	6.00

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
	Withdrawals with more than 2 years of service					
20	158	130	1.215	135	106	1.274
25	1,848	1,558	1.186	2,878	2,357	1.221
30	2,529	2,295	1.102	4,512	4,227	1.067
35	2,198	2,016	1.090	4,115	3,795	1.084
40	1,910	1,720	1.110	3,542	3,267	1.084
45	1,706	1,677	1.017	3,261	3,091	1.055
50	1,581	1,456	1.086	2,929	2,702	1.084
53 & over	2,665	2,256	1.181	4,355	3,745	1.163
TOTAL	**14,595**	**13,108**	**1.113**	**25,727**	**23,290**	**1.105**

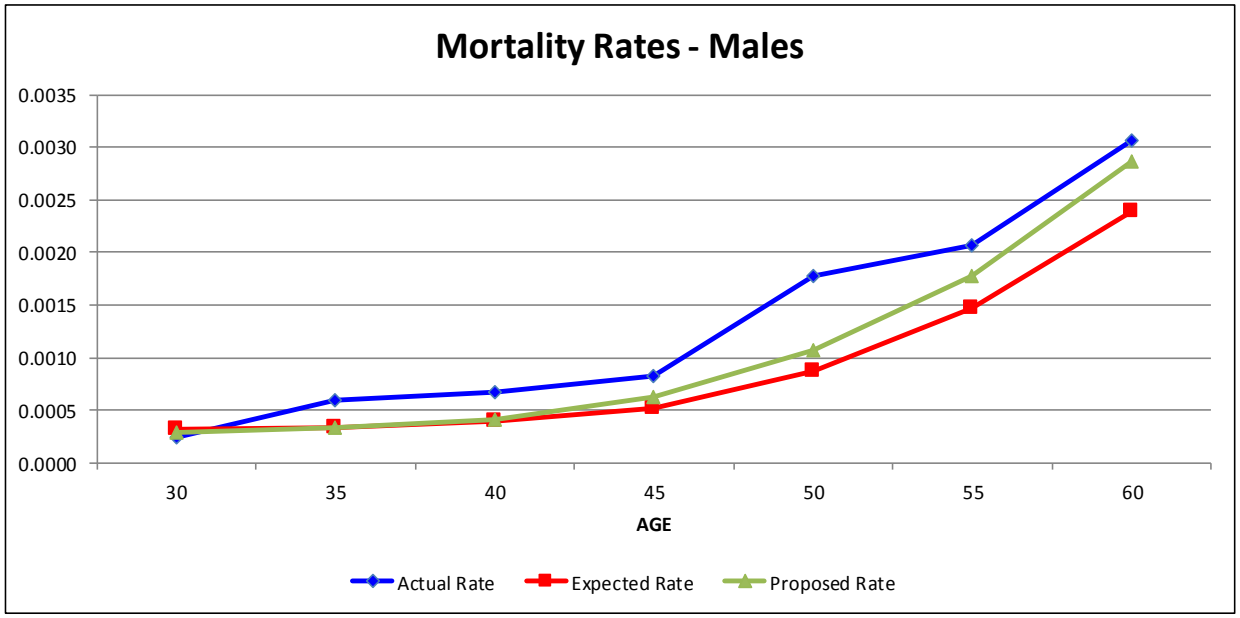
PUBLIC EMPLOYEES' RETIREMENT SYSTEM

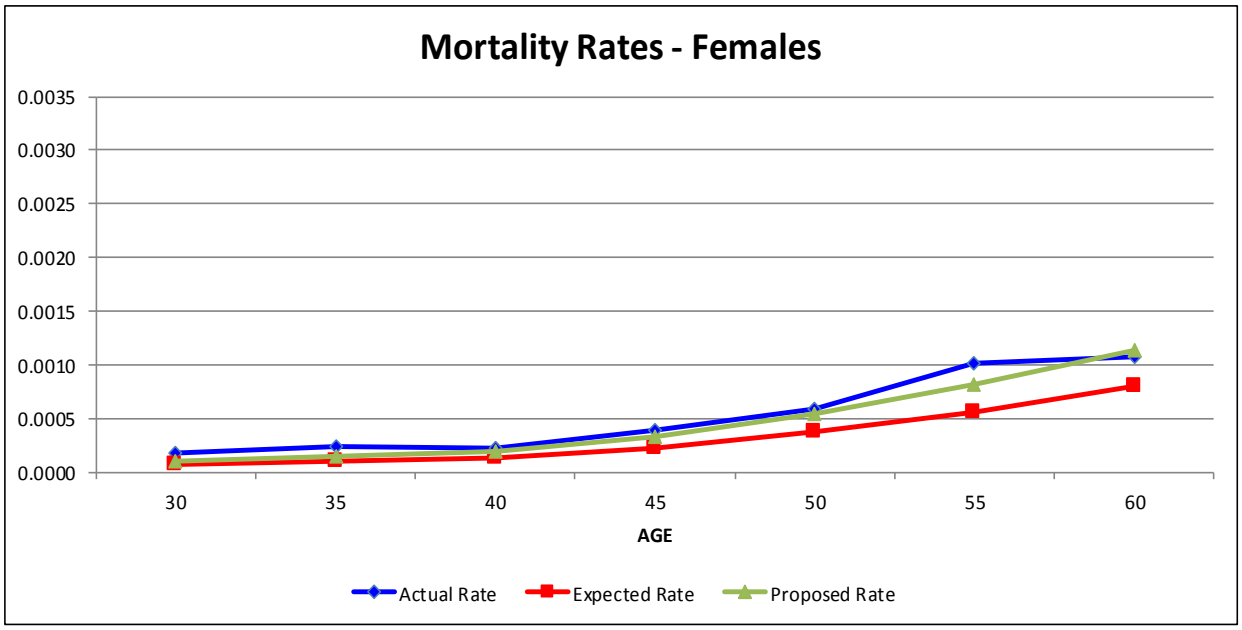
RATES OF PRE-RETIREMENT MORTALITY

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	6	8	0.750	8	3	2.667
35	16	9	1.778	12	5	2.400
40	19	11	1.727	12	7	1.714
45	25	16	1.563	22	12	1.833
50	53	26	2.038	33	21	1.571
55	59	42	1.405	55	30	1.833
60	76	59	1.288	46	34	1.353
63 & over	92	95	0.968	39	30	1.300
TOTAL	**346**	**266**	**1.301**	**227**	**142**	**1.599**

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





Due to a data system change for the 2015-2016 plan year that that allowed persons who died with a subsequent refund payment to be identified and included with pre-retirement deaths rather than withdrawals, the actual rates of pre-retirement deaths were much more than expected at most ages for both males and females. Therefore, we are recommending an increase in the pre-retirement mortality table rates at most ages. The new mortality table will be 50% of the RP-2014 Blue-Collar employee mortality table projected with Scale BB to 2022 for males and 45% of the RP-2014 Blue-Collar employee mortality table projected with Scale BB to 2022 for females.

The following table shows a comparison between the present pre-retirement mortality rates and the proposed rates. The proposed rates allow for some improved mortality in the future.

COMPARATIVE RATES OF PRE-RETIREMENT MORTALITY

AGE	RATES OF DEATH			
	MALES		FEMALES	
	Present	Proposed	Present	Proposed
20	0.0159%	0.0256%	0.0054%	0.0080%
25	0.0346	0.0306	0.0058	0.0085
30	0.0318	0.0286	0.0073	0.0107
35	0.0337	0.0330	0.0096	0.0141
40	0.0390	0.0397	0.0132	0.0195
45	0.0513	0.0615	0.0220	0.0324
50	0.0859	0.1065	0.0369	0.0543
55	0.1466	0.1761	0.0557	0.0811
60	0.2391	0.2868	0.0805	0.1137
65	0.4076	0.4862	0.1214	0.1694

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	6	7	0.857	8	5	1.600
35	16	9	1.778	12	7	1.714
40	19	11	1.727	12	10	1.200
45	25	19	1.316	22	18	1.222
50	53	32	1.656	33	31	1.065
55	59	51	1.157	55	44	1.250
60	76	71	1.070	46	48	0.958
63 & over	92	109	0.844	39	43	0.907
TOTAL	**346**	**309**	**1.120**	**227**	**206**	**1.102**

