Tacoma Employees' Retirement System

Investigation of Experience January 1, 2016 – December 31, 2019

Prepared by:

Mark C. Olleman, FSA, EA, MAAA
Consulting Actuary

Daniel R. Wade, FSA, EA, MAAA
Consulting Actuary

Julie D. Smith, FSA, EA, MAAA
Consulting Actuary

Milliman, Inc.
1301 Fifth Avenue, Suite 3800
Seattle, WA 98101-2605
Tel +1 206 624 7940
milliman.com

Issued September 1, 2020

1301 Fifth Avenue
Suite 3800
Seattle, WA 98101-2605
USA

Tel +1 206 624 7940

milliman.com

September 1, 2020

Retirement Board
Tacoma Employees' Retirement System
3628 South 35th Street
Tacoma, WA 98409

Dear Members of the Retirement Board:

It is a pleasure to submit this report of our investigation of the experience of the Tacoma Employees' Retirement System (TERS) for the period of 2016 through 2019. The results of this investigation are the basis for recommended changes in actuarial assumptions for the actuarial valuation to be performed as of January 1, 2021.

In preparing this report, we relied, without audit, on information (some oral and some in writing) supplied by the System's staff. This information includes, but is not limited to, statutory provisions, member census data, and financial information. We found this information to be reasonably consistent and comparable with information used for other purposes. The experience study results depend on the integrity of this information. If any of this information is inaccurate or incomplete, our results may be different, and our calculations may need to be revised.

We further certify that the assumptions developed in this report satisfy Actuarial Standards Board (ASB) Standards of Practice, in particular, No. 27 (Selection of Economic Assumptions for Measuring Pension Obligations) and No. 35 (Selection of Demographic and Other Non-economic Assumptions for Measuring Pension Obligations). The Retirement Board has the final decision regarding the appropriateness of the assumptions and their adoption.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law. Due to the limited scope of our assignment, we did not perform an analysis of the potential range of future measurements.

Milliman's work is prepared solely for use and benefit of the System and its Trustees and employees (for their use in administering the Fund). To the extent that Milliman's work is not subject to disclosure under applicable public records laws, Milliman's work may not be provided to third parties without Milliman's prior written consent. Milliman does not intend to benefit or create a legal duty to any third-party recipient of its work product. Milliman's consent to release its work product to any third party may be conditioned on the third party signing a Release, subject to the following exceptions:

a) The System may provide a copy of Milliman's work, in its entirety, to the System's professional service advisors who are subject to a duty of confidentiality and who agree to not use Milliman's work for any purposes other than to benefit the System.

b) The System may provide a copy of Milliman's work, in its entirety, to other governmental entities, as required by law.

No third-party recipient of Milliman's work product should rely on Milliman's work product. Such recipients should engage qualified professionals for advice appropriate to their own specific needs.

The consultants who worked on this assignment are retirement actuaries. Milliman's advice is not intended to be a substitute for qualified legal or accounting counsel.

The signing actuaries are independent of the plan sponsor. We are not aware of any relationship that would impair the objectivity of our work.

On the basis of the foregoing, 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 and the Code of Professional Conduct and Qualification Standards for Actuaries Issuing Statements of Actuarial Opinion in the United States of the American Academy of Actuaries. We are members of the American Academy of Actuaries and Fellows of the Society of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

We would like to acknowledge the help in the preparation of the data for this investigation given by Tim Allen, Catherine Marx, and members of the staff.

Respectfully submitted,

Mark C. Olleman, FSA, EA, MAAA
Consulting Actuary

Daniel R. Wade, FSA, EA, MAAA
Consulting Actuary

Julie D. Smith, FSA, EA, MAAA
Consulting Actuary

MCO/DRW/JDS/nlo

Table of Contents

1. Executive Summary

Overview

This is a study of the active and retired member experience of the Tacoma Employees' Retirement System (TERS) over the four-year period from 2016 through 2019. This report includes a discussion of the economic actuarial assumptions, the demographic assumptions for active members, and the mortality experience for retirees. All of these assumptions were previously reviewed in 2016.

Summary of Results

This section of the report includes a brief summary of each of the other sections of the report, our recommendations for changes in the current actuarial assumptions, and the impact of the recommendations on the measured liabilities if the assumptions are adopted by the Retirement Board.

At the end of this section, we include a copy of the Funding and Benefits Policy, which was updated in January 2020.

Section 2 Introduction

Just as certain investment choices have an associated "investment risk," choices in actuarial assumptions have an associated "actuarial risk." Determining the adequacy of the current contribution rates is dependent on the assumptions used to project the future benefit payments and then to discount the value of future benefits to determine the present values. Thus, it is important that the Retirement Board understand the sensitivity of the actuarial calculations to the underlying assumptions.

Section 2 provides an introduction to the process of setting both demographic and economic actuarial assumptions. We discuss the following:

- The "actuarial risk" associated with setting actuarial assumptions.
- An overview of the presentation of results you will see in this report.
- Our philosophy in setting actuarial assumptions.
- Actuarial Standards of Practice No. 27 and No. 35.

Section 3 Economic Assumptions

In Section 3, we discuss the economic assumptions. The following table compares the current economic assumptions with the two alternative economic assumptions we would recommend to the Retirement Board. In our professional judgment, both sets of assumptions are reasonable and are not expected to have any significant bias.

	Current	Alternative #1	Change from Current	Alternative #2	Change from Current
Inflation	2.75%	2.25%	-0.50%	2.50%	-0.25%
Net Real Rate of Return	4.25%	4.25%	0.00%	4.25%	0.00%
Investment Return (Discount Rate)	7.00%	6.50%	-0.50%	6.75%	-0.25%
Inflation	2.75%	2.25%	-0.50%	2.50%	-0.25%
Real Wage Growth	1.00%	0.75%	-0.25%	0.75%	-0.25%
Wage Growth	3.75%	3.00%	-0.75%	3.25%	-0.50%
Spread (Investment Return minus Wage Growth)	3.25%	3.50%	0.25%	3.50%	0.25%

The assumed inflation rate is the basis for all of the other economic assumptions. It affects other assumptions including payroll growth, individual member salary increase, and investment return. We believe the current inflation assumption is higher than most forecasts for future inflation experience, and therefore recommend that a lower inflation assumption be used. We also believe that the entire set of economic assumptions should reflect the inflation assumption. Therefore, we recommend that if the Retirement Board chooses to lower the inflation assumption, then the investment return and wage growth assumptions should also be lowered.

Section 4 Retired Mortality

In Section 4, we discuss the mortality assumptions. The mortality assumption is used to predict the life expectancy of both members currently in pay status and those expected to receive a benefit in the future. Our recommendation is to:

- Update the base tables to PubG-2010, a more recent set of mortality tables that are specific to public plans. The 2010 in the title refers to the central year of the data used by the Society of Actuaries; the “Pub” indicates that the mortality experience was specific to public retirement plans in the United States. We recommend using the amount-weighted tables adjusting the male tables by 105% to reflect TERS experience and no adjustment to the female tables.
- Update the mortality projection scale to be based on Social Security Administration data from the most recent 60 years available (1957 – 2017)

The current mortality assumptions use projected mortality improvements based on the RP-2014 table and a full generational mortality assumption (Social Security Administration data from 1953 – 2013) where longevity is assumed to vary by year of birth. Members born later are assumed to live longer. Most actuarial valuations for public sector retirement systems use this approach and we are recommending TERS continue to use generational mortality, with the table described in Section 4.

Section 5 Salary Increases Due to Promotion and Longevity

Merit salary increases are individual salary increases above overall general wage increases. The two primary reasons for merit salary increases are seniority and promotion. We base this assumption on years of service. We are recommending no changes to the merit salary increase scales.

Section 6 Retirements

The retirement assumption is separated into two distinct periods for each individual:

1. Retirement with reduced benefits. This category is for people who are eligible for reduced retirement, but are not yet eligible for the 2% multiplier. For both males and females, the most recent four years supported the current assumptions, so we are recommending that those assumptions be unchanged.
2. Retirement after eligibility for full benefits. There were more retirements after eligibility for full benefits than expected for both males and females. Therefore, we are recommending an increase in the assumption for most ages, with some minor reductions in rates for females at earlier ages.

   Note that, as we have done in previous cycles, we studied whether or not there was a greater incidence of retirement in the first year eligible for unreduced benefits than in subsequent years. This is the fifth consecutive study where the difference has not been significant. Therefore, we recommend that the same assumptions be applied both during and after the first year of eligibility for full benefits.

