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PERS
of MISSISSIPPI

State of Mississippi Retirement Systems
Experience Investigation for the
Four-Year Period
Ending June 30, 2022

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April 21, 2023

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) and the Municipal Retirement Systems (MRS) for the four-year period from July 1, 2018 to June 30, 2022. The study was based on the data submitted by PERS for the annual valuation. In preparing this report, we relied, without audit, on the data provided.

The purpose of the investigation was to assess the reasonability of the current PERS economic assumptions and demographic actuarial assumptions for each Retirement System. Actuarial assumptions are used to measure and budget future costs. Changing assumptions will not change the actual cost of future benefits. Once the assumptions have been adopted, the actuarial valuation measures the adequacy of the fixed contribution rate. As a result of the investigation, it is recommended that revised demographic tables be adopted by the Board for future use.

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

In order to prepare the measurement of the impact on liabilities in this report, we have utilized actuarial models that we developed to measure liabilities and develop actuarial costs. These models include tools that we have produced and tested, along with commercially available valuation software that we have reviewed to confirm the appropriateness and accuracy of the output. In utilizing these models, we develop and use input parameters and assumptions about future contingent events along with recognized actuarial approaches to develop the needed results.

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).

We note that as we prepare this report, the world has been in a pandemic during much of the experience study period. We have taken this into consideration as we reviewed the experience, particularly regarding mortality, retirement, termination and disability patterns. While we do not believe that there is yet sufficient data to warrant the significant modification of any of our assumptions specifically due to COVID-19, we will continue to monitor the situation and advise the Board in the future of any adjustments that we believe would be appropriate.

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,

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

Ben Mobley, ASA, FCA, MAAA
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) 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 for PERS and MRS for the four-year period ending June 30, 2022. 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, 2023 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, outside of the recent pandemic. 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 recovery from the pandemic in 2021 followed by the downward trend in global markets in 2022. 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, although the last two years have experienced higher than normal inflation due to the recovery from the pandemic, we believe that long-term inflation will settle back down in the 2.40% to 2.50% range. So therefore, **we are recommending that the price inflation assumption remain at 2.40%**.

We are also recommending that the long-term expected return on assets assumption remain at 7.00%, reflecting the 2.40% inflation assumption and a 4.60% real rate of return assumption. This will be discussed in detail later in this report, but a real rate of return of 4.60% is supported by the forecasting models developed using the Board's investment consultant's capital market assumptions and the Board's target asset allocation. Further analysis of the 40 sets of capital market assumptions included in the Horizon Actuarial Services, LLC. Survey conducted in 2022 and the Board's target asset allocation also support this recommendation.

Based on the Board's funding policy, the current long-term investment return assumption adopted by the PERS' Board is 7.55% and will be reduced until it reaches the rate recommended by the actuary in the most recent experience study using net investment gains based on the following parameters:

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

An example of this methodology is if the actual net investment return on a market return basis is 15.00% (excess return of 7.45% over the assumed rate) for the fiscal year ending June 30, 2023, then the investment return assumption will be reduced by 10 basis points from 7.55% to 7.45% for the 2023 valuation. This methodology would continue for each subsequent valuation until the investment return assumption is equal to our recommended rate of 7.00%.

Finally, we are recommending that the general wage inflation (payroll growth) assumption used as the underlying payroll growth for active members and used in the level percent of payroll amortization method remain at 2.65%.

The following table summarizes the current and proposed economic assumptions:

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

* Net of investment expenses only.

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.

Please note that for the Municipal Retirement System (MRS), we recommend continuation of the investment return assumption methodology that has been in place for the past two years. The calculation of the millage rates for each of the municipalities is determined by a projected cash flow analysis, using the current market value of assets as of each valuation date, an assumption that assessed property values remain level over time, and an assumption methodology on investment earnings. The current methodology utilizes a 1.50% differential between the current long-term investment return assumption used for PERS. The 6.05% assumption is 1.50% less than the current assumption used by PERS (7.55%). As MRS is closed to new members, we are assuming a more conservative assumption even though assets are commingled with PERS' assets.

Recommended Demographic Assumption Changes

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

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

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

In this experience study, we also analyzed recent experience on a benefit-weighted basis where the exposures and deaths are multiplied by the monthly retirement benefit amount. This helps to reflect any differences that arise from better mortality experience among those with larger benefits. Because a valuation is designed to measure the amount and timing of future benefit payments (liability) rather than simply the number of retirees leaving pay status, this benefit-weighted approach is an important factor in valuing plan obligations. The Actual to Expected Ratios on the benefit-weighted basis were very similar to the Actual to Expected Ratios on a count basis over the past four years, so therefore, there was no distinguishing difference in providing this analysis.

The current post-retirement mortality assumption for healthy lives, which we changed in the 2018 experience study, is a generational mortality approach using the Pub-2010 Mortality Tables. These tables, released in 2019, were developed using public pension plan mortality experience only. In the 2020 experience study, we adjusted these tables to better match the mortality experience of the State of Mississippi and the membership of PERS. Since these new tables have been adopted, PERS has experienced approximately 800 more retiree deaths than expected, due in large part to the COVID-19 pandemic, in our opinion. While a task to determine the cause of these deaths would be extremely time-consuming, we do believe that this amount is within ranges as to what other public sector retirement plans are experiencing across the country for COVID-related deaths.

Therefore, we have decided to recommend continuation of the Pub-2010 Public Safety Headcount Mortality Tables, with the same adjustments or refinements for service retirees and beneficiaries from the current table. We believe mortality experience in the next experience study may come back to more normal levels, which should give us more credible data to determine if a change in the mortality table is warranted.

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

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

- **Retirement: Recommend minor adjustments in the rates of retirement to better match experience of the System.**
- **Disability: Decrease rates of disability retirement at most ages.**
- **Withdrawal: Recommend minor adjustments in the rates of withdrawal that better match experience of the System based on an age by service matrix table broken down by tier.**
- **Merit Salary Scale: No change in the merit salary at this time.**
- **Pre-Retirement Mortality: No change in mortality table.**

Section IV of this report will provide more detail to these recommended demographic changes.

Actuarial Methods

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

- Actuarial Cost Method
- Asset Valuation Method
- Amortization Method

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

Other Assumptions

Another assumption that is included in the PERS valuation is the determination of administrative expense component that is added to the total normal cost each year. The current assumption is 0.28% of payroll. **After reviewing the total amount of administrative expenses for the past four years and the percentage of payroll, we are recommending a slight decrease in this assumption from 0.28% to 0.26% of payroll.** The following table shows actual percentages over the past four years:

($ in Thousands)

Year Ending June 30	Administrative Expenses	Annual Payroll	Percentage
2019	16,905	6,144,916	0.28%
2020	19,757	6,287,441	0.31%
2021	15,691	6,246,077	0.25%
2022	15,926	6,454,760	0.25%

Financial Impact

Although the assumption changes, if approved, will first be reflected in the 2023 valuations, we have provided the following table which highlights the impact of the recommended changes on the unfunded accrued liability (UAL), funding ratio, actuarially determined employer contribution (ADEC), amortization period, and projected funding ratio on the 2022 valuation and projection results.

($ in Millions)

	Before All Changes	After All Changes at 7.55%	After All Changes at 7.00%
2022 Valuation UAL	$20,127	$20,313	$23,703
2022 Funding Ratio	61.3%	61.1%	57.4%
2022 Actuarially Determined Employer Contribution (ADEC)	21.72%	21.92%	25.35%
Projected Funding Ratio 2047*	86.1%	84.4%	61.6%

* Recommended Fixed Contribution Rate (FCR) of 22.40% kept constant.

It should be noted that since there is no recommended change in the post-retirement mortality table or the investment return assumption, there is no financial impact to the MRS valuation results.

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

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

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

Unlike demographic assumptions, economic assumptions do not lend themselves to analysis largely on the basis of internal historical patterns because economic assumptions are impacted by external forces in the economy. The investment return and general wage increase assumptions are selected on the basis of expectations in an inflation-free environment and then increased by the long-term expectation for inflation, called the "building block" approach.

Sources of data considered in the analysis and selection of the economic assumptions included:

- The 2022 Social Security Trustees Report
- Future expectations of PERS investment consultant, Callan
- Future expectations of other investment consultants (2022 Horizon Survey)
- U.S. Department of the Treasury bond rates
- Assumptions used by other large public retirement systems, based on the Public Fund Survey, published by the National Association of State Retirement Administrators (NASRA)
- Historical observations of price and wage growth statistics and investment returns

Actuarial Standard of Practice (ASOP) No. 27, *"Selection of Economic Assumptions for Measuring Pension Obligations"* provides guidance to actuaries in selecting economic assumptions for measuring obligations under defined benefit plans. ASOP No. 27 requires that each economic assumption selected by the actuary should be reasonable which means it has the following characteristics:

- It is appropriate for the purpose of the measurement;
- It reflects the actuary's professional judgment;
- It takes into account historical and current economic data that is relevant as of the measurement date;
- It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and

- It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included and disclosed, or when alternative assumptions are used for the assessment of risk.

With respect to relevant data, the standard recommends the actuary review appropriate recent and long-term historical economic data but advises the actuary not to give undue weight to recent experience. Furthermore, it advises the actuary to consider that some historical economic data may not be appropriate for use in developing assumptions for future periods due to changes in the underlying environment. In addition, with respect to any particular valuation, each economic assumption should be consistent with all other economic assumptions over the measurement period.

ASOP 27 recognizes that economic data and analyses are available from a variety of sources, including representatives of the plan sponsor, investment advisors, economists, and other professionals. The actuary is permitted to incorporate the views of experts, but the selection or advice must reflect the actuary's professional judgment.

The standard also discusses a "range of reasonable assumptions" which in part states "the actuary should also recognize that different actuaries will apply professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop both for an individual actuary and across actuarial practice."

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

Item	Current Assumptions	Proposed Assumptions
Price Inflation	2.40%	2.40%
Real Rate of Return*	4.60	4.60
Investment Return	7.00%	7.00%
Price Inflation	2.40%	2.40%
Real Wage Growth	0.25	0.25
Wage Inflation	2.65%	2.65%
Payroll Growth	2.65%	2.65%

* 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 2.40% per year, which was recommended and adopted in the last experience study.

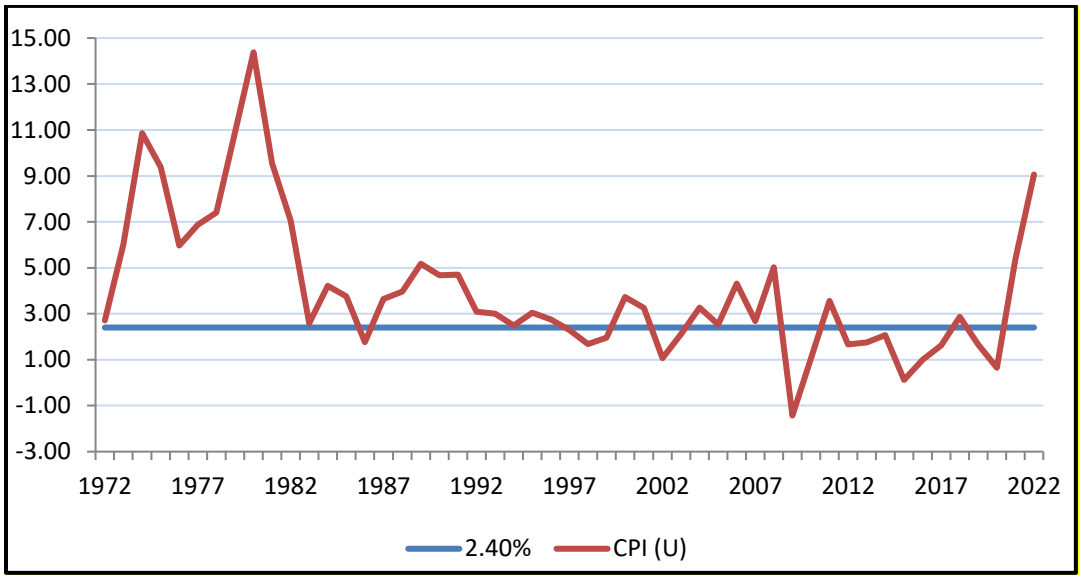
Past Experience

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 – 2022	96	2.96%	4.06%
1962 – 2022	60	3.88	2.92
1972 – 2022	50	4.00	3.11
1982 – 2022	40	2.83	1.76
1992 – 2022	30	2.53	1.86
2002 – 2022	20	2.53	2.23
2012 - 2022	10	2.59	2.69

The following graph illustrates the historical levels of price inflation measured as of June 30th of each of the last 50 years and compared to the current 2.40% annual rate currently assumed.

Annual Rate of CPI (U) Increases



As can be seen from the table on the previous page, over the last 30 years, the average annual rate of increase in the CPI-U has been just over 2.50%. The higher annual rates over the past two years have increased this average. In the last experience study in 2020, the 30-year average of price inflation was approximately 2.30%.

Forecasts

Based upon information contained in the "Survey of Professional Forecasters" for the fourth quarter of 2022 as published by the Philadelphia Federal Reserve Bank, the median expected annual rate of inflation for the next ten years is 2.37%. Although 10 years of future expectation is too short of a period for the basis of our inflation assumption, the information does provide some evidence that the consensus expectations of these experts are for rates of inflation very close to our current assumption of 2.40% for the near-term future.

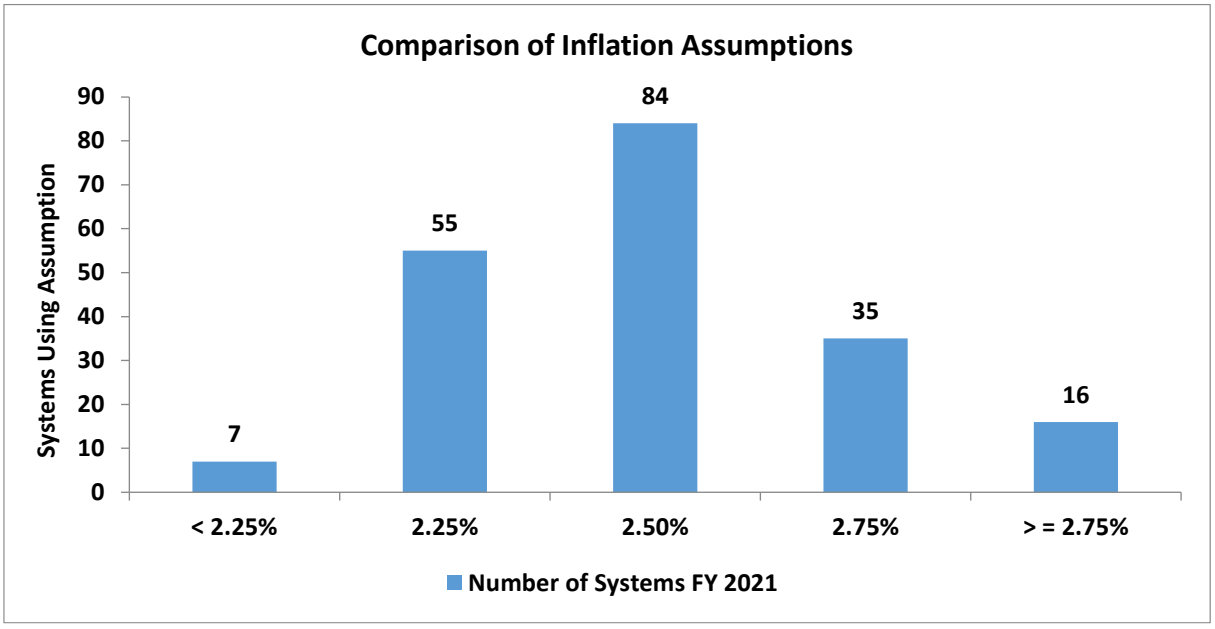
PERS' investment consultant, Callan, also has an inflation forecast in their capital market assumptions. Their short-term assumption (10 years) is 2.50%. Horizon Actuarial Services surveys a significant portion of the major investment advisors and publishes their assumptions. For the 2022 study, the long-term inflation assumption was 2.44%.

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 2022 annual report, the projected ultimate average annual increase in the CPI over the next 75 years was estimated to be 2.40%, under the intermediate (best estimate) cost assumption. The range of inflation assumptions used in the Social Security 75-year modeling, which includes a low and high-cost scenario, in addition to the intermediate cost projection, was 1.80% to 3.00%. These rates remained unchanged from their 2020 annual report.

Peer Comparison

While we do not recommend the selection of any assumption based on what other systems use, it does provide another set of relevant information to consider. The following chart shows the inflation rate assumptions of 194 plans in the Public Plan Database of the Center for Retirement Research. Based on the current data, the average inflation assumption is 2.52%. The assumptions are from actuarial valuations reported in FYE 2021. Although inflation has spiked recently, we have not seen a reversal of this trend and expect most systems to take a wait-and-see approach.



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 2.59% is closer to the System's assumed rate of 2.40%, the longer 50-year average of 4.00% is much higher and it includes the very high rates of inflation from the late 1970s and early 1980s. Those high rates will not be part of the 50-year average for much longer.

Although we have experienced rather high inflation over the last few months due to the recovery from the COVID-19 pandemic, current economic forecasts suggest annual inflation rates closer to 2.40% over the short-term and long-term, respectively. We concur with these forecasts and recommend maintaining the inflation assumption for PERS at 2.40%.

Price Inflation Assumption	
Current	2.40%
Recommended	2.40%

Investment Return

Background

The investment return assumption reflects anticipated returns on the current and future assets. 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 rate recommended by the actuary is 7.00%, consisting of a price inflation assumption of 2.40% and a real rate of return assumption of 4.60%.

Based on the Board's funding policy, the current investment return assumption adopted by the PERS' Board in conjunction with the experience investigation is 7.55% and will be reduced until it reaches the rate recommended by the actuary in the most recent experience study using net investment gains based on the following parameters:

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

An example of this methodology is if the actual net investment return on a market return basis is 15.00% (excess return of 7.45% over the assumed rate) for the fiscal year ending June 30, 2023, then the investment return assumption will be reduced by 10 basis points from 7.55% to 7.45% for the 2023 valuation. This methodology would continue for each subsequent valuation until the investment return assumption is equal to the recommended rate of 7.00%.

Long Term Perspective

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

Past Experience

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

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

Year Ending 6/30	Actuarial Value	Market Value
2018	8.74	9.17
2019	6.79	6.25
2020	6.72	3.11
2021	12.47	32.17
2022	8.49	(8.64)
Average	8.64%	8.41%

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 (40 were included in the 2022 study with a 10-year horizon) and provide ranges of results as well as averages. This information provides an additional perspective on what a broad group of investment experts anticipate for future investment returns.

Our forward-looking analysis used the real rates of return in Callan's capital market assumptions for 2023-2032 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 5.52%, 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	5.52%	13.84%	-15.54%	-4.13%	4.69%	14.33%	29.77%
5	4.80	6.12	-4.90	0.65	4.69	8.90	15.25
10	4.71	4.33	-2.18	1.82	4.69	7.65	12.05
20	4.67	3.06	-0.22	2.65	4.69	6.77	9.84
30	4.65	2.50	0.67	3.02	4.69	6.39	8.88
40	4.64	2.16	1.20	3.24	4.69	6.16	8.31
50	4.64	1.93	1.56	3.40	4.69	6.00	7.92

The percentile results are the percentages of random returns over the time span shown that are expected to be less than the amount indicated. For example, for the 10-year time span, 5% of the resulting real rates of return will be below -2.18% and 95% will be above that. As the time span increases, the results begin to converge. Over a 50-year time span, the results indicate there will be a 25% chance that real returns will be below 3.40% and a 25% chance they will be above 6.00%. In other words, there is a 50% chance the real returns will be between 3.40% and 6.00%.

For a broader view of expected returns, we also reviewed the 2022 Survey of Capital Market Assumptions produced by Horizon Actuarial Services, LLC to see what other investment professionals are currently using for capital market assumptions. The Horizon survey includes both 10-year horizon and 20-year horizon capital market assumptions. We applied the same statistical analysis to these survey results as we did the capital market assumption of PERS investment advisor with the following real return results for the 10-year horizon and 20-year horizon:

Horizon Survey 10-year horizon

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	4.82%	13.57%	-15.86%	-4.64%	4.02%	13.48%	28.60%
5	4.13	6.01	-5.39	0.06	4.02	8.15	14.37
10	4.04	4.24	-2.72	1.20	4.02	6.92	11.24
20	4.00	3.00	-0.79	2.02	4.02	6.07	9.08
30	3.98	2.45	0.07	2.38	4.02	5.69	8.13
40	3.98	2.12	0.59	2.60	4.02	5.46	7.57
50	3.97	1.90	0.95	2.75	4.02	5.31	7.19

Horizon Survey 20-year horizon

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	5.54%	13.57%	-15.15%	-3.93%	4.74%	14.19%	29.30%
5	4.85	6.01	-4.68	0.77	4.74	8.87	15.09
10	4.76	4.24	-2.01	1.92	4.74	7.64	11.96
20	4.72	3.00	-0.08	2.74	4.74	6.79	9.79
30	4.70	2.45	0.79	3.10	4.74	6.41	8.85
40	4.70	2.12	1.31	3.32	4.74	6.18	8.29
50	4.69	1.90	1.67	3.47	4.74	6.03	7.91

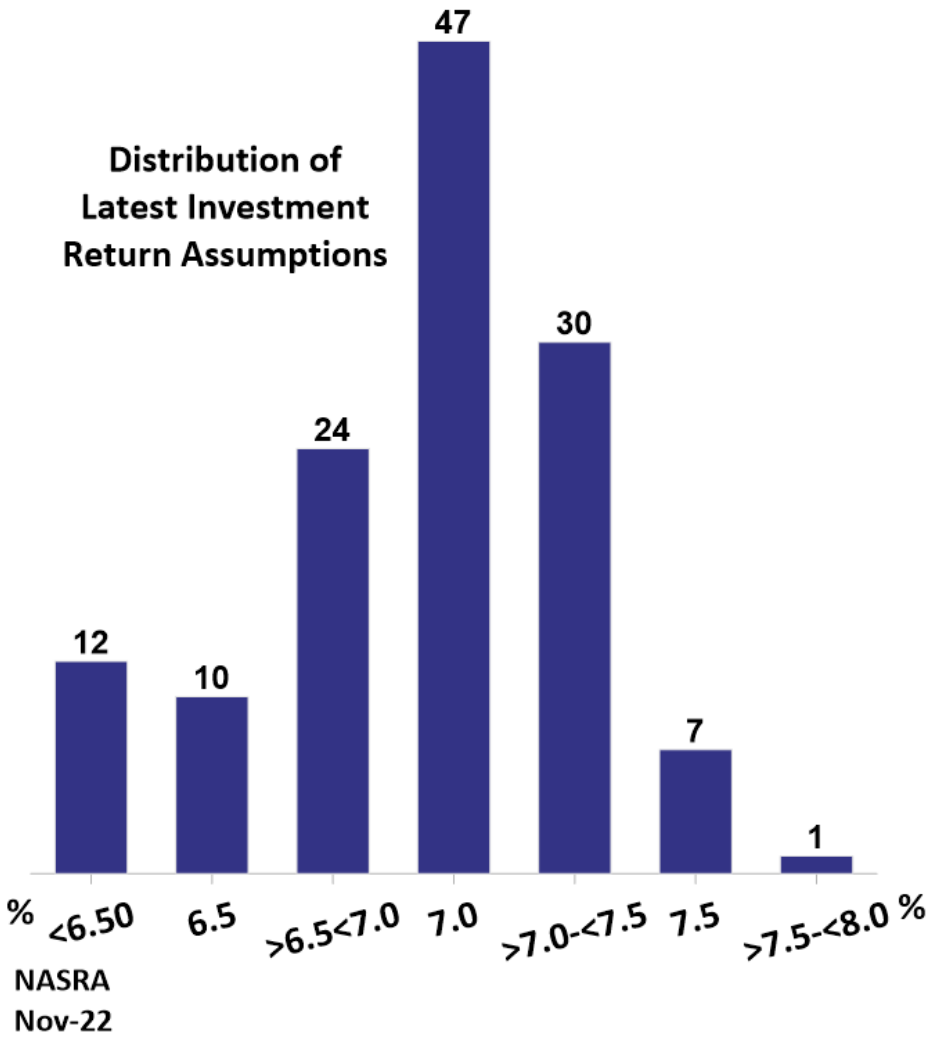
As you can see from the two tables above, setting a real return assumption depends on the time horizon a plan seeks. The 20-year horizon is approximately 0.70% higher at all percentiles than the 10-year horizon. While PERS is a long-term vehicle expected to pay benefits to its retirees for many years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

Using a 2.40% inflation assumption, the current investment return assumption of 7.55% utilizes a 5.15% real rate of return (using the "building block" methodology). Based on the table above, 5.15% falls into the 59th percentile. While it is above thresholds that we recommend for a long-term assumption, it is still a reasonable assumption, as it falls within the 40-60th percentile range.

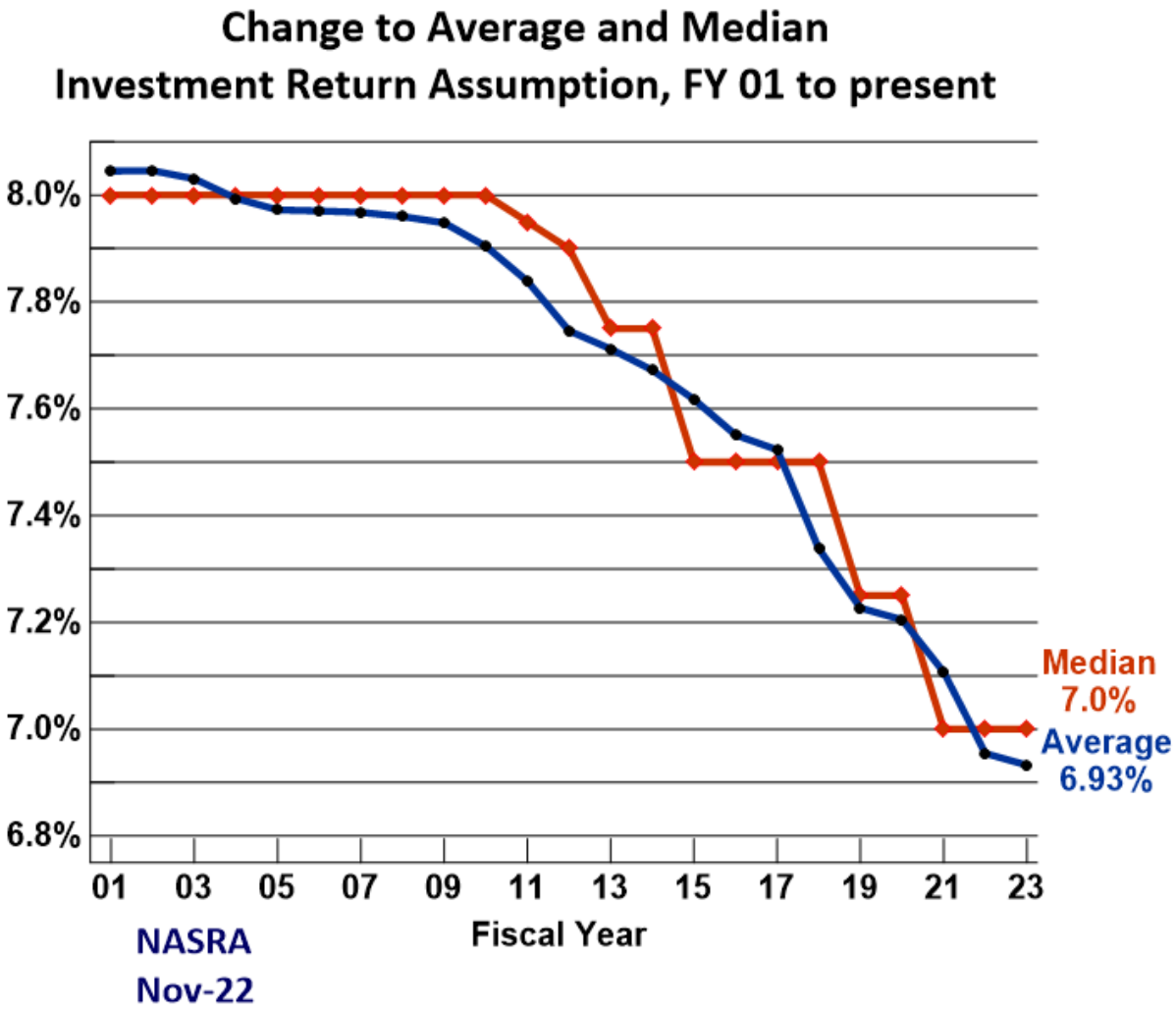
Peer Comparison

Public retirement systems have historically compared their investment performance to their peer group. While we believe there is some merit in assessing the movement in the assumed rate of return for other systems, this is not an appropriate basis for setting this assumption in our opinion. For example, different plans have different plan dynamics which will impact their choice of the assumed investment return. This peer group information merely provides another set of relevant data to consider as long as we recognize that asset allocation varies from system to system.

The following chart shows the nominal investment return assumptions of 131 plans in the National Association of State Retirement Administrators (NASRA). The assumptions shown below are as of November 2022 and are updated frequently by the NASRA staff.



The following chart shows the changes in expected investment return assumption from the NASRA public plan survey over the last 22 years from 2001.



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 short-term expectations impact our judgment regarding the appropriateness of the current assumption over the long term.

Based on our analysis of Callan's capital market assumptions and the Horizon Survey capital market assumptions, we are recommending continuation of a real return assumption of 4.60%. We acknowledge that this real return assumption is above Horizon Survey's anticipated return over the next 10 years of 4.02%, but we do put more weight on a slightly longer time horizon. Based on our recommended inflation assumption of 2.40% and real return assumption of 4.60%, we are recommending continuation of the 7.00% expected long term nominal rate of return assumption.