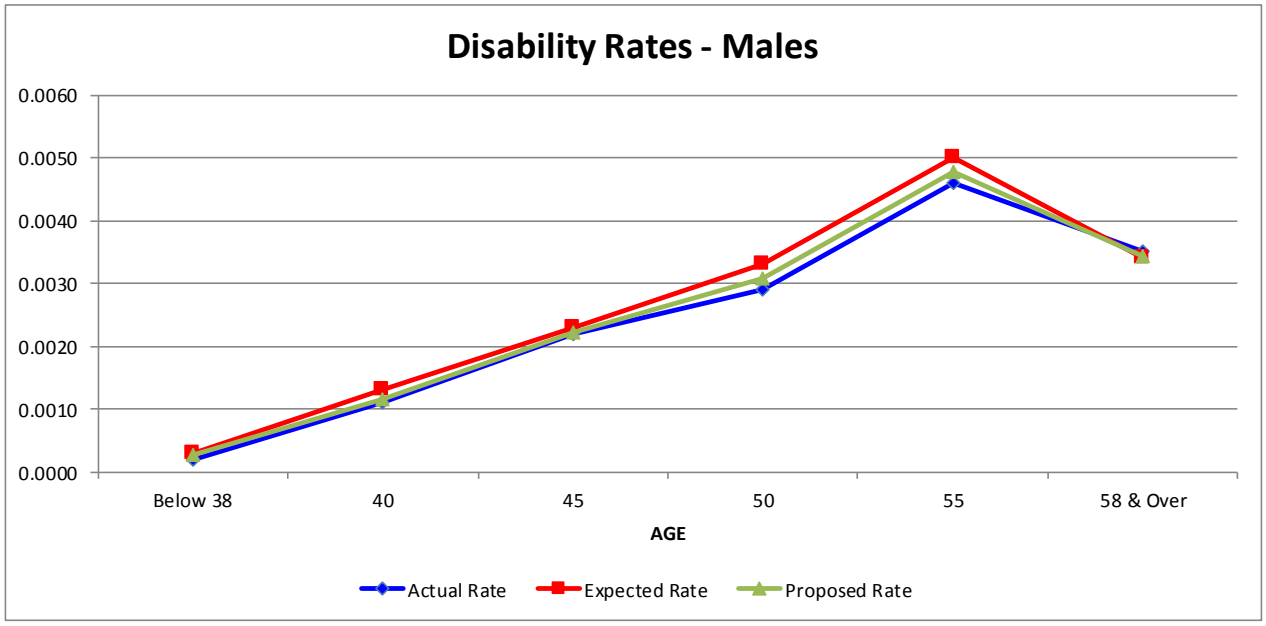
PUBLIC EMPLOYEES' RETIREMENT SYSTEM

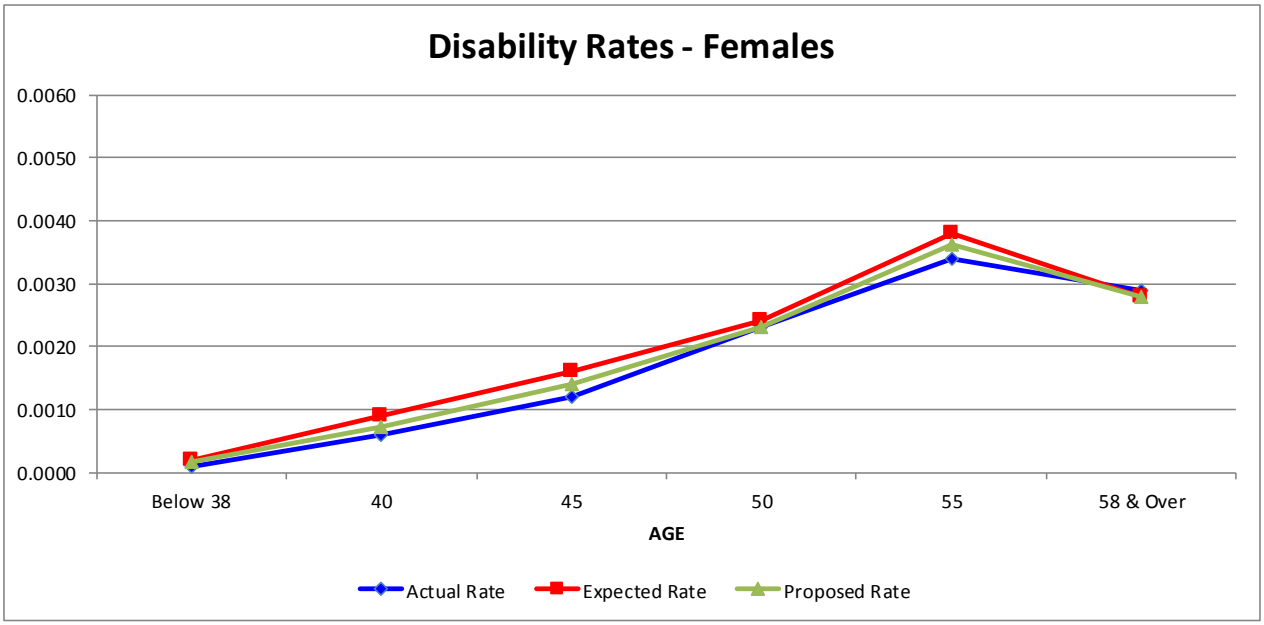
RATES OF DISABILITY RETIREMENT

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	13	23	0.565	13	27	0.481
40	31	35	0.886	29	48	0.604
45	68	71	0.958	68	90	0.756
50	87	100	0.870	128	136	0.941
55	133	142	0.937	187	206	0.908
58 & over	155	152	1.020	186	180	1.033
TOTAL	**487**	**523**	**0.931**	**611**	**687**	**0.889**

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





As can be seen from the table on the previous page, the actual rates of disability retirement are slightly less than expected for both males and females at ages less than 58. The Plan experienced similar rates of disability retirement during the previous investigation, so therefore, we recommend decreasing the rates of disability retirement for ages less than 60 and a slight increase in rates from ages 60-64.

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

COMPARATIVE RATES OF DISABILITY RETIREMENT

AGE	RATES OF DISABILITY			
	MALES		FEMALES	
	Present	Proposed	Present	Proposed
20	0.012%	0.010%	0.011%	0.009%
25	0.017	0.012	0.014	0.011
30	0.020	0.017	0.018	0.014
35	0.044	0.036	0.022	0.017
40	0.120	0.110	0.090	0.070
45	0.240	0.230	0.160	0.140
50	0.320	0.290	0.230	0.220
55	0.520	0.500	0.400	0.380
60	0.520	0.530	0.400	0.410
65	0.200	0.200	0.150	0.150

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	13	19	0.684	13	21	0.619
40	31	33	0.939	29	38	0.763
45	68	67	1.015	68	79	0.861
50	87	92	0.946	128	129	0.992
55	133	137	0.971	187	197	0.949
58 & over	155	154	1.006	186	181	1.028
TOTAL	**487**	**502**	**0.970**	**611**	**645**	**0.947**

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	323	277	1.166	775	673	1.152
61	259	253	1.024	567	478	1.186
62	509	479	1.063	806	716	1.126
63	390	332	1.175	582	548	1.062
64	254	240	1.058	448	431	1.039
65	382	330	1.158	614	550	1.116
66	250	238	1.050	440	366	1.202
67	183	157	1.166	257	210	1.224
68	131	111	1.180	157	144	1.090
69	136	111	1.225	134	110	1.218
70	92	87	1.057	123	103	1.194
71	81	75	1.080	80	71	1.127
72	63	63	1.000	56	53	1.057
73	44	49	0.898	39	43	0.907
74	44	44	1.000	49	34	1.441
Subtotal	**3,141**	**2,846**	**1.104**	**5,127**	**4,530**	**1.132**
75 & Over	228	981	0.232	148	562	0.263
GRAND TOTAL	**3,369**	**3,827**	**0.880**	**5,275**	**5,092**	**1.036**

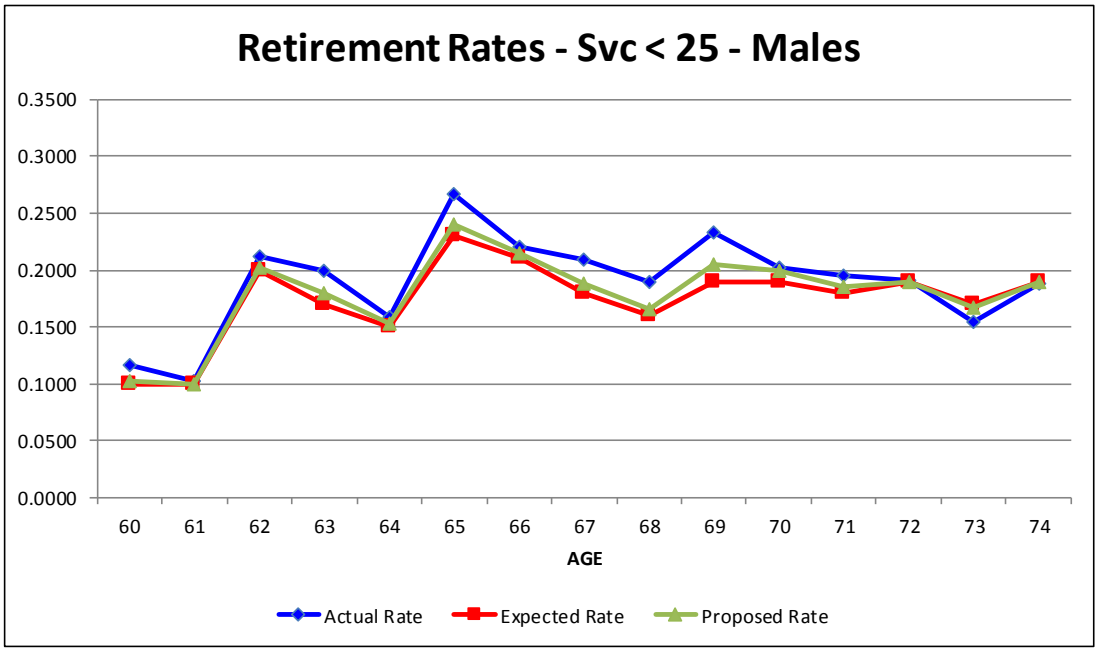
COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

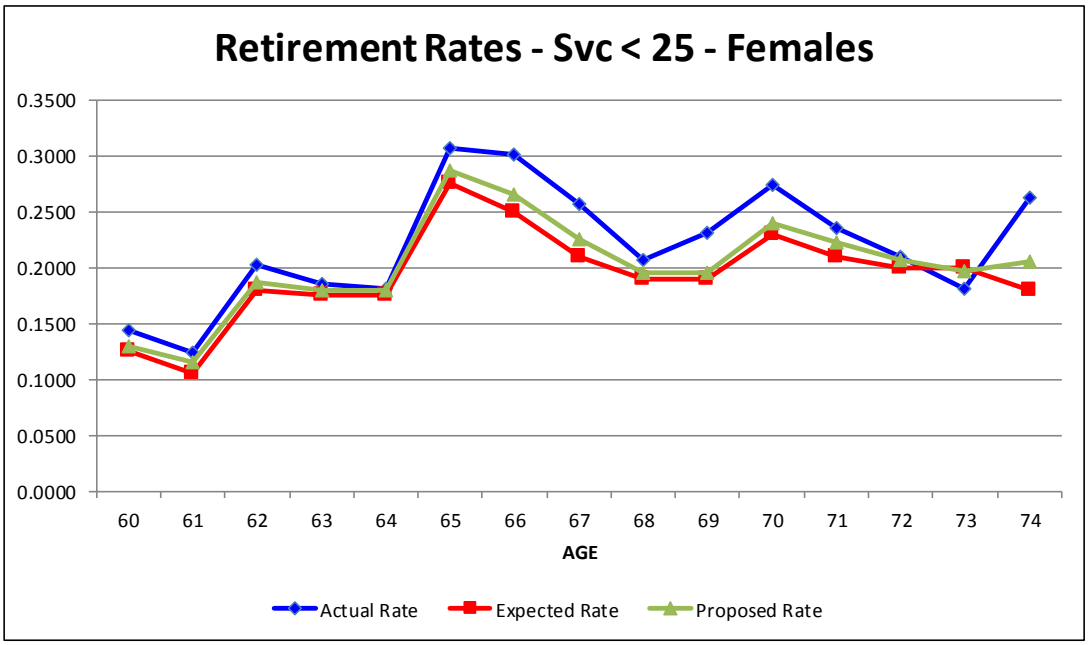
Retirements with 25 or more years of service

AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Below 48	197	143	1.378	171	127	1.346
48-51	490	390	1.256	717	588	1.219
52	168	151	1.113	290	247	1.174
53	137	131	1.046	342	282	1.213
54	183	153	1.196	313	310	1.010
55	199	186	1.070	421	367	1.147
56	214	196	1.092	391	351	1.114
57	164	178	0.921	420	381	1.102
58	173	153	1.131	393	378	1.040
59	172	156	1.103	423	434	0.975
60	189	202	0.936	421	413	1.019
61	169	205	0.824	441	423	1.043
62	233	280	0.832	571	538	1.061
63	176	174	1.011	357	365	0.978
64	131	135	0.970	285	286	0.997
65	119	137	0.869	302	297	1.017
66	131	119	1.101	192	175	1.097
67	71	69	1.029	98	119	0.824
68	68	62	1.097	77	65	1.185
69	48	46	1.043	60	53	1.132
70	32	34	0.941	50	35	1.429
71	24	28	0.857	39	36	1.083
72	23	26	0.885	28	20	1.400
73	17	14	1.214	14	17	0.824
74	16	13	1.231	8	16	0.500
Subtotal	**3,544**	**3,381**	**1.048**	**6,824**	**6,323**	**1.079**
75 & Over	79	322	0.245	67	240	0.279
GRAND TOTAL	**3,623**	**3,703**	**0.978**	**6,891**	**6,563**	**1.050**

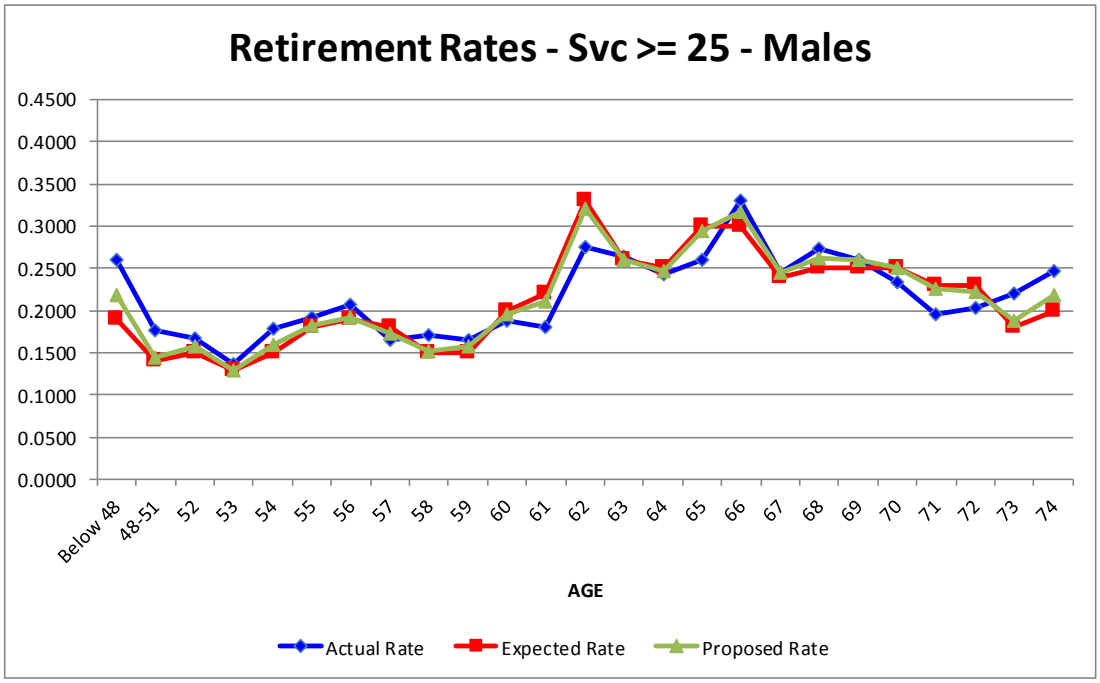
The following graphs show a comparison of the present, actual, and proposed rates of service retirements.

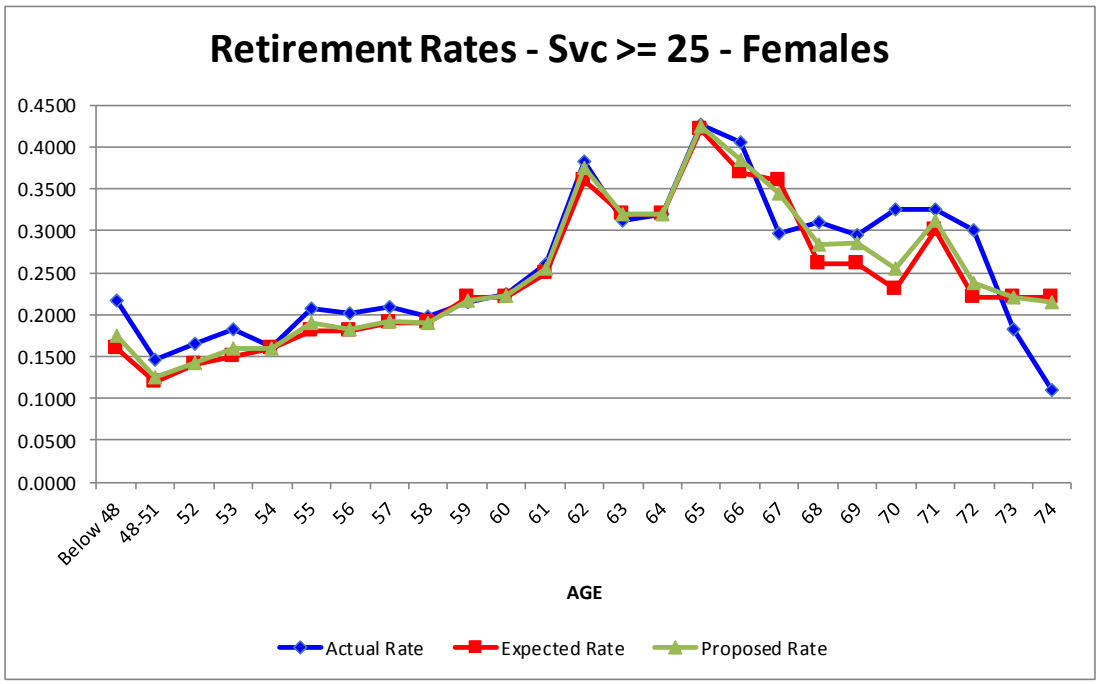
RATES OF RETIREMENT FOR ACTIVE MEMBERS WITH LESS THAN 25 YEARS OF SERVICE





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





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 very close to expected at almost all ages. However, we do recommend an increase in the rates of retirement at younger ages once a member reaches 25 years of service for both males and females and some very minor adjustments at other ages to better reflect experience of 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			19.00%	21.75%			16.00%	17.50%
50			14.00	14.50			12.00	12.50
55			18.00	18.25			18.00	19.00
60	10.00%	10.25%	20.00	19.50	12.50%	13.00%	22.00	22.25
62	20.00	20.25	33.00	32.00	18.00	18.75	36.00	37.50
65	23.00	24.00	30.00	29.50	27.50	28.75	42.00	42.50
70	19.00	20.00	25.00	25.00	23.00	24.00	23.00	25.50
75	100.00	100.00	100.00	100.00	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	323	284	1.137	775	700	1.107
61	259	253	1.024	567	523	1.084
62	509	485	1.049	806	746	1.080
63	390	351	1.111	582	563	1.034
64	254	244	1.041	448	444	1.009
65	382	344	1.110	614	575	1.068
66	250	244	1.025	440	387	1.137
67	183	164	1.116	257	225	1.142
68	131	114	1.149	157	148	1.061
69	136	120	1.133	134	113	1.186
70	92	91	1.011	123	108	1.139
71	81	77	1.052	80	76	1.053
72	63	63	1.000	56	55	1.018
73	44	48	0.917	39	43	0.907
74	44	44	1.000	49	38	1.289
Subtotal	**3,141**	**2,926**	**1.073**	**5,127**	**4,744**	**1.081**
75 & Over	228	981	0.232	148	562	0.263
GRAND TOTAL	**3,369**	**3,907**	**0.862**	**5,275**	**5,306**	**0.994**