Section 7 Disability Retirement

The number of disabilities was smaller than what was expected. Disability retirements are uncommon. We are recommending that the assumed disabilities are decreased slightly.

Section 8 Other Terminations of Employment

We are recommending increases in the probability of termination for females with more than two years of service based on the experience over the period studied. For males, we recommend no change to the current assumption.

Section 9 Other Assumptions

In this section, we comment on the portability assumption and continued membership among vested terminated employees. We are recommending that the assumption for the impact of portability be lowered to reflect the experience over the past 13 years, while also taking into account the last four years alone.

Section 10 Summary of Valuation Assumptions

The recommended assumptions are expressed in numerical format in this section.

Impact of Recommended Assumption Changes

The following Exhibit A summarizes the impact of the assumption changes on various liability measures. Remember that these assumptions do not impact the actual costs of benefits. Assumptions are used to measure whether benefits are being adequately funded.

This exhibit shows results based on both the Actuarial Assets and the Fair Value of Assets. It includes the impact on the Normal Cost Rate, Actuarial Accrued Liability (AAL), Funding Ratio, Unfunded Actuarial Accrued Liability (UAAL), and the contribution rate required for a 25-year amortization of the UAAL. We show the results under the current economic assumptions as well as both of the recommended sets of economic assumptions. The results are based solely on the impact the new assumptions would have had on the January 1, 2020 valuation results.

According to the January 1, 2020 valuation report, the Funding Ratio using the Fair Value of Assets was 101.1% so there is no UAAL to amortize. The Funding Ratio using the Actuarial Value of Assets was 98.0% with an UAAL amortization period of 6.3 years. The Funding Ratio measure may not be appropriate for assessing the sufficiency of plan assets to cover the estimated cost of settling the Plan’s benefit obligations if the plan were to be terminated.

Using the Actuarial Value of Assets, the recommended demographic assumption changes decrease the Funding Ratio by 0.8% (98.0% to 97.2%) and increase the 25-year amortization contribution rate by 0.50% of pay (19.22% to 19.72%). The Actuarially Determined Total Contribution Rate remains unchanged from the valuation at 21.00% of pay, based on the current contribution rate.

If, in addition to the recommended demographic changes, the recommended economic changes for alternative #1 are made including changing the investment return assumption from 7.00% to 6.50% and the inflation assumption from 2.75% to 2.25%, then the Funding Ratio is reduced an additional 5.0% (from 97.2% to 92.2%) and the 25-year amortization contribution rate is increased by 3.55% of pay (19.72% to 23.27%). The Actuarially Determined Total Contribution rate in this scenario is 23.27% of pay. Under alternative #2 for the economic assumptions which includes changing the investment return assumption to 6.75% and the inflation assumption to 2.50%, the 25-year amortization contribution rate is equal to the Actuarially Determined Total Contribution Rate at 21.20% of pay. For each of these scenarios, the corresponding numbers based on the fair value of assets are in Exhibit A.

The following table summarizes the results on both an Actuarial Value of Assets and a Fair Value of Assets basis.

Exhibit A
Impact of Recommended Assumptions on January 1, 2020 Actuarial Valuation Results

(All Dollar Amounts in Millions)

			Actuarial Value of Assets Basis			Fair Value of Assets Basis		
	Normal Cost Rate (NCR)	Actuarial Accrued Liability	Funding Ratio	Unfunded Actuarial Accrued Liability	NCR + Amortization[1]	Funding Ratio	Unfunded Actuarial Accrued Liability	NCR + Amortization[1]
January 1, 2020 actuarial valuation	18.59%	$1,856.0	98.0%	$37.3	19.22%	101.1%	($20.1)	18.59%
Changes to active decrements and portability	18.53	1,855.7	98.0	37.0	19.15	101.1	(20.4)	18.53
Changes to mortality assumption for current mortality and future mortality improvement	18.73	1,870.3	97.2	51.6	19.72	100.3	(5.8)	18.73
Changes to alternative #1 economic assumptions	19.74	1,971.9	92.2	153.2	23.27	95.1	95.8	21.90
Changes to alternative #2 economic assumptions	19.02	1,918.0	94.8	99.3	21.20	97.8	41.9	19.82

1. For scenarios with a funding ratio over 100%, the normal cost rate is shown.

Notes:

January 1, 2020 actuarial value of assets = $1,818.7 million. The fair value of assets = $1,876.1 million.

All amortization rates are based on a 25-year amortization.

Alternative #1 includes 6.50% investment return and 2.25% inflation.

Alternative #2 includes 6.75% investment return and 2.50% inflation.

Exhibit B
Funding and Benefits Policy

Objective

A sustainable pension plan is able to pay the promised benefits to members - now and in the future. This policy is intended to provide guidance as to when adjustments to TERS contributions and benefits should be considered. The Funding and Benefits Policy is meant to assist in establishing a contribution rate which is relatively stable over the long term while the System provides its members dependable retirement income.

Policy

When the Funding Ratio is:

a) Above 120% - Investment de-risking will be considered, and then the potential for recommendations to the City Council on contribution rate reductions and/or benefit improvements will be reviewed, provided the Retirement System's funding status is expected to remain stable after the changes.
b) Between 95% and 120% - There will be no action, provided that the combined employer and employee contribution rate is greater than or equal to the Actuarially Determined Total Contribution; if this condition is not met, then the Retirement Board will consider recommending an increase in the contribution rates.
c) Below 95% - The Retirement Board will consider recommending an increase in the contribution rates.

Additional Guidelines

a) There is a long-term goal of maintaining a combined employer and employee contribution rate greater than or equal to the Actuarially Determined Total Contribution so that the System is appropriately funded.
b) Increases in the contribution rate may be made in small increments.
c) To the extent possible, ample notification regarding changes in the contribution rate should be provided to all parties to facilitate budgetary adjustments.
d) Contribution rate increases should consider amortizing any Unfunded Actuarial Accrued Liability over a period of 25 years or less.
e) Contribution holidays (i.e. intentional contribution of less than the Actuarially Determined Total Contribution) should be avoided.
f) Calculations based on the Fair Value of Assets will also be considered.
g) Long-term funding projections will also be considered.
h) Funding Ratios between 100% and 120% should be viewed as desirable reserves to offset future adverse events and not as surplus funds.

Terminology

a) The Funding Ratio is calculated by dividing the System's Actuarial Value of Assets by the Actuarial Accrued Liability.
b) Unfunded Actuarial Accrued Liability (UAAL) is the dollar amount by which the System's Actuarial Accrued Liability exceeds the Actuarial Value of Assets.
c) The Actuarially Determined Total Contribution is the greater of (1) the Normal Cost Rate or (2) the recommended combined employer and employee contribution for the reporting period that amortizes the UAAL (if any) over a maximum of 25 years, but will not be less than the actual contribution rate.

2. Introduction

Actuarial assumptions can be broken into three broad groups:

- Economic Assumptions
- Retired Mortality
- Active Demographic Assumptions

This study encompasses all three types of assumptions. This section provides an overview of the process and importance of setting actuarial assumptions.

TERS's assumptions are studied on a four-year cycle.

A. Funding and Valuation Principles and "Actuarial Risk"

Just as investment choices have an associated "investment risk," choices in actuarial assumptions have an associated "actuarial risk." Our responsibility is to always consider the impact our work will have on current and future taxpayers and on the members of TERS.

Determining the adequacy of the current contribution rates is dependent on the assumptions used to project the future benefit payments and then to discount the value of future benefits to determine the present values. Thus, it is important that the Retirement Board members understand the sensitivity of the actuarial calculations to the underlying assumptions.

- If actual experience shows that the assumptions overestimated the true cost of the plan, decisions for change may be inappropriately made based on the current higher cost levels. This may also result in an overstatement of costs today and the longer-term impact will not be realized until many years in the future when contributions may need to be lowered due to the current overstatement.
- If actual experience shows that the assumptions underestimated the true cost of the plan, decisions for change may be inappropriately made based on the lower current cost levels. This may result in an unexpected need to increase contributions in the future and may lead to budgeting difficulties.
- The valuation only presents the costs as of one date. Further analysis illustrating the potential volatility of the cost results may be needed to fully appreciate the "actuarial risk" associated with actuarial assumptions.

The setting of the actuarial assumption for investment return could have an effect on the investment managers' investment strategies. If a higher, more aggressive assumption is used, there may be a tendency to stretch the investment risk to meet the assumption.

Since the actuarial assumption is for the long term, it is expected that in the short term there will be years in which the actual investment return will exceed the actuarial assumption, and there will be years when the actual experience will not meet the assumed rate. It is the expected long-term rate that is used to project and finance the retirement benefits.