Investment Return Assumption		
	Current	**Recommended**
Real Rate of Return*	4.60%	4.60%
Inflation	2.40	2.40
Net Investment Return	7.00%	7.00%

* 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 2.65% and is composed of a 2.40% rate of inflation assumption and a 0.25% real rate of wage inflation.

Past Experience

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

As with our analysis of inflation, we provide below wage inflation and a comparison with price inflation over various time periods. Currently, this wage data is only available through calendar year 2021. 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
2011-2021	3.49%	2.14%	1.35%
2001-2021	3.10%	2.31%	0.79%
1991-2021	3.46%	2.37%	1.09%
1981-2021	3.77%	2.76%	1.01%
1971-2021	4.57%	3.90%	0.67%

Thus, over the last 50 years, annual real wage growth has averaged 0.67%.

Social Security Administration

The wage index used for the historical analysis is projected forward by the Office of the Chief Actuary of the Social Security Administration in their 75-year projections. In April of 2022, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.55%, 1.15% higher than the Social Security intermediate inflation assumption of 2.40% per year. The range of the assumed real wage inflation in the 2022 Trustees report was 0.53% to 1.77% per year.

Public Sector Compensation and Wages

The Bureau of Labor Statistics publishes the Employment Cost Index, including detail for real (net of inflation) total compensation and wages and salaries. Further, this index is also broken down for state and local government workers. From 2004 through 2022, total compensation grew at an annualized rate of 2.78%, while wages and salaries grew at a rate of 2.12% (Inflation was 2.51% over the same period). This difference is a reflection that state and local government workers have had much of their compensation increase delivered through benefits rather than wages and salaries. While it is certainly reasonable to anticipate that total compensation will continue to increase faster than wages and salaries, it is also reasonable to anticipate that the difference between the two will moderate over time.

Recommendation

The data the Social Security Administration collects is nationwide and predominantly from the private sector which includes many collectively bargained employees. It is questionable whether public sector employees can match the productivity rates of the private sector. **Therefore, we recommend that the plan maintain a 0.25% real wage growth inflation assumption and a total wage inflation growth of 2.65%.**

Wage Inflation Assumption		
	Current	Recommended
Price Inflation	2.40%	2.40%
Real Wage Growth	0.25%	0.25%
Wage Inflation	2.65%	2.65%

Payroll Growth

Background

The assumed future rate of payroll growth increase in the total payroll of PERS' active members is an assumption used in the level percentage of payroll amortization method that affects the calculation of the amortization period required to fully amortize the unfunded actuarial accrued liability and the actuarially determined employer contribution. The total payroll growth is impacted by individual member's increases and population growth. The current assumption is 2.65% per year which is comprised of the inflation assumption of 2.40% and real wage growth of 0.25%.

Past Experience

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

Period	Number of Years	Annual Payroll Growth	Annual Active Membership Growth	Net Payroll Growth
2002 – 2022	20	2.15%	-0.26%	2.41%
2007 – 2022	15	1.46%	-0.80%	2.27%
2012 – 2022	10	0.98%	-1.16%	2.16%
2017 – 2022	5	1.34%	-1.07%	2.44%

Recommendation

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

ACTUARIAL COST METHOD

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

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

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

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

ACTUARIAL VALUE OF ASSETS

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

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

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

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

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

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

These rules or principles prevent the asset valuation methodology from being used to manipulate annual funding patterns. No matter what asset valuation method is used, it is important to note that, like a cost method or actuarial assumptions, the asset valuation method does not affect the true cost of the plan; it only impacts the incidence of cost.

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

AMORTIZATION OF THE UNFUNDED ACTUARIAL ACCRUED LIABILITY

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

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

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

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

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

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

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

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

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

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

Recommendation

In the current PERS Board funding policy, an actuarially determined employer contribution (ADEC) is calculated during each annual valuation and the ADEC is compared to the Fixed Contribution Rate adopted by the Board as one of its Signal Light metrics. The methodology in calculating the ADEC is as follows:

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

We recommend no changes in these methods.

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

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

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

The purpose of a study of demographic experience is to compare what actually happened to the membership during the study period (July 1, 2018 through June 30, 2022) with what was expected to happen based on the assumptions used in the most recent Actuarial Valuations.

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

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

We note in particular that the period of time in this study overlaps with the COVID-19 pandemic that affected not only the health of individuals, but also led to individuals and employers responding differently than they had before. As a result, we have been more cautious in recommending changes for demographic assumptions than we would be in a more normal period.

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 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.

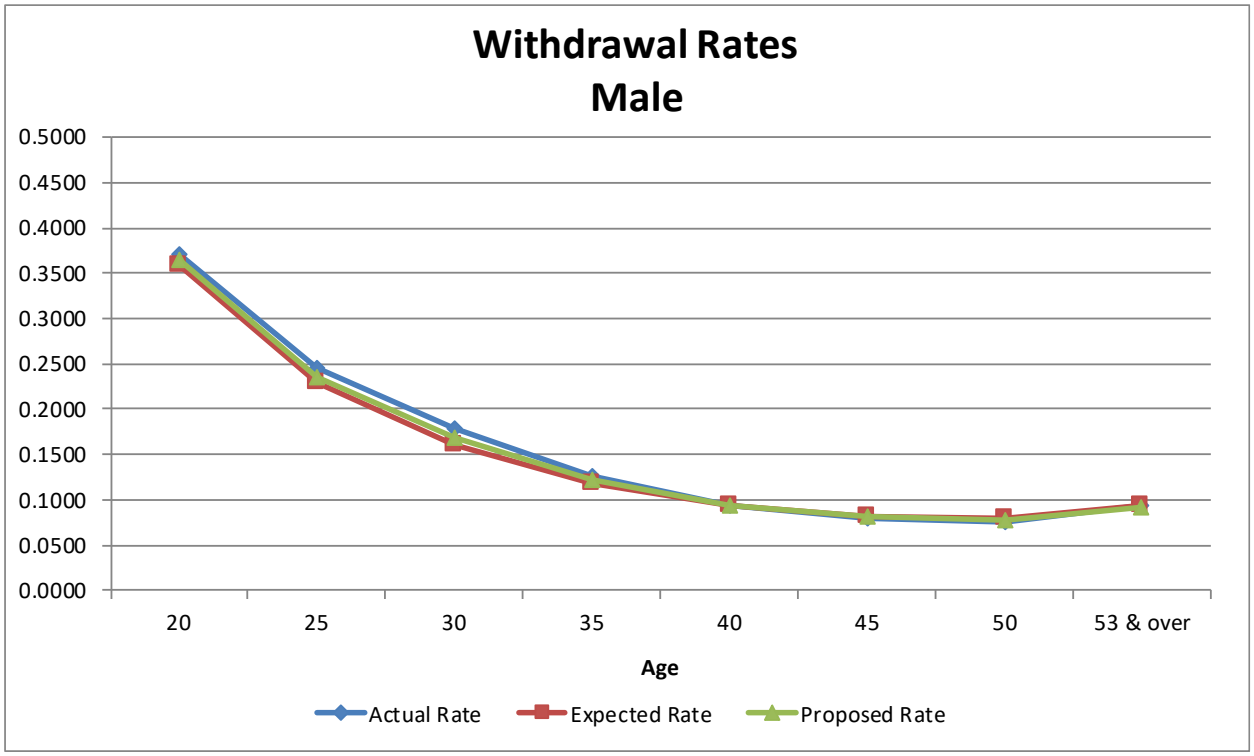
RATES OF WITHDRAWAL

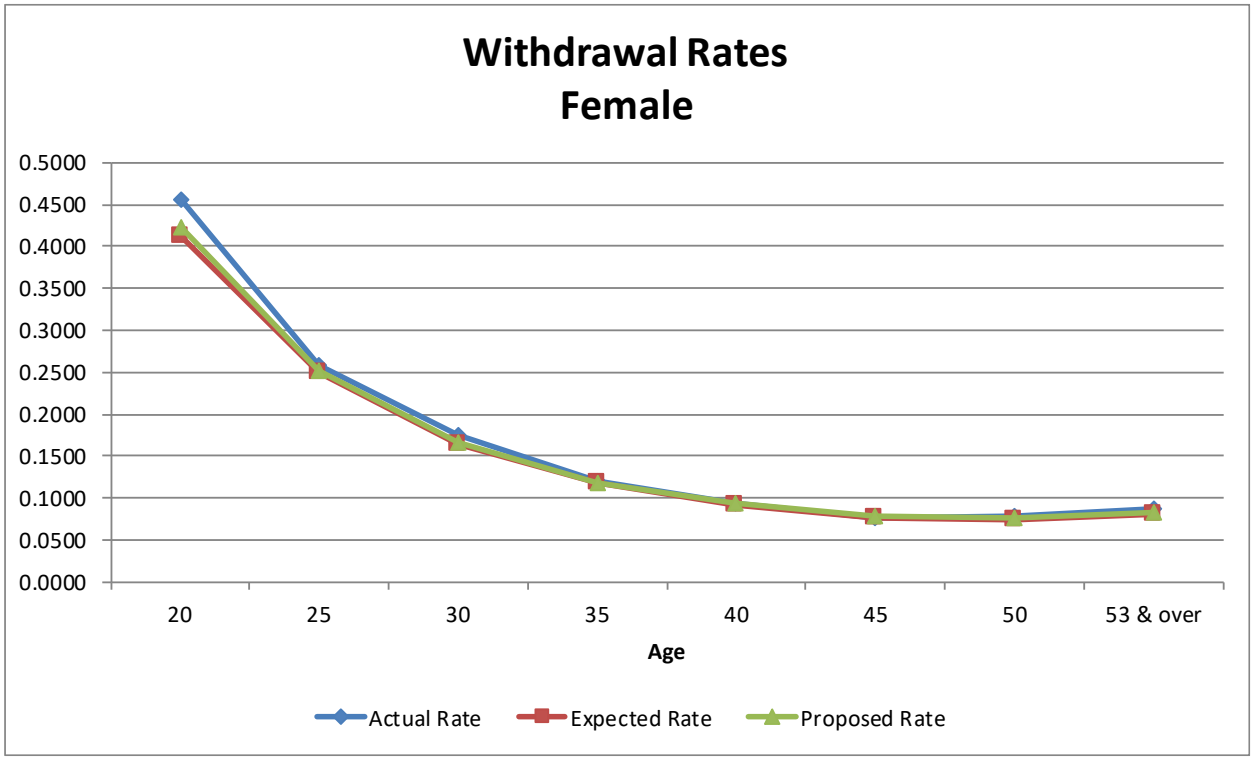
COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS FROM ACTIVE SERVICE

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
20	1,101	1,063	1.035	1,030	929	1.109
25	3,814	3,576	1.066	6,327	6,144	1.030
30	3,958	3,573	1.108	6,683	6,201	1.078
35	2,966	2,775	1.069	5,353	5,193	1.031
40	2,471	2,438	1.013	4,894	4,717	1.038
45	2,120	2,177	0.974	3,992	4,019	0.993
50	1,867	1,984	0.941	3,676	3,496	1.051
53 & over	3,816	3,754	1.017	5,842	5,314	1.099
TOTAL	**22,113**	**21,340**	**1.036**	**37,797**	**36,013**	**1.050**

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

RATES OF WITHDRAWAL FOR ACTIVE MEMBERS





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. In the prior study, we changed to an age/service matrix of rates of withdrawal and in aggregate this table seems to be reasonable. The results of our four-year study indicate that, in aggregate, the actual number of withdrawals was slightly more than expected at most ages. Therefore, we are only recommending fine-tuning the rates of withdrawal that will hopefully better match experience in the future.

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

COMPARATIVE RATES OF WITHDRAWAL

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

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

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

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

AGE	PROPOSED RATES OF WITHDRAWAL FOR MALES (Tiers 1-3)								
	SERVICE								
	0	1	2	3	4	5	10	15	20
20	42.00	35.00	28.00	25.00	17.00	13.00	-	-	-
25	35.00	27.00	21.00	17.50	16.00	13.00	6.50	-	-
30	35.00	27.00	21.00	16.00	14.00	12.50	6.50	3.75	-
35	35.00	25.00	19.00	15.00	13.00	12.50	6.50	3.75	3.25
40	35.00	24.00	18.00	14.00	11.50	10.00	6.00	3.75	3.25
45	32.00	23.50	17.00	12.50	11.50	9.50	6.00	3.75	3.25
50	27.00	19.00	15.00	12.50	11.50	9.00	5.75	3.75	3.25
53+	25.00	19.00	14.00	12.50	11.00	9.00	5.75	3.75	3.25

AGE	PROPOSED RATES OF WITHDRAWAL FOR FEMALES (Tiers 1-3)								
	SERVICE								
	0	1	2	3	4	5	10	15	20
20	45.00	42.00	35.00	27.00	17.00	12.50	-	-	-
25	37.00	27.50	23.00	18.00	17.00	12.50	7.00	-	-
30	35.00	27.00	21.00	16.00	13.50	12.50	7.00	4.00	-
35	30.00	24.00	19.00	14.00	12.00	12.00	6.00	4.00	3.50
40	28.00	23.00	17.50	13.50	11.50	9.50	6.00	4.00	3.50
45	27.50	20.00	16.75	12.75	11.50	9.50	6.00	4.00	3.50
50	27.50	20.00	14.50	12.75	11.50	9.50	6.00	4.00	3.50
53+	25.00	19.00	14.50	12.75	11.00	9.50	6.00	4.00	3.50

AGE	PROPOSED RATES OF WITHDRAWAL FOR MALES (Tier 4)									
	SERVICE									
	0	1	2	3	4	5	10	15	20	25
20	42.00	35.00	28.00	25.00	17.00	13.00	-	-	-	-
25	35.00	27.00	21.00	17.50	16.00	13.00	6.50	-	-	-
30	35.00	27.00	21.00	16.00	14.00	12.50	6.50	3.75	-	-
35	35.00	25.00	19.00	15.00	13.00	12.50	6.50	3.75	3.25	-
40	35.00	24.00	18.00	14.00	11.50	10.00	6.00	3.75	3.25	3.25
45	32.00	23.50	17.00	12.50	11.50	9.50	6.00	3.75	3.25	3.25
50	27.00	19.00	15.00	12.50	11.50	9.00	5.75	3.75	3.25	3.25
53+	25.00	19.00	14.00	12.50	11.00	9.00	5.75	3.75	3.25	3.25

AGE	PROPOSED RATES OF WITHDRAWAL FOR FEMALES (Tier 4)									
	SERVICE									
	0	1	2	3	4	5	10	15	20	25
20	45.00	42.00	35.00	27.00	17.00	12.50	-	-	-	-
25	37.00	27.50	23.00	18.00	17.00	12.50	7.00	-	-	-
30	35.00	27.00	21.00	16.00	13.50	12.50	7.00	4.00	-	-
35	30.00	24.00	19.00	14.00	12.00	12.00	6.00	4.00	3.50	-
40	28.00	23.00	17.50	13.50	11.50	9.50	6.00	4.00	3.50	3.50
45	27.50	20.00	16.75	12.75	11.50	9.50	6.00	4.00	3.50	3.50
50	27.50	20.00	14.50	12.75	11.50	9.50	6.00	4.00	3.50	3.50
53+	25.00	19.00	14.50	12.75	11.00	9.50	6.00	4.00	3.50	3.50

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

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
20	1,101	1,085	1.015	1,030	955	1.079
25	3,814	3,664	1.041	6,327	6,193	1.022
30	3,958	3,765	1.051	6,683	6,352	1.052
35	2,966	2,855	1.039	5,353	5,258	1.018
40	2,471	2,449	1.009	4,894	4,838	1.012
45	2,120	2,140	0.991	3,992	4,136	0.965
50	1,867	1,907	0.979	3,676	3,611	1.018
53 & over	3,816	3,707	1.029	5,842	5,515	1.059
TOTAL	**22,113**	**21,571**	**1.025**	**37,797**	**36,858**	**1.025**

RATES OF PRE-RETIREMENT MORTALITY

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

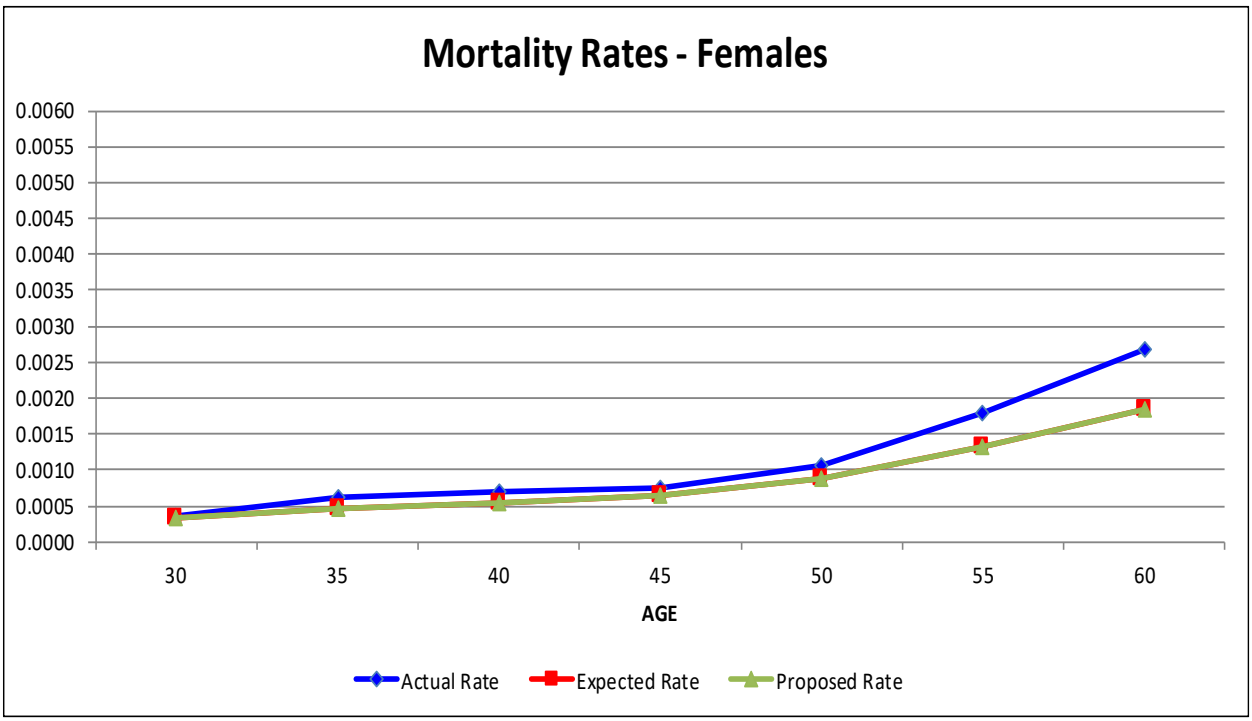
It is difficult to isolate the mortality for active members as it may be impacted by active members first terminating or moving to disabled status before death. The data collection methods used in this study do not fully capture known deaths, and so sometimes this can be misleading. Finally, the probability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

COMPARISON OF ACTUAL AND EXPECTED PRE-RETIREMENT DEATHS

CENTRAL AGE OF GROUP	NUMBER OF DEATHS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
30	25	19	1.316	14	13	1.077
35	15	24	0.625	28	21	1.333
40	42	29	1.448	36	28	1.286
45	51	34	1.500	39	34	1.147
50	82	47	1.745	57	47	1.213
55	88	64	1.375	84	62	1.355
60	134	96	1.396	110	75	1.467
63 & over	224	200	1.120	128	82	1.561
TOTAL	**661**	**513**	**1.288**	**496**	**362**	**1.370**

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


Mortality Rates - Males
0.0060
0.0055
0.0050
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
30
35
40
45
50
55
60
AGE
Actual Rate
Expected Rate
Proposed Rate


Mortality Rates - Females
0.0060
0.0055
0.0050
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
30
35
40
45
50
55
60
AGE
Actual Rate
Expected Rate
Proposed Rate

As can be seen from the table and graphs on the previous pages, the number of actual pre-retirement deaths was higher than expected. However, if we break down the 4-year period into the pre- and post-COVID years, we can see that the number of pre-retirement deaths during the first two years of the study period was very close to expected. As we will discuss in the post-retirement mortality section of this report, the number of total deaths for PERS was much higher in the last two years of the study period.

Therefore, we recommend no change in the current pre-retirement mortality table at this time. We believe mortality experience in the next experience study may come back to more normal levels, which should give us more credible data to determine if a change in the mortality table is warranted.

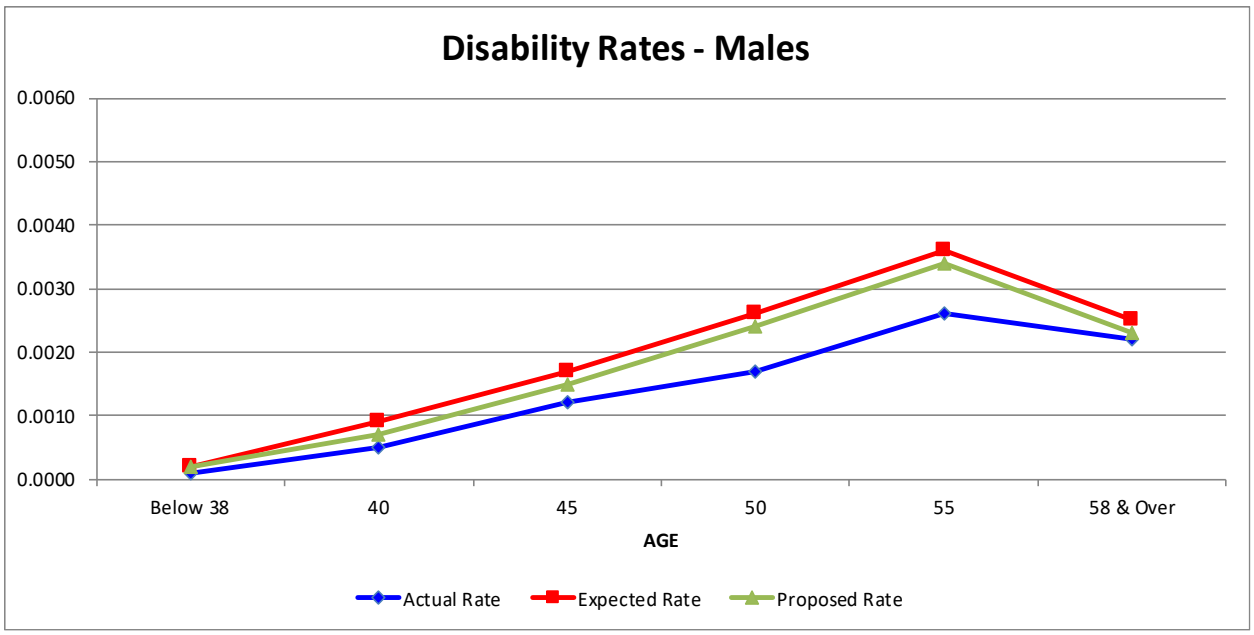
Membership Table	Set Forward (+)/ Setback (-)	Adjustment to Rates	Projection Scale
PubS.H-2010(B) Employee	None	Male: 105%, Female: 70%	MP-2020

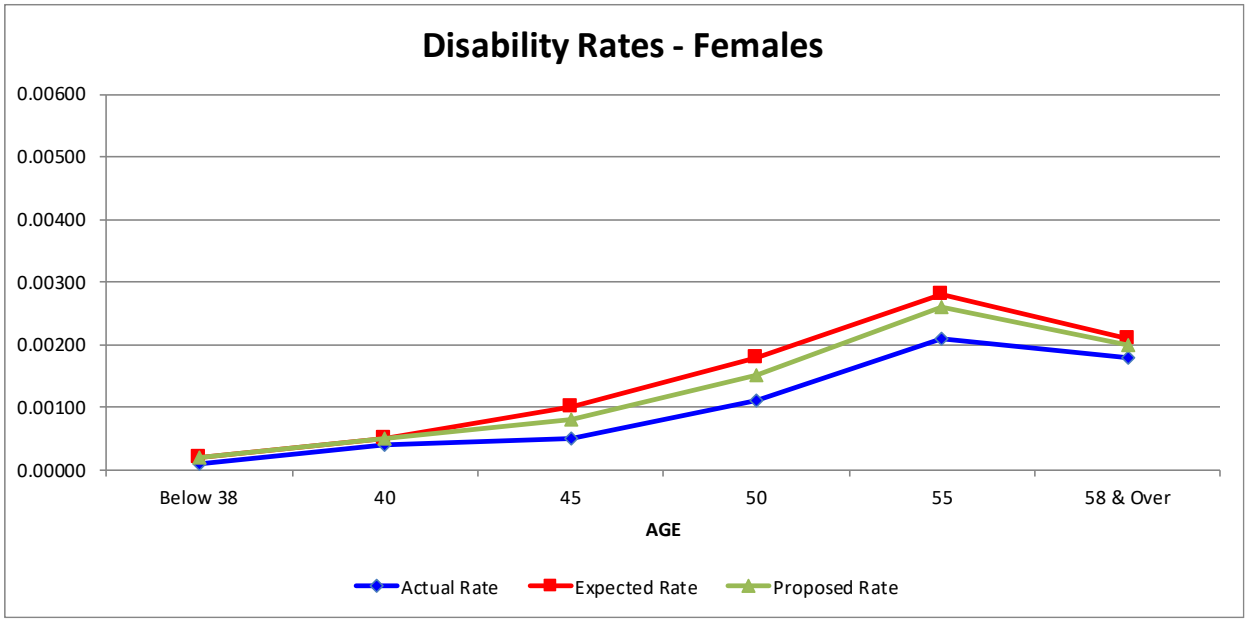
RATES OF DISABILITY RETIREMENT

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	9	12	0.750	6	20	0.300
40	14	24	0.583	23	27	0.852
45	32	46	0.696	26	54	0.481
50	49	74	0.662	59	94	0.628
55	66	92	0.717	98	133	0.737
58 & over	99	111	0.892	121	138	0.877
TOTAL	**269**	**359**	**0.749**	**333**	**466**	**0.715**

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





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

COMPARATIVE RATES OF DISABILITY RETIREMENTS

AGE	RATES OF DISABILITY			
	MALES		FEMALES	
	Present	Proposed	Present	Proposed
20	0.006%	0.006%	0.006%	0.006%
25	0.011	0.011	0.011	0.011
30	0.016	0.016	0.016	0.016
35	0.020	0.020	0.020	0.020
40	0.090	0.065	0.050	0.050
45	0.170	0.150	0.100	0.070
50	0.260	0.230	0.170	0.145
55	0.370	0.360	0.290	0.275
60	0.310	0.270	0.250	0.250

COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS BASED ON PROPOSED RATES

CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Below 38	9	12	0.750	6	20	0.300
40	14	18	0.778	23	25	0.920
45	32	40	0.800	26	40	0.650
50	49	67	0.731	59	81	0.728
55	66	86	0.767	98	121	0.810
58 & over	99	105	0.943	121	137	0.883
TOTAL	**269**	**328**	**0.820**	**333**	**424**	**0.785**

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	282	271	1.041	662	646	1.025
61	239	232	1.030	497	462	1.076
62	409	434	0.942	718	704	1.020
63	289	293	0.986	585	566	1.034
64	248	231	1.074	460	460	1.000
65	351	328	1.070	655	638	1.027
66	229	233	0.983	461	421	1.095
67	190	159	1.195	274	252	1.087
68	151	140	1.079	185	172	1.076
69	118	116	1.017	151	146	1.034
70	120	101	1.188	135	122	1.107
71	91	88	1.034	83	76	1.092
72	76	81	0.938	82	70	1.171
73	59	60	0.983	58	44	1.318
74	45	46	0.978	38	39	0.974
75	42	42	1.000	38	33	1.152
76	36	35	1.029	36	25	1.440
77	27	29	0.931	18	15	1.200
78	17	22	0.773	10	12	0.833
79	20	20	1.000	11	9	1.222
Subtotal	**3,039**	**2,961**	**1.026**	**5,157**	**4,912**	**1.050**
80 & Over	64	287	0.223	37	143	0.259
GRAND TOTAL	**3,103**	**3,248**	**0.955**	**5,194**	**5,055**	**1.027**

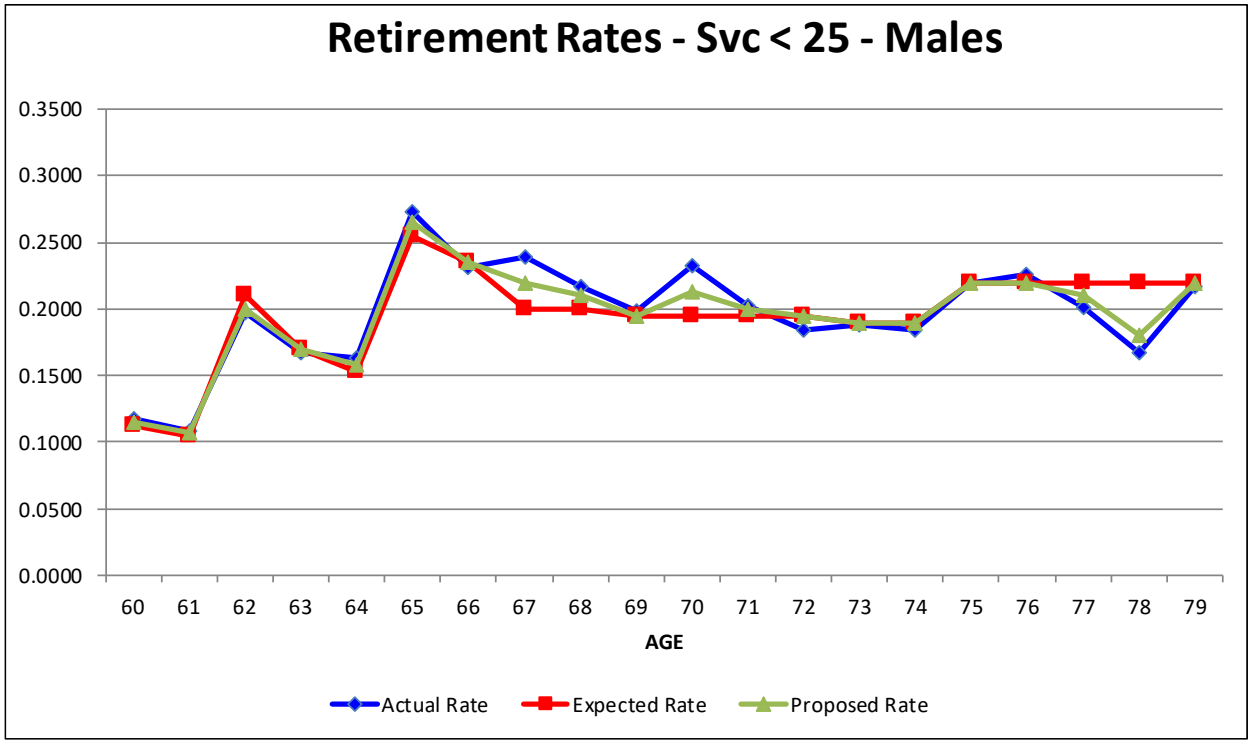
COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