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	197	164	1.201	171	138	1.239
48-51	490	404	1.213	717	612	1.172
52	168	159	1.057	290	251	1.155
53	137	131	1.046	342	300	1.140
54	183	164	1.116	313	310	1.010
55	199	189	1.053	421	388	1.085
56	214	198	1.081	391	356	1.098
57	164	171	0.959	420	386	1.088
58	173	155	1.116	393	378	1.040
59	172	164	1.049	423	429	0.986
60	189	197	0.959	421	417	1.010
61	169	196	0.862	441	431	1.023
62	233	271	0.860	571	560	1.020
63	176	174	1.011	357	365	0.978
64	131	134	0.978	285	286	0.997
65	119	135	0.881	302	301	1.003
66	131	126	1.040	192	182	1.055
67	71	71	1.000	98	114	0.860
68	68	65	1.046	77	70	1.100
69	48	48	1.000	60	58	1.034
70	32	34	0.941	50	39	1.282
71	24	28	0.857	39	38	1.026
72	23	25	0.920	28	22	1.273
73	17	14	1.214	14	17	0.824
74	16	14	1.143	8	16	0.500
Subtotal	**3,544**	**3,431**	**1.033**	**6,824**	**6,464**	**1.056**
75 & Over	79	322	0.245	67	240	0.279
GRAND TOTAL	**3,623**	**3,753**	**0.965**	**6,891**	**6,704**	**1.028**

PUBLIC EMPLOYEES' RETIREMENT SYSTEM

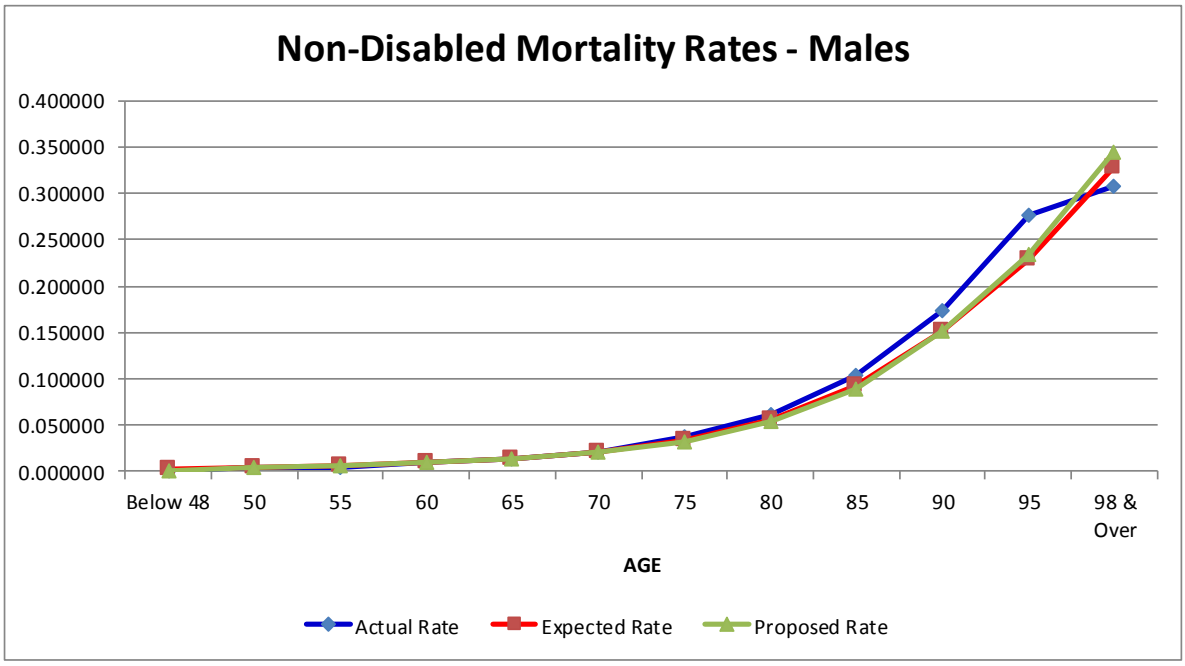
RATES OF POST-RETIREMENT MORTALITY

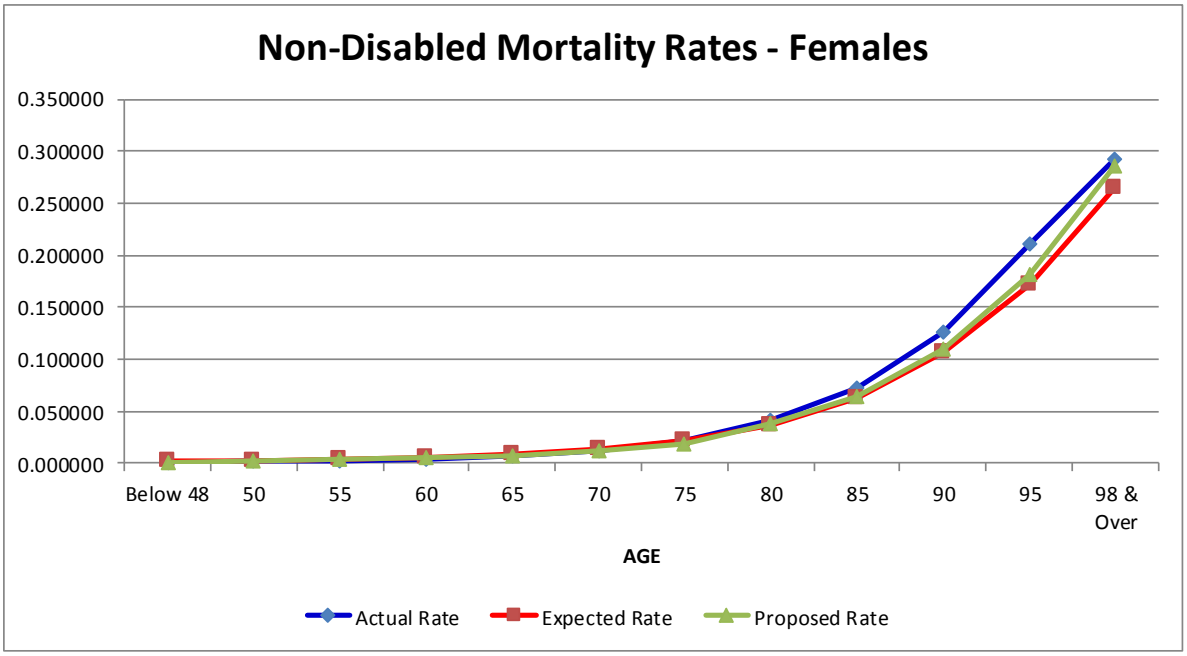
COMPARISON OF ACTUAL AND EXPECTED CASES OF POST-RETIREMENT DEATHS

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 AND BENEFICIARIES					
Below 53	17	16	1.063	18	14	1.286
55	33	44	0.750	34	49	0.694
60	133	117	1.137	128	161	0.795
65	343	350	0.980	365	436	0.837
70	525	511	1.027	549	589	0.932
75	706	628	1.124	688	704	0.977
80	783	715	1.095	943	847	1.113
85	797	713	1.118	1,233	1,064	1.159
90	535	465	1.151	1,095	927	1.181
95	210	173	1.214	629	512	1.229
98 & over	40	43	0.930	205	185	1.108
TOTAL	**4,122**	**3,775**	**1.092**	**5,887**	**5,488**	**1.073**
	DISABILITY RETIREMENTS					
Below 48	14	16	0.875	22	10	2.200
50	16	25	0.640	22	19	1.158
55	47	44	1.068	53	38	1.395
60	74	72	1.028	85	61	1.393
65	93	89	1.045	63	74	0.851
70	76	68	1.118	70	66	1.061
75	59	50	1.180	35	56	0.625
80	29	30	0.967	41	44	0.932
85	24	15	1.600	19	24	0.792
88 & over	5	9	0.556	24	23	1.043
TOTAL	**437**	**418**	**1.045**	**434**	**415**	**1.046**

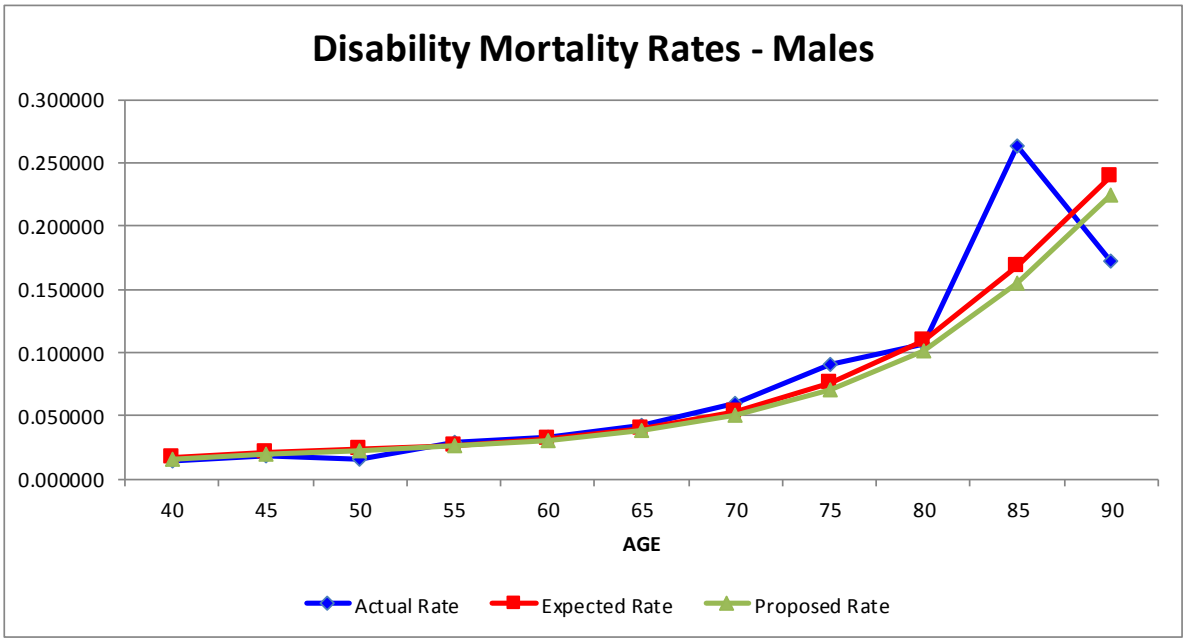
The following graphs show a comparison of the present, actual and proposed rates of post-retirement deaths.