Recognition should be made that a higher investment return assumption will tend to lower required contributions in the short term, while a lower investment return assumption will tend to require higher contributions. In the public sector environment, any move back from a higher return assumption to a lower return assumption could result in higher contribution rates in the short term and, thus, higher taxes. Using a slightly lower assumption gives a greater probability of having actuarial experience gains in the future, whereas using a slightly higher assumption implies a willingness to assume a greater "actuarial risk" of future experience losses. The same concepts apply to the selection of the other actuarial assumptions.

The questions that need to be asked in the public sector are: How great an actuarial risk is the Retirement Board willing to accept in the actuarial assumptions? If actuarial experience gains materialize for TERS, its funded status will be better than expected. If actuarial experience losses materialize, what will be the consequences?

As stated above, the actuarial assumptions can be divided into three groups: economic, retired mortality and active demographic. The economic assumptions must not only reflect TERS's actual experience but also give even greater consideration to the long-term expectation of future economic growth for the nation, as well as the global economy. By long term, we are looking at time periods from 20 to 40, possibly to 60, years – a much longer time frame than any period investment managers or economists typically discuss.

The non-economic, or demographic assumptions including retired mortality, are based on TERS's actual experience, adjusted to reflect trends and historical experience. Thus, the economic assumptions are much more subjective than the demographic assumptions, and the demographic assumptions are much more dependent on the results of the experience studies.

B. Overview

This report presents the results of an investigation of the recent actuarial experience of TERS. We will refer to this investigation as an experience study.

Throughout this report, we refer to "expected" and "proposed" actuarial assumptions. The "expected" assumptions are those used for our actuarial valuation of TERS as of January 1, 2020. They may also be referred to as the "current" or "old" assumptions. The "proposed" or "recommended" assumptions are those we recommend for use in the valuation dated January 1, 2021 and for subsequent valuations until further changes are made. Note that the Retirement Board has the authority and responsibility to make the final decision regarding the appropriateness of the assumptions.

Economic assumptions are generally chosen on the basis of the actuary's expectations as to the effect of future economic conditions on the operation of TERS. However, setting these assumptions is much more subjective than setting and recommending the demographic assumptions.

After reviewing the economic assumptions in Section 3, this report shows the results of our study of retiree mortality and active member demographic assumptions in the later sections. The exhibits are detailed comparisons between the actual and expected experience on both the current and proposed bases.

For each type of assumption, the graphs show the actual rates from both 2012 to 2015 (the prior study), and 2016 to 2019 (the current study).

The graphs also show expected rates (or old rates) based on the assumptions used in the January 1, 2020 actuarial valuation, and the proposed rates recommended for the January 1, 2021 actuarial valuation. The exhibits also show the total numbers of actual and expected deaths, terminations, retirements, and disabilities. Actual versus expected ratios larger than 100% on the current basis indicate that the rates may need to be raised; actual versus expected ratios smaller than 100% indicate that rates may need to be lowered.

For each exhibit, the actual decrement rates are shown as bar graphs. For withdrawal and salary increases, the rates are shown by years of service. For retired mortality and retirement decrements, these are shown on an age-by-age basis. For disability decrements, only a quinquennial-age basis is used. The current rates – the expected rates – used in the January 1, 2020 actuarial valuation, are shown as well as the new proposed assumptions as line graphs. Therefore, the assumption changes we are proposing are illustrated by the difference between the two lines in each exhibit.

C. Our Philosophy

Similar to an actuarial valuation, the calculation of actual and expected experience is a fairly mechanical process. From one actuary to another, you would expect to see very little difference. However, the setting of assumptions is a different story, as it is more art than science. In this report, we recommend new assumptions. To help you understand our thought process, here is 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 generally recommend rates somewhere between the old rates and the new experience. If the experience during the next study shows the same result, we will probably recognize this trend at that point. On the other hand, if the experience returns closer to its prior level, we will not have overreacted, possibly causing unnecessary volatility in contribution rates.
- **Anticipate trends:** If there is an identified trend that is expected to continue, we believe that this should be recognized. An example of this is the retiree mortality assumption. It is an established trend that people are continuing to live longer; therefore, a generational table is used to reflect future decreases in mortality rates.
- **Simplify:** Where there is no material difference in results, we attempt to simplify our assumptions and methods. There is no point in complexity that does not improve accuracy.

D. Actuarial Standard of Practice No. 27 – Selection of Economic Assumptions

The Actuarial Standards Board has adopted a new version of Actuarial Standard of Practice (ASOP) No. 27, Selection of Economic Assumptions for Measuring Pension Obligations. This standard provides guidance to actuaries giving advice on selecting economic assumptions for measuring obligations under defined benefit plans. The process for selecting economic assumptions involves identifying components of each assumption and evaluating relevant data, then selecting reasonable assumptions that have no significant bias, such that the selections are not anticipated to result in actual performance persistently above or below assumptions based on the outlook at the time the assumptions are selected. We provide more detail on ASOP No. 27 at the beginning of the section of this report concerning economic assumptions.

E. Actuarial Standard of Practice No. 35 – Selection of Demographic Assumptions

Actuarial Standard of Practice No. 35 (ASOP No. 35) governs the selection of demographic and other noneconomic assumptions for measuring pension obligations. ASOP No. 35 states that the actuary should use professional judgment to estimate possible future outcomes based on past experience and future expectations, and select assumptions based upon application of that professional judgment. The actuary should select reasonable demographic assumptions in light of the particular characteristics of the defined benefit plan that is the subject of the measurement. A reasonable assumption is one that is expected to appropriately model the contingency being measured and is not anticipated to produce significant cumulative actuarial gains or losses over the measurement period.

ASOP No. 35 Steps

The actuary should follow the following steps in selecting the demographic assumptions:

1. Identify the types of assumptions. Types of demographic assumptions include but are not limited to retirement, mortality, termination of employment, disability, election of optional forms of payment, administrative expenses, family composition, and treatment of missing or incomplete data. The actuary should consider the purpose and nature of the measurement, the materiality of each assumption, and the characteristics of the covered group in determining which types of assumptions should be incorporated into the actuarial model.
2. Consider the relevant assumption universe. The relevant assumption universe includes experience studies or published tables based on the experience of other representative populations, the experience of the plan sponsor, the effects of plan design, general trends, and future expectations.
3. Consider the assumption format. The assumption format includes whether assumptions are based on parameters such as gender, age, service or calendar year. The actuary should consider the impact the format may have on the results, the availability of relevant information, the potential to model anticipated plan experience, and the size of the covered population.
4. Select the specific assumptions. In selecting an assumption the actuary should consider the potential impact of future plan design as well as the factors listed above.
5. Evaluate the reasonableness of the selected assumption. The assumption should be expected to appropriately model the contingency being measured. The assumption should not be anticipated to produce significant actuarial gains or losses.

ASOP No. 35 General Considerations and Application

Each individual demographic assumption should satisfy the criteria of ASOP No. 35. In selecting demographic assumptions the actuary should also consider the internal consistency between the assumptions, materiality, cost effectiveness, and the combined effect of all assumptions. At each measurement date, the actuary should consider whether the selected assumptions continue to be reasonable, but the actuary is not required to do a complete assumption study at each measurement date. In our opinion, the demographic assumptions recommended in this report have been developed in accordance with ASOP No. 35.

3. Economic Assumptions

Actuarial Standard of Practice (ASOP) No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, provides guidance to actuaries giving advice on selecting economic assumptions for measuring obligations under defined benefit plans. Because no one knows what the future holds, the best an actuary can do is to use professional judgment to estimate possible future economic outcomes. These estimates are based on a mixture of past experience, future expectations, and professional judgment. The actuary should consider a number of factors, including the purpose and nature of the measurement, and appropriate recent and long-term historical economic data. However, the Standard explicitly advises the actuary not to give undue weight to recent experience.

ASOP 27 states that each economic assumption selected by the actuary should be reasonable. The assumption is reasonable if 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 relevant historical and current economic data.
- It reflects the actuary's estimate of future experience and observation of the estimates in market data.
- It has no specific bias (i.e. it is not significantly optimistic or pessimistic), but may specifically make provision for adverse deviation.

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

In our opinion, the economic assumptions we recommend for Retirement Board consideration in this report have been developed in accordance with ASOP No. 27.

The following table compares the current economic assumptions with the two alternative economic assumptions we would recommend to the Retirement Board. In our professional judgment, both sets of assumptions are reasonable and are not expected to have any significant bias.