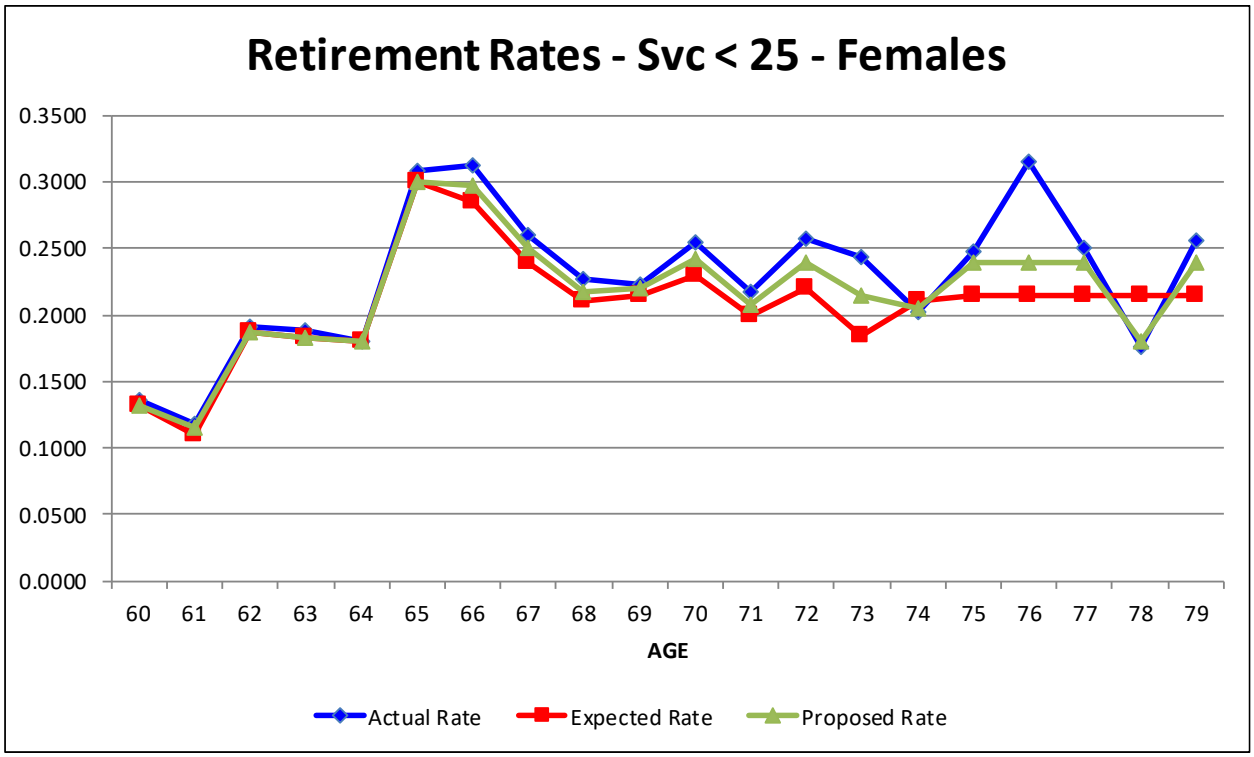
Retirements with 25 or more years of service

AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Below 48	187	138	1.355	103	97	1.062
48-51	575	516	1.114	864	707	1.222
52	177	166	1.066	270	234	1.154
53	162	147	1.102	281	256	1.098
54	167	150	1.113	279	253	1.103
55	184	155	1.187	330	296	1.115
56	162	165	0.982	313	296	1.057
57	189	169	1.118	310	308	1.006
58	168	150	1.120	340	315	1.079
59	158	136	1.162	335	344	0.974
60	172	159	1.082	336	332	1.012
61	167	163	1.025	350	384	0.911
62	212	211	1.005	423	473	0.894
63	149	146	1.021	330	338	0.976
64	125	129	0.969	272	290	0.938
65	180	167	1.078	287	314	0.914
66	111	121	0.917	204	203	1.005
67	75	75	1.000	115	119	0.966
68	63	63	1.000	79	74	1.068
69	42	49	0.857	45	56	0.804
70	40	42	0.952	47	47	1.000
71	27	34	0.794	36	38	0.947
72	21	24	0.875	25	26	0.962
73	18	18	1.000	22	21	1.048
74	15	16	0.938	12	16	0.750
75	16	18	0.889	11	13	0.846
76	13	16	0.813	10	9	1.111
77	14	14	1.000	12	9	1.333
78	8	10	0.800	5	7	0.714
79	6	7	0.857	5	6	0.833
Subtotal	**3,603**	**3,374**	**1.068**	**6,051**	**5,881**	**1.029**
80 & Over	28	98	0.286	20	72	0.278
GRAND TOTAL	**3,631**	**3,472**	**1.046**	**6,071**	**5,953**	**1.020**

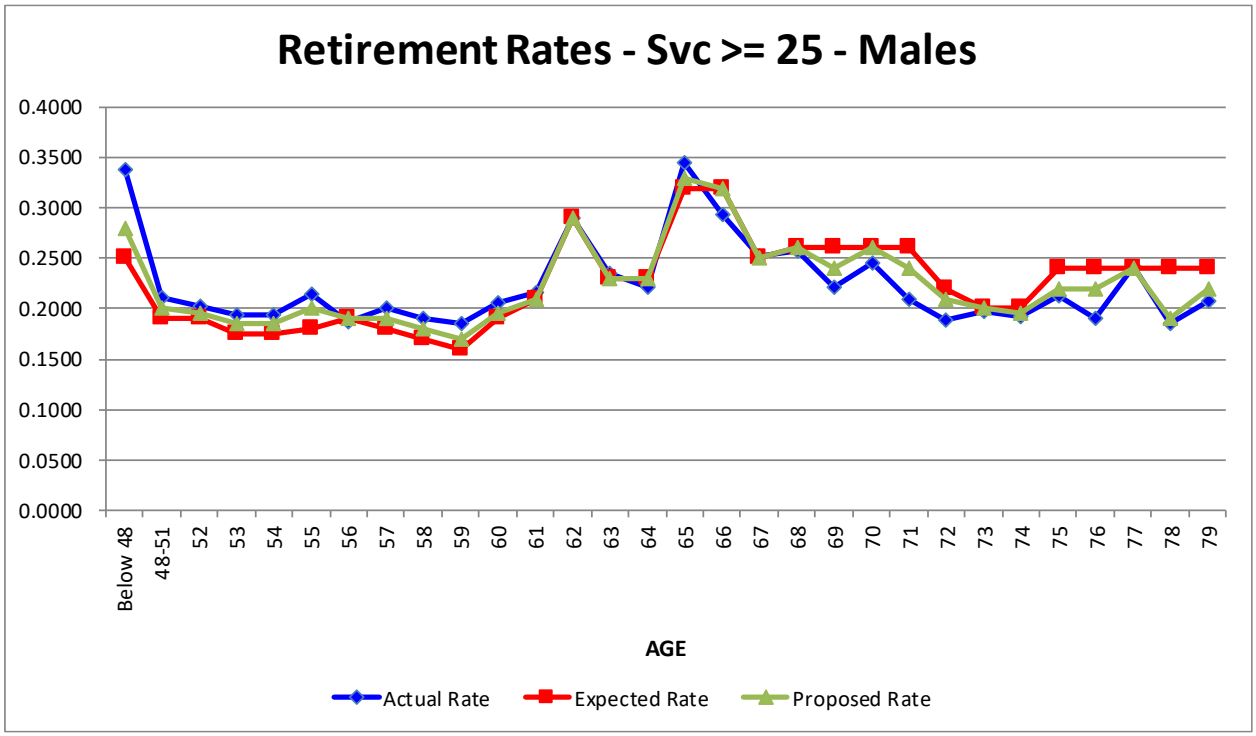
The following graphs show a comparison of the present, actual, and proposed rates of service retirements.

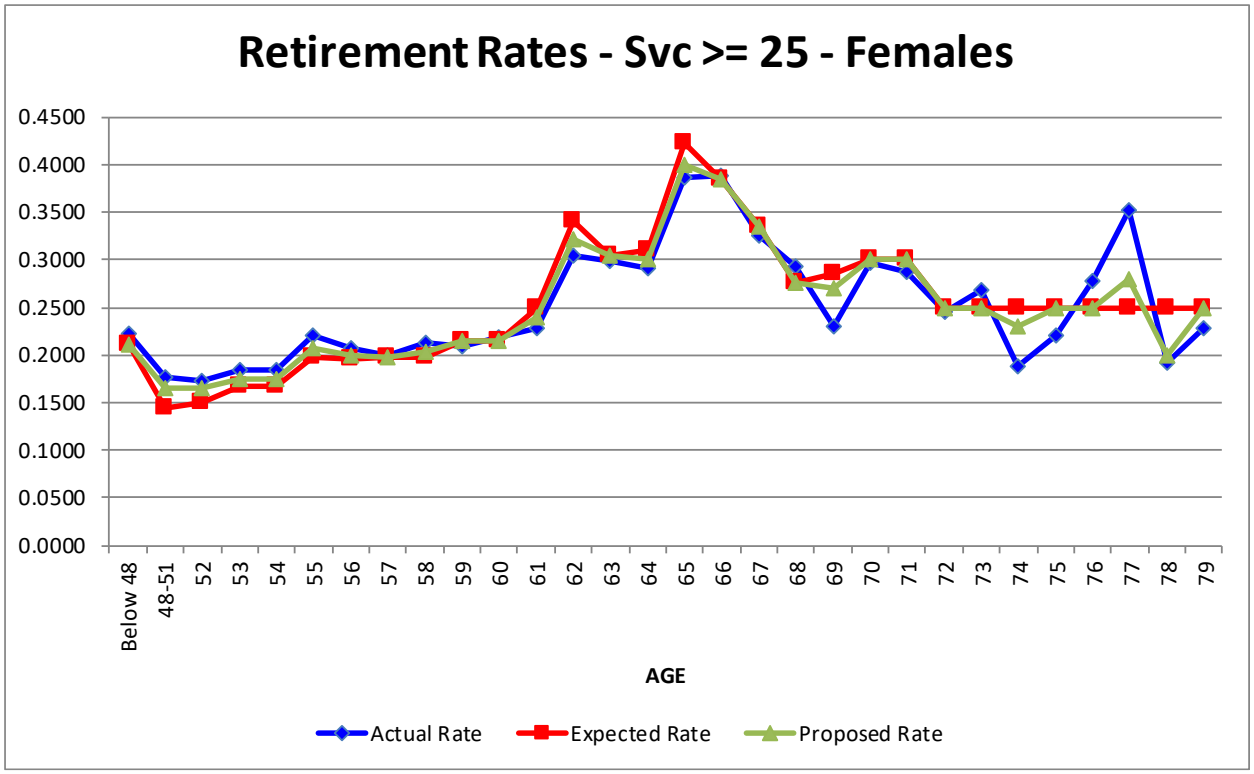
RATES OF RETIREMENT FOR ACTIVE MEMBERS WITH LESS THAN 25 YEARS OF SERVICE





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 reasonably close to expected at most ages. **However, we do recommend some slight adjustments in the rates of retirement, especially at the earlier ages, to better match anticipated experience going forward.**

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			25.00%	28.00%			21.00%	21.00%
50			19.00	20.00			14.50	16.50
55			18.00	20.00			19.75	20.75
60	11.25%	11.50%	19.00	19.50	13.25%	13.25%	21.50	21.50
62	21.00	20.00	29.00	29.00	18.75	18.75	34.00	32.25
65	25.50	26.50	32.00	33.00	30.00	30.00	42.25	40.00
70	19.50	21.25	26.00	26.00	23.00	24.25	30.00	30.00
75	22.00	22.00	24.00	22.00	21.50	24.00	25.00	25.00
80	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	282	277	1.018	662	646	1.025
61	239	238	1.004	497	483	1.029
62	409	414	0.988	718	704	1.020
63	289	293	0.986	585	566	1.034
64	248	238	1.042	460	460	1.000
65	351	341	1.029	655	638	1.027
66	229	233	0.983	461	439	1.050
67	190	175	1.086	274	263	1.042
68	151	147	1.027	185	178	1.039
69	118	116	1.017	151	149	1.013
70	120	110	1.091	135	128	1.055
71	91	90	1.011	83	79	1.051
72	76	81	0.938	82	76	1.079
73	59	60	0.983	58	51	1.137
74	45	46	0.978	38	39	0.974
75	42	42	1.000	38	37	1.027
76	36	35	1.029	36	27	1.333
77	27	28	0.964	18	17	1.059
78	17	18	0.944	10	10	1.000
79	20	20	1.000	11	10	1.100
Subtotal	**3,039**	**3,002**	**1.012**	**5,157**	**5,000**	**1.031**
80 & Over	64	287	0.223	37	143	0.259
GRAND TOTAL	**3,103**	**3,289**	**0.943**	**5,194**	**5,143**	**1.010**

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	187	155	1.206	103	97	1.062
48-51	575	543	1.059	864	805	1.073
52	177	171	1.035	270	257	1.051
53	162	155	1.045	281	268	1.049
54	167	159	1.050	279	264	1.057
55	184	172	1.070	330	311	1.061
56	162	165	0.982	313	303	1.033
57	189	178	1.062	310	308	1.006
58	168	159	1.057	340	323	1.053
59	158	145	1.090	335	344	0.974
60	172	163	1.055	336	332	1.012
61	167	163	1.025	350	368	0.951
62	212	211	1.005	423	449	0.942
63	149	146	1.021	330	338	0.976
64	125	129	0.969	272	281	0.968
65	180	172	1.047	287	297	0.966
66	111	121	0.917	204	203	1.005
67	75	75	1.000	115	119	0.966
68	63	63	1.000	79	74	1.068
69	42	46	0.913	45	53	0.849
70	40	42	0.952	47	47	1.000
71	27	31	0.871	36	38	0.947
72	21	23	0.913	25	26	0.962
73	18	18	1.000	22	21	1.048
74	15	15	1.000	12	15	0.800
75	16	17	0.941	11	13	0.846
76	13	15	0.867	10	9	1.111
77	14	14	1.000	12	10	1.200
78	8	8	1.000	5	5	1.000
79	6	6	1.000	5	6	0.833
Subtotal	**3,603**	**3,480**	**1.035**	**6,051**	**5,984**	**1.011**
80 & Over	28	98	0.286	20	72	0.278
GRAND TOTAL	**3,631**	**3,578**	**1.015**	**6,071**	**6,056**	**1.002**

RATES OF POST-RETIREMENT MORTALITY

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

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

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

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

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

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

The issue of future mortality improvement is one that the actuarial profession has become increasingly focused on studying and monitoring. This has resulted in changes to the relevant Actuarial Standard of Practice, ASOP 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. This ASOP requires the pension actuary to make and disclose a specific recommendation with respect to future improvements in mortality after the valuation date, although it does not require that an actuary assume there will be future improvements. There have been significant improvements in longevity in the past, although there are different opinions about future expectations, and thus there is a subjective component in the estimation of future mortality improvement. We believe it is prudent to anticipate that the trend will continue to some degree in the future and that it is appropriate to reflect some future mortality improvement as part of the mortality assumption.

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

The generational approach is our preferred method for recognizing future mortality improvements in the valuation process because it is more direct and results in longer life expectancy for members who are younger, consistent with what we believe is more likely to occur. Over the last ten to fifteen years, this method has become quite common as computing power has increased.

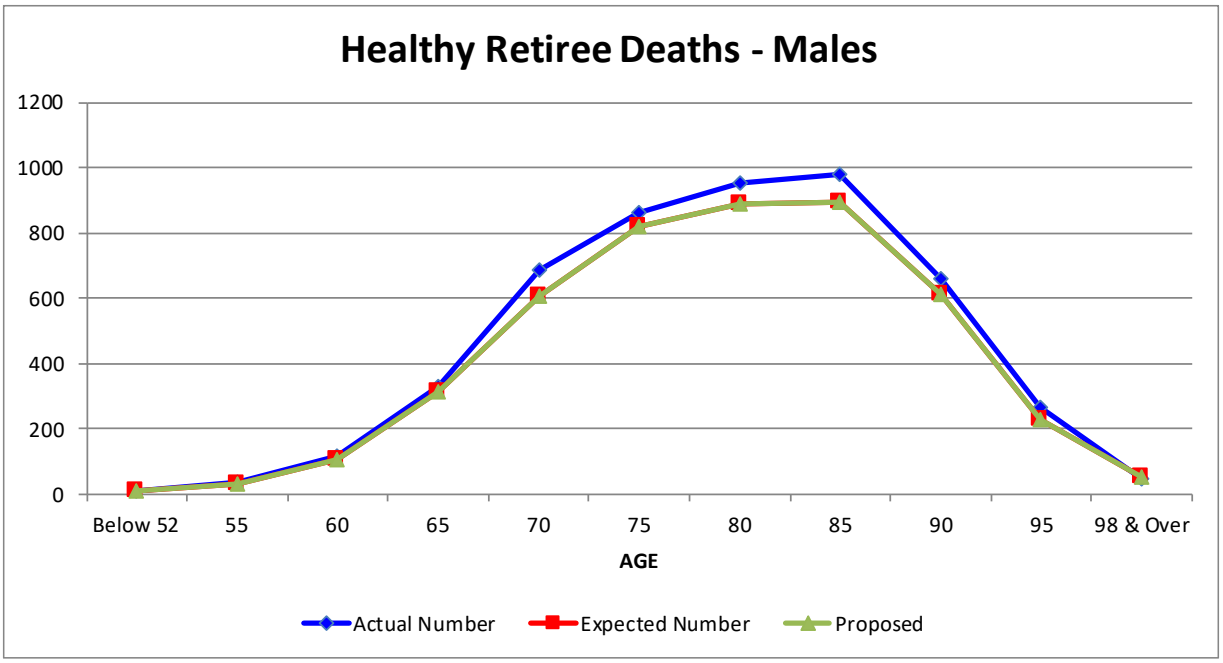
In this experience study, we also analyzed recent experience on a benefit-weighted basis where the exposures and deaths are multiplied by the monthly retirement benefit amount. This helps to reflect any differences that arise from better mortality experience among those with larger benefits. Because a valuation is designed to measure the amount and timing of future benefit payments (liability) rather than simply the number of retirees leaving pay status, this benefit-weighted approach is an important factor in valuing plan obligations. The Actual to Expected Ratios on the benefit-weighted basis were very similar to the Actual to Expected Ratios on a count basis over the past four years so we have based our recommendations on a count basis.

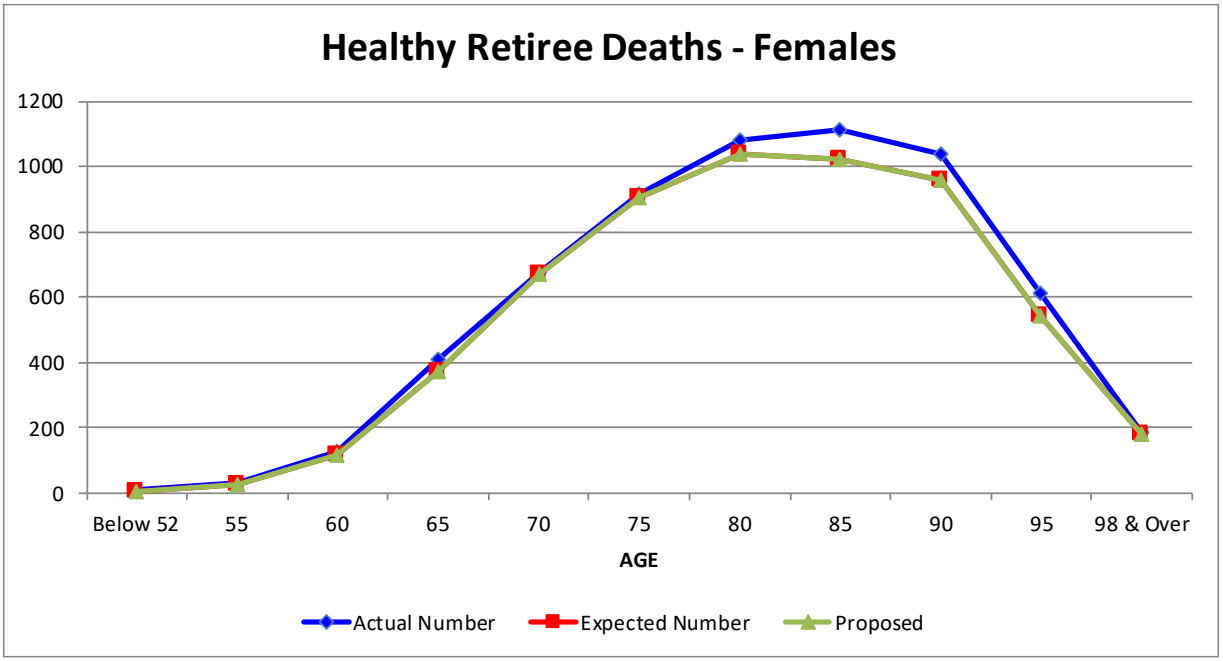
COMPARISON OF ACTUAL AND EXPECTED CASES OF POST-RETIREMENT DEATHS

CENTRAL AGE OF GROUP	NUMBER OF POST-RETIREMENT DEATHS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	SERVICE RETIREMENTS					
Below 53	9	12	0.750	9	5	1.800
55	38	33	1.152	30	27	1.111
60	117	106	1.104	128	116	1.103
65	330	317	1.041	408	370	1.103
70	687	606	1.134	678	669	1.013
75	865	819	1.056	915	905	1.011
80	954	888	1.074	1,080	1,040	1.038
85	981	893	1.099	1,112	1,021	1.089
90	659	613	1.075	1,038	961	1.080
95	267	230	1.161	615	541	1.137
98 & over	47	51	0.922	187	181	1.033
TOTAL	**4,954**	**4,568**	**1.085**	**6,200**	**5,836**	**1.062**
	BENEFICIARIES					
Below 53	7	9	0.778	11	11	1.000
55	6	8	0.750	10	13	0.769
60	11	14	0.786	34	27	1.259
65	23	22	1.045	41	47	0.872
70	34	34	1.000	75	85	0.882
75	64	49	1.306	147	140	1.050
80	72	54	1.333	252	238	1.059
85	72	56	1.286	401	347	1.156
90	70	53	1.321	413	376	1.098
95	30	25	1.200	261	224	1.165
98 & over	4	5	0.800	62	77	0.805
TOTAL	**393**	**329**	**1.195**	**1,707**	**1,585**	**1.077**
	DISABILITY RETIREMENTS					
Below 48	8	9	0.889	15	7	2.143
50	24	18	1.333	16	18	0.889
55	42	42	1.000	43	42	1.024
60	74	77	0.961	91	77	1.182
65	92	105	0.876	107	91	1.176
70	114	99	1.152	96	89	1.079
75	79	67	1.179	98	74	1.324
80	47	39	1.205	65	59	1.102
85	30	24	1.250	57	46	1.239
88 & over	8	8	1.000	24	27	0.889
TOTAL	**518**	**488**	**1.061**	**612**	**530**	**1.155**

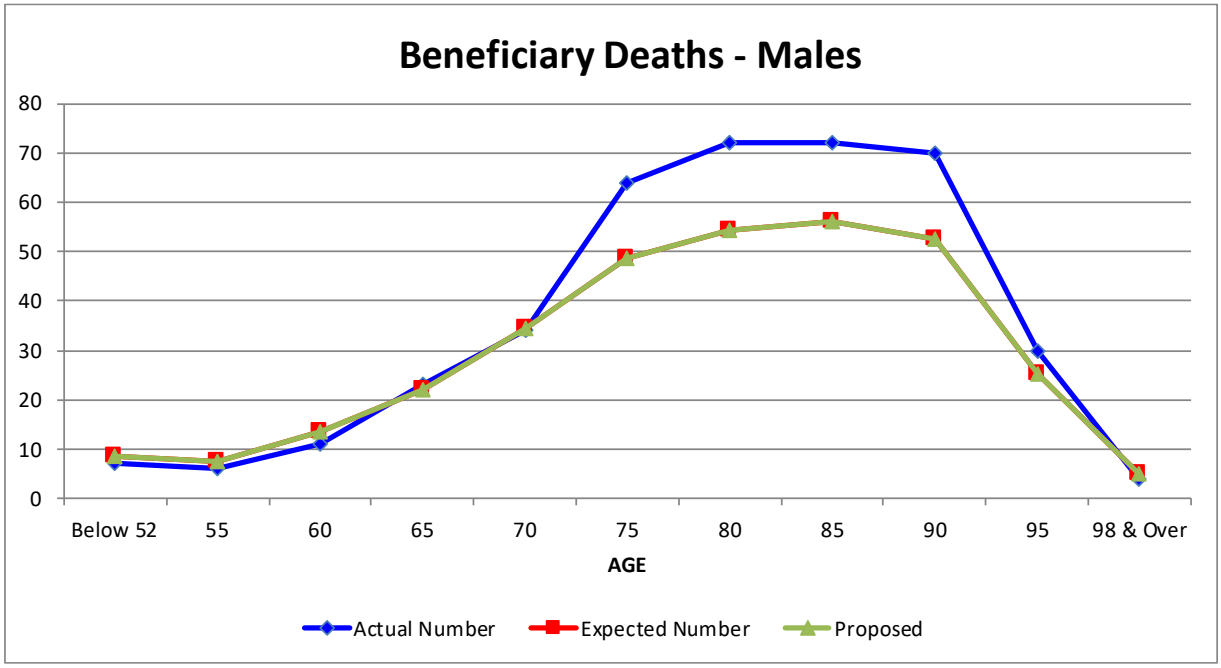
The following graphs show a comparison of the present, actual and proposed number of post-retirement deaths.