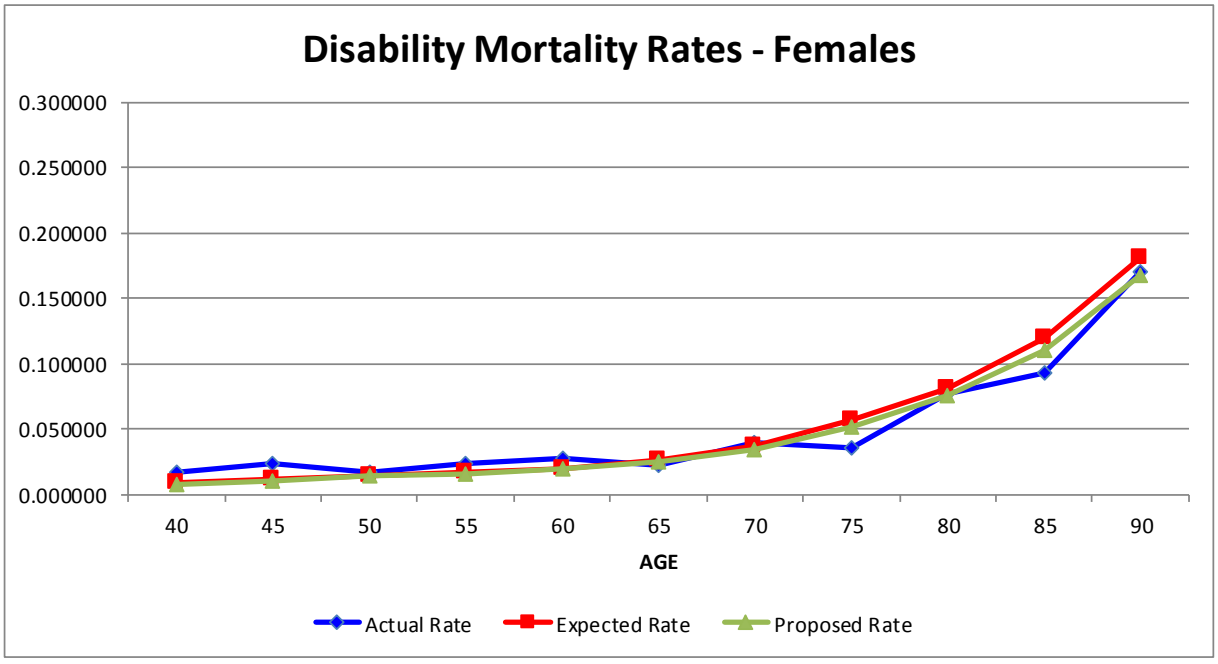
POST-RETIREMENT DEATHS
SERVICE RETIREMENTS AND BENEFICIARIES
OF DECEASED MEMBERS





POST-RETIREMENT DEATHS
DISABILITY RETIREMENTS





The current basis for rate of post-retirement mortality for service retirees and beneficiaries is the static mortality table, RP-2014 Healthy Annuitant Blue Collar Table projected with Scale BB to 2016 with male rates set forward one year. The current basis for post-retirement mortality for disability retirements is the RP-2014 Disabled Retiree table set forward 5 years for males and 4 years for females.

The results of the experience analysis indicate that this table actually provides a reasonable margin for future mortality improvements (7-9%). In fact, the PERS plan experienced a very small gain due to post-retirement mortality for the 2016 valuation. So, therefore, we are only recommending a slight adjustment to the current mortality table to accommodate a reasonable margin going forward. We recommend continuation of the RP-2014 Healthy Annuitant Blue Collar Table projected with Scale BB to 2022 with male rates set forward one year and adjusted by 106% for males at all ages and as follows for females: 90% for ages less than 76, 95% for age 76, 105% for age 78 and 1.10% for ages 79 and greater. These adjustments provide a better fit to expected post-retirement deaths in the future. We also recommend adoption of the RP-2014 Disabled Retiree Table set forward 4 years for males and 3 years for females. The following table shows a comparison between the present and proposed rates of mortality.

COMPARATIVE RATES OF POST-RETIREMENT MORTALITY

AGE	RATES OF POST-RETIREMENT DEATH			
	MALES		FEMALES	
	Present	Proposed	Present	Proposed
	SERVICE RETIREMENTS & BENEFICIARIES OF DECEASED MEMBERS			
55	0.6396%	0.6659%	0.3985%	0.3481%
60	0.8974	0.9047	0.5621	0.4763
65	1.3437	1.3141	0.8517	0.7130
70	2.0935	2.0267	1.3633	1.1412
75	3.3706	3.2631	2.2423	1.8771
80	5.5724	5.3947	3.7254	3.8115
85	9.3496	9.0513	6.3460	6.4928
90	15.8265	15.8263	10.9418	11.2631
DISABILITY RETIREMENTS				
35	1.0997%	1.0420%	0.5027%	0.4669%
40	1.7039	1.5340	0.8112	0.7286
45	2.0395	1.9757	1.1352	1.0787
50	2.3369	2.2791	1.3992	1.3494
55	2.6604	2.5868	1.6447	1.5931
60	3.1685	3.0433	1.9884	1.9028
65	4.0346	3.8253	2.6348	2.4702
70	5.4287	5.0965	3.7962	3.5148
75	7.6616	7.1235	5.6372	5.2059
80	11.3303	10.4436	8.3652	7.7357
85	17.3005	15.8714	12.2939	11.3909
90	24.7169	23.1944	18.1474	16.7890

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 AND BENEFICIARIES					
Below 53	17	15	1.133	18	10	1.800
55	33	45	0.733	34	43	0.791
60	133	118	1.127	128	136	0.941
65	343	342	1.003	365	365	1.000
70	525	495	1.061	549	493	1.114
75	706	608	1.161	688	610	1.128
80	783	692	1.132	943	859	1.098
85	797	693	1.150	1,233	1,089	1.132
90	535	465	1.151	1,095	955	1.147
95	210	178	1.180	629	542	1.161
98 & over	40	45	0.889	205	200	1.025
TOTAL	**4,122**	**3,696**	**1.115**	**5,887**	**5,302**	**1.110**
	DISABILITY RETIREMENTS					
Below 48	14	15	0.933	22	9	2.444
50	16	24	0.667	22	18	1.222
55	47	43	1.093	53	37	1.432
60	74	70	1.057	85	59	1.441
65	93	84	1.107	63	70	0.900
70	76	64	1.188	70	62	1.129
75	59	46	1.283	35	52	0.673
80	29	28	1.036	41	40	1.025
85	24	14	1.714	19	23	0.826
88 & over	5	9	0.556	24	21	1.143
TOTAL	**437**	**397**	**1.101**	**434**	**391**	**1.110**

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	$436,079	$449,083	0.971
1	1,453,139	1,488,445	0.976
2	1,217,146	1,234,013	0.986
3	1,089,443	1,101,442	0.989
4	1,039,020	1,050,526	0.989
5-9	4,943,687	4,983,595	0.992
10-14	4,016,723	4,056,958	0.990
15-19	3,118,072	3,158,496	0.987
20-24	2,324,752	2,356,399	0.987
25-29	1,321,361	1,335,539	0.989
30-34	516,145	521,569	0.990
35 & Over	272,487	275,939	0.987
TOTAL	**$21,748,054**	**$22,012,004**	**0.988**

Over the past four years, actual rates of salary increase have been less than expected at all service breakdowns. In the economic section of this experience study report, we are recommending the wage inflation assumption be reduced from 3.75% to 3.25% (see page 22). As the wage inflation assumption is part of our building block approach to determining the salary scale, the total salary scale will be reduced accordingly at all service intervals. The following table shows a comparison between the present and proposed rates of salary increase.

SERVICE OF GROUP	SALARY INCREASE RATES	
	MALES AND FEMALES	
	Present	Proposed
0	19.00%	18.50%
1	9.00%	8.50%
2	6.50%	6.00%
3	5.50%	5.00%
4	5.00%	4.50%
5-7	4.50%	4.00%
8-27	4.00%	3.50%
28 and Over	3.75%	3.25%

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	$436,079	$447,198	0.975
1	1,453,139	1,481,617	0.981
2	1,217,146	1,228,219	0.991
3	1,089,443	1,096,223	0.994
4	1,039,020	1,045,523	0.994
5-9	4,943,687	4,959,707	0.997
10-14	4,016,723	4,037,451	0.995
15-19	3,118,072	3,143,309	0.992
20-24	2,324,752	2,345,069	0.991
25-29	1,321,361	1,329,113	0.994
30-34	516,145	519,055	0.994
35 & Over	272,487	274,609	0.992
TOTAL	**$21,748,054**	**$21,907,093**	**0.993**

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 this investigation period, the plan experienced an estimated 58% assumption. **Therefore, we recommend no change at this time.**

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 experience investigation period, about 5.7% of active deaths each year were in the line of duty so, therefore, **we recommend no change in this assumption at this time**.

DISABILITY ASSUMPTION: Currently, it is assumed that 6% of active member disabilities are in the line of duty and 94% of active member disabilities are not in the line of duty. During the experience investigation period, an average of about 9% of disabilities each year were in the line of duty, but this average was largely due to an unusually high number of line of duty disabilities in the 2015-2016 plan year. During the last experience study, the average for the period was 7%. **Therefore, we recommend that the assumption be changed so that 7% of active member disabilities are assumed to be in the line of duty and 93% 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 so we review this assumption based on the number of retirements that choose Joint and Survivor Options. While not the most ideal method to develop this assumption, **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 0.62 years. **Therefore, we recommend no change at this time.**

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 0.25 years. **Therefore, we recommend no change at this time.**

ASSUMED INTEREST RATE ON EMPLOYEE CONTRIBUTIONS: 2.00%

OTHER ASSUMPTION LOADS: Varying loads dependent on age are made for pre-retirement dependent children option and for disability dependent children options. **We recommend no change at this time.**

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 54 actual withdrawals versus 30 expected withdrawals over the four year period of this investigation. In the prior investigation, the number of actual withdrawals was nearly equal the number of expected withdrawals. At this time, **we recommend an increase in rates of withdrawal.**

- There were 63 actual retirements versus 81 expected retirements over the four-year period of this investigation. There are numerous members eligible to retire that we expect to retire in the next few years. Therefore, we do not recommend a change in the retirement decrements.