	Current	Alternative #1	Change from Current	Alternative #2	Change from Current
Inflation	2.75%	2.25%	-0.50%	2.50%	-0.25%
Net Real Rate of Return	4.25%	4.25%	0.00%	4.25%	0.00%
Investment Return (Discount Rate)	7.00%	6.50%	-0.50%	6.75%	-0.25%
Inflation	2.75%	2.25%	-0.50%	2.50%	-0.25%
Real Wage Growth	1.00%	0.75%	-0.25%	0.75%	-0.25%
Wage Growth	3.75%	3.00%	-0.75%	3.25%	-0.50%
Spread (Investment Return minus Wage Growth)	3.25%	3.50%	0.25%	3.50%	0.25%

The assumed inflation rate is the basis for all of the other economic assumptions. It affects other assumptions including payroll growth, individual member salary increase, and investment return. We believe the current inflation assumption is higher than most forecasts for future inflation experience, and therefore recommend that a lower inflation assumption be used. We also believe that the entire set of economic assumptions should reflect

the inflation assumption. Therefore, we recommend that if the Retirement Board chooses to lower the inflation assumption, then the investment return and wage growth assumptions should also be lowered.

Actuarial assumptions are used to measure and budget future costs. Changing assumptions will not change the actual cost of future benefits. Aggressive assumptions plan for good future experience ahead of time and factor it into budget estimates. Conservative assumptions provide a margin for adverse deviation and tend to recognize good experience after it happens.

Conservative assumptions increase short term contributions. Future gains are larger since they exceed expected experience by a greater margin. Future losses are smaller in that they are not as far below expected experience.

Aggressive assumptions decrease short term contributions. Future gains are smaller because they were already included in expected experience. Future losses are larger because they are further below expected experience.

The choice of assumptions depends on a system's risk tolerance. The final determination on whether or not a set of assumptions was either conservative or aggressive will only be revealed by future experience.

This section is organized into eight subsections:

Subsection A: Experience of the System

Subsection B: General Economic Trends

Subsection C: Price Inflation (including Cost-of-Living Adjustments)

Subsection D: General Wage Increase Assumption

Subsection E: Expense Assumptions

Subsection F: Actuarial Valuation of Assets

Subsection G: Growth in Membership

Subsection H: Investment Return Assumption (Discount Rate)

The first two subsections provide background. Assumptions are proposed in the last six subsections.

A. Experience of the System

Exhibit 1 summarizes the rates of investment return on the assets held by TERS since 1980.

Exhibit 2 compares the rates of general wage increases granted to TERS members for various periods since 1985 to the national index of wages used to determine Social Security benefits and to price inflation as measured by the Consumer Price Index (CPI).

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

1. Increases in each individual's salary due to promotion or longevity, which occur even in the absence of inflation; and
2. Increases in the general wage level of the membership, which are directly related to inflation and increases in productivity.

The statistics presented in Exhibit 2 and the assumptions we discuss in this section are concerned with general wage increases. The assumptions with respect to promotion and longevity are studied in the next section.

Exhibit 3 presents an analysis of expenses of TERS over recent years, both in dollars and as percentages of average assets of the System and covered payroll.

Exhibit 4 summarizes the TERS actuarial economic assumptions used for each valuation year since 1976.

Exhibit 1

Investment Return Net of Investment Expenses

Period Ended	1 Year	5 Years	10 Years	15 Years	Since 1980
12/31/2019	17.0	6.8	8.6	6.7	9.1
12/31/2018	-3.4	5.1	9.6	6.6	
12/31/2017	13.4	9.0	5.8	8.7	
12/31/2016	8.7	9.1	4.9	7.2	
12/31/2015	-0.4	7.6	5.8	6.4	
12/31/2014	8.1	10.5	6.7	6.7	
12/31/2013	15.8	14.2	7.4	7.2	
12/31/2012	14.1	2.7	8.6	6.8	
12/31/2011	1.3	0.8	6.2	6.8	
12/31/2010	14.1	4.0	5.8	7.3	
12/31/2009	27.3	3.0	4.8	8.0	
12/31/2008	-32.0	1.0	3.9	6.1	
12/31/2007	3.9	14.9	8.9	10.1	
12/31/2006	18.6	11.9	10.0	10.2	
12/31/2005	8.7	7.5	9.0	10.6	
12/31/2004	15.5	6.6	10.5	9.8	
12/31/2003	29.4	6.8	8.8	10.1	
12/31/2002	-8.9	3.2	7.8	8.8	
12/31/2001	-2.9	8.1	9.4	9.8	
12/31/2000	3.9	10.6	12.2	10.8	
12/31/1999	16.9	14.7	11.5	11.8	
12/31/1998	9.0	10.8	11.8	11.0	
12/31/1997	14.9	12.6	11.7	10.8	
12/31/1996	8.7	10.8	10.7	12.2	
12/31/1995	24.7	13.8	10.9	11.5	
12/31/1994	-1.6	8.4	10.4	10.5	
12/31/1993	18.2	12.7	11.1		
12/31/1992	5.7	10.9	10.0		
12/31/1991	24.4	10.5	12.9		
12/31/1990	-2.1	8.0	10.4		
12/31/1989	19.7	12.4	11.6		
12/31/1988	8.8	9.5			
12/31/1987	4.1	9.1			
12/31/1986	10.7	15.2			
12/31/1985	19.8	12.9			
12/31/1984	4.6	10.7			
12/31/1983	6.8				
12/31/1982	37.2				
12/31/1981	-0.1				
12/31/1980	8.8				

Exhibit 2

Annual Rates of Wage and Price Inflation

Year Ending December 31,	General Wage Increase		Price Increase
	Tacoma ERS	National Index	CPI Index
1985	2.0%	4.3%	3.8%
1986	1.5%	3.0%	1.1%
1987	1.5%	6.4%	4.4%
1988	3.5%	4.9%	4.4%
1989	3.0%	4.0%	4.6%
1990	4.0%	4.6%	6.1%
1991	3.0%	3.7%	3.1%
1992	3.0%	5.2%	2.9%
1993	3.2%	0.9%	2.7%
1994	3.0%	2.7%	2.7%
1995	3.1%	4.0%	2.5%
1996	3.1%	4.9%	3.3%
1997	2.9%	5.8%	1.7%
1998	3.3%	5.2%	1.6%
1999	3.0%	5.6%	2.7%
2000	3.0%	5.5%	3.4%
2001	3.0%	2.4%	1.5%
2002	3.0%	1.0%	2.4%
2003	1.0%	2.4%	1.9%
2004	2.5%	2.9%	3.3%
2005	2.3%	5.4%	3.4%
2006	1.0%	4.6%	2.5%
2007	2.0%	4.5%	4.1%
2008	4.8%	2.3%	0.1%
2009	7.3%	-1.5%	2.7%
2010	3.4%	2.4%	1.5%
2011	0.9%	3.1%	3.0%
2012	1.4%	3.1%	1.7%
2013	2.5%	1.3%	1.5%
2014	3.4%	3.5%	0.8%
2015	4.1%	3.5%	0.7%
2016	2.5%	1.1%	2.1%
2017	2.5%	3.5%	2.1%
2018	2.9%	3.6%	1.9%
2019	3.7%	3.1% *	2.3%
	Geometric Averages		
5 year periods			
1985-1989	2.3%	4.5%	3.7%
1990-1994	3.2%	3.4%	3.5%
1995-1999	3.1%	5.1%	2.4%
2000-2004	2.5%	2.8%	2.5%
2005-2009	3.5%	3.0%	2.6%
2010-2014	2.3%	2.7%	1.7%
2015-2019	3.1%	3.0%	1.8%
10 year periods			
1990-1999	3.2%	4.2%	2.9%
2000-2009	3.0%	2.9%	2.5%
2010-2019	2.7%	2.8%	1.8%
25 year period			
1995-2019	2.9%	3.3%	2.2%
35 year period			
1985-2019	2.9%	3.5%	2.6%

** Estimated*

Exhibit 3

Investment and Administrative Expenses

(Dollar amounts in millions)