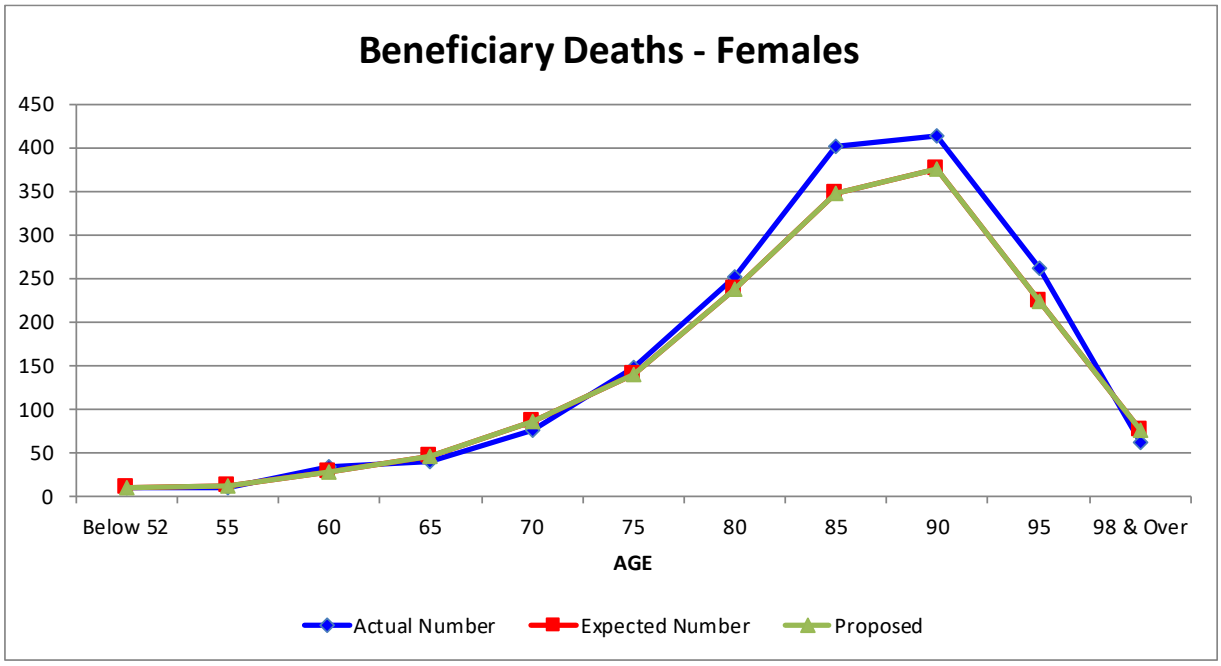
POST-RETIREMENT DEATHS
SERVICE RETIREMENTS



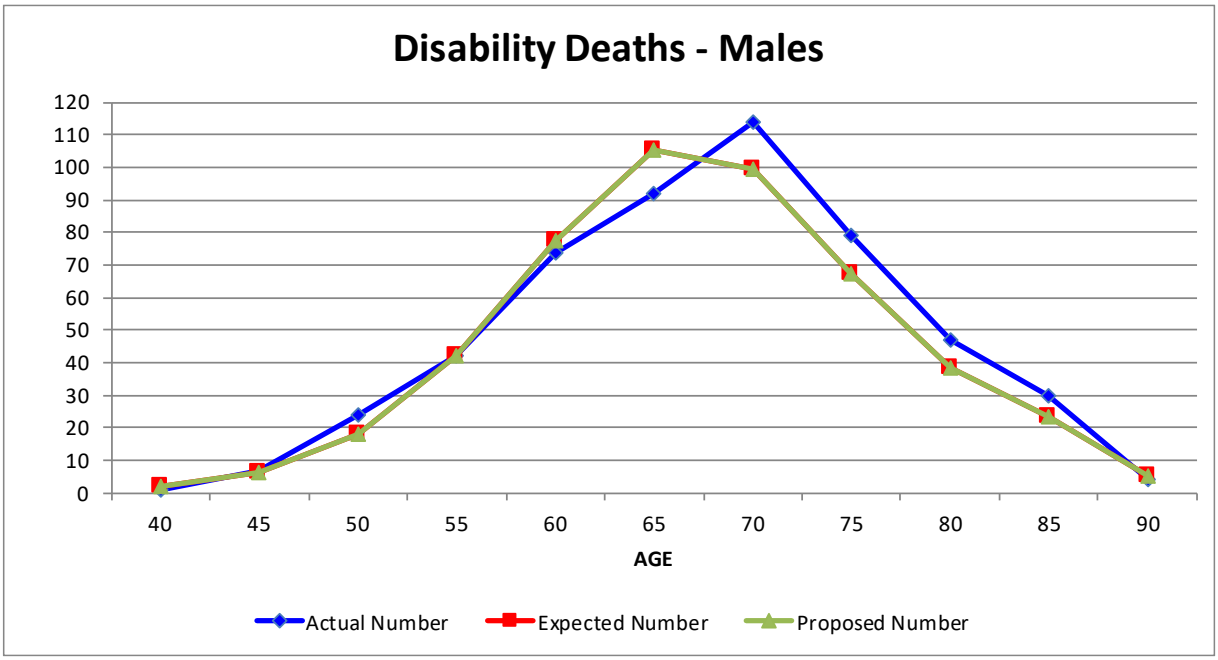


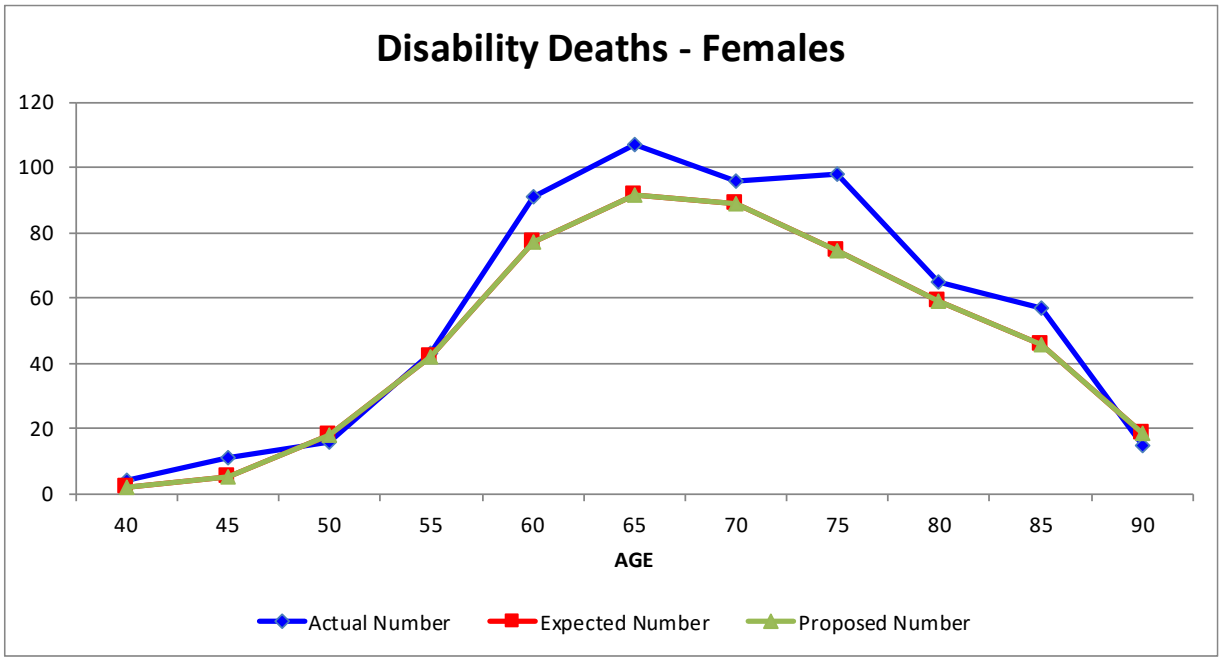
POST-RETIREMENT DEATHS
BENEFICIARIES





POST-RETIREMENT DEATHS
DISABILITY RETIREMENTS





The actuarial gain/loss analysis performed during the 2019 and 2020 valuations for PERS has indicated that the current mortality table that was adopted after the last experience study fits nicely into the actual mortality experience of PERS' service retirees, beneficiaries, and disabled retirees. The ratio of actual to expected experience shown on page 54 and the actuarial gain/loss analysis performed during the 2021 and 2022 valuations for PERS has indicated more deaths are occurring than expected. We believe this is a direct result of the COVID-19 pandemic. Over the last two years of this study period, PERS has experienced 817 more retiree deaths and 232 more contingent annuitant deaths than expected resulting in actuarial gains for PERS.

Therefore, since we believe the past two years post-retirement mortality experience has been influenced by the pandemic and the two prior years resulted in very reasonable results, we have decided to recommend continuation of the Pub-2010 Public Safety Headcount Mortality Tables, with similar adjustments or refinements for service retirees and beneficiaries from the current table. We believe mortality experience in the next experience study may come back to more normal levels, which should give us more credible data to determine if a change in the mortality table is warranted.

Service Retirees (Current Table)*

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

* Please note that none of the current tables have any setbacks or set forwards.

Contingent Annuitants (Current Table)*

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

* Please note that none of the current tables have any setbacks or set forwards.

Disabled Retirees (Current Table)*

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

* Please note that none of the current tables have any setbacks or set forwards.

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	$549,076	$528,283	1.039
1	1,384,744	1,372,174	1.009
2	1,279,639	1,267,381	1.010
3	1,175,454	1,158,291	1.015
4	1,123,706	1,106,334	1.016
5-9	4,823,563	4,741,092	1.017
10-14	4,163,954	4,114,035	1.012
15-19	3,658,774	3,630,083	1.008
20-24	2,788,358	2,771,892	1.006
25-29	1,283,374	1,274,739	1.007
30-34	482,557	481,209	1.003
35 & Over	216,311	216,205	1.000
TOTAL	**$22,929,510**	**$22,661,718**	**1.012**

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As can be seen from the table above, actual rates of salary increase has been somewhat more than expected at almost all service breakdowns. However, if we break down the four year-periods and remove the last year of the period (2021-2022), which experienced much higher than expected salary increases and resulted in an actuarial loss in the 2022 valuation of $377 million, then the actual to expected ratio drops from 1.012 to 1.005 and all service breakdowns are within 1% of expected. We believe the last year of the study is skewing the results and is not a full representation of actual salary increases going forward. **Therefore, we recommend no change in the merit salary scale at this time.**

OTHER ASSUMPTIONS

DEFERRED VESTEDS: Currently, the valuation assumes 60% of participants that leave the System as deferred vested will receive a deferred benefit upon attaining the eligibility requirements for retirement. During the last two investigation periods, the plan actually experienced an estimated 62% and 65% of participants receiving a deferred benefit, respectively. **Therefore, we recommend an increase of our assumption from 60% to 65% at this time.**

LINE OF DUTY DEATH ASSUMPTION: Currently, it is assumed that 4% of active member deaths are in the line of duty and 96% of active member deaths are not in the line of duty. For the past six years, approximately 3.1% of active member deaths were in the line of duty. There has definitely been a downward trend for this assumption. However, we lowered this assumption during the last experience study from 6% to 4%, and at this time, **we recommend no change in the 4% assumption.**

LINE OF DUTY DISABILITY ASSUMPTION: Currently, it is assumed that 12% of active member disabilities are in the line of duty and 88% of active member disabilities are not in the line of duty. During the experience investigation period, an average of about 13% of disabilities each year were in the line of duty. During the last experience study, the average for the period was 14%. **Therefore, we recommend that the assumption be maintained at 12% of active member disabilities are assumed to be in the line of duty**.

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

SPOUSE AGE DIFFERENCE: Currently, for married members, it is assumed a male is three years older than his spouse. We have reviewed this assumption during this experience period and found that the age difference between males and females in PERS is about 2.3 years. In the previous study period, the age difference was about 2.8 years. **Therefore, we recommend a change in the spouse age difference from 3 years to 2 years.**

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 0.67 years. In the last experience study, the average was 0.56 years. We are unsure if this upward trend is a result of the pandemic so we are cautious to increase this assumption. **However, we do recommend a slight increase to 0.55 years of unused leave at retirement. We will review this again in two years and make further adjustments if this trend continues.**

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

MILITARY SERVICE: Currently, we assume that participants will have on average 0.25 years of military service at retirement. We reviewed this assumption for those participants who retired during this four-year period and the average number of years of military service was 0.21 years. In the last experience study, the average was 0.21 years. **Therefore, we recommend lowering this assumption to 0.20 years of military service at retirement.**

ASSUMED INTEREST RATE ON EMPLOYEE CONTRIBUTIONS: This assumption is adopted by the Board each year, but **2.00% remains a reasonable assumption at this time.**

OTHER ASSUMPTION LOADS: Varying loads for pre-retirement dependent children option and for disability dependent child's options are made to the liabilities to account for the number of children possibly covered. **We recommend no change at this time in these loads.**

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 no change in the factors at this time.**

MUNICIPAL RETIREMENT SYSTEMS

SUMMARY OF RESULTS

Since this is a closed System with only retired members remaining, the only demographic assumption to review is post-retirement mortality. Over the period of this investigation, we have found the following observations:

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

Service Retirees*

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

Contingent Annuitants*

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

Disabled Retirees*

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

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

Year	CPI (U)	Year	CPI (U)
1961	29.8	1992	140.2
1962	30.2	1993	144.4
1963	30.6	1994	148.0
1964	31.0	1995	152.5
1965	31.6	1996	156.7
1966	32.4	1997	160.3
1967	33.3	1998	163.0
1968	35.7	1999	166.2
1969	34.7	2000	172.4
1970	38.8	2001	178.0
1971	40.6	2002	179.9
1972	41.7	2003	183.7
1973	44.2	2004	189.7
1974	49.0	2005	194.5
1975	53.6	2006	202.9
1976	56.8	2007	208.352
1977	60.7	2008	218.815
1978	65.2	2009	215.693
1979	72.3	2010	217.965
1980	82.7	2011	225.722
1981	90.6	2012	229.478
1982	97.0	2013	233.504
1983	99.5	2014	238.343
1984	103.7	2015	238.638
1985	107.6	2016	241.018
1986	109.5	2017	244.955
1987	113.5	2018	251.989
1988	118.0	2019	256.143
1989	124.1	2020	257.797
1990	129.9	2021	271.696
1991	136.0	2022	296.311

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

Geometric Real Rates of Return and Standard Deviations by Asset Class

Asset Class	Expected Real Rate of Return	Standard Deviation
Domestic Equity	4.75%	17.75%
International Equity	4.75	20.15
Global Equity	4.95	21.25
Fixed Income	1.75	4.10
Real Estate	3.25	14.20
Private Equity	6.00	27.60
Cash Equivalents	0.25	0.90

Asset Allocation Targets

Asset Class	Asset Allocation
Domestic Equity	27.00%
International Equity	22.00
Global Equity	12.00
Fixed Income	20.00
Real Estate	10.00
Private Equity	8.00
Cash Equivalents	1.00

Year	Wage Index	Annual Increase	Year	Wage Index	Annual Increase
1960	$4,007.12	3.92%	1991	$21,811.60	3.73%
1961	4,086.76	1.99	1992	22,935.42	5.15
1962	4,291.40	5.01	1993	23,132.67	0.86
1963	4,396.64	2.45	1994	23,753.53	2.68
1964	4,576.32	4.09	1995	24,705.66	4.01
1965	4,658.72	1.80	1996	25,913.90	4.89
1966	4,938.36	6.00	1997	27,426.00	5.84
1967	5,213.44	5.57	1998	28,861.44	5.23
1968	5,571.76	6.87	1999	30,469.84	5.57
1969	5,893.76	5.78	2000	32,154.82	5.53
1970	6,186.24	4.96	2001	32,921.92	2.39
1971	6,497.08	5.02	2002	33,252.09	1.00
1972	7,133.80	9.80	2003	34,064.95	2.44
1973	7,580.16	6.26	2004	35,648.55	4.65
1974	8,030.76	5.94	2005	36,952.94	3.66
1975	8,630.92	7.47	2006	38,651.41	4.60
1976	9,226.48	6.90	2007	40,405.48	4.54
1977	9,779.44	5.99	2008	41,334.97	2.30
1978	10,556.03	7.94	2009	40,711.61	-1.51
1979	11,479.46	8.75	2010	41,673.83	2.36
1980	12,513.46	9.01	2011	42,979.61	3.13
1981	13,773.10	10.07	2012	44,321.67	3.12
1982	14,531.34	5.51	2013	44,888.16	1.28
1983	15,239.24	4.87	2014	46,481.52	3.55
1984	16,135.07	5.88	2015	48,098.63	3.48
1985	16,822.51	4.26	2016	48,642.15	1.13
1986	17,321.82	2.97	2017	50,321.89	3.45
1987	18,426.51	6.38	2018	52,145.80	3.62
1988	19,334.04	4.93	2019	54,099.99	3.75
1989	20,099.55	3.96	2020	55,628.60	2.83
1990	21,027.98	4.62	2021	60,575.07	8.89

TABLE 1(a)
RATES OF SEPARATION FROM ACTIVE SERVICE – MALES

AGE	RATES OF DEATH*	RATES OF DISABILITY	RATES OF RETIREMENT	
			LESS THAN 25 YRS OF SERVICE**	25 OR MORE YEARS OF SERVICE**
20	0.000483	0.00006		
21	0.000515	0.00007		
22	0.000536	0.00008		
23	0.000546	0.00009		
24	0.000557	0.00010		
25	0.000567	0.00011		
26	0.000578	0.00012		
27	0.000588	0.00013		
28	0.000609	0.00014		
29	0.000620	0.00015		
30	0.000630	0.00016		
31	0.000651	0.00017		
32	0.000662	0.00018		
33	0.000683	0.00019		
34	0.000693	0.00020		
35	0.000714	0.00020		
36	0.000746	0.00029		
37	0.000767	0.00038		
38	0.000809	0.00047		
39	0.000840	0.00056		
40	0.000893	0.00065		0.2800
41	0.000935	0.00082		0.2800
42	0.000997	0.00099		0.2800
43	0.001061	0.00116		0.2800
44	0.001134	0.00133		0.2800
45	0.001218	0.00150		0.2800
46	0.001302	0.00166		0.2800
47	0.001407	0.00182		0.2800
48	0.001512	0.00198		0.2000
49	0.001638	0.00214		0.2000
50	0.001764	0.00230		0.2000
51	0.001901	0.00256		0.2000
52	0.002058	0.00282		0.1950
53	0.002216	0.00308		0.1850
54	0.002394	0.00334		0.1850
55	0.002594	0.00360		0.2000
56	0.002804	0.00360		0.1900
57	0.003045	0.00350		0.1900
58	0.003329	0.00340		0.1800
59	0.003633	0.00290		0.1700
60	0.003980	0.00270	0.1150	0.1950
61	0.004358	0.00260	0.1075	0.2100
62	0.004788	0.00260	0.2000	0.2900
63	0.005261	0.00250	0.1700	0.2300
64	0.005775	0.00240	0.1575	0.2300
65	0.006353	0.00240	0.2650	0.3300
66	0.007172	0.00240	0.2350	0.3200
67	0.008096	0.00240	0.2200	0.2500
68	0.009146	0.00240	0.2100	0.2600
69	0.010322	0.00240	0.1950	0.2400
70	0.011655	0.00240	0.2125	0.2600
71	0.013157	0.00240	0.2000	0.2400
72	0.014858	0.00240	0.1950	0.2100
73	0.016779	0.00240	0.1900	0.2000
74	0.018942	0.00240	0.1900	0.1950
75	0.021389	0.00240	0.2200	0.2200
76	0.024150	0.00240	0.2200	0.2200
77	0.027258	0.00240	0.2100	0.2400
78	0.030776	0.00240	0.1800	0.1900
79	0.034755	0.00240	0.2200	0.2200
80	0.039239	0.00000	1.0000	1.0000

* Adjusted Base rates
**For Tier 4 members, 30 years of service.

TABLE 1(b)
RATES OF SEPARATION FROM ACTIVE SERVICE – MALES (continued)

RATES OF WITHDRAWAL - MALES*																										
AGE	SERVICE																									
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>=25
15	0.4200	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.4200	0.3500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.4200	0.3500	0.2800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	0.4200	0.3500	0.2800	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	0.4200	0.3500	0.2800	0.2500	0.1700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.4200	0.3500	0.2800	0.2500	0.1700	0.1300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	0.4200	0.3500	0.2800	0.2500	0.1700	0.1300	0.1300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.4200	0.3500	0.2800	0.2500	0.1700	0.1300	0.1300	0.0850	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.3500	0.2700	0.2100	0.1750	0.1600	0.1300	0.1300	0.0850	0.0850	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	0.3500	0.2700	0.2100	0.1750	0.1600	0.1300	0.1300	0.0850	0.0850	0.0800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	0.3500	0.2700	0.2100	0.1750	0.1600	0.1300	0.1300	0.0850	0.0850	0.0800	0.0650	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	0.3500	0.2700	0.2100	0.1750	0.1600	0.1300	0.1300	0.0850	0.0850	0.0800	0.0650	0.0650	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	0.3500	0.2700	0.2100	0.1750	0.1600	0.1300	0.1300	0.0850	0.0850	0.0800	0.0650	0.0650	0.0550	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	0.3500	0.2700	0.2100	0.1600	0.1400	0.1250	0.1050	0.0850	0.0850	0.0800	0.0650	0.0650	0.0550	0.0550	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	0.3500	0.2700	0.2100	0.1600	0.1400	0.1250	0.1050	0.0850	0.0850	0.0800	0.0650	0.0650	0.0550	0.0550	0.0400	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	0.3500	0.2700	0.2100	0.1600	0.1400	0.1250	0.1050	0.0850	0.0850	0.0800	0.0650	0.0650	0.0550	0.0550	0.0400	0.0375	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31	0.3500	0.2700	0.2100	0.1600	0.1400	0.1250	0.1050	0.0850	0.0850	0.0800	0.0650	0.0650	0.0550	0.0550	0.0400	0.0375	0.0350	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32	0.3500	0.2700	0.2100	0.1600	0.1400	0.1250	0.1050	0.0850	0.0850	0.0800	0.0650	0.0650	0.0550	0.0550	0.0400	0.0375	0.0350	0.0325	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
33	0.3500	0.2500	0.1900	0.1500	0.1300	0.1250	0.1000	0.0850	0.0850	0.0750	0.0650	0.0600	0.0550	0.0500	0.0400	0.0375	0.0350	0.0325	0.0325	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
34	0.3500	0.2500	0.1900	0.1500	0.1300	0.1250	0.1000	0.0850	0.0850	0.0750	0.0650	0.0600	0.0550	0.0500	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
35	0.3500	0.2500	0.1900	0.1500	0.1300	0.1250	0.1000	0.0850	0.0850	0.0750	0.0650	0.0600	0.0550	0.0500	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0325	0.0000	0.0000	0.0000	0.0000	0.0000
36	0.3500	0.2500	0.1900	0.1500	0.1300	0.1250	0.1000	0.0850	0.0850	0.0750	0.0650	0.0600	0.0550	0.0500	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0325	0.0325	0.0000	0.0000	0.0000	0.0000
37	0.3500	0.2500	0.1900	0.1500	0.1300	0.1250	0.1000	0.0850	0.0850	0.0750	0.0650	0.0600	0.0550	0.0500	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0000	0.0000	0.0000
38	0.3500	0.2400	0.1800	0.1400	0.1150	0.1000	0.0800	0.0850	0.0750	0.0750	0.0600	0.0550	0.0500	0.0500	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0000	0.0000
39	0.3500	0.2400	0.1800	0.1400	0.1150	0.1000	0.0800	0.0850	0.0750	0.0750	0.0600	0.0550	0.0500	0.0500	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0000
40	0.3500	0.2400	0.1800	0.1400	0.1150	0.1000	0.0800	0.0850	0.0750	0.0750	0.0600	0.0550	0.0500	0.0500	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0000
41	0.3500	0.2400	0.1800	0.1400	0.1150	0.1000	0.0800	0.0850	0.0750	0.0750	0.0600	0.0550	0.0500	0.0500	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0000
42	0.3500	0.2400	0.1800	0.1400	0.1150	0.1000	0.0800	0.0850	0.0750	0.0750	0.0600	0.0550	0.0500	0.0500	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0000
43-47	0.3200	0.2350	0.1700	0.1250	0.1150	0.0950	0.0800	0.0850	0.0750	0.0700	0.0600	0.0525	0.0475	0.0425	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0000
48-52	0.2700	0.1900	0.1500	0.1250	0.1150	0.0900	0.0750	0.0750	0.0700	0.0600	0.0575	0.0525	0.0475	0.0425	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0000
53-79	0.2500	0.1900	0.1400	0.1250	0.1100	0.0900	0.0750	0.0750	0.0700	0.0600	0.0575	0.0500	0.0450	0.0425	0.0400	0.0375	0.0350	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0325	0.0000
80	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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

TABLE 2(a)
RATES OF SEPARATION FROM ACTIVE SERVICE – FEMALES

AGE	RATES OF DEATH*	RATES OF DISABILITY	RATES OF RETIREMENT	
			LESS THAN 25 YRS OF SERVICE**	25 OR MORE YEARS OF SERVICE**
20	0.000126	0.00006		
21	0.000140	0.00007		
22	0.000154	0.00008		
23	0.000161	0.00009		
24	0.000175	0.00010		
25	0.000189	0.00011		
26	0.000203	0.00012		
27	0.000210	0.00013		
28	0.000224	0.00014		
29	0.000238	0.00015		
30	0.000259	0.00016		
31	0.000273	0.00017		
32	0.000287	0.00018		
33	0.000308	0.00019		
34	0.000329	0.00020		
35	0.000350	0.00020		
36	0.000371	0.00026		
37	0.000399	0.00032		
38	0.000420	0.00038		
39	0.000448	0.00044		
40	0.000483	0.00050		0.2100
41	0.000511	0.00054		0.2100
42	0.000546	0.00058		0.2100
43	0.000581	0.00062		0.2100
44	0.000623	0.00066		0.2100
45	0.000665	0.00070		0.2100
46	0.000707	0.00085		0.2100
47	0.000756	0.00100		0.2100
48	0.000805	0.00115		0.1650
49	0.000861	0.00130		0.1650
50	0.000917	0.00145		0.1650
51	0.000980	0.00171		0.1650
52	0.001043	0.00197		0.1650
53	0.001113	0.00223		0.1750
54	0.001190	0.00249		0.1750
55	0.001274	0.00275		0.2075
56	0.001358	0.00275		0.2000
57	0.001449	0.00270		0.1975
58	0.001540	0.00260		0.2025
59	0.001645	0.00250		0.2150
60	0.001757	0.00250	0.1325	0.2150
61	0.001876	0.00240	0.1150	0.2400
62	0.002002	0.00240	0.1875	0.3225
63	0.002135	0.00240	0.1825	0.3050
64	0.002275	0.00230	0.1800	0.3000
65	0.002429	0.00220	0.3000	0.4000
66	0.002779	0.00180	0.2975	0.3850
67	0.003171	0.00160	0.2500	0.3350
68	0.003626	0.00150	0.2175	0.2750
69	0.004144	0.00150	0.2200	0.2700
70	0.004739	0.00150	0.2425	0.3000
71	0.005418	0.00150	0.2075	0.3000
72	0.006195	0.00150	0.2400	0.2500
73	0.007077	0.00150	0.2150	0.2500
74	0.008092	0.00150	0.2050	0.2300
75	0.009247	0.00150	0.2400	0.2500
76	0.010570	0.00150	0.2400	0.2500
77	0.012082	0.00150	0.2400	0.2800
78	0.013811	0.00150	0.1800	0.2000
79	0.015785	0.00150	0.2400	0.2500
80	0.018046	0.00000	1.0000	1.0000

*Adjusted Base Rates
**For Tier 4 members, 30 years of service.

TABLE 2(b)
RATES OF SEPARATION FROM ACTIVE SERVICE – FEMALES (Continued)

RATES OF WITHDRAWAL - FEMALES*																										
AGE	SERVICE																									
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>=25
15	0.4500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.4500	0.4200	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.4500	0.4200	0.3500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	0.4500	0.4200	0.3500	0.2700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	0.4500	0.4200	0.3500	0.2700	0.1700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.4500	0.4200	0.3500	0.2700	0.1700	0.1250	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	0.4500	0.4200	0.3500	0.2700	0.1700	0.1250	0.1250	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.4500	0.4200	0.3500	0.2700	0.1700	0.1250	0.1250	0.0900	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.3700	0.2750	0.2300	0.1800	0.1700	0.1250	0.1250	0.0900	0.0900	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	0.3700	0.2750	0.2300	0.1800	0.1700	0.1250	0.1250	0.0900	0.0900	0.0800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	0.3700	0.2750	0.2300	0.1800	0.1700	0.1250	0.1250	0.0900	0.0900	0.0800	0.0700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	0.3700	0.2750	0.2300	0.1800	0.1700	0.1250	0.1250	0.0900	0.0900	0.0800	0.0700	0.0650	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	0.3700	0.2750	0.2300	0.1800	0.1700	0.1250	0.1250	0.0900	0.0900	0.0800	0.0700	0.0650	0.0600	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	0.3500	0.2700	0.2100	0.1600	0.1350	0.1250	0.1050	0.0800	0.0750	0.0750	0.0700	0.0650	0.0600	0.0550	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	0.3500	0.2700	0.2100	0.1600	0.1350	0.1250	0.1050	0.0800	0.0750	0.0750	0.0700	0.0650	0.0600	0.0550	0.0500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	0.3500	0.2700	0.2100	0.1600	0.1350	0.1250	0.1050	0.0800	0.0750	0.0750	0.0700	0.0650	0.0600	0.0550	0.0500	0.0400	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31	0.3500	0.2700	0.2100	0.1600	0.1350	0.1250	0.1050	0.0800	0.0750	0.0750	0.0700	0.0650	0.0600	0.0550	0.0500	0.0400	0.0350	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32	0.3500	0.2700	0.2100	0.1600	0.1350	0.1250	0.1050	0.0800	0.0750	0.0750	0.0700	0.0650	0.0600	0.0550	0.0500	0.0400	0.0350	0.0350	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
33	0.3000	0.2400	0.1900	0.1400	0.1200	0.1200	0.0950	0.0800	0.0750	0.0750	0.0600	0.0600	0.0525	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
34	0.3000	0.2400	0.1900	0.1400	0.1200	0.1200	0.0950	0.0800	0.0750	0.0750	0.0600	0.0600	0.0525	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
35	0.3000	0.2400	0.1900	0.1400	0.1200	0.1200	0.0950	0.0800	0.0750	0.0750	0.0600	0.0600	0.0525	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000	0.0000	0.0000	0.0000	0.0000
36	0.3000	0.2400	0.1900	0.1400	0.1200	0.1200	0.0950	0.0800	0.0750	0.0750	0.0600	0.0600	0.0525	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000	0.0000	0.0000	0.0000
37	0.3000	0.2400	0.1900	0.1400	0.1200	0.1200	0.0950	0.0800	0.0750	0.0750	0.0600	0.0600	0.0525	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000	0.0000	0.0000
38	0.2800	0.2300	0.1750	0.1350	0.1150	0.0950	0.0925	0.0800	0.0750	0.0700	0.0600	0.0550	0.0500	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000	0.0000
39	0.2800	0.2300	0.1750	0.1350	0.1150	0.0950	0.0925	0.0800	0.0750	0.0700	0.0600	0.0550	0.0500	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
40	0.2800	0.2300	0.1750	0.1350	0.1150	0.0950	0.0925	0.0800	0.0750	0.0700	0.0600	0.0550	0.0500	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
41	0.2800	0.2300	0.1750	0.1350	0.1150	0.0950	0.0925	0.0800	0.0750	0.0700	0.0600	0.0550	0.0500	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
42	0.2800	0.2300	0.1750	0.1350	0.1150	0.0950	0.0925	0.0800	0.0750	0.0700	0.0600	0.0550	0.0500	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
43-47	0.2750	0.2000	0.1675	0.1275	0.1150	0.0950	0.0850	0.0750	0.0750	0.0650	0.0600	0.0550	0.0500	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
48-52	0.2750	0.2000	0.1450	0.1275	0.1150	0.0950	0.0800	0.0750	0.0700	0.0650	0.0600	0.0550	0.0500	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
53-79	0.2500	0.1900	0.1450	0.1275	0.1100	0.0950	0.0800	0.0750	0.0700	0.0600	0.0600	0.0550	0.0500	0.0450	0.0450	0.0400	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0000
80	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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

TABLE 3

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

SERVICE	PERS
0	0.1790
1	0.0790
2	0.0540
3	0.0440
4	0.0390
5	0.0340
6	0.0340
7	0.0340
8	0.0290
9	0.0290
10	0.0290
11	0.0290
12	0.0290
13	0.0290
14	0.0290
15	0.0290
16	0.0290
17	0.0290
18	0.0290
19	0.0290
20	0.0290
21	0.0290
22	0.0290
23	0.0290
24	0.0290
25	0.0290
26	0.0290
27	0.0290
28	0.0265
29	0.0265
30	0.0265
31	0.0265
32	0.0265
33	0.0265
34	0.0265
35	0.0265
36	0.0265
37	0.0265
38	0.0265
39	0.0265
40	0.0265

* Includes wage inflation of 2.65%

TABLE 4
BASE RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF SERVICE*

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

*Adjusted Base Rates

TABLE 5
BASE RATES OF MORTALITY FOR BENEFICIARIES OF DECEASED MEMBERS*

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

*Adjusted Base Rates

TABLE 6
BASE RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF DISABILITY*

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

*Adjusted Base Rates

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April 21, 2023

The Board of Trustees of
Public Employees' Retirement System of Mississippi &
The Administrative Board of the Highway Safety Patrol
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 Mississippi Highway Safety Patrol Retirement System (HSPRS) for the four-year period from July 1, 2018 to June 30, 2022. The study was based on the data submitted by the Public Employees' Retirement System (PERS) for the annual valuation. In preparing this report, we relied, without audit, on the data provided.