- There were two 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 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 1 in the prior study. The current rates of disability expect four in the period. **We recommend lowering the disability rates by 25%.**

- Actual rates of salary increase were lower than expected over the four year period. Since we recommend lowering the wage inflation assumption from 3.75% to 3.25%, total expected salary increases will be one-half percent lower.

- As mentioned in the PERS section of this report, we recommend that the rates of mortality for service retirements be revised to match the PERS mortality table, the RP-2014 Healthy Annuitant Blue Collar Mortality Table Projected with Scale BB to 2022 set forward one year for males with adjustments. In addition, we recommend that the rates of mortality for disability retirements be revised to the RP-2014 Disabled Mortality Table set back forward four years for males and set forward three years for females. **We recommend each of the Systems have the same mortality table.**

SUPPLEMENTAL LEGISLATIVE RETIREMENT PLAN

SUMMARY OF RESULTS

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

- We have reviewed the withdrawal rates for both non-election years and election years. The number of withdrawals during non-election years (2% of exposed) was not enough to warrant adding withdrawal rates during these years. The actual number of withdrawals during the election year was very close to the expected withdrawals (19 vs. 18). We recommend no change in the rates of withdrawal.

- We also reviewed the service retirements rates for both non-election years and election years. The number of service retirements during non-election years (2% of exposed) was not enough to warrant adding rates during those years. The actual number of service retirements during the election year was significantly less than expected (29 vs. 50). **Therefore, we are recommending decreasing the retirement rates.**

- There were 6 deaths while in active service over the four-year period of this investigation compared with 2 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 which is close to what was expected. Therefore, we recommend no change at this time.

- 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 3.25% for all ages.

- As mentioned in the PERS section of this report, we recommend that the rates of mortality for service retirements be revised to match the PERS mortality table, the RP-2014 Healthy Annuitant Blue Collar Mortality Table Projected with Scale BB to 2022 set forward one year for males with adjustments. In addition, we recommend that the rates of mortality for disability retirements be revised to the RP-2014 Disabled Mortality Table set back forward four years for males and set forward three years for females. **We recommend each of the Systems have the same mortality table.**

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 economic assumptions and the post-retirement mortality experience. Over the period of this investigation, we have found the following observations:

- In conjunction with the recommended decrease in the wage inflation assumption, total expected salary increases will be one-half percent lower.

- As mentioned in the PERS section of this report, we recommend that the rates of mortality for service retirements be revised to match the PERS mortality table, the RP-2014 Healthy Annuitant Blue Collar Mortality Table Projected with Scale BB to 2022 set forward one year for males with adjustments. In addition, we recommend that the rates of mortality for disability retirements be revised to the RP-2014 Disabled Mortality Table set back forward four years for males and set forward three years for females. **We recommend each of the Systems have the same mortality table.**

Appendix A – Historical June CPI (U) Index

Year	CPI (U)	Year	CPI (U)
1961	29.8	1989	124.1
1962	30.2	1990	129.9
1963	30.6	1991	136.0
1964	31.0	1992	140.2
1965	31.6	1993	144.4
1966	32.4	1994	148.0
1967	33.3	1995	152.5
1968	35.7	1996	156.7
1969	34.7	1997	160.3
1970	38.8	1998	163.0
1971	40.6	1999	166.2
1972	41.7	2000	172.4
1973	44.2	2001	178.0
1974	49.0	2002	179.9
1975	53.6	2003	183.7
1976	56.8	2004	189.7
1977	60.7	2005	194.5
1978	65.2	2006	202.9
1979	72.3	2007	208.352
1980	82.7	2008	218.815
1981	90.6	2009	215.693
1982	97.0	2010	217.965
1983	99.5	2011	225.722
1984	103.7	2012	229.478
1985	107.6	2013	233.504
1986	109.5	2014	238.343
1987	113.5	2015	238.638
1988	118.0	2016	241.038

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
U.S. Broad	4.60%	18.25%
International Equity	4.50	19.70
Emerging Markets Equity	4.75	27.45
Global	4.75	21.00
Fixed Income	0.75	3.75
Real Estate	3.50	16.35
Private Equity	5.10	32.90
Emerging Debt	2.25	9.60
Cash	0.00	0.90

Asset Allocation Targets

Asset Class	Asset Allocation
U.S. Broad	27.00%
International Equity	18.00
Emerging Markets Equity	4.00
Global	12.00
Fixed Income	18.00
Real Estate	10.00
Private Equity	8.00
Emerging Debt	2.00
Cash	1.00

Appendix C – Social Security Administration Wage Index

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

TABLE 1

PUBLIC EMPLOYEES' RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE – MALES

AGE	ULTIMATE RATES OF WITHDRAWAL*	RATES OF DEATH	RATES OF DISABILITY	RATES OF RETIREMENT	
				LESS THAN 25 YRS OF SERVICE**	25 OR MORE YEARS OF SERVICE**
20	0.2500	0.000256	0.00010		
21	0.2500	0.000284	0.00010		
22	0.2500	0.000308	0.00011		
23	0.2300	0.000322	0.00011		
24	0.2100	0.000326	0.00011		
25	0.1800	0.000306	0.00012		
26	0.1670	0.000292	0.00014		
27	0.1540	0.000284	0.00016		
28	0.1410	0.000281	0.00017		
29	0.1280	0.000282	0.00017		
30	0.1150	0.000286	0.00017		
31	0.1090	0.000292	0.00020		
32	0.1030	0.000301	0.00025		
33	0.0970	0.000311	0.00030		
34	0.0910	0.000321	0.00034		
35	0.0850	0.000330	0.00036		
36	0.0815	0.000339	0.00051		
37	0.0780	0.000348	0.00066		
38	0.0745	0.000360	0.00081		
39	0.0710	0.000376	0.00096		
40	0.0675	0.000397	0.00110		0.2175
41	0.0665	0.000424	0.00134		0.2175
42	0.0655	0.000458	0.00158		0.2175
43	0.0645	0.000501	0.00182		0.2175
44	0.0635	0.000554	0.00206		0.2175
45	0.0625	0.000615	0.00230		0.2175
46	0.0625	0.000687	0.00242		0.2175
47	0.0625	0.000767	0.00254		0.2175
48	0.0625	0.000858	0.00266		0.1450
49	0.0625	0.000957	0.00278		0.1450
50	0.0625	0.001065	0.00290		0.1450
51	0.0625	0.001182	0.00332		0.1450
52	0.0625	0.001309	0.00374		0.1575
53	0.0625	0.001446	0.00416		0.1300
54	0.0625	0.001596	0.00458		0.1600
55	0.0625	0.001761	0.00500		0.1825
56	0.0625	0.001945	0.00506		0.1925
57	0.0625	0.002135	0.00512		0.1725
58	0.0625	0.002349	0.00518		0.1525
59	0.0625	0.002592	0.00524		0.1575
60	0.0625	0.002868	0.00530	0.1025	0.1950
61	0.0625	0.003179	0.00530	0.1000	0.2100
62	0.0625	0.003531	0.00530	0.2025	0.3200
63	0.0625	0.003927	0.00530	0.1800	0.2600
64	0.0625	0.004369	0.00530	0.1525	0.2475
65	0.0625	0.004862	0.00200	0.2400	0.2950
66	0.0625	0.005307	0.00200	0.2150	0.3175
67	0.0625	0.005793	0.00200	0.1875	0.2450
68	0.0625	0.006323	0.00200	0.1650	0.2625
69	0.0625	0.006958	0.00200	0.2050	0.2600
70	0.0625	0.007656	0.00200	0.2000	0.2500
71	0.0625	0.008425	0.00200	0.1850	0.2250
72	0.0625	0.009271	0.00200	0.1900	0.2225
73	0.0625	0.010202	0.00200	0.1675	0.1875
74	0.0625	0.011226	0.00200	0.1900	0.2175
75	0.0625	0.012353	0.00000	1.0000	1.0000

*For all ages, rates of 32.5% for the first year of employment and 23.5% for the second year of employment.
**For Tier 4 members, 30 years of service.