Investment Expenses

Year	Year End Assets*	Investment Expenses*	Expenses as a % of Year End Assets
1996	486.8	1.432	0.29%
1997	553.5	1.503	0.27%
1998	596.4	1.833	0.31%
1999	690.2	1.795	0.26%
2000	710.7	2.071	0.29%
2001	680.5	2.078	0.31%
2002	611.2	1.383	0.23%
2003	779.2	1.469	0.19%
2004	889.9	2.053	0.23%
2005	955.5	2.671	0.28%
2006	1,117.6	4.154	0.37%
2007	1,144.4	4.494	0.39%
2008	763.6	3.700	0.48%
2009	957.3	1.913	0.20%
2010	1,081.1	2.688	0.25%
2011	1,082.9	3.174	0.29%
2012	1,218.7	3.942	0.32%
2013	1,388.9	4.827	0.35%
2014	1,478.5	4.930	0.33%
2015	1,448.7	5.566	0.38%
2016	1,547.7	5.909	0.38%
2017	1,723.2	6.276	0.36%
2018	1,635.0	6.625	0.41%
2019	1,876.1	7.053	0.38%

** Fair Value of Assets and Investment Expenses as reported in the CAFRs.*

Exhibit 3

Investment and Administrative Expenses

(Dollar amounts in millions)

Administrative Expenses

Year	Covered Earnings	Administrative Expenses*	Expenses as a % of Covered Earnings
1996	116.3	1.240	1.07%
1997	116.1	1.185	1.02%
1998	122.3	1.187	0.97%
1999	132.0	1.172	0.89%
2000	133.4	1.193	0.89%
2001	142.5	1.340	0.94%
2002	154.2	1.218	0.79%
2003	154.1	1.286	0.83%
2004	172.5	1.415	0.82%
2005	172.8	1.296	0.75%
2006	175.0	1.408	0.80%
2007	180.0	1.530	0.85%
2008	197.4	1.674	0.85%
2009	209.9	1.748	0.83%
2010	219.6	1.847	0.84%
2011	219.4	1.755	0.80%
2012	210.6	1.706	0.81%
2013	213.8	1.660	0.78%
2014	221.3	1.716	0.78%
2015	227.4	1.727	0.76%
2016	236.4	1.918	0.81%
2017	241.6	1.663	0.69%
2018	252.8	1.691	0.67%
2019	266.7	1.790	0.67%

** Administrative Expenses as reported in the CAFRs.*

Exhibit 4

Comparison of Actuarial Economic Assumptions

Actuarial Valuation Date	(a) Price Inflation*	(b) Wage Inflation	(b) - (a) Real Wage Inflation	(c) Discount Rate	(c) - (a) Real Investment	(c) - (b) Spread
1976 - 1989		5.00%		7.00%		2.00%
1991 - 1993		5.00% **		7.00% **		2.00%
1995		4.50%		7.00%		2.50%
1997 - 1999	4.50%	5.00%	0.50%	7.50%	3.00%	2.50%
2001 - 2003	4.00%	4.50%	0.50%	7.75%	3.75%	3.25%
2005 - 2007	3.25%	4.00%	0.75%	7.75%	4.50%	3.75%
2009 - 2012	3.25%	4.25%	1.00%	7.75%	4.50%	3.50%
2013	3.00%	4.00%	1.00%	7.50%	4.50%	3.50%
2014 - 2016	3.00%	4.00%	1.00%	7.25%	4.25%	3.25%
2017 - 2020	2.75%	3.75%	1.00%	7.00%	4.25%	3.25%

** There was no explicit assumption for price inflation until the January 1, 1997 Valuation.*

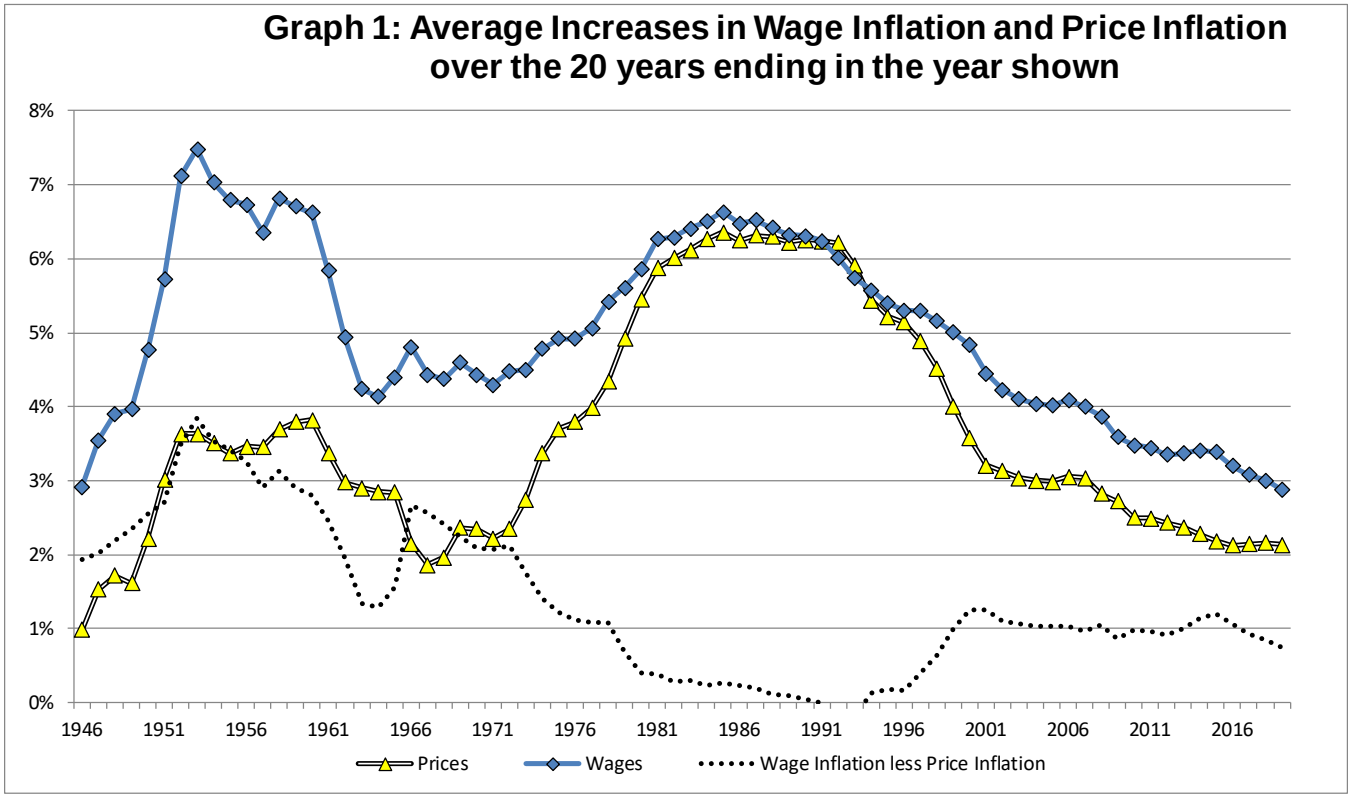
*** A select and ultimate assumption was used. The ultimate rate is displayed here.*

B. General Economic Trends

From a short-term viewpoint, the statistics presented in Exhibits 1 through 4 regarding the economic experience of TERS are important. However, in the long run, broader economic forces will control the experience of TERS in the area of general wage increases and investment returns. Inflation will drive wages, and investment yields will be governed by national and international markets. Accordingly, our analysis of the economic assumptions tends to focus more on national economic statistics than the actual experience of TERS itself.

Historical Economic Statistics

Graph 1 provides a historical perspective by showing wage inflation compared to price inflation. As the dotted line shows, wages have grown faster than prices by one percent or more in over half of the 20-year periods shown. The exception is the roughly 23 periods that includes high inflation in the late 1970s, as well as the three most recent 20-year periods. The wage statistics reflect the general wage level, including price inflation and productivity gains, but excluding pay increases due to an individual's promotion or longevity. Therefore the difference represents "real wage increases."


Graph 1: Average Increases in Wage Inflation and Price Inflation over the 20 years ending in the year shown
8%
7%
6%
5%
4%
3%
2%
1%
0%
1946
1951
1956
1961
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
Prices
Wages
Wage Inflation less Price Inflation

C. Price Inflation

Use in the Valuation

When we refer to inflation in this report, we are referring to price inflation. The current assumption for inflation is 2.75% per year. The inflation assumption has an indirect impact on the results of the actuarial valuation through the development of the assumptions for: investment returns, general wage increases, overall payroll increases, and the interest rate on member accounts.

The long-term relationship between inflation and investment return has long been recognized by economists. The basic principle is that the investors demand a "real return" – the excess of actual investment returns over inflation. If inflation rates are expected to be high, investors will demand investment returns that are also expected to be high enough to exceed inflation, while lower inflation rates will result in lower expected investment returns, at least in the long run.