The purpose of the investigation was to assess the reasonability of the current economic assumptions and demographic actuarial assumptions for HSPRS. Actuarial assumptions are used to measure and budget future costs. Changing assumptions will not change the actual cost of future benefits. Once the assumptions have been adopted, the actuarial valuation measures the adequacy of the fixed contribution rate. As a result of the investigation, it is recommended that revised demographic tables be adopted for future use.

All recommended rates of separation, mortality and salary increase at each age or service level 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.

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In order to prepare the measurement of the impact on liabilities in this report, we have utilized actuarial models that we developed to measure liabilities and develop actuarial costs. These models include tools that we have produced and tested, along with commercially available valuation software that we have reviewed to confirm the appropriateness and accuracy of the output. In utilizing these models, we develop and use input parameters and assumptions about future contingent events along with recognized actuarial approaches to develop the needed results.

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).

We note that as we prepare this report, the world has been in a pandemic during much of the experience study period. We have taken this into consideration as we reviewed the experience, particularly regarding mortality, retirement, termination and disability patterns. While we do not believe that there is yet sufficient data to warrant the significant modification of any of our assumptions specifically due to COVID-19, we will continue to monitor the situation and advise the Board in the future of any adjustments that we believe would be appropriate.

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,

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

Ben Mobley, ASA, FCA, MAAA
Consulting Actuary

Table of Contents

The purpose of an actuarial valuation is to provide a timely best estimate of the ultimate costs of a retirement system. An actuarial valuation of the Mississippi Highway Safety Patrol Retirement System (HSPRS) is prepared annually to determine the actuarial contribution rate required to fund it 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 the HSPRS under the PERS' Board of Trustees purview for the four-year period ending June 30, 2022. 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, 2023 actuarial valuation.

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, outside of the COVID pandemic. 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 HSPRS. 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 recovery from the pandemic in 2021 followed by the downward trend in global markets in 2022. 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, although the last two years have experienced higher than normal inflation due to the recovery from the pandemic, we believe that long-term inflation will settle back down in the 2.40% to 2.50% range. So therefore, **we are recommending that the price inflation assumption remain at 2.40%**.

We are also recommending that the long-term expected return on assets assumption remain at 7.00%, reflecting the 2.40% inflation assumption and a 4.60% real rate of return assumption. This will be discussed in detail later in this report, but a real rate of return of 4.60% is supported by the forecasting models developed using the Board's investment consultant's capital market assumptions and the Board's target asset allocation. Further analysis of the 40 sets of capital market assumptions included in the Horizon Actuarial Services, LLC. Survey conducted in 2022 and the Board's target asset allocation also support this recommendation.

Based on the Board's funding policy, the current long-term investment return assumption adopted by the PERS' Board is 7.55% and will be reduced until it reaches the rate recommended by the actuary in the most recent experience study using net investment gains based on the following parameters:

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

An example of this methodology is if the actual net investment return on a market return basis is 15.00% (excess return of 7.45% over the assumed rate) for the fiscal year ending June 30, 2023, then the investment return assumption will be reduced by 10 basis points from 7.55% to 7.45% for the 2023 valuation. This methodology would continue for each subsequent valuation until the investment return assumption is equal to our recommended rate of 7.00%.

Finally, we are recommending that the general wage inflation (payroll growth) assumption used as the underlying payroll growth for active members and used in the level percent of payroll amortization method remain at 2.65%.

The following table summarizes the current and proposed economic assumptions:

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

* Net of investment expenses only.

We recognize there may be other sets of economic assumptions that are also reasonable for purposes of funding HSPRS. 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 future mortality improvement as part of the mortality assumption.

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

In this experience study, we also analyzed recent experience on a benefit-weighted basis where the exposures and deaths are multiplied by the monthly retirement benefit amount. This helps to reflect any differences that arise from better mortality experience among those with larger benefits. Because a valuation is designed to measure the amount and timing of future benefit payments (liability) rather than simply the number of retirees leaving pay status, this benefit-weighted approach is an important factor in valuing plan obligations. The Actual to Expected Ratios on the benefit-weighted basis were very similar to the Actual to Expected Ratios on a count basis over the past four years, so therefore, there was no distinguishing difference in providing this analysis.

Since the mortality experience of HSPRS is too small and not credible enough for its own recommended post-retirement mortality table, we have combined PERS and HSPRS data together to recommend a mortality table to be used for all Plans.

The current post-retirement mortality assumption for healthy lives, which we changed in the 2018 experience study, is a generational mortality approach using the Pub-2010 Mortality Tables. These tables, released in 2019, were developed using public pension plan mortality experience only. In the 2020 experience study, we adjusted these tables to better match the mortality experience of the State of Mississippi and the membership of PERS. Since these new tables have been adopted, PERS has experienced approximately 800 more retiree deaths than expected, due in large part to the COVID-19 pandemic, in our opinion. While a task to determine the cause of these deaths would be extremely time-consuming, we do believe that this amount is within ranges as to what other public sector retirement plans are experiencing across the country for COVID-related deaths.

Therefore, we have decided to recommend continuation of the Pub-2010 Public Safety Headcount Mortality Tables, with the same adjustments or refinements for service retirees and beneficiaries from the current table. We believe mortality experience in the next experience study may come back to more normal levels, which should give us more credible data to determine if a change in the mortality table is warranted.

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

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

- **Retirement: Recommend minor adjustments in the rates of retirement to better match experience of the System.**
- **Disability: Decrease rates of disability retirement at all ages.**
- **Withdrawal: No change in the rates of withdrawal at this time.**
- **Merit Salary Scale: Change to a service based table with minor adjustments to better match experience of the System.**
- **Pre-Retirement Mortality: No change in mortality table.**

Section IV of this report will provide more detail to these recommended demographic changes.

Actuarial Methods

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

- Actuarial Cost Method
- Asset Valuation Method
- Amortization Method

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

Other Assumptions

Another assumption that is included in the valuation is the determination of administrative expense component that is added to the total normal cost each year. The current assumption is 1.00% 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.** The following table shows actual percentages over the past four years:

Year Ending June 30	Administrative Expenses	Annual Payroll	Percentage
2019	312,000	31,811,231	0.98%
2020	328,000	32,345,730	1.01%
2021	320,000	29,780,428	1.07%
2022	319,000	33,758,750	0.94%

Also included in the valuations is the determination of unused leave and military service that is assumed for all members at retirement. The current assumption is 2.00 years. **After reviewing the average amount as of June 30, 2022, we are recommending a slight increase in this assumption from 2.00 years to 2.25 years.**

Financial Impact

Although the assumption changes, if approved, will first be reflected in the 2023 valuations, we have provided the following table which highlights the impact of the recommended changes on the unfunded accrued liability (UAL), funding ratio, amortization period and projected funding ratio on the 2022 valuation and projection results.

($ in Thousands)

	Before All Changes	After All Changes
2022 Valuation UAL	$184,865	$189,966
2022 Funding Ratio	69.4%	68.8%
Projected Funding Ratio 2042*	90.6%	86.9%

* Fixed Contribution Rate (FCR) of 49.08% kept constant.

There are four economic assumptions used in the actuarial valuation performed for HSPRS. They are:

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

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

Unlike demographic assumptions, economic assumptions do not lend themselves to analysis largely on the basis of internal historical patterns because economic assumptions are impacted by external forces in the economy. The investment return and general wage increase assumptions are selected on the basis of expectations in an inflation-free environment and then increased by the long-term expectation for inflation, called the "building block" approach.

Sources of data considered in the analysis and selection of the economic assumptions included:

- The 2022 Social Security Trustees Report
- Future expectations of PERS investment consultant, Callan
- Future expectations of other investment consultants (2022 Horizon Survey)
- U.S. Department of the Treasury bond rates
- Assumptions used by other large public retirement systems, based on the Public Fund Survey, published by the National Association of State Retirement Administrators (NASRA)
- Historical observations of price and wage growth statistics and investment returns

Actuarial Standard of Practice (ASOP) No. 27, *"Selection of Economic Assumptions for Measuring Pension Obligations"* provides guidance to actuaries in selecting economic assumptions for measuring obligations under defined benefit plans. ASOP No. 27 requires that each economic assumption selected by the actuary should be reasonable which means it has the following characteristics:

- It is appropriate for the purpose of the measurement;
- It reflects the actuary's professional judgment;
- It takes into account historical and current economic data that is relevant as of the measurement date;
- It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and

- It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included and disclosed, or when alternative assumptions are used for the assessment of risk.

With respect to relevant data, the standard recommends the actuary review appropriate recent and long-term historical economic data but advises the actuary not to give undue weight to recent experience. Furthermore, it advises the actuary to consider that some historical economic data may not be appropriate for use in developing assumptions for future periods due to changes in the underlying environment. In addition, with respect to any particular valuation, each economic assumption should be consistent with all other economic assumptions over the measurement period.

ASOP 27 recognizes that economic data and analyses are available from a variety of sources, including representatives of the plan sponsor, investment advisors, economists, and other professionals. The actuary is permitted to incorporate the views of experts, but the selection or advice must reflect the actuary's professional judgment.

The standard also discusses a "range of reasonable assumptions" which in part states "the actuary should also recognize that different actuaries will apply professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop both for an individual actuary and across actuarial practice."

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

Item	Current Assumptions	Proposed Assumptions
Price Inflation	2.40%	2.40%
Real Rate of Return*	4.60	4.60
Investment Return	7.00%	7.00%
Price Inflation	2.40%	2.40%
Real Wage Growth	0.25	0.25
Wage Inflation	2.65%	2.65%
Payroll Growth	2.65%	2.65%

* 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 2.40% per year which was recommended and adopted in the last experience study.

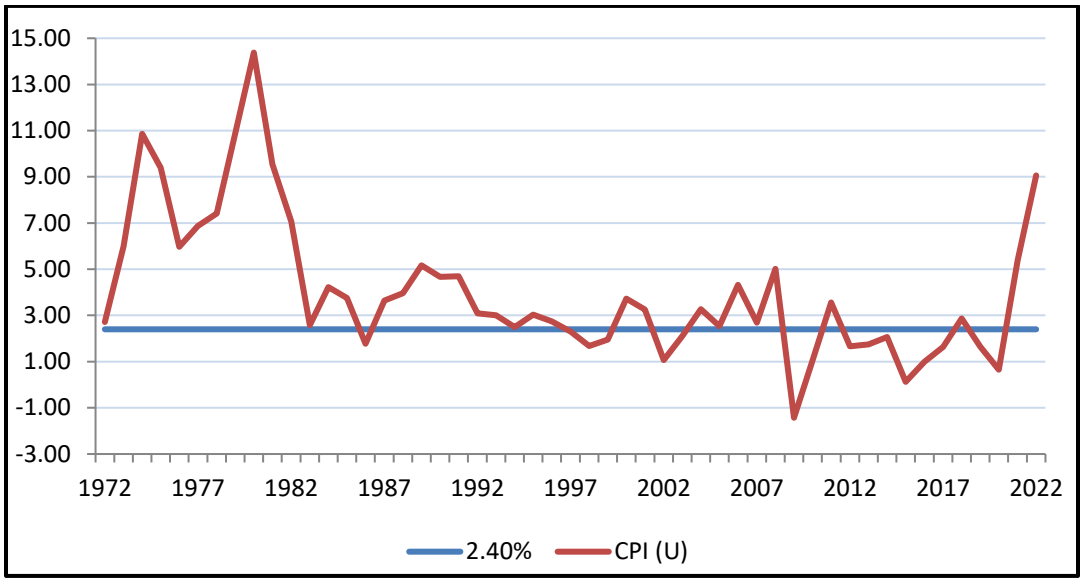
Past Experience

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 – 2022	96	2.96%	4.06%
1962 – 2022	60	3.88	2.92
1972 – 2022	50	4.00	3.11
1982 – 2022	40	2.83	1.76
1992 – 2022	30	2.53	1.86
2002 – 2022	20	2.53	2.23
2012 - 2022	10	2.59	2.69

The following graph illustrates the historical levels of price inflation measured as of June 30th of each of the last 50 years and compared to the current 2.40% annual rate currently assumed.

Annual Rate of CPI (U) Increases



As can be seen from the table on the previous page, over the last 30 years, the average annual rate of increase in the CPI-U has been just over 2.50%. The higher annual rates over the past two years has increased this average. In the last experience study in 2020, the 30-year average of price inflation was approximately 2.30%.

Forecasts

Based upon information contained in the "Survey of Professional Forecasters" for the fourth quarter of 2022 as published by the Philadelphia Federal Reserve Bank, the median expected annual rate of inflation for the next ten years is 2.37%. Although 10 years of future expectation is too short of a period for the basis of our inflation assumption, the information does provide some evidence that the consensus expectations of these experts are for rates of inflation very close to our current assumption of 2.40% for the near-term future.

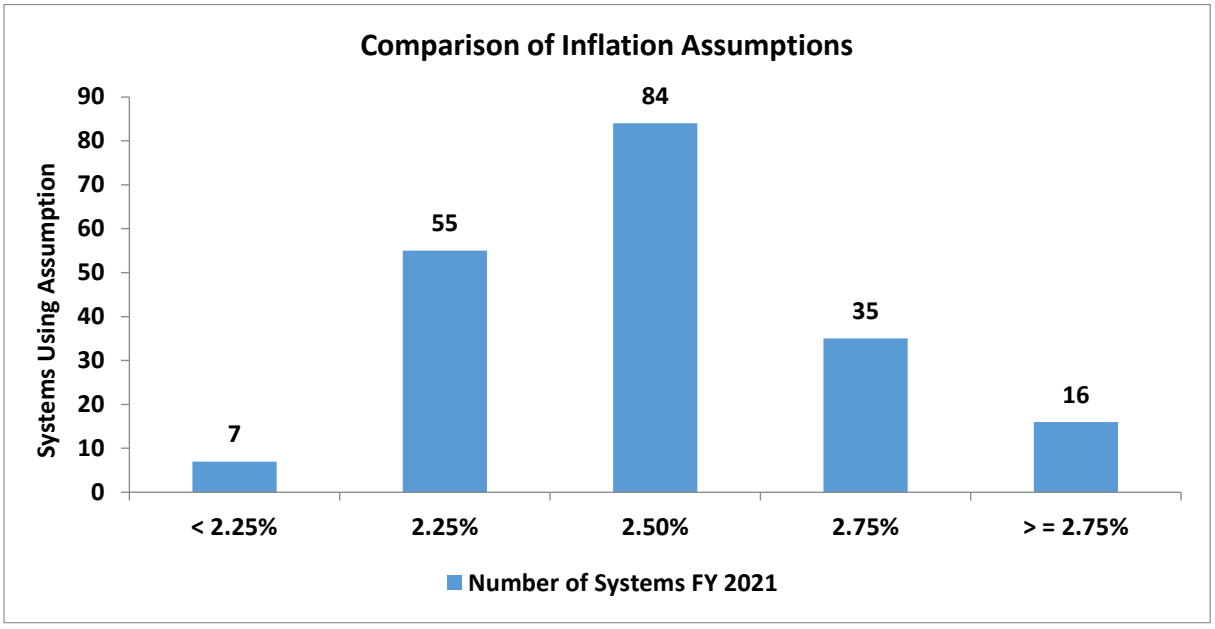
PERS' investment consultant, Callan, also has an inflation forecast in their capital market assumptions. Their short-term assumption (10 years) is 2.50%. Horizon Actuarial Services surveys a significant portion of the major investment advisors and publishes their assumptions. For the 2022 study, the long-term inflation assumption was 2.44%.

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 2022 annual report, the projected ultimate average annual increase in the CPI over the next 75 years was estimated to be 2.40%, under the intermediate (best estimate) cost assumption. The range of inflation assumptions used in the Social Security 75-year modeling, which includes a low and high-cost scenario, in addition to the intermediate cost projection, was 1.80% to 3.00%. These rates remained unchanged from their 2020 annual report.

Peer Comparison

While we do not recommend the selection of any assumption based on what other systems use, it does provide another set of relevant information to consider. The following chart shows the inflation rate assumptions of 197 plans in the Public Plan Database of the Center for Retirement Research. Based on the current data, the average inflation assumption is 2.52%. The assumptions are from actuarial valuations reported in FYE 2021. Although inflation has spiked recently, we have not seen a reversal of this trend and expect most systems to take a wait-and-see approach.



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 2.59% is closer to the System's assumed rate of 2.40%, the longer 50-year average of 4.00% is much higher and it includes the very high rates of inflation from the late 1970s and early 1980s. Those high rates will not be part of the 50-year average for much longer.

Although we have experienced rather high inflation over the last few months due to the recovery from the COVID-19 pandemic, current economic forecasts suggest annual inflation rates closer to 2.40% over the short-term and long-term, respectively. We concur with these forecasts and recommend maintaining the inflation assumption for HSPRS at 2.40%.

Price Inflation Assumption	
Current	2.40%
Recommended	2.40%

Investment Return

Background

The investment return assumption reflects anticipated returns on the current and future assets. 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 rate recommended by the actuary is 7.00%, consisting of a price inflation assumption of 2.40% and a real rate of return assumption of 4.60%.

Based on the Board's funding policy, the current investment return assumption adopted by the PERS' Board in conjunction with the experience investigation is 7.55% and will be reduced until it reaches the rate recommended by the actuary in the most recent experience study using net investment gains based on the following parameters:

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

An example of this methodology is if the actual net investment return on a market return basis is 15.00% (excess return of 7.45% over the assumed rate) for the fiscal year ending June 30, 2023, then the investment return assumption will be reduced by 10 basis points from 7.55% to 7.45% for the 2023 valuation. This methodology would continue for each subsequent valuation until the investment return assumption is equal to the recommended rate of 7.00%.

Long Term Perspective

Because the economy is constantly changing, assumptions about what may occur in the near term are volatile. Asset managers and investment consultants usually focus on this near-term horizon in order to make prudent choices regarding how to invest the trust funds. For actuarial calculations, we typically consider longer 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 HSPRS, 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 HSPRS are valued using a widely accepted asset-smoothing methodology that fully recognizes the expected investment income and also recognizes 20% of each year's investment gain or loss (the difference between actual and expected investment income). The recent experience over the last five years is shown in the table below.

Year Ending 6/30	Actuarial Value	Market Value
2018	8.54%	8.22%
2019	6.69	7.18
2020	6.79	3.11
2021	12.61	32.50
2022	8.78	(8.69)
Average	8.68%	8.46%

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 (40 were included in the 2022 study with a 10-year horizon) and provide ranges of results as well as averages. This information provides an additional perspective on what a broad group of investment experts anticipate for future investment returns.

Our forward-looking analysis used the real rates of return in Callan's capital market assumptions for 2023-2032 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 5.52%, 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	5.52%	13.84%	-15.54%	-4.13%	4.69%	14.33%	29.77%
5	4.80	6.12	-4.90	0.65	4.69	8.90	15.25
10	4.71	4.33	-2.18	1.82	4.69	7.65	12.05
20	4.67	3.06	-0.22	2.65	4.69	6.77	9.84
30	4.65	2.50	0.67	3.02	4.69	6.39	8.88
40	4.64	2.16	1.20	3.24	4.69	6.16	8.31
50	4.64	1.93	1.56	3.40	4.69	6.00	7.92

The percentile results are the percentages of random returns over the time span shown that are expected to be less than the amount indicated. For example, for the 10-year time span, 5% of the resulting real rates of return will be below -2.18% and 95% will be above that. As the time span increases, the results begin to converge. Over a 50-year time span, the results indicate there will be a 25% chance that real returns will be below 3.40% and a 25% chance they will be above 6.00%. In other words, there is a 50% chance the real returns will be between 3.40% and 6.00%.

For a broader view of expected returns, we also reviewed the 2022 Survey of Capital Market Assumptions produced by Horizon Actuarial Services, LLC to see what other investment professionals are currently using for capital market assumptions. The Horizon survey includes both 10-year horizon and 20-year horizon capital market assumptions. We applied the same statistical analysis to these survey results as we did the capital market assumption of PERS investment advisor with the following real return results for the 10-year horizon and 20-year horizon:

Horizon Survey 10-year horizon

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	4.82%	13.57%	-15.86%	-4.64%	4.02%	13.48%	28.60%
5	4.13	6.01	-5.39	0.06	4.02	8.15	14.37
10	4.04	4.24	-2.72	1.20	4.02	6.92	11.24
20	4.00	3.00	-0.79	2.02	4.02	6.07	9.08
30	3.98	2.45	0.07	2.38	4.02	5.69	8.13
40	3.98	2.12	0.59	2.60	4.02	5.46	7.57
50	3.97	1.90	0.95	2.75	4.02	5.31	7.19

Horizon Survey 20-year horizon

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	5.54%	13.57%	-15.15%	-3.93%	4.74%	14.19%	29.30%
5	4.85	6.01	-4.68	0.77	4.74	8.87	15.09
10	4.76	4.24	-2.01	1.92	4.74	7.64	11.96
20	4.72	3.00	-0.08	2.74	4.74	6.79	9.79
30	4.70	2.45	0.79	3.10	4.74	6.41	8.85
40	4.70	2.12	1.31	3.32	4.74	6.18	8.29
50	4.69	1.90	1.67	3.47	4.74	6.03	7.91

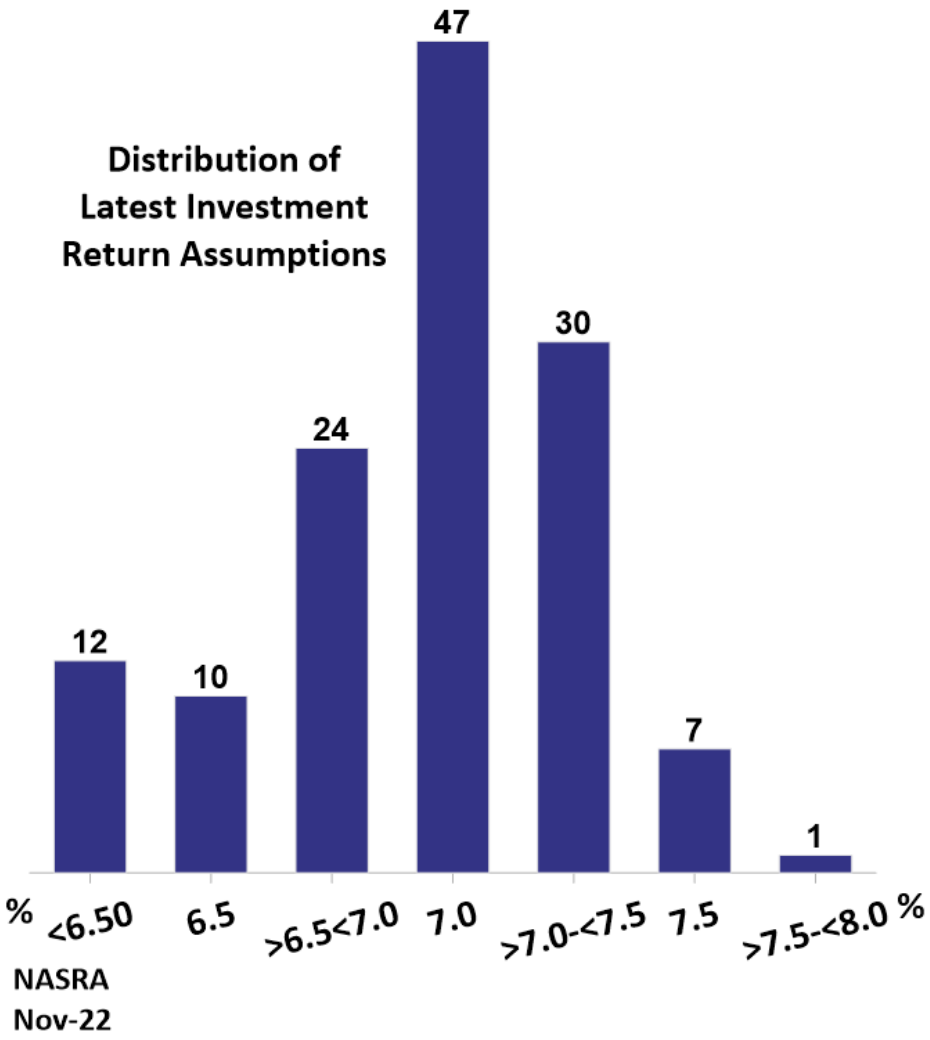
As you can see from the two tables above, setting a real return assumption depends on the time horizon a plan seeks. The 20-year horizon is approximately 0.70% higher at all percentiles than the 10-year horizon. While PERS is a long-term vehicle expected to pay benefits to its retirees for many years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

Using a 2.40% inflation assumption, the current investment return assumption of 7.55% utilizes a 5.15% real rate of return (using the "building block" methodology). Based on the table above, 5.15% falls into the 59th percentile. While it is above thresholds that we recommend for a long-term assumption, it is still a reasonable assumption, as it falls within the 40-60th percentile range.

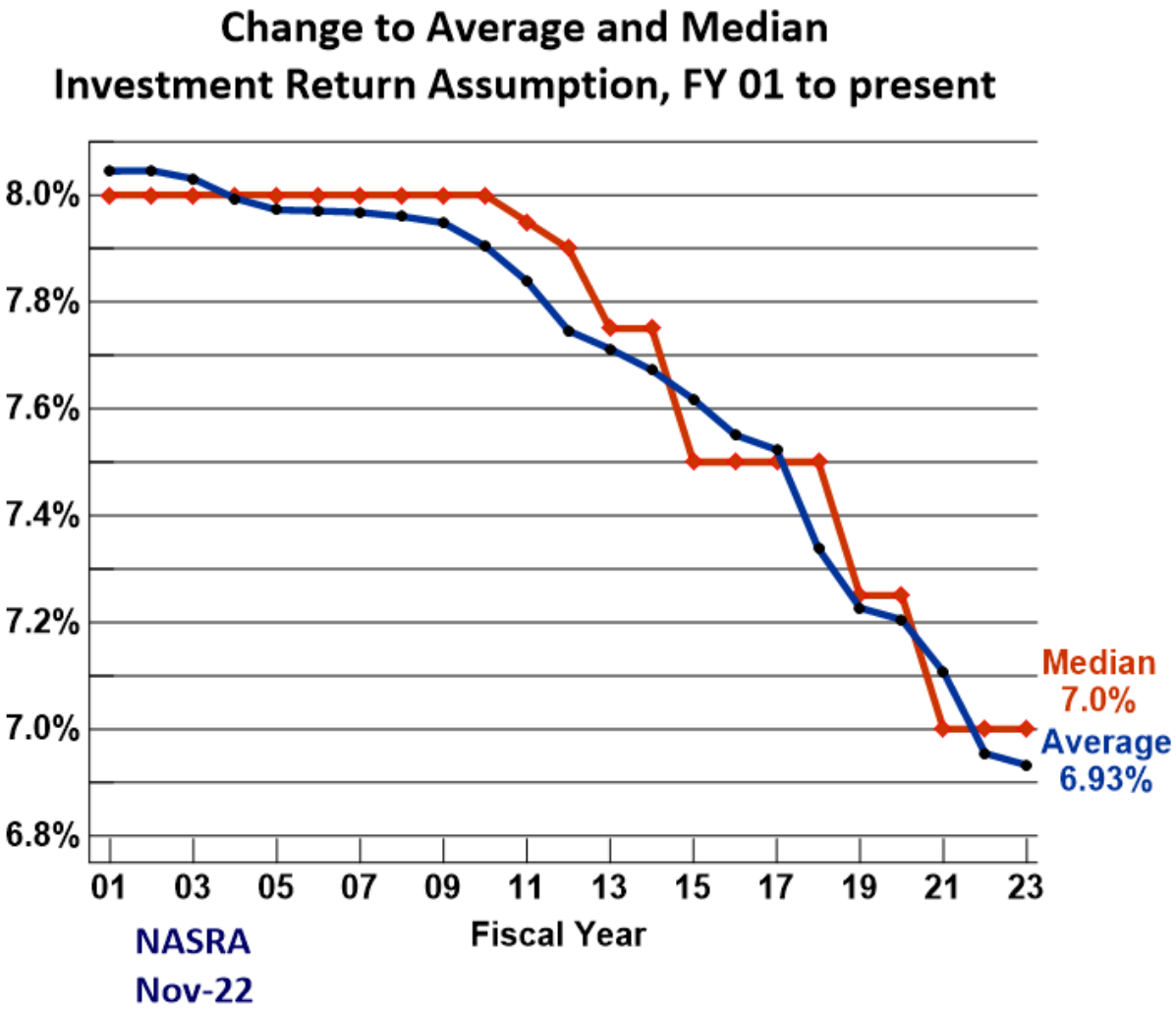
Peer Comparison

Public retirement systems have historically compared their investment performance to their peer group. While we believe there is some merit in assessing the movement in the assumed rate of return for other systems, this is not an appropriate basis for setting this assumption in our opinion. For example, different plans have different plan dynamics which will impact their choice of the assumed investment return. This peer group information merely provides another set of relevant data to consider as long as we recognize that asset allocation varies from system to system.