TABLE 2

PUBLIC EMPLOYEES' RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE – FEMALES

AGE	ULTIMATE RATES OF WITHDRAWAL*	RATES OF DEATH	RATES OF DISABILITY	RATES OF RETIREMENT	
				LESS THAN 25 YRS OF SERVICE**	25 OR MORE YEARS OF SERVICE**
20	0.3000	0.000080	0.00009		
21	0.3000	0.000080	0.00009		
22	0.3000	0.000080	0.00009		
23	0.2400	0.000082	0.00009		
24	0.2100	0.000083	0.00009		
25	0.1825	0.000085	0.00011		
26	0.1700	0.000088	0.00011		
27	0.1575	0.000092	0.00014		
28	0.1450	0.000097	0.00014		
29	0.1325	0.000101	0.00014		
30	0.1200	0.000107	0.00014		
31	0.1135	0.000114	0.00015		
32	0.1070	0.000120	0.00015		
33	0.1005	0.000127	0.00016		
34	0.0940	0.000134	0.00017		
35	0.0875	0.000141	0.00017		
36	0.0840	0.000148	0.00028		
37	0.0805	0.000157	0.00039		
38	0.0770	0.000167	0.00050		
39	0.0735	0.000180	0.00061		
40	0.0700	0.000195	0.00070		0.1750
41	0.0680	0.000214	0.00084		0.1750
42	0.0660	0.000235	0.00098		0.1750
43	0.0640	0.000261	0.00112		0.1750
44	0.0620	0.000290	0.00126		0.1750
45	0.0600	0.000324	0.00140		0.1750
46	0.0600	0.000361	0.00156		0.1750
47	0.0600	0.000402	0.00172		0.1750
48	0.0600	0.000446	0.00188		0.1250
49	0.0600	0.000493	0.00204		0.1250
50	0.0600	0.000543	0.00220		0.1250
51	0.0600	0.000594	0.00252		0.1250
52	0.0600	0.000648	0.00284		0.1425
53	0.0600	0.000704	0.00316		0.1600
54	0.0600	0.000757	0.00348		0.1600
55	0.0600	0.000811	0.00380		0.1900
56	0.0600	0.000868	0.00384		0.1825
57	0.0600	0.000928	0.00388		0.1925
58	0.0600	0.000993	0.00392		0.1900
59	0.0600	0.001062	0.00396		0.2175
60	0.0600	0.001137	0.00410	0.1300	0.2225
61	0.0600	0.001220	0.00410	0.1150	0.2550
62	0.0600	0.001312	0.00410	0.1875	0.3750
63	0.0600	0.001426	0.00410	0.1800	0.3200
64	0.0600	0.001553	0.00410	0.1800	0.3200
65	0.0600	0.001694	0.00150	0.2875	0.4250
66	0.0600	0.001879	0.00150	0.2650	0.3850
67	0.0600	0.002086	0.00150	0.2250	0.3450
68	0.0600	0.002315	0.00150	0.1950	0.2825
69	0.0600	0.002568	0.00150	0.1950	0.2850
70	0.0600	0.002850	0.00150	0.2400	0.2550
71	0.0600	0.003163	0.00150	0.2225	0.3125
72	0.0600	0.003510	0.00150	0.2075	0.2375
73	0.0600	0.003895	0.00150	0.1975	0.2200
74	0.0600	0.004322	0.00150	0.2050	0.2150
75	0.0600	0.004796	0.00000	1.0000	1.0000

*For all ages, rates of 32.5% for the first year of employment and 23.5% for the second year of employment.
**For Tier 4 members, 30 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
20	0.080	0.000256	0.000080	0.000675
21	0.080	0.000284	0.000080	0.000675
22	0.080	0.000308	0.000080	0.000675
23	0.072	0.000322	0.000082	0.000765
24	0.064	0.000326	0.000083	0.000765
25	0.056	0.000306	0.000085	0.000765
26	0.048	0.000292	0.000088	0.000765
27	0.046	0.000284	0.000092	0.000900
28	0.044	0.000281	0.000097	0.000900
29	0.042	0.000282	0.000101	0.000945
30	0.040	0.000286	0.000107	0.001035
31	0.038	0.000292	0.000114	0.001080
32	0.036	0.000301	0.000120	0.001215
33	0.034	0.000311	0.000127	0.001350
34	0.032	0.000321	0.000134	0.001395
35	0.030	0.000330	0.000141	0.001530
36	0.028	0.000339	0.000148	0.001575
37	0.026	0.000348	0.000157	0.001710
38	0.024	0.000360	0.000167	0.001800
39	0.022	0.000376	0.000180	0.001890
40	0.020	0.000397	0.000195	0.002025
41	0.018	0.000424	0.000214	0.002115
42	0.016	0.000458	0.000235	0.002295
43	0.014	0.000501	0.000261	0.002385
44	0.012	0.000554	0.000290	0.002565
45	0.010	0.000615	0.000324	0.002700
46	0.010	0.000687	0.000361	0.002970
47	0.010	0.000767	0.000402	0.003240
48	0.010	0.000858	0.000446	0.003465
49	0.010	0.000957	0.000493	0.003825
50	0.010	0.001065	0.000543	0.004140
51	0.010	0.001182	0.000594	0.004545
52	0.010	0.001309	0.000648	0.005040
53	0.010	0.001446	0.000704	0.005625
54	0.010	0.001596	0.000757	0.006165
55	0.000	0.001761	0.000811	0.006975
56	0.000	0.001945	0.000868	0.008010
57	0.000	0.002135	0.000928	0.009000
58	0.000	0.002349	0.000993	0.010170
59	0.000	0.002592	0.001062	0.011655
60	0.000	0.002868	0.001137	0.011655
61	0.000	0.003179	0.001220	0.000000

SERVICE	RATES OF RETIREMENT*
0	0.00
1	0.00
2	0.00
3	0.00
4	0.00
5	0.05
6	0.05
7	0.05
8	0.05
9	0.05
10	0.05
11	0.05
12	0.05
13	0.05
14	0.05
15	0.05
16	0.05
17	0.05
18	0.05
19	0.05
20	0.05
21	0.05
22	0.05
23	0.05
24	0.05
25	0.01
26	0.15
27	0.20
28	0.25
29	0.25
30	0.25
31	0.25
32	0.25
33	0.25
34	0.25
35	0.25
36	0.35
37	0.50
38	0.75
39	0.75
40+	1.00

* The annual rate of service retirement is 100% at age 61.

TABLE 4

SUPPLEMENTAL LEGISLATIVE RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE

AGE	RATES OF DEATH		RATES OF DISABILITY
	MALES	FEMALES	
20	0.000256	0.000080	0.0004
21	0.000284	0.000080	0.0004
22	0.000308	0.000080	0.0005
23	0.000322	0.000082	0.0005
24	0.000326	0.000083	0.0005
25	0.000306	0.000085	0.0005
26	0.000292	0.000088	0.0006
27	0.000284	0.000092	0.0006
28	0.000281	0.000097	0.0007
29	0.000282	0.000101	0.0007
30	0.000286	0.000107	0.0007
31	0.000292	0.000114	0.0008
32	0.000301	0.000120	0.0009
33	0.000311	0.000127	0.0010
34	0.000321	0.000134	0.0011
35	0.000330	0.000141	0.0011
36	0.000339	0.000148	0.0012
37	0.000348	0.000157	0.0013
38	0.000360	0.000167	0.0014
39	0.000376	0.000180	0.0016
40	0.000397	0.000195	0.0017
41	0.000424	0.000214	0.0018
42	0.000458	0.000235	0.0019
43	0.000501	0.000261	0.0021
44	0.000554	0.000290	0.0022
45	0.000615	0.000324	0.0023
46	0.000687	0.000361	0.0025
47	0.000767	0.000402	0.0026
48	0.000858	0.000446	0.0027
49	0.000957	0.000493	0.0028
50	0.001065	0.000543	0.0030
51	0.001182	0.000594	0.0031
52	0.001309	0.000648	0.0032
53	0.001446	0.000704	0.0033
54	0.001596	0.000757	0.0034
55	0.001761	0.000811	0.0035
56	0.001945	0.000868	0.0036
57	0.002135	0.000928	0.0037
58	0.002349	0.000993	0.0038
59	0.002592	0.001062	0.0039
60	0.002868	0.001137	0.0040
61	0.003179	0.001220	0.0041
62	0.003531	0.001312	0.0042
63	0.003927	0.001426	0.0044
64	0.004369	0.001553	0.0045
65	0.004862	0.001694	0.0000
66	0.005307	0.001879	0.0000
67	0.005793	0.002086	0.0000
68	0.006323	0.002315	0.0000
69	0.006958	0.002568	0.0000
70	0.007656	0.002850	0.0000
71	0.008425	0.003163	0.0000
72	0.009271	0.003510	0.0000
73	0.010202	0.003895	0.0000
74	0.011226	0.004322	0.0000
75	0.012353	0.004796	0.0000
76	0.013594	0.005322	0.0000
77	0.014959	0.005906	0.0000
78	0.016461	0.006554	0.0000
79	0.018114	0.007273	0.0000
80	0.019932	0.008071	0.0000

- Withdrawal and Vesting: 20% in an election year, none in a non-election year.
- Service Retirement: 30% in an election year, none in a non-election year. All members assumed to retire no later than age 80.

TABLE 5

MUNICIPAL RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE

AGE	RATES OF WITHDRAWAL	RATES OF DEATH	RATES OF DISABILITY	RATES OF RETIREMENT	
				SERVICE	RATE*
20	0.10650	0.00060	0.00140	20	0.450
21	0.10248	0.00064	0.00160	21	0.175
22	0.09846	0.00068	0.00180	22	0.175
23	0.09444	0.00072	0.00200	23	0.175
24	0.09042	0.00076	0.00220	24	0.175
25	0.08640	0.00080	0.00240	25	0.175
26	0.08286	0.00088	0.00280	26	0.175
27	0.07932	0.00096	0.00320	27	0.175
28	0.07578	0.00104	0.00360	28	0.175
29	0.07224	0.00112	0.00400	29	0.350
30	0.06870	0.00120	0.00440	30	0.350
31	0.06468	0.00128	0.00504	31	0.350
32	0.06066	0.00136	0.00568	32	0.350
33	0.05664	0.00144	0.00632	33	0.350
34	0.05262	0.00152	0.00696	34	0.200
35	0.04860	0.00160	0.00760	35+	0.200
36	0.04482	0.00172	0.00800		
37	0.04104	0.00184	0.00840		
38	0.03726	0.00196	0.00880		
39	0.03348	0.00208	0.00920		
40	0.02970	0.00220	0.00960		
41	0.02664	0.00238	0.01004		
42	0.02358	0.00256	0.01048		
43	0.02052	0.00274	0.01092		
44	0.01746	0.00292	0.01136		
45	0.01440	0.00310	0.01180		
46	0.01200	0.00344	0.01340		
47	0.00960	0.00378	0.01500		
48	0.00720	0.00412	0.01660		
49	0.00480	0.00446	0.01820		
50	0.00240	0.00480	0.01980		
51	0.00000	0.00512	0.02136		
52		0.00544	0.02292		
53		0.00576	0.02448		
54		0.00608	0.02604		
55		0.00640	0.02760		
56		0.00678	0.02908		
57		0.00716	0.03056		
58		0.00754	0.03204		
59		0.00792	0.03352		
60		0.00830	0.03500		
61		0.00870	0.03685		
62		0.00910	0.03870		
63		0.00950	0.04055		
64		0.00990	0.04240		
65		0.00000	0.00000		

* The annual rate of service retirement is 100% at age 65.