Historical Perspective

Graph 1 shows that since 1925 there have been extended periods where the 20-year average for price inflation has stayed either between 2% - 4% or between 4% - 6%. For individual 1-year periods (where all years are weighted evenly), the 25th percentile is 1.3%, the 50th percentile is 2.7%, and the 75th percentile is 3.9%. The average inflation over the entire 94-year period is 2.9%. Average inflation over the last 20 years is 2.1%.

Historical Price Inflation Since 1925	
	Single-Year Inflation
25th Percentile	1.3%
50th Percentile	2.7%
75th Percentile	3.9%
94-year Average	2.9%

Forecasts of Inflation

Since the U.S. Treasury started issuing inflation indexed bonds (Treasury Inflation-Protected Securities or TIPS), it is possible to determine the approximate rate of inflation anticipated by the financial markets over the next 30 years by comparing the yields on inflation-indexed bond with traditional fixed government bonds. The Treasury began selling a new 30-Year TIPS in 2010.

The analysis of TIPS yields implies expectations of inflation rates over the next 30 years of about 1.8% as of August 2020 and was also approximately 1.8% as of the beginning of 2020. Capital market assumptions by investment advisors tend to be in this range. Note that Wilshire, the investment advisor for TERS, was forecasting 1.50% over the next ten years for US inflation as of June 30, 2020.

Most economists forecast inflation lower than the current assumption of 2.75%, but they may be looking at shorter periods than appropriate for a pension valuation. To find an economic forecast with a long enough time frame to suit our purpose, we looked at the expected increase in the CPI by the Office of the Chief Actuary for the Social Security Administration. In the 2020 Trustees Report, the projected ultimate annual increase in the CPI under the low, intermediate, and high cost assumptions were 3.0%, 2.4%, and 1.8%.

Assumption for Inflation

We believe that it is appropriate to consider revising the inflation assumption downward from the current assumption of 2.75%. We are recommending that the Retirement Board lower the assumption to either **2.25%** or **2.50%.**

Assumption for Cost-of-Living Adjustments (COLAs) for Retirees

The current assumption is that retiree COLAs will be equal to the maximum in the Tacoma Municipal Code, 2.125%. We recommend continuing this practice. In reality, in some years price inflation will be higher than the CPI assumption. When this is the case, the COLAs will be limited to 2.125%. In some years the CPI increase will be lower than the 2.125% maximum, which could result in COLAs less than 2.125%.

Note that if the retiree experiences some years with CPI over the maximum, followed by CPI under the maximum, the retiree could continue to receive 2.125% increases every year, so long as the total purchasing power of the benefit is not higher than the original purchasing power of the original benefit. For current retirees, purchasing power is less than the original benefit as measured by Seattle-Tacoma-Bremerton CPI, which has increased by more than 2.125% for the past four years. This means that future COLAs could be higher than CPI increases if the CPI increases by less than 2.125%.

We modeled some scenarios for future inflation results and its effects on COLAs. While there will be some actuarial gains in some scenarios as not everyone will be expected to receive the full 2.125% increase every year, we decided to recommend a continuation of the 2.125% assumption.

D. General Wage Increase Assumption

Use in the Valuation

An individual's wages are affected by:

1. Price inflation (discussed above),
2. Real wage increases (also called "productivity"), and
3. Promotion and longevity (also called merit increases).

The general wage increase assumption discussed here is the sum of:

1. Price inflation, and
2. Real wage increases.

In the actuarial valuation members' salaries are projected to increase according to the sum of:

1. The general wage increase assumption (discussed here), and
2. The promotion and longevity (also called "merit increase") assumptions reviewed separately in Section 5.

The total payroll on which contributions are based is assumed to increase by the general wage increase assumption, but not by the promotion and longevity increases of individual members.

The wages we are projecting are those to be paid to TERS members. In theory, in the long term, future general wage increases will be decided more by the experience in the nation as a whole than the experience in Tacoma. Economic developments (such as the rates of inflation) are not going to be slowed or accelerated to any significant degree because of Tacoma experience. Over the very long term, we do not expect the wage growth for

Tacoma to be significantly different than that of the nation as a whole. The need to attract and retain employees should prevent Tacoma from providing wage increases much lower than national averages, while budgetary pressures will likely make it difficult for Tacoma wages to increase much more rapidly than national averages over the very long term.

In the short term, we expect significant budgetary pressures for public sector employers. While wage growth is a long-term assumption, the short-term will impact the projected final average salary calculations for current employees.

Historical Perspective

As seen in Exhibit 2, wage growth for Tacoma employees lagged behind national wage growth for an extended period of time, but over the past 15 years has generally been in line with national averages. The current long-term assumption for general wage increases is 3.75% per year.

The current real wage increase assumption (1.00%) is the difference between the current general wage increase assumption (3.75%) and the current price inflation assumption (2.75%). This represents increases in the standard of living and/or productivity. The following table shows the national increases since 1926 broken into various periods, along with the comparable inflation rate for that period. Historical information regarding wage growth can be viewed in graphical form in Graph 1.

Geometric Average Increase in National Average CPI for Previous Period of Years

Period Ending	10 years	20 years	50 years	93 years
2019	1.8%	2.1%	3.9%	2.9%
2009	2.5%	2.7%	4.1%	
1999	2.9%	4.0%	4.0%	
1989	5.1%	6.2%	4.5%	
1979	7.4%	4.9%	3.0%	
1969	2.5%	2.4%		
1959	2.2%	3.8%		

Geometric Average Increase in National Average Wages for Previous Period of Years

Period Ending	10 years	20 years	50 years	93 years
2019	2.8%	2.9%	4.5%	4.3%
2009	2.9%	3.6%	4.8%	
1999	4.2%	5.0%	5.2%	
1989	5.8%	6.3%	6.1%	
1979	6.9%	5.6%	4.8%	
1969	4.3%	4.6%		
1959	4.9%	6.7%		

Geometric Average Increase in National Average Wages Minus Geometric Average Increase in National Average CPI for Previous Period of Years

Period Ending	10 years	20 years	50 years	93 years
2019	1.0%	0.8%	0.6%	1.4%
2009	0.4%	0.9%	0.7%	
1999	1.3%	1.0%	1.2%	
1989	0.7%	0.1%	1.6%	
1979	-0.5%	0.7%	1.8%	
1969	1.8%	2.2%		
1959	2.7%	2.9%		

Resources: Social Security National Average Wage from 1951 to 2018; Total Private Nonagricultural Wages from 1926 to 1951; Inflation as measured by the CPI-U.

Forecasts of Future Wages

Wage inflation has been projected by the Office of the Chief Actuary of the Social Security Administration. In the 2020 Trustees Report, the intermediate long-term annual increase in the National Average Wage is estimated to be approximately 1.14% higher than the Social Security intermediate inflation assumption of 2.4% per year. The range of the ultimate assumed real wage growth in the 2020 Trustees Report was from 0.52% to 1.76% per year.

Recommendation – General Wage Increase

We recommend that the real general wage growth be lowered to 0.75%. We believe that the current 1.00% assumption is reasonable based on historical data, as well as the forecast by the Social Security Administration. A change to an assumption of 0.75% can also be supported by history, particularly the past 20-50 years. Budgetary

pressures in the short-term may result in lower wage growth in the short-term, which will have an effect on the projected final average salary calculations for current employees.

The total general wage increase assumption is equal to the real wage increase assumption plus the price inflation assumption underlying the other assumptions used for the actuarial valuation. Therefore, if the real wage increase assumption is decreased to 0.75% and the price inflation assumption is lowered by 0.50% or 0.25%, then the total general wage increase assumption would decrease from 3.75% to 3.00% or 3.25%.

Total General Wage Inflation		
	Alternative #1	**Alternative #2**
Price Inflation	2.25%	2.50%
Real Wage Inflation	0.75	0.75
Total General Wage Inflation	3.00%	3.25%

E. Expense Assumptions

Because investment expenses become larger as assets grow, we distinguish between administrative expenses and investment expenses. The investment expense assumption is expressed as a percentage of assets and is incorporated into the overall investment return assumption. The administrative expense assumption is expressed as a percentage of payroll and is incorporated into the normal cost. Investment and administrative expenses for the last 20 years are shown in Exhibit 3 near the beginning of this section.

Our current investment expense assumption is 0.35% of assets. As shown in Exhibit 3 actual investment expenses have been close to 0.35% of assets over the last 10 years. Note, however, that the capital market assumptions from both Milliman investment specialists and Wilshire Associates are net of passive investment fees. In theory, active management fees are paid to reflect anticipated returns above those of passive indexing. As discussed below, we assume that active management fees and the increased returns from active management are offsetting and therefore use the capital market assumptions net of passive investment fees.