The following chart shows the nominal investment return assumptions of 131 plans in the National Association of State Retirement Administrators (NASRA). The assumptions shown below are as of November 2022 and are updated frequently by the NASRA staff.



The following chart shows the changes in expected investment return assumption from the NASRA public plan survey over the last 22 years from 2001.



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 short-term expectations impact our judgment regarding the appropriateness of the current assumption over the long term.

Based on our analysis of Callan's capital market assumptions and the Horizon Survey capital market assumptions, we are recommending continuation of a real return assumption of 4.60%. We acknowledge that this real return assumption is above Horizon Survey's anticipated return over the next 10 years of 4.02%, but we do put more weight on a slightly longer time horizon. Based on our recommended inflation assumption of 2.40% and real return assumption of 4.60%, we are recommending continuation of the 7.00% expected long term nominal rate of return assumption.

Investment Return Assumption		
	Current	**Recommended**
Real Rate of Return*	4.60%	4.60%
Inflation	2.40	2.40
Net Investment Return	7.00%	7.00%

* 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 2.65% and is composed of a 2.40% rate of inflation assumption and a 0.25% real rate of wage inflation.

Past Experience

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

As with our analysis of inflation, we provide below wage inflation and a comparison with price inflation over various time periods. Currently, this wage data is only available through calendar year 2021. 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
2011-2021	3.49%	2.14%	1.35%
2001-2021	3.10%	2.31%	0.79%
1991-2021	3.46%	2.37%	1.09%
1981-2021	3.77%	2.76%	1.01%
1971-2021	4.57%	3.90%	0.67%

Thus, over the last 50 years, annual real wage growth has averaged 0.67%.

Social Security Administration

The wage index used for the historical analysis is projected forward by the Office of the Chief Actuary of the Social Security Administration in their 75-year projections. In April of 2022, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.55%, 1.15% higher than the Social Security intermediate inflation assumption of 2.40% per year. The range of the assumed real wage inflation in the 2022 Trustees report was 0.53% to 1.77% per year.

Public Sector Compensation and Wages

The Bureau of Labor Statistics publishes the Employment Cost Index, including detail for real (net of inflation) total compensation and wages and salaries. Further, this index is also broken down for state and local government workers. From 2004 through 2022, total compensation grew at an annualized rate of 2.78%, while wages and salaries grew at a rate of 2.12% (Inflation was 2.51% over the same period). This difference is a reflection that state and local government workers have had much of their compensation increase delivered through benefits rather than wages and salaries. While it is certainly reasonable to anticipate that total compensation will continue to increase faster than wages and salaries, it is also reasonable to anticipate that the difference between the two will moderate over time.

Recommendation

The data the Social Security Administration collects is nationwide and predominantly from the private sector which includes many collectively bargained employees. It is questionable whether public sector employees can match the productivity rates of the private sector. **Therefore, we recommend that the plan maintain a 0.25% real wage growth inflation assumption and a total wage inflation growth of 2.65%.**

Wage Inflation Assumption		
	Current	Recommended
Price Inflation	2.40%	2.40%
Real Wage Growth	0.25%	0.25%
Wage Inflation	2.65%	2.65%

Payroll Growth

Background

The assumed future rate of payroll growth increase in the total payroll of HSPRS' active members is an assumption used in the level percentage of payroll amortization method that affects the calculation of the amortization period required to fully amortize the unfunded actuarial accrued liability and the actuarially determined employer contribution. The total payroll growth is impacted by individual member's increases and population growth. The current assumption is 2.65% per year which is comprised of the inflation assumption of 2.40% and real wage growth of 0.25%.

Recommendation

As we did for PERS, we are recommending that HSPRS maintain the payroll growth assumption of 2.65%, which is equal to the recommended wage inflation assumption.

ACTUARIAL COST METHOD

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

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 HSPRS.**

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.

Recommendation

In the new HSPRS Board funding policy, an actuarially determined employer contribution (ADEC) is calculated during each annual valuation and the ADEC is compared to the Fixed Contribution Rate adopted by the Board as one of its Signal Light metrics. The methodology in calculating the ADEC is as follows:

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

We recommend no changes in these methods.

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

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

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

The purpose of a study of demographic experience is to compare what actually happened to the membership during the study period (July 1, 2018 through June 30, 2022) with what was expected to happen based on the assumptions used in the most recent Actuarial Valuations.

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

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

We note in particular that the period of time in this study overlaps with the COVID-19 pandemic that affected not only the health of individuals, but also led to individuals and employers responding differently than they had before. As a result, we have been more cautious in recommending changes for demographic assumptions than we would be in a more normal period.

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.

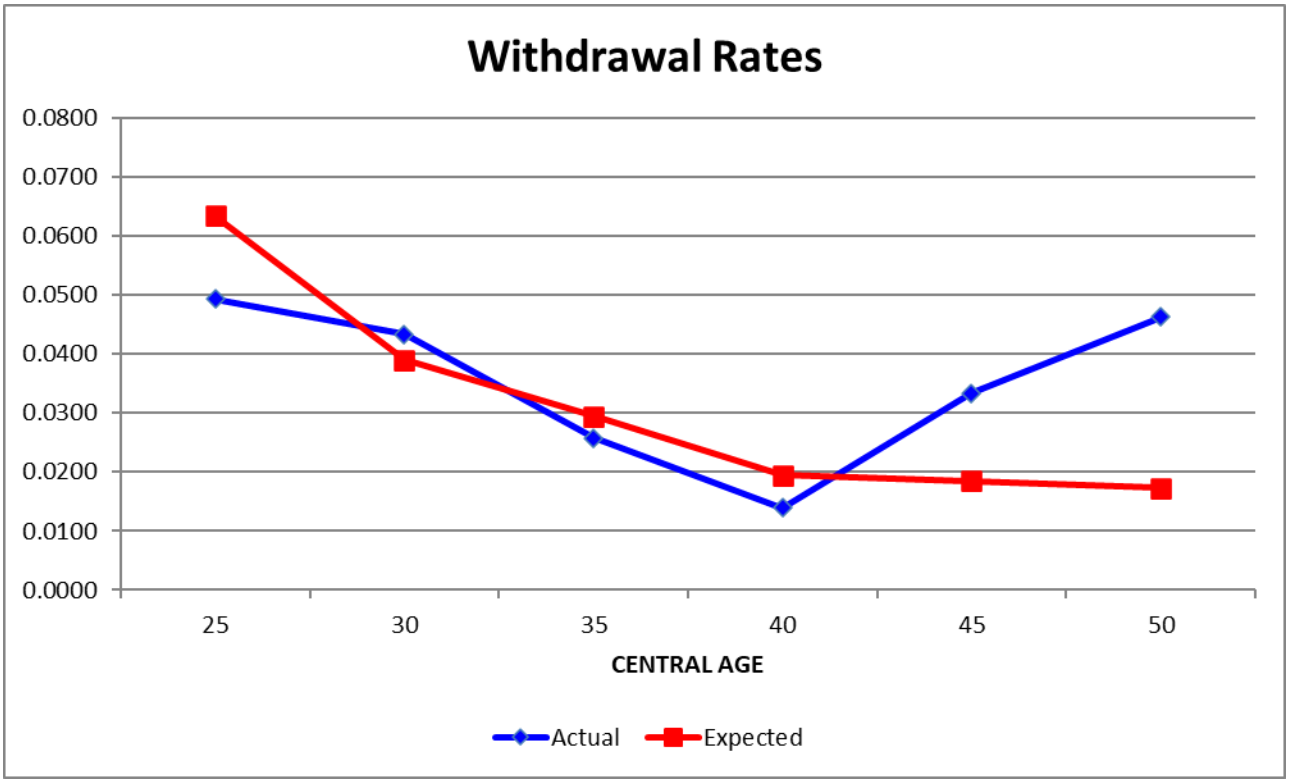
RATES OF WITHDRAWAL

COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS FROM ACTIVE SERVICE

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS		
	Actual	Expected	Ratio of Actual to Expected
25	7	9	0.778
30	10	9	1.111
35	7	8	0.875
40	5	7	0.714
45	9	5	1.800
50	8	3	2.667
53 & over	0	0	0.000
TOTAL	**46**	**41**	**1.122**

The following graph shows a comparison of the actual and expected rates of withdrawal.

RATES OF WITHDRAWAL FOR ACTIVE MEMBERS



The rates of withdrawal adopted by the Board are used to determine the expected number of separations from active service which will occur as a result of resignation or dismissal. The results of our four-year study indicate that, in aggregate, the actual number of withdrawals was just slightly more than expected.

As seen on the table on page 32, there were 46 actual withdrawals versus 41 expected withdrawals over the four-year period of this investigation. As seen on the graph on the previous page, the biggest difference between actual and expected was seen at or near age 50. In the prior investigation period, the number of actual withdrawals at age 50 was only three (compared to eight during this study). **Therefore, at this time, we recommend no changes in the rates of withdrawal and will wait until the next experience study to see if this trend continues.**

RATES OF PRE-RETIREMENT MORTALITY

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

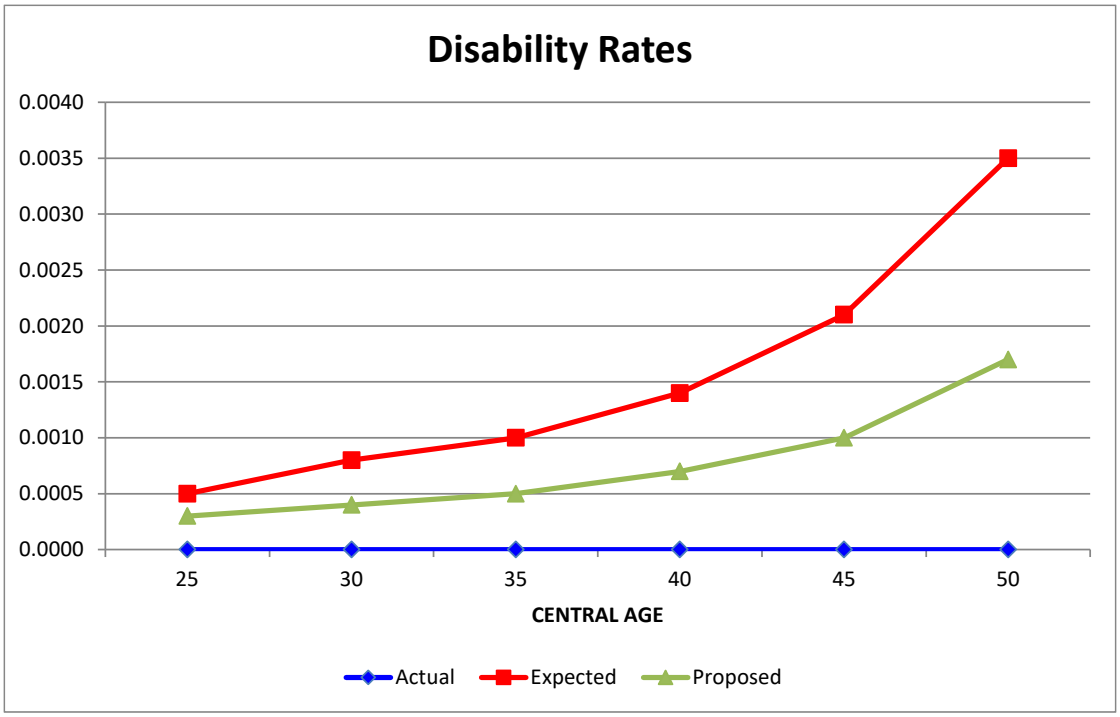
It is difficult to isolate the mortality for active members as it may be impacted by active members first terminating or moving to disabled status before death. The data collection methods used in this study do not fully capture known deaths, and so sometimes this can be misleading. Finally, the probability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

To be consistent with PERS, **we recommend no change in the current pre-retirement mortality table at this time.** We believe mortality experience in the next experience study may come back to more normal levels, which should give us more credible data to determine if a change in the mortality table is warranted.

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

RATES OF DISABILITY RETIREMENT

There were no disability retirements over the four-year period of this investigation or the prior study period. In fact, this Plan has only had 1 disability retirement in the past 12 years. Although, the rates of disability retirement were lowered in the last experience study, **we recommend another decrease in the rates of disability at this time.**



AGE	RATES OF DISABILITY	
	Current	Proposed
25	0.04%	0.02%
30	0.05%	0.03%
35	0.08%	0.04%
40	0.10%	0.05%
45	0.14%	0.07%
50	0.21%	0.10%
55	0.35%	0.17%

RATES OF RETIREMENT

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

YEARS OF SERVICE	NUMBER OF RETIREMENTS		
	Actual	Expected	Ratio of Actual to Expected
Under 20	1	1	1.000
20	5	4	1.250
21	8	7	1.143
22	1	5	0.200
23	4	6	0.667
24	8	6	1.333
25	18	15	1.200
26	9	6	1.500
27	10	4	2.500
28	5	3	1.667
29	0	1	0.000
30	4	2	2.000
31	4	6	0.667
32	8	8	1.000
33	4	4	1.000
34	2	2	1.000
Subtotal	**91**	**80**	**1.138**
35	2	1	2.000
36	1	2	0.500
37	2	4	0.500
38	4	3	1.333
39	0	1	0.000
40 & over	2	4	0.500
GRAND TOTAL	**102**	**95**	**1.074**

As you can see from the table on the previous page, in aggregate, there were 102 actual retirements versus 95 expected retirements over the four-year period of this investigation. In the prior investigation, there were less retirements than we expected and rates were changed slightly, including extending the fixed retirement age from age 61 to age 63.

Reviewing the retirement experience more closely, we see that more actual retirements occurred with less than 35 years of service than expected (91 vs. 80). **Therefore, we recommend a change in the rates of retirement to better match experience with an emphasis on the retirements with less than 35 years of service.**

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

COMPARATIVE RATES OF RETIREMENT

SERVICE	CURRENT RATES OF RETIREMENT*	PROPOSED RATES OF RETIREMENT*
5	0.075	0.075
6	0.075	0.075
7	0.075	0.075
8	0.075	0.075
9	0.075	0.075
10	0.075	0.075
11	0.075	0.075
12	0.075	0.075
13	0.075	0.075
14	0.075	0.075
15	0.075	0.075
16	0.075	0.075
17	0.075	0.075
18	0.075	0.075
19	0.075	0.075
20	0.075	0.090
21	0.100	0.120
22	0.100	0.075
23	0.100	0.075
24	0.100	0.120
25	0.200	0.240
26	0.100	0.180
27	0.100	0.250
28	0.150	0.250
29	0.150	0.100
30	0.150	0.250
31	0.350	0.275
32	0.350	0.350
33	0.350	0.350
34	0.350	0.350
35	0.350	0.350
36	0.350	0.350
37	0.500	0.350
38	0.500	0.500
39	0.500	0.500
40+	1.000	1.000

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

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS BASED ON PROPOSED RATES

YEARS OF SERVICE	NUMBER OF RETIREMENTS		
	Actual	Expected	Ratio of Actual to Expected
Under 20	1	1	1.000
20	5	5	1.000
21	8	8	1.000
22	1	4	0.250
23	4	5	0.800
24	8	8	1.000
25	18	18	1.000
26	9	9	1.000
27	10	8	1.250
28	5	4	1.250
29	0	1	0.000
30	4	3	1.333
31	4	5	0.800
32	8	8	1.000
33	4	4	1.000
34	2	2	1.000
Subtotal	**91**	**93**	**0.978**
35	2	1	2.000
36	1	2	0.500
37	2	3	0.667
38	4	3	1.333
39	0	1	0.000
40 & over	2	4	0.500
TOTAL	**102**	**107**	**0.953**

RATES OF POST-RETIREMENT MORTALITY

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

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

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

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

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

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

The issue of future mortality improvement is one that the actuarial profession has become increasingly focused on studying and monitoring. This has resulted in changes to the relevant Actuarial Standard of Practice, ASOP 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. This ASOP requires the pension actuary to make and disclose a specific recommendation with respect to future improvements in mortality after the valuation date, although it does not require that an actuary assume there will be future improvements. There have been significant improvements in longevity in the past, although there are different opinions about future expectations, and thus there is a subjective component in the estimation of future mortality improvement. We believe it is prudent to anticipate that the trend will continue to some degree in the future and that it is appropriate to reflect some future mortality improvement as part of the mortality assumption.

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

The generational approach is our preferred method for recognizing future mortality improvements in the valuation process because it is more direct and results in longer life expectancy for members who are younger, consistent with what we believe is more likely to occur. Over the last ten to fifteen years, this method has become quite common as computing power has increased.

In this experience study, we also analyzed recent experience on a benefit-weighted basis where the exposures and deaths are multiplied by the monthly retirement benefit amount. This helps to reflect any differences that arise from better mortality experience among those with larger benefits. Because a valuation is designed to measure the amount and timing of future benefit payments (liability) rather than simply the number of retirees leaving pay status, this benefit-weighted approach is an important factor in valuing plan obligations. The Actual to Expected Ratios on the benefit-weighted basis were very similar to the Actual to Expected Ratios on a count basis over the past four years so we have based our recommendations on a count basis.

COMPARISON OF ACTUAL AND EXPECTED CASES OF POST-RETIREMENT DEATHS

CENTRAL AGE OF GROUP	NUMBER OF POST-RETIREMENT DEATHS MALES AND FEMALES		
	Actual	Expected	Ratio of Actual to Expected
SERVICE RETIREMENTS			
57 & Under	0	1	0.000
60	5	4	1.377
65	8	6	1.233
70	6	9	0.670
75	7	10	0.680
80	11	12	0.908
85	8	8	1.027
90	10	7	1.441
93 & Over	2	2	1.064
Total	**57**	**59**	**0.962**
SURVIVORS			
57 & Under	1	0	0.000
60	1	0	0.000
65	0	1	0.000
70	2	1	2.000
75	3	4	0.750
80	7	6	1.167
85	11	8	1.375
90	9	9	1.000
93 & Over	7	9	0.778
Total	**41**	**38**	**1.079**

As can be seen from the table on the previous page, the number of actual post-retirement deaths was fairly close to the expected number during the last four-year period. However, since the HSPRS does not have enough mortality data by itself to warrant credible data, we recommend that the rates of mortality for post-retirements match the PERS mortality tables which had no changes.

Service Retirees (Current Table)*

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

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

Contingent Annuitants (Current Table)*

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

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

Disabled Retirees (Current Table)*

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

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

RATES OF SALARY INCREASE

COMPARISON OF ACTUAL AND EXPECTED SALARIES OF ACTIVE MEMBERS

Age of Group	SALARIES AT END OF YEAR		
	MALES AND FEMALES		
	Actual	Expected	Ratio of Actual to Expected
20	$0	$0	0.000
21	360,458	234,965	1.534
22	650,993	559,961	1.163
23	1,112,265	967,060	1.150
24	1,552,383	1,396,859	1.111
25	1,581,301	1,447,348	1.093
26	1,455,134	1,411,416	1.031
27	1,484,074	1,388,916	1.069
28 - 42	50,511,563	49,660,026	1.017
43 - 47	25,255,920	24,986,001	1.011
48 - 59	33,273,064	33,058,084	1.007
60 & Over	1,783,049	1,783,876	1.000
TOTAL	**$119,020,204**	**$116,894,512**	**1.018**

During the period under investigation, the actual rates of salary increase were higher than expected in aggregate but as you can see from the table above, the relationship between salary increases and age is not consistent. The following table uses the same data but is shown using service as the basis. As you can see, there is a slightly better relationship between salary growth and service bands.

Service	SALARIES AT END OF YEAR MALES AND FEMALES		
	Actual	Expected	Ratio of Actual to Expected
< 1	$10,100,274	$8,151,414	1.239
1	4,616,877	4,677,149	0.987
2	4,731,649	4,787,670	0.988
3	2,804,711	2,735,903	1.025
4	2,112,945	2,169,780	0.974
5	2,999,854	3,049,127	0.984
6	2,523,285	2,485,373	1.015
7	2,258,856	2,201,493	1.026
8	2,375,439	2,406,379	0.987
9	1,928,394	1,917,266	1.006
10	3,950,386	3,925,936	1.006
11	6,812,267	6,713,964	1.015
12	7,271,930	7,227,750	1.006
13	7,357,446	7,467,734	0.985
14	5,188,132	5,126,411	1.012
15	2,809,971	2,806,157	1.001
16	2,980,780	2,974,165	1.002
17	4,059,610	4,060,851	1.000
18	4,634,676	4,707,073	0.985
19	5,397,685	5,361,817	1.007
20	5,299,017	5,169,566	1.025
21	4,600,797	4,641,016	0.991
22	4,146,433	4,170,606	0.994
23	4,581,073	4,621,848	0.991
24	4,187,383	4,030,202	1.039
25+	9,290,334	9,307,862	0.998
TOTAL	**$119,020,204**	**$116,894,512**	**1.018**

Actual rates of salary increase were higher than expected at most service levels over the four-year period. However, if we remove the first year of the period (2018-2019), which experienced much higher than expected salary increases and resulted in an actuarial loss in the 2019 valuation of $377 million, then the actual to expected ratio drops from 1.018 to 1.006 and all service level breakdowns are within 1% of expected. We believe the first year of the study is skewing the results and is not a full representation of actual salary increases going forward. **We recommend a switch to a service-based table and change rates to better match experience.**

The following table shows the proposed rates of salary increase based on service.

SERVICE	Rate
0	0.0500
1	0.0500
2	0.0500
3	0.0500
4	0.0500
5	0.0475
6	0.0475
7	0.0475
8	0.0425
9	0.0425
10	0.0425
11	0.0425
12	0.0425
13	0.0425
14	0.0400
15	0.0400
16	0.0400
17	0.0400
18	0.0400
19	0.0400
20	0.0400
21	0.0375
22	0.0375
23	0.0375
24	0.0375
25	0.0350

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

Service	SALARIES AT END OF YEAR MALES AND FEMALES		
	Actual	Expected	Ratio of Actual to Expected
< 1	$10,100,274	$8,143,899	1.240
1	4,616,877	4,685,083	0.985
2	4,731,649	4,806,367	0.984
3	2,804,711	2,747,900	1.021
4	2,112,945	2,180,851	0.969
5	2,999,854	3,057,422	0.981
6	2,523,285	2,492,180	1.012
7	2,258,856	2,207,644	1.023
8	2,375,439	2,402,368	0.989
9	1,928,394	1,914,940	1.007
10	3,950,386	3,921,532	1.007
11	6,812,267	6,712,187	1.015
12	7,271,930	7,228,017	1.006
13	7,357,446	7,470,364	0.985
14	5,188,132	5,118,874	1.014
15	2,809,971	2,803,829	1.002
16	2,980,780	2,973,883	1.002
17	4,059,610	4,062,379	0.999
18	4,634,676	4,709,052	0.984
19	5,397,685	5,367,516	1.006
20	5,299,017	5,179,037	1.023
21	4,600,797	4,640,277	0.991
22	4,146,433	4,173,524	0.994
23	4,581,073	4,628,899	0.990
24	4,187,383	4,038,045	1.037
25+	9,290,334	9,313,577	0.998
TOTAL	**$119,020,204**	**$116,979,646**	**1.017**

OTHER ASSUMPTIONS

PERCENT MARRIED: Currently, 100% of active members are assumed to be married and elect a joint & survivor payment form. We are not provided with marital status on the census data. **However, we believe the current assumption is fairly conservative and recommend no change at this time.**

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

UNUSED LEAVE AND MILITARY SERVICE: Currently, we assume that participants will have on average 2.00 total years of unused leave (sick and personal) and military service at retirement. We reviewed this assumption for retired participants for each of the past four years and the average number of years of unused leave is 1.60 years and the average number of military years is 0.56 years. There has definitely been an increase in these service amounts at retirement during this period. **Therefore, we recommend increasing this assumption to 2.25 years.**

Year	Military Service	Unused Leave	Total
2019	0.52	1.46	1.98
2020	0.54	1.53	2.07
2021	0.57	1.64	2.21
2022	0.60	1.75	2.35
Average	0.56	1.60	2.15

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 no change in the factors at this time.**

Year	CPI (U)	Year	CPI (U)
1961	29.8	1992	140.2
1962	30.2	1993	144.4
1963	30.6	1994	148.0
1964	31.0	1995	152.5
1965	31.6	1996	156.7
1966	32.4	1997	160.3
1967	33.3	1998	163.0
1968	35.7	1999	166.2
1969	34.7	2000	172.4
1970	38.8	2001	178.0
1971	40.6	2002	179.9
1972	41.7	2003	183.7
1973	44.2	2004	189.7
1974	49.0	2005	194.5
1975	53.6	2006	202.9
1976	56.8	2007	208.352
1977	60.7	2008	218.815
1978	65.2	2009	215.693
1979	72.3	2010	217.965
1980	82.7	2011	225.722
1981	90.6	2012	229.478
1982	97.0	2013	233.504
1983	99.5	2014	238.343
1984	103.7	2015	238.638
1985	107.6	2016	241.018
1986	109.5	2017	244.955
1987	113.5	2018	251.989
1988	118.0	2019	256.143
1989	124.1	2020	257.797
1990	129.9	2021	271.696
1991	136.0	2022	296.311

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

Geometric Real Rates of Return and Standard Deviations by Asset Class

Asset Class	Expected Real Rate of Return	Standard Deviation
Domestic Equity	4.75%	17.75%
International Equity	4.75	20.15
Global Equity	4.95	21.25
Fixed Income	1.75	4.10
Real Estate	3.25	14.20
Private Equity	6.00	27.60
Cash Equivalents	0.25	0.90

Asset Allocation Targets

Asset Class	Asset Allocation
Domestic Equity	27.00%
International Equity	22.00
Global Equity	12.00
Fixed Income	20.00
Real Estate	10.00
Private Equity	8.00
Cash Equivalents	1.00

Year	Wage Index	Annual Increase	Year	Wage Index	Annual Increase
1960	$4,007.12	3.92%	1991	$21,811.60	3.73%
1961	4,086.76	1.99	1992	22,935.42	5.15
1962	4,291.40	5.01	1993	23,132.67	0.86
1963	4,396.64	2.45	1994	23,753.53	2.68
1964	4,576.32	4.09	1995	24,705.66	4.01
1965	4,658.72	1.80	1996	25,913.90	4.89
1966	4,938.36	6.00	1997	27,426.00	5.84
1967	5,213.44	5.57	1998	28,861.44	5.23
1968	5,571.76	6.87	1999	30,469.84	5.57
1969	5,893.76	5.78	2000	32,154.82	5.53
1970	6,186.24	4.96	2001	32,921.92	2.39
1971	6,497.08	5.02	2002	33,252.09	1.00
1972	7,133.80	9.80	2003	34,064.95	2.44
1973	7,580.16	6.26	2004	35,648.55	4.65
1974	8,030.76	5.94	2005	36,952.94	3.66
1975	8,630.92	7.47	2006	38,651.41	4.60
1976	9,226.48	6.90	2007	40,405.48	4.54
1977	9,779.44	5.99	2008	41,334.97	2.30
1978	10,556.03	7.94	2009	40,711.61	-1.51
1979	11,479.46	8.75	2010	41,673.83	2.36
1980	12,513.46	9.01	2011	42,979.61	3.13
1981	13,773.10	10.07	2012	44,321.67	3.12
1982	14,531.34	5.51	2013	44,888.16	1.28
1983	15,239.24	4.87	2014	46,481.52	3.55
1984	16,135.07	5.88	2015	48,098.63	3.48
1985	16,822.51	4.26	2016	48,642.15	1.13
1986	17,321.82	2.97	2017	50,321.89	3.45
1987	18,426.51	6.38	2018	52,145.80	3.62
1988	19,334.04	4.93	2019	54,099.99	3.75
1989	20,099.55	3.96	2020	55,628.60	2.83
1990	21,027.98	4.62	2021	60,575.07	8.89

TABLE 1

RATES OF SEPARATION FROM ACTIVE SERVICE

AGE	RATES OF WITHDRAWAL		RATES OF DEATH* MALES	RATES OF DEATH* FEMALES	RATES OF DISABILITY
	Less than 20 Years of Service	20 or More Years of Service			
20	0.08000	0.02000	0.000483	0.000126	0.000169
21	0.08000	0.02000	0.000515	0.000140	0.000169
22	0.08000	0.02000	0.000536	0.000154	0.000169
23	0.08000	0.02000	0.000546	0.000161	0.000191
24	0.08000	0.02000	0.000557	0.000175	0.000191
25	0.08000	0.02000	0.000567	0.000189	0.000191
26	0.06000	0.02000	0.000578	0.000203	0.000191
27	0.04500	0.02000	0.000588	0.000210	0.000225
28	0.04500	0.02000	0.000609	0.000224	0.000225
29	0.04000	0.02000	0.000620	0.000238	0.000236
30	0.04000	0.02000	0.000630	0.000259	0.000259
31	0.03750	0.02000	0.000651	0.000273	0.000270
32	0.03500	0.02000	0.000662	0.000287	0.000304
33	0.03250	0.02000	0.000683	0.000308	0.000338
34	0.03000	0.02000	0.000693	0.000329	0.000349
35	0.02750	0.02000	0.000714	0.000350	0.000383
36	0.02500	0.02000	0.000746	0.000371	0.000394
37	0.02250	0.02000	0.000767	0.000399	0.000428
38	0.02000	0.02000	0.000809	0.000420	0.000450
39	0.02000	0.02000	0.000840	0.000448	0.000473
40	0.02000	0.02000	0.000893	0.000483	0.000506
41	0.02000	0.02000	0.000935	0.000511	0.000529
42	0.02000	0.02000	0.000998	0.000546	0.000574
43	0.02000	0.02000	0.001061	0.000581	0.000596
44	0.02000	0.02000	0.001134	0.000623	0.000641
45	0.02000	0.00000	0.001218	0.000665	0.000675
46	0.02000	0.00000	0.001302	0.000707	0.000743
47	0.02000	0.00000	0.001407	0.000756	0.000810
48	0.02000	0.00000	0.001512	0.000805	0.000866
49	0.02000	0.00000	0.001638	0.000861	0.000956
50	0.02000	0.00000	0.001764	0.000917	0.001035
51	0.02000	0.00000	0.001901	0.000980	0.001136
52	0.02000	0.00000	0.002058	0.001043	0.001260
53	0.02000	0.00000	0.002216	0.001113	0.001406
54	0.02000	0.00000	0.002394	0.001190	0.001541
55	0.00000	0.00000	0.002594	0.001274	0.001744
56			0.002804	0.001358	0.002003
57			0.003045	0.001449	0.002250
58			0.003329	0.001540	0.002543
59			0.003633	0.001645	0.002914
60			0.003980	0.001757	0.002914
61			0.004358	0.001876	0.000000

SERVICE	RATES OF RETIREMENT**
0	0.000
1	0.000
2	0.000
3	0.000
4	0.000
5	0.075
6	0.075
7	0.075
8	0.075
9	0.075
10	0.075
11	0.075
12	0.075
13	0.075
14	0.075
15	0.075
16	0.075
17	0.075
18	0.075
19	0.075
20	0.090
21	0.120
22	0.075
23	0.075
24	0.120
25	0.240
26	0.180
27	0.250
28	0.250
29	0.100
30	0.250
31	0.275
32	0.350
33	0.350
34	0.350
35	0.350
36	0.350
37	0.350
38	0.500
39	0.500
40+	1.000

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

TABLE 2

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

SERVICE	Rate
0	0.0500
1	0.0500
2	0.0500
3	0.0500
4	0.0500
5	0.0475
6	0.0475
7	0.0475
8	0.0425
9	0.0425
10	0.0425
11	0.0425
12	0.0425
13	0.0425
14	0.0400
15	0.0400
16	0.0400
17	0.0400
18	0.0400
19	0.0400
20	0.0400
21	0.0375
22	0.0375
23	0.0375
24	0.0375
25	0.0350

* Includes wage inflation of 2.65%

TABLE 3

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

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

*Adjusted Base Rates

TABLE 4

BASE RATES OF MORTALITY FOR BENEFICIARIES OF DECEASED MEMBERS*

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

*Adjusted Base Rates

TABLE 5

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

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

*Adjusted Base Rates

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April 21, 2023

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 Supplemental Legislative Retirement Plan of Mississippi (SLRP) for the four-year period from July 1, 2018 to June 30, 2022. The study was based on the data submitted by the Public Employees' Retirement System (PERS) for the annual valuation. In preparing this report, we relied, without audit, on the data provided.