TABLE 6

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

SERVICE	PERS
0	0.1850
1	0.0850
2	0.0600
3	0.0500
4	0.0450
5	0.0400
6	0.0400
7	0.0400
8	0.0350
9	0.0350
10	0.0350
11	0.0350
12	0.0350
13	0.0350
14	0.0350
15	0.0350
16	0.0350
17	0.0350
18	0.0350
19	0.0350
20	0.0350
21	0.0350
22	0.0350
23	0.0350
24	0.0350
25	0.0350
26	0.0350
27	0.0350
28	0.0325
29	0.0325
30	0.0325
31	0.0325
32	0.0325
33	0.0325
34	0.0325
35	0.0325
36	0.0325
37	0.0325
38	0.0325
39	0.0325
40	0.0325

AGE	HSPRS	SLRP	MRS
20	0.08814	0.0325	0.0475
21	0.08430	0.0325	0.0475
22	0.07030	0.0325	0.0475
23	0.06630	0.0325	0.0475
24	0.06198	0.0325	0.0475
25	0.05559	0.0325	0.0475
26	0.05240	0.0325	0.0475
27	0.05141	0.0325	0.0475
28	0.04743	0.0325	0.0475
29	0.04743	0.0325	0.0475
30	0.04743	0.0325	0.0475
31	0.04743	0.0325	0.0475
32	0.04743	0.0325	0.0475
33	0.04743	0.0325	0.0475
34	0.04743	0.0325	0.0475
35	0.04743	0.0325	0.0475
36	0.04743	0.0325	0.0475
37	0.04743	0.0325	0.0475
38	0.04743	0.0325	0.0475
39	0.04743	0.0325	0.0475
40	0.04743	0.0325	0.0475
41	0.04743	0.0325	0.0475
42	0.04743	0.0325	0.0475
43	0.04245	0.0325	0.0425
44	0.04245	0.0325	0.0425
45	0.04245	0.0325	0.0425
46	0.04245	0.0325	0.0425
47	0.04245	0.0325	0.0425
48	0.03748	0.0325	0.0375
49	0.03748	0.0325	0.0375
50	0.03748	0.0325	0.0375
51	0.03748	0.0325	0.0375
52	0.03748	0.0325	0.0375
53	0.03748	0.0325	0.0325
54	0.03748	0.0325	0.0325
55	0.03748	0.0325	0.0325
56	0.03748	0.0325	0.0325
57	0.03748	0.0325	0.0325
58	0.03748	0.0325	0.0325
59	0.03748	0.0325	0.0325
60	0.03250	0.0325	0.0325
61	0.03250	0.0325	0.0325
62	0.03250	0.0325	0.0325
63	0.03250	0.0325	0.0325
64	0.03250	0.0325	0.0325
65	0.03250	0.0325	0.0325
66	0.03250	0.0325	0.0325
67	0.03250	0.0325	0.0325
68	0.03250	0.0325	0.0325
69	0.03250	0.0325	0.0325
70	0.03250	0.0325	0.0325
71	0.03250	0.0325	0.0325
72	0.03250	0.0325	0.0325
73	0.03250	0.0325	0.0325
74	0.03250	0.0325	0.0325
75	0.03250	0.0325	0.0325

* Includes inflation of 3.25%

TABLE 7

ALL SYSTEMS

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

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.000544	0.000160	71	0.022237	0.012593
20	0.000601	0.000160	72	0.024429	0.013908
21	0.000654	0.000160	73	0.026871	0.015367
22	0.000682	0.000160	74	0.029594	0.016983
23	0.000691	0.000163	75	0.032631	0.018771
24	0.000648	0.000167	76	0.036018	0.021902
25	0.000619	0.000171	77	0.039797	0.025496
26	0.000601	0.000177	78	0.044011	0.029624
27	0.000595	0.000185	79	0.048710	0.034374
28	0.000597	0.000193	80	0.053947	0.038115
29	0.000605	0.000203	81	0.059780	0.042314
30	0.000620	0.000215	82	0.066277	0.047032
31	0.000638	0.000227	83	0.073509	0.052331
32	0.000659	0.000241	84	0.081559	0.058274
33	0.000679	0.000254	85	0.090513	0.064928
34	0.000701	0.000268	86	0.101289	0.072365
35	0.000719	0.000282	87	0.113365	0.080663
36	0.000738	0.000295	88	0.126894	0.089916
37	0.000763	0.000313	89	0.142052	0.100229
38	0.000797	0.000334	90	0.158263	0.112631
39	0.000842	0.000359	91	0.175202	0.126190
40	0.000898	0.000391	92	0.192677	0.140796
41	0.000971	0.000427	93	0.210614	0.156378
42	0.001062	0.000471	94	0.229014	0.172901
43	0.001173	0.000521	95	0.247923	0.190353
44	0.001303	0.000581	96	0.267403	0.208729
45	0.001456	0.000647	97	0.285187	0.228018
46	0.001627	0.000722	98	0.305686	0.247137
47	0.001818	0.000804	99	0.324923	0.269675
48	0.002029	0.000892	100	0.348795	0.290868
49	0.004205	0.000987	101	0.369903	0.315057
50	0.004537	0.002480	102	0.393830	0.337145
51	0.004898	0.002676	103	0.414291	0.362179
52	0.005331	0.002878	104	0.437601	0.384366
53	0.005767	0.003088	105	0.456803	0.409500
54	0.006208	0.003280	106	0.475121	0.431046
55	0.006659	0.003481	107	0.492468	0.451934
56	0.007070	0.003692	108	0.508786	0.472023
57	0.007500	0.003919	109	0.524039	0.491198
58	0.007963	0.004170	110	0.530000	0.509367
59	0.008474	0.004450	111	0.530000	0.526464
60	0.009047	0.004763	112	0.530000	0.542451
61	0.009692	0.005114	113	0.530000	0.550000
62	0.010420	0.005505	114	0.530000	0.550000
63	0.011235	0.005988	115	0.530000	0.550000
64	0.012141	0.006526	116	0.530000	0.550000
65	0.013141	0.007130	117	0.530000	0.550000
66	0.014237	0.007804	118	0.530000	0.550000
67	0.015437	0.008560	119	1.000000	0.550000
68	0.016888	0.009407	120	1.000000	1.000000
69	0.018492	0.010354			
70	0.020267	0.011412			

TABLE 8

ALL SYSTEMS

RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF DISABILITY

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.008914	0.002231	71	0.054287	0.037962
20	0.009036	0.002286	72	0.057934	0.041045
21	0.008476	0.002328	73	0.061945	0.044413
22	0.008090	0.002383	74	0.066363	0.048078
23	0.007863	0.002465	75	0.071235	0.052059
24	0.007775	0.002576	76	0.076616	0.056372
25	0.007810	0.002700	77	0.082562	0.061036
26	0.007915	0.002837	78	0.089136	0.066074
27	0.008108	0.003003	79	0.096405	0.071506
28	0.008353	0.003182	80	0.104436	0.077357
29	0.008616	0.003361	81	0.113303	0.083652
30	0.008896	0.003553	82	0.123081	0.090420
31	0.009159	0.003746	83	0.133850	0.097694
32	0.009386	0.003939	84	0.145697	0.105510
33	0.009649	0.004132	85	0.158714	0.113909
34	0.009982	0.004380	86	0.173005	0.122939
35	0.010420	0.004669	87	0.187464	0.132652
36	0.010997	0.005027	88	0.202100	0.143420
37	0.011750	0.005454	89	0.216924	0.155186
38	0.012696	0.005964	90	0.231944	0.167890
39	0.013887	0.006570	91	0.247169	0.181474
40	0.015340	0.007286	92	0.262610	0.195880
41	0.017039	0.008112	93	0.278276	0.211049
42	0.017741	0.009049	94	0.294176	0.226923
43	0.018428	0.009635	95	0.310320	0.243443
44	0.019101	0.010215	96	0.326717	0.260551
45	0.019757	0.010787	97	0.343376	0.278189
46	0.020395	0.011352	98	0.360308	0.296297
47	0.021016	0.011907	99	0.377522	0.314819
48	0.021621	0.012450	100	0.395026	0.333694
49	0.022210	0.012979	101	0.412831	0.352865
50	0.022791	0.013494	102	0.430946	0.372273
51	0.023369	0.013992	103	0.448227	0.391860
52	0.023953	0.014479	104	0.464592	0.410849
53	0.024557	0.014958	105	0.479987	0.429112
54	0.025190	0.015439	106	0.494376	0.446544
55	0.025868	0.015931	107	0.500000	0.463061
56	0.026604	0.016447	108	0.500000	0.478604
57	0.027414	0.016999	109	0.500000	0.493137
58	0.028312	0.017603	110	0.500000	0.500000
59	0.029314	0.018273	111	0.500000	0.500000
60	0.030433	0.019028	112	0.500000	0.500000
61	0.031685	0.019884	113	0.500000	0.500000
62	0.033081	0.020860	114	0.500000	0.500000
63	0.034633	0.021976	115	0.500000	0.500000
64	0.036353	0.023250	116	1.000000	0.500000
65	0.038253	0.024702	117	1.000000	1.000000
66	0.040346	0.026348	118	1.000000	1.000000
67	0.042647	0.028203	119	1.000000	1.000000
68	0.045170	0.030280	120	1.000000	1.000000
69	0.047935	0.032591			
70	0.050965	0.035148			