Administrative expenses during the last 20 years have ranged from 0.67% to 0.94% of covered earnings of members, as shown in Exhibit 3. We recommend continuing the current assumption of adding 0.80% of salary to the normal cost of the System to allow for administrative expenses.

F. Actuarial Valuation of Assets

The current actuarial asset valuation method spreads asset gains and losses over four years and does not limit actuarial assets to be in a specific corridor around the fair value of assets. The expected return is determined each year based on the beginning of year fair value and actual cash flows during the year. Any difference between the expected fair value return and the actual fair value return is recognized evenly over a period of four years. This method was adopted effective January 1, 1997.

Actuarial Standard of Practice No. 44 (Selection and Use of Asset Valuation Methods for Pension Valuations) Section 3.3 states:

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

The Standard goes on to say that if no such corridor is used the asset method may still satisfy the Standard if in the actuary's professional judgment, the asset method recognizes differences from market value in a sufficiently short period. In fact, we do believe that the four year period is sufficiently short to satisfy the Standard. We recommend no change to the actuarial asset valuation method.

G. Growth in Membership

We propose continuing the assumption that no future growth in membership will occur. This assumption affects the amortization payment rate, which is the portion of the total contributions used to either liquidate the Unfunded Actuarial Accrued Liability (UAAL), or increase the funding reserve, if any. The UAAL amortization payments are spread over anticipated future salaries of the entire membership of the System. With no assumed growth in membership, future salary growth due only to general wage increases is being anticipated. If increases should occur not only because of wage increases but also because of additional members, there will be a larger pool of salaries over which to spread the UAAL, if any.

H. Investment Return Assumption (Discount Rate)

Use in the Valuation

The assumed rate of investment return is used to discount the future projected benefit payments of the retirement plan to the valuation date. As such, it is one of the most important assumptions used in valuing the plan's liabilities and developing actuarially determined contribution rates. The assumption is intended to reflect the long-term expected future return on the portfolio of assets that fund the benefits.

The discount rate is the rate used to discount future benefit payments into an actuarial present value. The traditional actuarial approach used in the public sector sets the discount rate equal to the expected investment return. Under current standards set by the GASB, when there is not an expected depletion date for the assets, the discount rate should be based on an estimated long-term investment yield on the investments that are expected to be used to finance the payment of benefits.

Measurement Specific Factors

The Actuarial Standards Board standard for selecting economic assumptions lists measurement specific factors that can be considered in selecting a reasonable investment return assumption within. Such factors are:

1. **The Purpose of the Measurement.** The purpose of the traditional approach to setting the discount rate is to determine a contribution based on reasonable expectations such that if the plan sponsor has set aside assets today equal to the actuarial present value of benefits and if those assets earn what is expected and people behave as expected, the fund would be liquidated when the last person has died. If the expected investment return assumption is set at the median of expectations, there is equal probability of having more or less money than necessary to pay the benefits if all other assumptions are met.

   The measurement of obligations for an ongoing plan will differ from those of a terminating or closed plan. An ongoing plan such as TERS may reflect a longer time horizon and a more diversified investment portfolio.

   For a governmental plan, benefit security is tied to the funding agency's ability to provide the required funding. The funding of the retirement system is dependent on the ability to increase or decrease allocated tax revenues to the system. A primary funding goal of most governmental plans then is a stable contribution rate, so that the budgeting and allocation of tax revenues are not subject to a great deal of fluctuations.

   It is reasonable when setting actuarial assumptions for a governmental plan to consider the impact not only on its membership, but on the taxpayers, and the agency's ability to provide sufficient income to maintain and secure a stable funding for the benefit security of the membership. This is sometimes reflected in a more conservative approach, that is, a set of assumptions where experience gains are more likely than losses, as experience gains are more easily absorbed into the funding than are experience losses which may result in a required increase in funding. This is sometimes referred to as "leaving a margin for adverse deviation."
2. **Investment Policy.** This usually refers to the plan's current asset allocation, the types of securities the system is eligible to invest in, and the target allocation, if different. It may also reflect the investment philosophy regarding risk tolerance and social investing.
3. **Reinvestment Risk.** This should reflect the reinvestment of moneys not immediately required to pay plan benefits.
4. **Investment Volatility.** If a system is required to liquidate assets at depressed values to meet benefit obligations, a higher risk is present.
5. **Investment Manager Performance.** Few investment managers consistently out-perform the market. Those who consistently under-perform may be replaced.
6. **Investment Expenses.** Investment returns are usually measured both with and without expenses. Actual expenses are measured periodically and taken into account when setting the TERS investment assumptions.
7. **Cash Flow Timing.** The expected stream of contributions and benefit payments may affect the liquidity of a plan's investment opportunities.
8. **Benefit Volatility.** This is a consideration for small plans, plans with full lump sum payment options, and supplemental benefits. The concern with these factors is a need to liquidate securities at depressed values. We do not expect benefit volatility to be a factor in considering the TERS investment return assumption.

Projection Model Using Capital Market Assumptions

To develop an analytical basis for assessing the investment return assumption, we use long-term assumptions developed by Wilshire Associates and their June 30, 2020 capital market assumptions. We compare that to the capital market assumptions developed by Milliman's investment specialists. Each asset class assumption is based on a consistent set of underlying assumptions, including the inflation assumption. These assumptions are not based on historical returns, but instead are based on a forward-looking capital market economic model. In

addition to the assumptions from Wilshire and Milliman, we reviewed a published 2020 survey conducted by Horizon Actuarial Services summarizing the expectations of various investment experts.

Wilshire, Milliman, and the Horizon survey all have 10-year forecasts. Wilshire and Milliman also have 30-year forecasts, while the Horizon survey has a 20-year forecast. The following table summarizes the expected compound returns from the various assumptions:

Expected Compound Returns			
Investment Horizon	Wilshire	Milliman Investment Specialists	Horizon Survey
10 years	5.63%	5.47%	6.22%
20 years	N/A	N/A	7.09%
30 years	6.19%	6.05%	N/A

The standard deviations in annual returns for the portfolio are 10.96%, 10.32%, and 10.79% for Wilshire, Milliman investment consultants, and the Horizon survey, respectively. The inflation assumptions are 1.50%, 2.20%, and 2.17%, respectively.

Wilshire's assumptions are used by the Retirement Board in analyzing the System's asset allocation. The assumptions and the Retirement Board's Strategic Asset Allocation policy, effective March 2019, are shown below. The expected returns are from Wilshire's June 30, 2020 Ultra Long Term (ULT) (30-Year) assumptions.

Asset Category	Target Asset Allocation	Expected Compound Return	Standard Deviation
Global Equity	**34.5%**	6.45%	17.10%
Private Equity	**10.0**	8.15	28.00
Fixed Income	**36.5**		
Investment Grade	19.5	1.25	5.15
High Yield	6.0	4.00	10.00
Long UST / TIPS	3.0	0.30	6.00
Emerging Market Debt*	5.0	4.50	13.00
Private Real Estate	**10.0**	6.80	14.00
Real Assets	**9.0**		
MLPs**	4.0	7.70	19.00
Private Real Assets	5.0	5.45	8.75
Total Portfolio	**100%**	6.19%	10.96

** Emerging Market Debt was not listed in Wilshire's June 30, 2020 analysis provided to Milliman. The expected compound returns were provided by Wilshire for December 31, 2019. The standard deviation was not provided. The standard deviation in this table is from Milliman's investment specialists.*

*** MLP assumptions are from Wilshire's December 31, 2019 forecasts.*

The following table shows the correlation coefficients among the various assets classes as provided by Wilshire as of June 30, 2020. Note that correlation coefficients for MLPs and emerging market debt were not available. Milliman used assumptions based on those developed by Milliman's investment specialists.

Correlation Table

	Global Equity	Private Equity	Invest Grade Fixed	TIPS	High Yield	Private Real Estate	Real Assets	Emerging Market Debt	MLPs
Global Equity	1.00								
Private Equity	0.74	1.00							
Investment Grade Fixed	0.20	0.31	1.00						
TIPS	0.00	-0.03	0.60	1.00					
High Yield	0.51	0.34	0.25	0.05	1.00				
Private Real Estate	0.52	0.51	0.19	0.09	0.57	1.00			
Real Assets	0.47	0.43	0.24	0.41	0.53	0.69	1.00		
Emerging Market Debt	0.46	0.44	0.22	0.23	0.57	0.09	0.06	1.00	
MLPs	0.36	0.36	0.08	0.26	0.59	0.28	0.43	0.25	1.00

However, the return is subject to significant year-to-year volatility as evidenced by the standard deviation. Volatility over time will lower the compound rate of return, but time also narrows the range of expected returns. The model provides a guide to see if it is reasonable to expect this return to compound over longer periods of time.