The purpose of the investigation was to assess the reasonability of the current economic assumptions and demographic actuarial assumptions for SLRP. Actuarial assumptions are used to measure and budget future costs. Changing assumptions will not change the actual cost of future benefits. Once the assumptions have been adopted, the actuarial valuation measures the adequacy of the fixed contribution rate. As a result of the investigation, it is recommended that revised demographic tables be adopted for future use.

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

In order to prepare the measurement of the impact on liabilities in this report, we have utilized actuarial models that we developed to measure liabilities and develop actuarial costs. These models include tools that we have produced and tested, along with commercially available valuation software that we have reviewed to confirm the appropriateness and accuracy of the output. In utilizing these models, we develop and use input parameters and assumptions about future contingent events along with recognized actuarial approaches to develop the needed results.

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).

We note that as we prepare this report, the world has been in a pandemic during much of the experience study period. We have taken this into consideration as we reviewed the experience, particularly regarding mortality, retirement, termination and disability patterns. While we do not believe that there is yet sufficient data to warrant the significant modification of any of our assumptions specifically due to COVID-19, we will continue to monitor the situation and advise the Board in the future of any adjustments that we believe would be appropriate.

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,

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

Ben Mobley, ASA, FCA, MAAA
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. An actuarial valuation of the Supplemental Legislative Retirement Plan of Mississippi (SLRP) is prepared annually to determine the actuarial contribution rate required to fund it 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 the SLRP under the PERS' Board of Trustees purview for the four-year period ending June 30, 2022. 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, 2023 actuarial valuation.

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 SLRP. 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 recovery from the pandemic in 2021 followed by the downward trend in global markets in 2022. 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, although the last two years have experienced higher than normal inflation due to the recovery from the pandemic, we believe that long-term inflation will settle back down in the 2.40% to 2.50% range. So therefore, **we are recommending that the price inflation assumption remain at 2.40%**.

We are also recommending that the long-term expected return on assets assumption remain at 7.00%, reflecting the 2.40% inflation assumption and a 4.60% real rate of return assumption. This will be discussed in detail later in this report, but a real rate of return of 4.60% is supported by the forecasting models developed using the Board's investment consultant's capital market assumptions and the Board's target asset allocation. Further analysis of the 40 sets of capital market assumptions included in the Horizon Actuarial Services, LLC. Survey conducted in 2022 and the Board's target asset allocation also support this recommendation.

Based on the Board's funding policy, the current long-term investment return assumption adopted by the PERS' Board is 7.55% and will be reduced until it reaches the rate recommended by the actuary in the most recent experience study using net investment gains based on the following parameters:

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

An example of this methodology is if the actual net investment return on a market return basis is 15.00% (excess return of 7.45% over the assumed rate) for the fiscal year ending June 30, 2023, then the investment return assumption will be reduced by 10 basis points from 7.55% to 7.45% for the 2023 valuation. This methodology would continue for each subsequent valuation until the investment return assumption is equal to our recommended rate of 7.00%.

Finally, we are recommending that the general wage inflation (payroll growth) assumption used as the underlying payroll growth for active members and used in the level percent of payroll amortization method remain at 2.65%.

The following table summarizes the current and proposed economic assumptions:

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

* Net of investment expenses only.

We recognize there may be other sets of economic assumptions that are also reasonable for purposes of funding SLRP. 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 future mortality improvement as part of the mortality assumption.

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

In this experience study, we also analyzed recent experience on a benefit-weighted basis where the exposures and deaths are multiplied by the monthly retirement benefit amount. This helps to reflect any differences that arise from better mortality experience among those with larger benefits. Because a valuation is designed to measure the amount and timing of future benefit payments (liability) rather than simply the number of retirees leaving pay status, this benefit-weighted approach is an important factor in valuing plan obligations. The Actual to Expected Ratios on the benefit-weighted basis were very similar to the Actual to Expected Ratios on a count basis over the past four years, so therefore, there was no distinguishing difference in providing this analysis.

Since the mortality experience of SLRP is too small and not credible enough for its own recommended post-retirement mortality table, we have combined PERS and SLRP data together to recommend a mortality table to be used for all Plans.

The current post-retirement mortality assumption for healthy lives, which we changed in the 2018 experience study, is a generational mortality approach using the Pub-2010 Mortality Tables. These tables, released in 2019, were developed using public pension plan mortality experience only. In the 2020 experience study, we adjusted these tables to better match the mortality experience of the State of Mississippi and the membership of PERS. Since these new tables have been adopted, PERS has experienced approximately 800 more retiree deaths than expected, due in large part to the COVID-19 pandemic, in our opinion. While a task to determine the cause of these deaths would be extremely time-consuming, we do believe that this amount is within ranges as to what other public sector retirement plans are experiencing across the country for COVID-related deaths.

Therefore, we have decided to recommend continuation of the Pub-2010 Public Safety Headcount Mortality Tables, with similar no adjustments or refinements for service retirees and beneficiaries from the current table. We believe mortality experience in the next experience study may come back to more normal levels, which should give us more credible data to determine if a change in the mortality table is warranted.

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

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

- **Retirement: Recommend minor adjustments in the rates of retirement for non-legislative years to better match experience of the System.**
- **Disability: Decrease rates of disability retirement at all ages.**
- **Withdrawal: No change in the rates of withdrawal at this time.**
- **Merit Salary Scale: No change to salary scale at this time.**
- **Pre-Retirement Mortality: No change in mortality table.**

Section IV of this report will provide more detail to these recommended demographic changes.

Actuarial Methods

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

- Actuarial Cost Method
- Asset Valuation Method
- Amortization Method

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

Other Assumptions

Another assumption that is included in the valuation is the determination of administrative expense component that is added to the total normal cost each year. The current assumption is 0.28% of payroll. **After reviewing the total amount of administrative expenses for the past four years and the percentage of payroll, we are recommending a decrease in this assumption from 0.28% to 0.15% of payroll.** The following table shows actual percentages over the past four years:

Year Ending June 30	Administrative Expenses	Annual Payroll	Percentage
2019	11,000	6,937,075	0.16%
2020	10,000	6,890,817	0.15%
2021	12,000	8,029,670	0.15%
2022	12,000	8,029,670	0.15%

Financial Impact

Although the assumption changes, if approved, will first be reflected in the 2023 valuation, we have provided the following table which highlights the impact of the recommended changes on the unfunded accrued liability (UAL), funding ratio, and projected funding ratio on the 2022 valuation and projection results.

($ in Thousands)

	Before All Changes	After All Changes
2022 Valuation UAL	$5,325	$5,421
2022 Funding Ratio	79.6%	79.3%
Projected Funding Ratio 2042*	90.8%	90.5%

* Recommended Fixed Contribution Rate (FCR) of 8.40% kept constant.

There are four economic assumptions used in the actuarial valuation performed for SLRP. They are:

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

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

Unlike demographic assumptions, economic assumptions do not lend themselves to analysis largely on the basis of internal historical patterns because economic assumptions are impacted by external forces in the economy. The investment return and general wage increase assumptions are selected on the basis of expectations in an inflation-free environment and then increased by the long-term expectation for inflation, called the "building block" approach.

Sources of data considered in the analysis and selection of the economic assumptions included:

- The 2022 Social Security Trustees Report
- Future expectations of PERS investment consultant, Callan
- Future expectations of other investment consultants (2022 Horizon Survey)
- U.S. Department of the Treasury bond rates
- Assumptions used by other large public retirement systems, based on the Public Fund Survey, published by the National Association of State Retirement Administrators (NASRA)
- Historical observations of price and wage growth statistics and investment returns

Actuarial Standard of Practice (ASOP) No. 27, *"Selection of Economic Assumptions for Measuring Pension Obligations"* provides guidance to actuaries in selecting economic assumptions for measuring obligations under defined benefit plans. ASOP No. 27 requires that each economic assumption selected by the actuary should be reasonable which means it has the following characteristics:

- It is appropriate for the purpose of the measurement;
- It reflects the actuary's professional judgment;
- It takes into account historical and current economic data that is relevant as of the measurement date;
- It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and

- It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included and disclosed, or when alternative assumptions are used for the assessment of risk.

With respect to relevant data, the standard recommends the actuary review appropriate recent and long-term historical economic data but advises the actuary not to give undue weight to recent experience. Furthermore, it advises the actuary to consider that some historical economic data may not be appropriate for use in developing assumptions for future periods due to changes in the underlying environment. In addition, with respect to any particular valuation, each economic assumption should be consistent with all other economic assumptions over the measurement period.

ASOP 27 recognizes that economic data and analyses are available from a variety of sources, including representatives of the plan sponsor, investment advisors, economists, and other professionals. The actuary is permitted to incorporate the views of experts, but the selection or advice must reflect the actuary's professional judgment.

The standard also discusses a "range of reasonable assumptions" which in part states "the actuary should also recognize that different actuaries will apply professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop both for an individual actuary and across actuarial practice."

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

Item	Current Assumptions	Proposed Assumptions
Price Inflation	2.40%	2.40%
Real Rate of Return*	4.60	4.60
Investment Return	7.00%	7.00%
Price Inflation	2.40%	2.40%
Real Wage Growth	0.25	0.25
Wage Inflation	2.65%	2.65%
Payroll Growth	2.65%	2.65%

* 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 2.40% per year which was recommended and adopted in the last experience study.

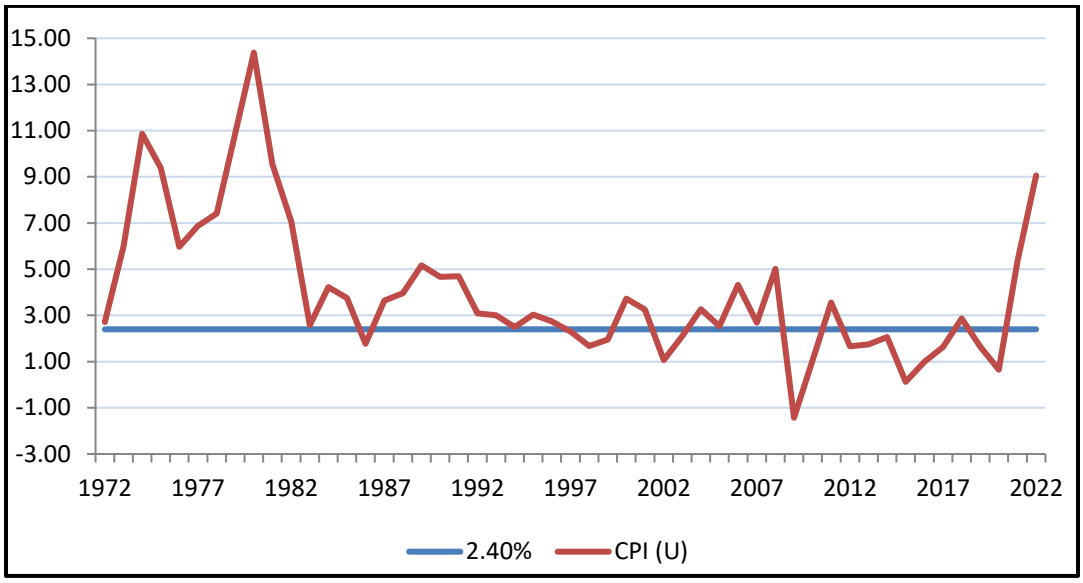
Past Experience

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 – 2022	96	2.96%	4.06%
1962 – 2022	60	3.88	2.92
1972 – 2022	50	4.00	3.11
1982 – 2022	40	2.83	1.76
1992 – 2022	30	2.53	1.86
2002 – 2022	20	2.53	2.23
2012 - 2022	10	2.59	2.69

The following graph illustrates the historical levels of price inflation measured as of June 30th of each of the last 50 years and compared to the current 2.40% annual rate currently assumed.

Annual Rate of CPI (U) Increases



As can be seen from the table on the previous page, over the last 30 years, the average annual rate of increase in the CPI-U has been just over 2.50%. The higher annual rates over the past two years has increased this average. In the last experience study in 2020, the 30-year average of price inflation was approximately 2.30%.

Forecasts

Based upon information contained in the "Survey of Professional Forecasters" for the fourth quarter of 2022 as published by the Philadelphia Federal Reserve Bank, the median expected annual rate of inflation for the next ten years is 2.37%. Although 10 years of future expectation is too short of a period for the basis of our inflation assumption, the information does provide some evidence that the consensus expectations of these experts are for rates of inflation very close to our current assumption of 2.40% for the near-term future.

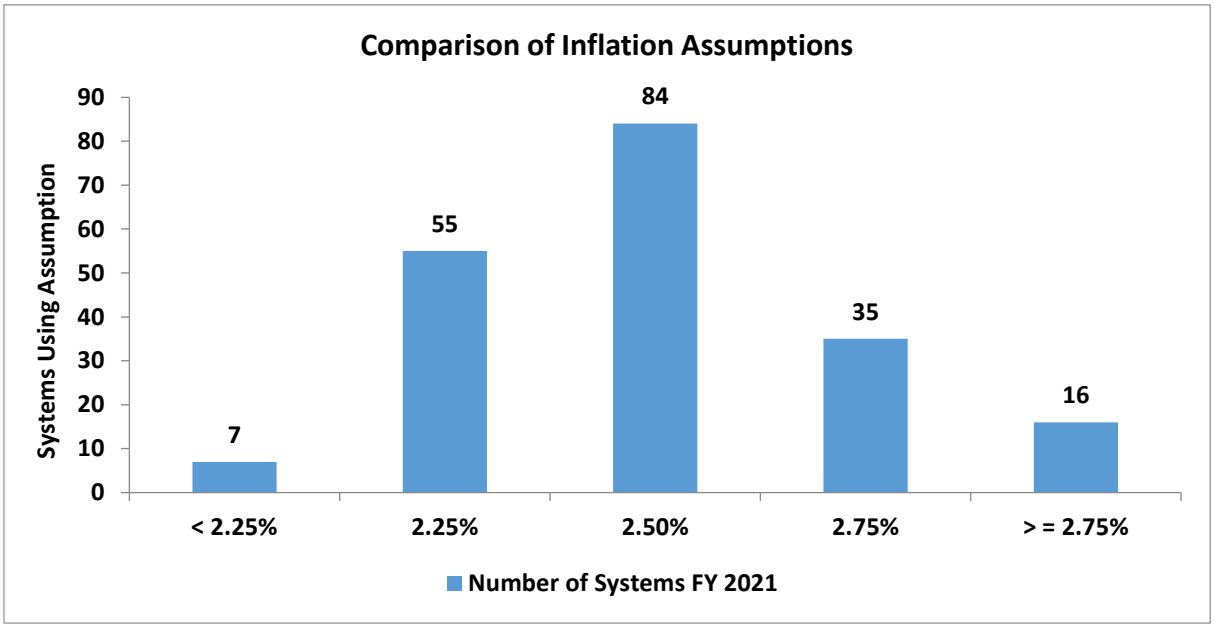
PERS' investment consultant, Callan, also has an inflation forecast in their capital market assumptions. Their short-term assumption (10 years) is 2.50%. Horizon Actuarial Services surveys a significant portion of the major investment advisors and publishes their assumptions. For the 2022 study, the long-term inflation assumption was 2.44%.

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 2022 annual report, the projected ultimate average annual increase in the CPI over the next 75 years was estimated to be 2.40%, under the intermediate (best estimate) cost assumption. The range of inflation assumptions used in the Social Security 75-year modeling, which includes a low and high-cost scenario, in addition to the intermediate cost projection, was 1.80% to 3.00%. These rates remained unchanged from their 2020 annual report.

Peer Comparison

While we do not recommend the selection of any assumption based on what other systems use, it does provide another set of relevant information to consider. The following chart shows the inflation rate assumptions of 197 plans in the Public Plan Database of the Center for Retirement Research. Based on the current data, the average inflation assumption is 2.52%. The assumptions are from actuarial valuations reported in FYE 2021. Although inflation has spiked recently, we have not seen a reversal of this trend and expect most systems to take a wait-and-see approach.



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 2.59% is closer to the System's assumed rate of 2.40%, the longer 50-year average of 4.00% is much higher and it includes the very high rates of inflation from the late 1970s and early 1980s. Those high rates will not be part of the 50-year average for much longer.

Although we have experienced rather high inflation over the last few months due to the recovery from the COVID-19 pandemic, current economic forecasts suggest annual inflation rates closer to 2.40% over the short-term and long-term, respectively. We concur with these forecasts and recommend maintaining the inflation assumption for SLRP at 2.40%.

Price Inflation Assumption	
Current	2.40%
Recommended	2.40%

Investment Return

Background

The investment return assumption reflects anticipated returns on the current and future assets. 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 rate recommended by the actuary is 7.00%, consisting of a price inflation assumption of 2.40% and a real rate of return assumption of 4.60%.

Based on the Board's funding policy, the current investment return assumption adopted by the PERS' Board in conjunction with the experience investigation is 7.55% and will be reduced until it reaches the rate recommended by the actuary in the most recent experience study using net investment gains based on the following parameters:

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

An example of this methodology is if the actual net investment return on a market return basis is 15.00% (excess return of 7.45% over the assumed rate) for the fiscal year ending June 30, 2023, then the investment return assumption will be reduced by 10 basis points from 7.55% to 7.45% for the 2023 valuation. This methodology would continue for each subsequent valuation until the investment return assumption is equal to the recommended rate of 7.00%.

Long Term Perspective

Because the economy is constantly changing, assumptions about what may occur in the near term are volatile. Asset managers and investment consultants usually focus on this near-term horizon in order to make prudent choices regarding how to invest the trust funds. For actuarial calculations, we typically consider longer 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 SLRP, 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 SLRP are valued using a widely accepted asset-smoothing methodology that fully recognizes the expected investment income and also recognizes 20% of each year's investment gain or loss (the difference between actual and expected investment income). The recent experience over the last five years is shown in the table below.

Year Ending 6/30	Actuarial Value	Market Value
2018	8.57%	8.25%
2019	6.81	7.28
2020	6.79	3.07
2021	12.64	32.56
2022	8.56	(8.72)
Average	8.67%	8.49%

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 (40 were included in the 2022 study with a 10-year horizon) and provide ranges of results as well as averages. This information provides an additional perspective on what a broad group of investment experts anticipate for future investment returns.

Our forward-looking analysis used the real rates of return in Callan's capital market assumptions for 2023-2032 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 5.52%, 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	5.52%	13.84%	-15.54%	-4.13%	4.69%	14.33%	29.77%
5	4.80	6.12	-4.90	0.65	4.69	8.90	15.25
10	4.71	4.33	-2.18	1.82	4.69	7.65	12.05
20	4.67	3.06	-0.22	2.65	4.69	6.77	9.84
30	4.65	2.50	0.67	3.02	4.69	6.39	8.88
40	4.64	2.16	1.20	3.24	4.69	6.16	8.31
50	4.64	1.93	1.56	3.40	4.69	6.00	7.92

The percentile results are the percentages of random returns over the time span shown that are expected to be less than the amount indicated. For example, for the 10-year time span, 5% of the resulting real rates of return will be below -2.18% and 95% will be above that. As the time span increases, the results begin to converge. Over a 50-year time span, the results indicate there will be a 25% chance that real returns will be below 3.40% and a 25% chance they will be above 6.00%. In other words, there is a 50% chance the real returns will be between 3.40% and 6.00%.

For a broader view of expected returns, we also reviewed the 2022 Survey of Capital Market Assumptions produced by Horizon Actuarial Services, LLC to see what other investment professionals are currently using for capital market assumptions. The Horizon survey includes both 10-year horizon and 20-year horizon capital market assumptions. We applied the same statistical analysis to these survey results as we did the capital market assumption of PERS investment advisor with the following real return results for the 10-year horizon and 20-year horizon:

Horizon Survey 10-year horizon

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	4.82%	13.57%	-15.86%	-4.64%	4.02%	13.48%	28.60%
5	4.13	6.01	-5.39	0.06	4.02	8.15	14.37
10	4.04	4.24	-2.72	1.20	4.02	6.92	11.24
20	4.00	3.00	-0.79	2.02	4.02	6.07	9.08
30	3.98	2.45	0.07	2.38	4.02	5.69	8.13
40	3.98	2.12	0.59	2.60	4.02	5.46	7.57
50	3.97	1.90	0.95	2.75	4.02	5.31	7.19

Horizon Survey 20-year horizon

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	5.54%	13.57%	-15.15%	-3.93%	4.74%	14.19%	29.30%
5	4.85	6.01	-4.68	0.77	4.74	8.87	15.09
10	4.76	4.24	-2.01	1.92	4.74	7.64	11.96
20	4.72	3.00	-0.08	2.74	4.74	6.79	9.79
30	4.70	2.45	0.79	3.10	4.74	6.41	8.85
40	4.70	2.12	1.31	3.32	4.74	6.18	8.29
50	4.69	1.90	1.67	3.47	4.74	6.03	7.91

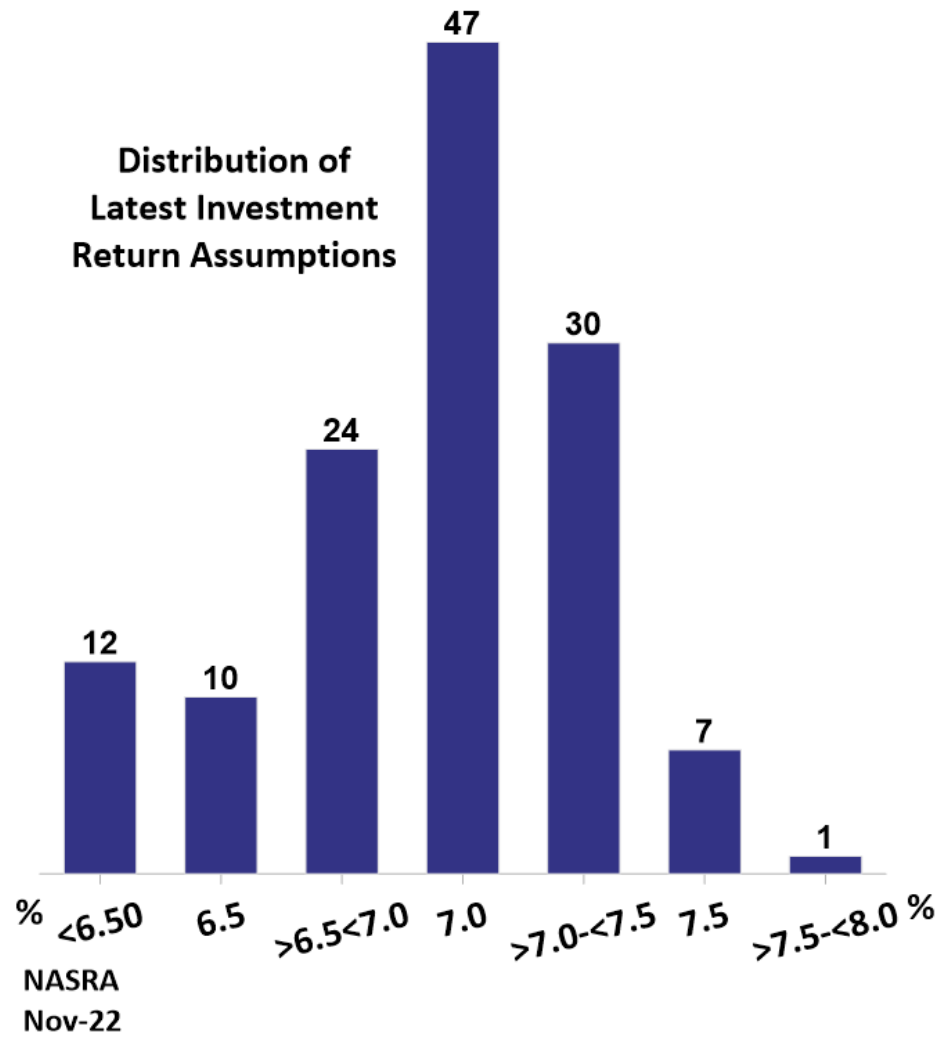
As you can see from the two tables above, setting a real return assumption depends on the time horizon a plan seeks. The 20-year horizon is approximately 0.70% higher at all percentiles than the 10-year horizon. While PERS is a long-term vehicle expected to pay benefits to its retirees for many years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

Using a 2.40% inflation assumption, the current investment return assumption of 7.55% utilizes a 5.15% real rate of return (using the "building block" methodology). Based on the table above, 5.15% falls into the 59th percentile. While it is above thresholds that we recommend for a long-term assumption, it is still a reasonable assumption, as it falls within the 40-60th percentile range.

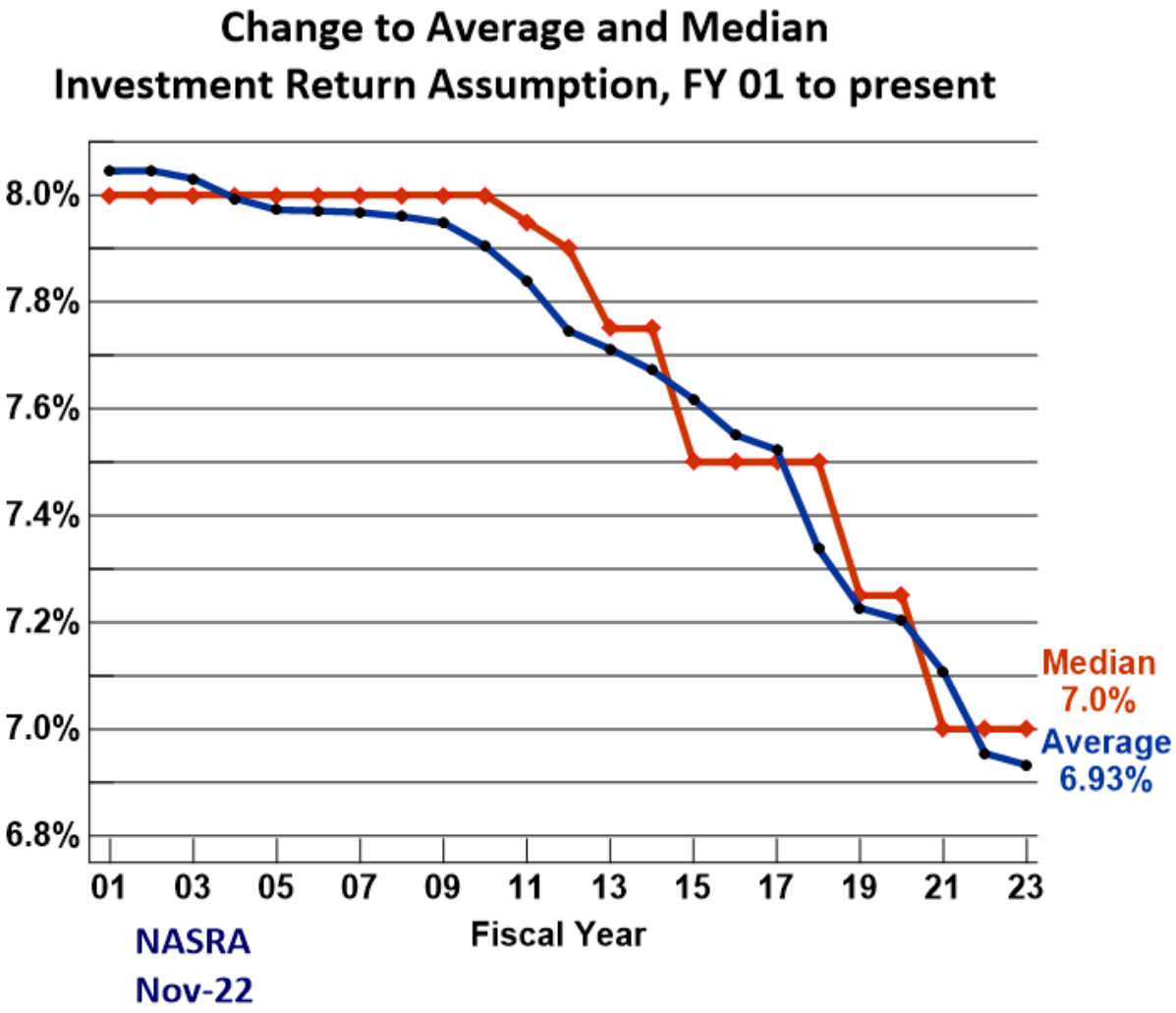
Peer Comparison

Public retirement systems have historically compared their investment performance to their peer group. While we believe there is some merit in assessing the movement in the assumed rate of return for other systems, this is not an appropriate basis for setting this assumption in our opinion. For example, different plans have different plan dynamics which will impact their choice of the assumed investment return. This peer group information merely provides another set of relevant data to consider as long as we recognize that asset allocation varies from system to system.

The following chart shows the nominal investment return assumptions of 131 plans in the National Association of State Retirement Administrators (NASRA). The assumptions shown below are as of November 2022 and are updated frequently by the NASRA staff.



The following chart shows the changes in expected investment return assumption from the NASRA public plan survey over the last 22 years from 2001.



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 short-term expectations impact our judgment regarding the appropriateness of the current assumption over the long term.

Based on our analysis of Callan's capital market assumptions and the Horizon Survey capital market assumptions, we are recommending continuation of a real return assumption of 4.60%. We acknowledge that this real return assumption is above Horizon Survey's anticipated return over the next 10 years of 4.02%, but we do put more weight on a slightly longer time horizon. Based on our recommended inflation assumption of 2.40% and real return assumption of 4.60%, we are recommending continuation of the 7.00% expected long term nominal rate of return assumption.

Investment Return Assumption		
	Current	**Recommended**
Real Rate of Return*	4.60%	4.60%
Inflation	2.40	2.40
Net Investment Return	7.00%	7.00%

* 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 2.65% and is composed of a 2.40% rate of inflation assumption and a 0.25% real rate of wage inflation.

Past Experience

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

As with our analysis of inflation, we provide below wage inflation and a comparison with price inflation over various time periods. Currently, this wage data is only available through calendar year 2021. 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
2011-2021	3.49%	2.14%	1.35%
2001-2021	3.10%	2.31%	0.79%
1991-2021	3.46%	2.37%	1.09%
1981-2021	3.77%	2.76%	1.01%
1971-2021	4.57%	3.90%	0.67%

Thus, over the last 50 years, annual real wage growth has averaged 0.67%.

Social Security Administration

The wage index used for the historical analysis is projected forward by the Office of the Chief Actuary of the Social Security Administration in their 75-year projections. In April of 2022, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.55%, 1.15% higher than the Social Security intermediate inflation assumption of 2.40% per year. The range of the assumed real wage inflation in the 2022 Trustees report was 0.53% to 1.77% per year.

Public Sector Compensation and Wages

The Bureau of Labor Statistics publishes the Employment Cost Index, including detail for real (net of inflation) total compensation and wages and salaries. Further, this index is also broken down for state and local government workers. From 2004 through 2022, total compensation grew at an annualized rate of 2.78%, while wages and salaries grew at a rate of 2.12% (Inflation was 2.51% over the same period). This difference is a reflection that state and local government workers have had much of their compensation increase delivered through benefits rather than wages and salaries. While it is certainly reasonable to anticipate that total compensation will continue to increase faster than wages and salaries, it is also reasonable to anticipate that the difference between the two will moderate over time.

Recommendation

The data the Social Security Administration collects is nationwide and predominantly from the private sector which includes many collectively bargained employees. It is questionable whether public sector employees can match the productivity rates of the private sector. **Therefore, we recommend that the plan maintain a 0.25% real wage growth inflation assumption and a total wage inflation growth of 2.65%.**

Wage Inflation Assumption		
	Current	Recommended
Price Inflation	2.40%	2.40%
Real Wage Growth	0.25%	0.25%
Wage Inflation	2.65%	2.65%

Payroll Growth

Background

The assumed future rate of payroll growth increase in the total payroll of SLRP' active members is an assumption used in the level percentage of payroll amortization method that affects the calculation of the amortization period required to fully amortize the unfunded actuarial accrued liability and the actuarially determined employer contribution. The total payroll growth is impacted by individual member's increases and population growth. The current assumption is 2.65% per year which is comprised of the inflation assumption of 2.40% and real wage growth of 0.25%.

Recommendation

As we did for PERS, we are recommending that SLRP maintain the payroll growth assumption of 2.65%, which is equal to the recommended wage inflation assumption.

ACTUARIAL COST METHOD

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

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 SLRP.**

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.

Recommendation

In the new SLRP Board funding policy, an actuarially determined employer contribution (ADEC) is calculated during each annual valuation and the ADEC is compared to the Fixed Contribution Rate adopted by the Board as one of its Signal Light metrics. The methodology in calculating the ADEC is as follows:

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

We recommend no changes in these methods.

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

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

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

The purpose of a study of demographic experience is to compare what actually happened to the membership during the study period (July 1, 2018 through June 30, 2022) with what was expected to happen based on the assumptions used in the most recent Actuarial Valuations.

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

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

We note in particular that the period of time in this study overlaps with the COVID-19 pandemic that affected not only the health of individuals, but also led to individuals and employers responding differently than they had before. As a result, we have been more cautious in recommending changes for demographic assumptions than we would be in a more normal period.

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.

RATES OF WITHDRAWAL

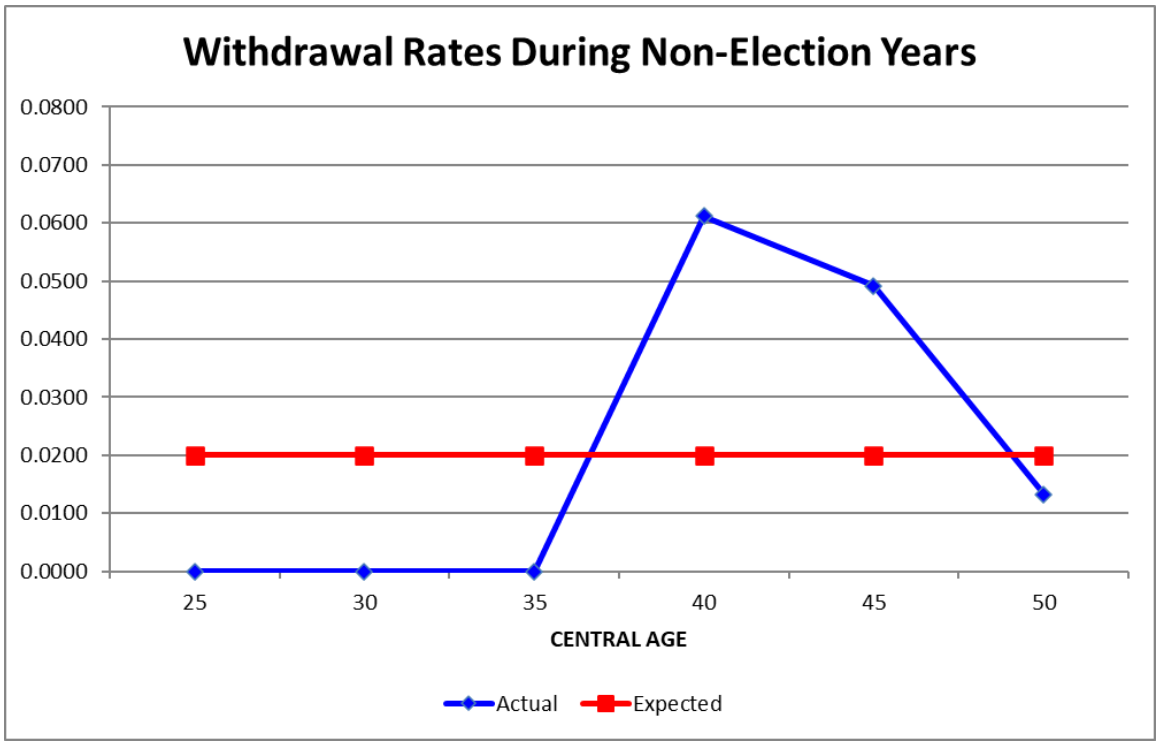
COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS FROM ACTIVE SERVICE

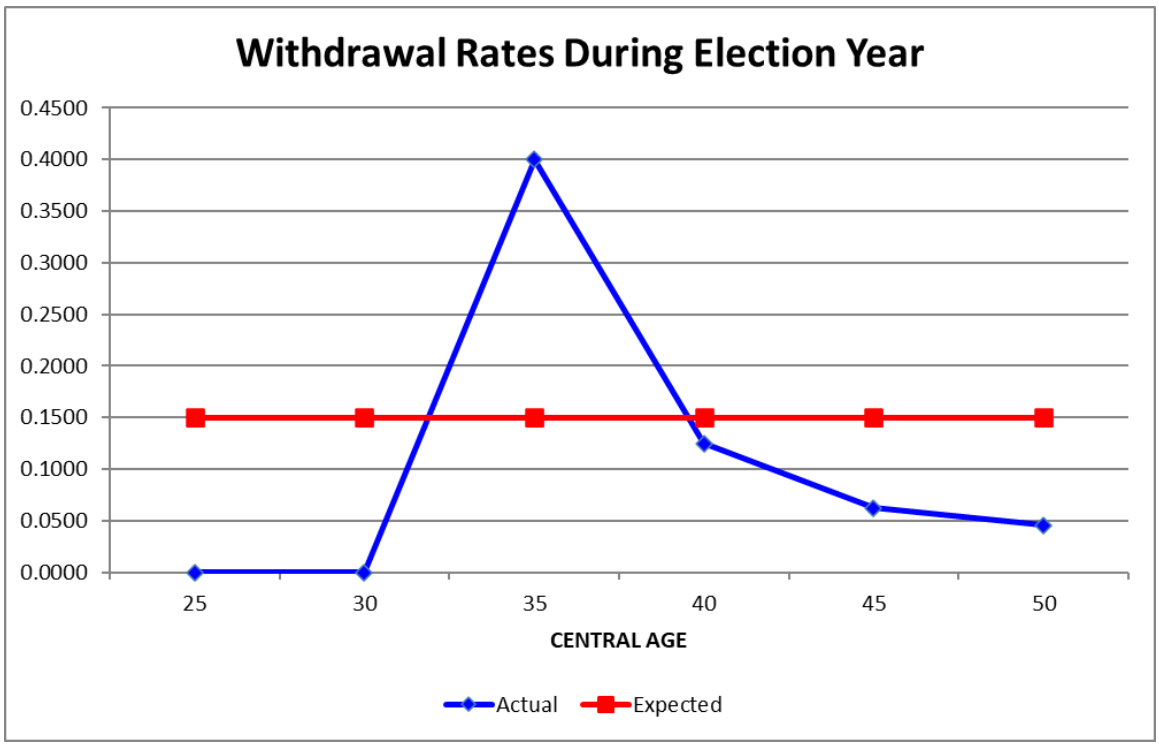
CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS DURING NON-ELECTION YEARS		
	Actual	Expected	Ratio of Actual to Expected
20	0	0	0.000
25	0	0	0.000
30	0	0	0.000
35	0	0	0.000
40	3	1	3.000
45	3	2	1.500
50	1	2	0.500
53 & over	1	2	0.000
TOTAL	**8**	**7**	**1.143**

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS DURING ELECTION YEAR		
	Actual	Expected	Ratio of Actual to Expected
20	0	0	0.000
25	0	0	0.000
30	0	1	0.000
35	2	1	2.000
40	2	2	1.000
45	1	2	0.500
50	1	3	0.333
53 & over	7	6	0.000
TOTAL	**13**	**15**	**0.867**

The following graphs show a comparison of the actual and expected rates of withdrawal.

RATES OF WITHDRAWAL FOR ACTIVE MEMBERS





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. During the four-year period of the investigation, there were 21 actual withdrawals and we expected 22 withdrawals. This period included one election year and three non-election years. **Since the actual results were very close to expected for non-election and election years, we recommend no changes in the rates of withdrawal.**

RATES OF PRE-RETIREMENT MORTALITY

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

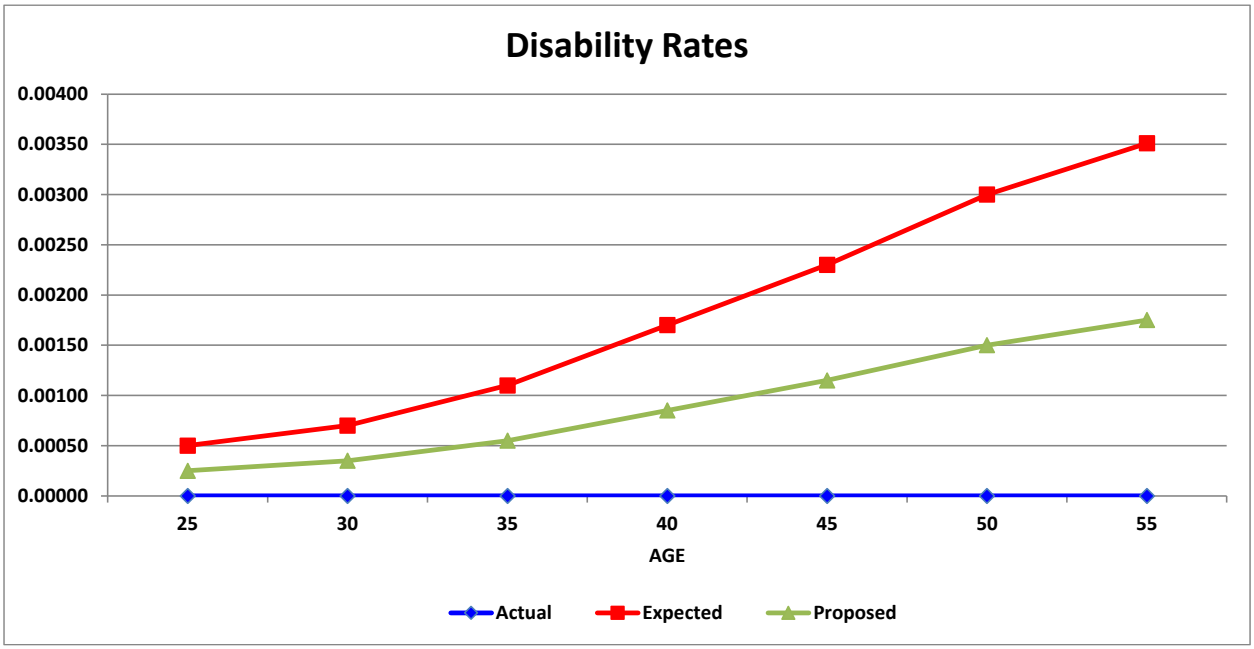
It is difficult to isolate the mortality for active members as it may be impacted by active members first terminating or moving to disabled status before death. The data collection methods used in this study do not fully capture known deaths, and so sometimes this can be misleading. Finally, the probability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

To be consistent with PERS, we recommend no change in the current pre-retirement mortality table at this time. We believe mortality experience in the next experience study may come back to more normal levels, which should give us more credible data to determine if a change in the mortality table is warranted.

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

RATES OF DISABILITY RETIREMENT

There were no disability retirements over the four-year period of this investigation. In fact, this Plan has not had a disability retirement in the past 12 years. The rates of disability retirement have not been lowered in a few years. **Therefore, we recommend a decrease in the rates of disability at this time.**



AGE	RATES OF DISABILITY	
	Current	Proposed
25	0.05%	0.03%
30	0.07%	0.04%
35	0.11%	0.06%
40	0.17%	0.09%
45	0.23%	0.12%
50	0.30%	0.15%
55	0.35%	0.18%

RATES OF RETIREMENT

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS DURING NON-ELECTION YEARS		
	Actual	Expected	Ratio of Actual to Expected
50	1	0	0.000
55	1	0	0.000
60	1	1	1.000
65	2	1	2.000
70	1	1	1.000
75	0	1	0.000
Subtotal	**6**	**4**	**1.500**
80 and Over	2	16	0.125
GRAND TOTAL	**8**	**20**	**0.400**

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS DURING ELECTION YEAR		
	Actual	Expected	Ratio of Actual to Expected
50	0	0	0.000
55	1	1	1.000
60	0	3	0.000
65	6	5	1.200
70	8	6	1.333
75	1	2	0.500
Subtotal	**16**	**17**	**0.941**
80 and Over	6	8	0.750
GRAND TOTAL	**22**	**25**	**0.880**

As you can see from the table on the previous page, during non-election years, there were 8 actual retirements versus 20 expected retirements over the four-year period of this investigation. However, this aggregate result is deceiving as the actual number of retirements before the age of 80 was slightly more than expected.

During election year(s), there were 22 actual retirements, which was very close to expected (25 retirements). This result was close for all ages.

Therefore, we only recommend a slight increase in the non-election year retirement rates from 2.5% to 3.5% for ages before age 80 to better match experience.

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS BASED ON PROPOSED RATES

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS DURING NON-ELECTION YEARS		
	Actual	Expected	Ratio of Actual to Expected
50	1	0	0.000
55	1	0	0.000
60	1	1	1.000
65	2	2	1.000
70	1	2	0.500
75	0	1	0.000
Subtotal	**6**	**6**	**1.000**
80 and Over	2	16	0.125
GRAND TOTAL	**8**	**22**	**0.364**

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS DURING ELECTION YEAR		
	Actual	Expected	Ratio of Actual to Expected
50	0	0	0.000
55	1	1	1.000
60	0	3	0.000
65	6	5	1.200
70	8	6	1.333
75	1	2	0.500
Subtotal	**16**	**17**	**0.941**
80 and Over	6	8	0.750
GRAND TOTAL	**22**	**25**	**0.880**

RATES OF POST-RETIREMENT MORTALITY

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

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

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

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

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

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

The issue of future mortality improvement is one that the actuarial profession has become increasingly focused on studying and monitoring. This has resulted in changes to the relevant Actuarial Standard of Practice, ASOP 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. This ASOP requires the pension actuary to make and disclose a specific recommendation with respect to future improvements in mortality after the valuation date, although it does not require that an actuary assume there will be future improvements. There have been significant improvements in longevity in the past, although there are different opinions about future expectations, and thus there is a subjective component in the estimation of future mortality improvement. We believe it is prudent to anticipate that the trend will continue to some degree in the future and that it is appropriate to reflect some future mortality improvement as part of the mortality assumption.

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

The generational approach is our preferred method for recognizing future mortality improvements in the valuation process because it is more direct and results in longer life expectancy for members who are younger, consistent with what we believe is more likely to occur. Over the last ten to fifteen years, this method has become quite common as computing power has increased.

In this experience study, we also analyzed recent experience on a benefit-weighted basis where the exposures and deaths are multiplied by the monthly retirement benefit amount. This helps to reflect any differences that arise from better mortality experience among those with larger benefits. Because a valuation is designed to measure the amount and timing of future benefit payments (liability) rather than simply the number of retirees leaving pay status, this benefit-weighted approach is an important factor in valuing plan obligations. The Actual to Expected Ratios on the benefit-weighted basis were very similar to the Actual to Expected Ratios on a count basis over the past four years so we have based our recommendations on a count basis.

COMPARISON OF ACTUAL AND EXPECTED CASES OF POST-RETIREMENT DEATHS

CENTRAL AGE OF GROUP	NUMBER OF POST-RETIREMENT DEATHS		
	MALES AND FEMALES		
	Actual	Expected	Ratio of Actual to Expected
SERVICE RETIREMENTS			
57 & Under	0	0	0.000
60	0	0	0.000
65	1	2	0.568
70	0	3	0.000
75	3	5	0.594
80	5	6	0.883
85	9	6	1.393
90	4	4	1.090
93 & Over	0	2	0.000
Total	**22**	**28**	**0.786**
SURVIVORS			
57 & Under	0	0	0.000
60	0	0	0.000
65	0	0	0.000
70	0	0	0.000
75	1	1	1.000
80	1	2	0.500
85	0	2	0.000
90	2	2	1.000
93 & Over	0	0	0.000
Total	**4**	**7**	**0.571**

As can be seen from the table on the previous page, the number of actual post-retirement deaths was fairly close to the expected number during the last four year period. However, since the SLRP does not have enough mortality data by itself to warrant credible data, we recommend that the rates of mortality for post-retirements match the PERS mortality tables which had no changes.

Service Retirees (Current Table)*

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

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

Contingent Annuitants (Current Table)*

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

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

Disabled Retirees (Current Table)*

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

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

RATES OF SALARY INCREASE

COMPARISON OF ACTUAL AND EXPECTED SALARIES OF ACTIVE MEMBERS

Age of Group	SALARIES AT END OF YEAR		
	MALES AND FEMALES		
	Actual	Expected	Ratio of Actual to Expected
20	$0	$0	0.000
25	338,960	318,489	1.064
30	649,157	635,639	1.021
35	862,576	851,778	1.013
40	2,834,965	2,718,491	1.043
45	3,449,207	3,364,477	1.025
50	4,270,057	4,195,875	1.018
55	4,861,604	4,749,951	1.024
60	3,403,617	3,336,718	1.020
65	2,835,714	2,817,988	1.006
68 & Over	4,498,152	4,381,810	1.027
TOTAL	**$28,004,009**	**$27,371,216**	**1.023**

Actual rates of salary increase, in aggregate, were higher than expected over the four-year period by approximately 2.3%. In the prior investigation, they were less than we expected by approximately 3.0% in aggregate. In this Plan, salaries are determined by the number of days spent in legislative session and in 2021 (3rd year of this study period), the number of hours was much higher than in other years and provided the members with significantly higher salary increases during that year. **We do not forsee an increase like that in the future, therefore, we recommend no change in the merit salary scale at this time.**

OTHER ASSUMPTIONS

PERCENT MARRIED: Currently, 100% of active members are assumed to be married and elect a joint & survivor payment form. We are not provided with marital status on the census data. **However, we believe the current assumption is fairly conservative and recommend no change at this time.**

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

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 no change in the factors at this time.**

Year	CPI (U)	Year	CPI (U)
1961	29.8	1992	140.2
1962	30.2	1993	144.4
1963	30.6	1994	148.0
1964	31.0	1995	152.5
1965	31.6	1996	156.7
1966	32.4	1997	160.3
1967	33.3	1998	163.0
1968	35.7	1999	166.2
1969	34.7	2000	172.4
1970	38.8	2001	178.0
1971	40.6	2002	179.9
1972	41.7	2003	183.7
1973	44.2	2004	189.7
1974	49.0	2005	194.5
1975	53.6	2006	202.9
1976	56.8	2007	208.352
1977	60.7	2008	218.815
1978	65.2	2009	215.693
1979	72.3	2010	217.965
1980	82.7	2011	225.722
1981	90.6	2012	229.478
1982	97.0	2013	233.504
1983	99.5	2014	238.343
1984	103.7	2015	238.638
1985	107.6	2016	241.018
1986	109.5	2017	244.955
1987	113.5	2018	251.989
1988	118.0	2019	256.143
1989	124.1	2020	257.797
1990	129.9	2021	271.696
1991	136.0	2022	296.311

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

Geometric Real Rates of Return and Standard Deviations by Asset Class

Asset Class	Expected Real Rate of Return	Standard Deviation
Domestic Equity	4.75%	17.75%
International Equity	4.75	20.15
Global Equity	4.95	21.25
Fixed Income	1.75	4.10
Real Estate	3.25	14.20
Private Equity	6.00	27.60
Cash Equivalents	0.25	0.90

Asset Allocation Targets

Asset Class	Asset Allocation
Domestic Equity	27.00%
International Equity	22.00
Global Equity	12.00
Fixed Income	20.00
Real Estate	10.00
Private Equity	8.00
Cash Equivalents	1.00

Year	Wage Index	Annual Increase	Year	Wage Index	Annual Increase
1960	$4,007.12	3.92%	1991	$21,811.60	3.73%
1961	4,086.76	1.99	1992	22,935.42	5.15
1962	4,291.40	5.01	1993	23,132.67	0.86
1963	4,396.64	2.45	1994	23,753.53	2.68
1964	4,576.32	4.09	1995	24,705.66	4.01
1965	4,658.72	1.80	1996	25,913.90	4.89
1966	4,938.36	6.00	1997	27,426.00	5.84
1967	5,213.44	5.57	1998	28,861.44	5.23
1968	5,571.76	6.87	1999	30,469.84	5.57
1969	5,893.76	5.78	2000	32,154.82	5.53
1970	6,186.24	4.96	2001	32,921.92	2.39
1971	6,497.08	5.02	2002	33,252.09	1.00
1972	7,133.80	9.80	2003	34,064.95	2.44
1973	7,580.16	6.26	2004	35,648.55	4.65
1974	8,030.76	5.94	2005	36,952.94	3.66
1975	8,630.92	7.47	2006	38,651.41	4.60
1976	9,226.48	6.90	2007	40,405.48	4.54
1977	9,779.44	5.99	2008	41,334.97	2.30
1978	10,556.03	7.94	2009	40,711.61	-1.51
1979	11,479.46	8.75	2010	41,673.83	2.36
1980	12,513.46	9.01	2011	42,979.61	3.13
1981	13,773.10	10.07	2012	44,321.67	3.12
1982	14,531.34	5.51	2013	44,888.16	1.28
1983	15,239.24	4.87	2014	46,481.52	3.55
1984	16,135.07	5.88	2015	48,098.63	3.48
1985	16,822.51	4.26	2016	48,642.15	1.13
1986	17,321.82	2.97	2017	50,321.89	3.45
1987	18,426.51	6.38	2018	52,145.80	3.62
1988	19,334.04	4.93	2019	54,099.99	3.75
1989	20,099.55	3.96	2020	55,628.60	2.83
1990	21,027.98	4.62	2021	60,575.07	8.89

TABLE 1

RATES OF SEPARATION FROM ACTIVE SERVICE

AGE	ADJUSTED BASE RATES OF DEATH		RATES OF DISABILITY
	MALES	FEMALES	
20	0.000483	0.000126	0.00020
21	0.000515	0.000140	0.00020
22	0.000536	0.000154	0.00025
23	0.000546	0.000161	0.00025
24	0.000557	0.000175	0.00025
25	0.000567	0.000189	0.00025
26	0.000578	0.000203	0.00030
27	0.000588	0.000210	0.00030
28	0.000609	0.000224	0.00035
29	0.000620	0.000238	0.00035
30	0.000630	0.000259	0.00035
31	0.000651	0.000273	0.00040
32	0.000662	0.000287	0.00045
33	0.000683	0.000308	0.00050
34	0.000693	0.000329	0.00055
35	0.000714	0.000350	0.00055
36	0.000746	0.000371	0.00060
37	0.000767	0.000399	0.00065
38	0.000809	0.000420	0.00070
39	0.000840	0.000448	0.00080
40	0.000893	0.000483	0.00085
41	0.000935	0.000511	0.00090
42	0.000998	0.000546	0.00095
43	0.001061	0.000581	0.00105
44	0.001134	0.000623	0.00110
45	0.001218	0.000665	0.00115
46	0.001302	0.000707	0.00125
47	0.001407	0.000756	0.00130
48	0.001512	0.000805	0.00135
49	0.001638	0.000861	0.00140
50	0.001764	0.000917	0.00150
51	0.001901	0.000980	0.00155
52	0.002058	0.001043	0.00160
53	0.002216	0.001113	0.00165
54	0.002394	0.001190	0.00170
55	0.002594	0.001274	0.00175
56	0.002804	0.001358	0.00180
57	0.003045	0.001449	0.00185
58	0.003329	0.001540	0.00190
59	0.003633	0.001645	0.00195
60	0.003980	0.001757	0.00200
61	0.004358	0.001876	0.00205
62	0.004788	0.002002	0.00210
63	0.005261	0.002135	0.00220
64	0.005775	0.002275	0.00225
65	0.006353	0.002429	0.00000
66	0.007172	0.002779	0.00000
67	0.008096	0.003171	0.00000
68	0.009146	0.003626	0.00000
69	0.010322	0.004144	0.00000
70	0.011655	0.004739	0.00000
71	0.013157	0.005418	0.00000
72	0.014858	0.006195	0.00000
73	0.016779	0.007077	0.00000
74	0.018942	0.008092	0.00000
75	0.021389	0.009247	0.00000
76	0.024150	0.010570	0.00000
77	0.027258	0.012082	0.00000
78	0.030776	0.013811	0.00000
79	0.034755	0.015785	0.00000
80	0.039239	0.018046	0.00000

* Withdrawal and Vesting: 15% in an election year, 2% in a non-election year.
* Service Retirement: 30% in an election year, 3.5% in a non-election year. All members assumed to retire no later than age 80.

TABLE 2

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

AGE	RATE
25	0.0265
26	0.0265
27	0.0265
28	0.0265
29	0.0265
30	0.0265
31	0.0265
32	0.0265
33	0.0265
34	0.0265
35	0.0265
36	0.0265
37	0.0265
38	0.0265
39	0.0265
40	0.0265
41	0.0265
42	0.0265
43	0.0265
44	0.0265
45	0.0265
46	0.0265
47	0.0265
48	0.0265
49	0.0265
50	0.0265
51	0.0265
52	0.0265
53	0.0265
54	0.0265
55	0.0265
56	0.0265
57	0.0265
58	0.0265
59	0.0265
60	0.0265
61	0.0265
62	0.0265
63	0.0265
64	0.0265
65+	0.0265

* Includes wage inflation of 2.65%

TABLE 3

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

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

*Adjusted Base Rates

TABLE 4

BASE RATES OF MORTALITY FOR BENEFICIARIES OF DECEASED MEMBERS*

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

*Adjusted Base Rates

TABLE 5

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

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

*Adjusted Base Rates