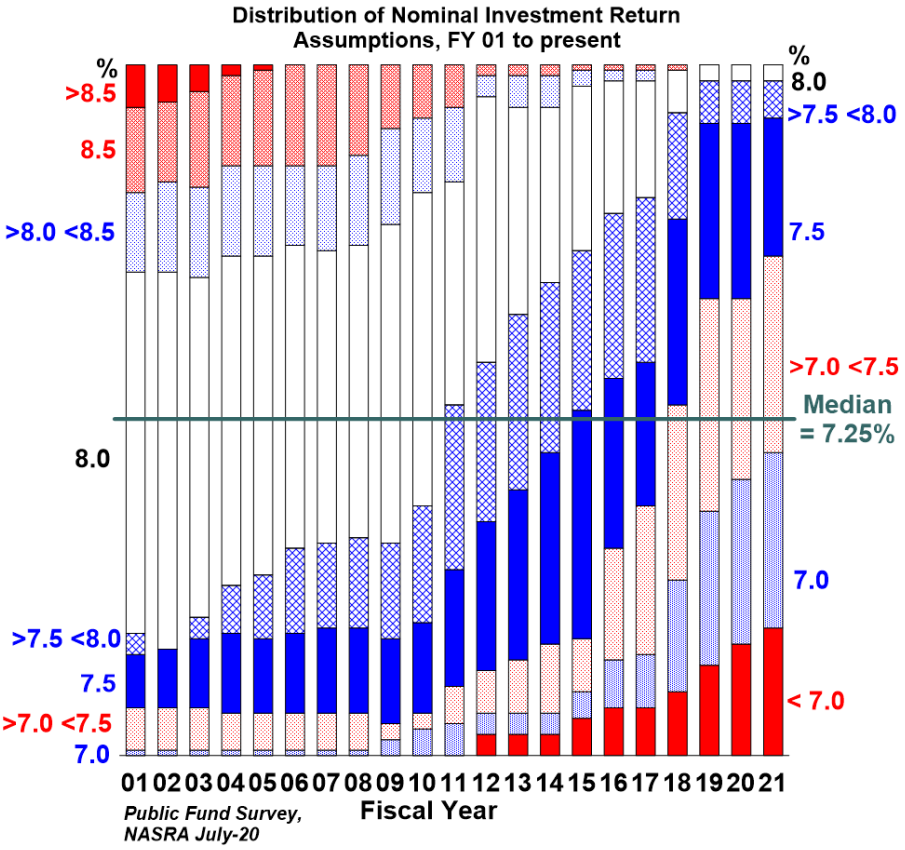
Note that the capital market assumptions from both Wilshire and Milliman's investment consultants are net of passive investment fees. In theory, active management fees are paid to reflect anticipated returns above those of passive indexing. We assume that active management fees and the increased returns from active management are offsetting and therefore use the capital market assumptions net of passive investment fees.

Using the assumptions from Milliman's investment consultants, we see the following distribution for annualized compound returns over the next five, ten, and thirty years:

	Percentile Results for Annualized Compound Net Returns				
Horizon in Years	5th	25th	50th	75th	95th
5	-2.42%	1.81%	4.85%	7.99%	12.67%
10	0.27%	3.31%	5.47%	7.68%	10.94%
30	3.02%	4.80%	6.05%	7.32%	9.18%

Peer System Comparison

According to a the Public Fund Survey conducted by the National Association of State Retirement Administrators (NASRA), the average investment return assumption for statewide systems has been slowly declining. As of the most recent information, the median assumption is now 7.25%, down from 8.00% for the median for 2001 - 2010. The following graph illustrates the decline in investment return assumptions since the inception of the survey in FY 2001.



Recommendation – Investment Return

Based on the ASOP No. 27 guidelines and our comments above, we recommend lowering the investment rate of return assumption, along with the inflation assumption discussed previously.

Investment Return	
Alternative #1 (with 2.25% inflation)	6.50%
Alternative #2 (with 2.50% inflation)	6.75%

The above assumptions would maintain the assumed net real rate of return at 4.25% (currently 7.00% minus 2.75% for inflation). This real rate of return is below the median real returns suggested by Wilshire's Ultra-Long Term assumptions and the Horizon 20 survey. However, the 4.25% real rate of return is above the median real

returns suggested by the 10-year period for all three sources, as well as the 30-year forecast by Milliman's investment specialists.

In our professional judgment the above investment return assumptions are reasonable and are not expected to have any significant bias. Note that these assumptions do not provide a margin for adverse deviation. If the Retirement Board is interested in having such a margin, a lower investment return assumption could be used.

4. Retired Mortality

Exhibits 5 through 7 show the actual and expected rates of mortality among service and disability retirees over the past four years.

The retired mortality results are shown for the following eligibility groups:

Exhibit 5: Mortality Among Service Retirees – Males

Exhibit 6: Mortality Among Service Retirees – Females

Exhibit 7: Mortality Among Disabled Retirees – Males and Females Results

Results and Recommendation

We have done considerable analysis regarding the correlation between benefit amounts and longevity. Our finding has been that retirees with larger benefits tend to live longer, on average, than those with smaller benefits. This has been the case over the past four years with TERS. Since the value of benefits is related both to how long people live and the amount of the monthly benefit they receive, there will be an understatement of liabilities if assumptions do not account for this correlation. Accordingly, we have studied TERS mortality experience for service retirees in a benefit-weighted manner.

We recommend:

- Updating the base tables to PubG-2010 amount-weighted healthy retiree mortality tables adjusted by 105% for males and no adjustment to females.
- Updating the base tables to PubG-2010 amount-weighted disabled retiree mortality tables for disabled retirees adjusted by 105% for males and no adjustment to females.
- Updating the mortality projection scale with the most recently available data. We continue to recommend a unisex table based on Social Security Administration data from the most recent 60 years available (1957-2017) for both service and disabled retirees. (Specific age based rates are provided in the summary of assumptions at the back of this report.)

The current mortality assumptions use projected mortality improvements based on blended RP-2014 tables and a full generational mortality assumption (projection scale based on Social Security Administration data from 1953-2013) where longevity is assumed to vary by year of birth. Members born later are assumed to live longer. Most actuarial valuations for public sector retirement systems use this approach and we are recommending TERS continue to use generational mortality, with the table described in Section 4. A generational approach is made up of two separate assumptions:

- The “base table” reflects current mortality based specifically on the last four years of experience.
- The “projection scale” predicts how much mortality will decrease in the future. Since the future has not occurred, it is much more difficult to set this assumption accurately.

Following is a summary of the healthy retiree mortality exposures and actual to expected (A/E) ratios by headcount. Note that the actual assumptions proposed are on a benefit-weighted basis and the total A/E for males and females is 99% on that basis.

			Proposed Assumptions	
	Exposures	Actual Deaths	Expected Deaths	A/E Ratio
Male	4,962	159	142	112%
Female	2,973	63	58	109%
Total	7,935	222	200	111%

Base Tables

In 2019, the Society of Actuaries published new mortality tables based on data from public sector retirement systems. In particular, tables specific to general members were included. As these tables reflect the general population, we believe they are reasonable to use as base tables with adjustments to specifically fit them to TERS experience. Also published were tables weighted by benefit amount and weighted by headcount. As Milliman has seen, the Society of Actuaries found that people with higher benefits tend to have greater longevity. We believe it is appropriate to use the amount-weighted mortality tables as they lead to a better estimate of the cost of benefits.

The adjustment to the base tables reflects TERS actual mortality experience for service retirees over the last four years weighted by benefit. The graphs and numbers shown in Exhibit 5 and Exhibit 6 are not by headcount but rather are benefit-weighted by thousands of dollars. There were 159 male service retiree deaths in the study period which translates to $404,000 of monthly benefits, as shown in Exhibit 5. For females, there were 63 service retiree deaths in the study period which translates to $93,000 of monthly benefits, as shown in Exhibit 6.

For males over the past four years, the actual mortality on a benefit-weighted basis (representing $404,000 of monthly benefits) was 4% higher than what was predicted based on the old assumptions ($390,000 of monthly benefits). This means that males have had lower longevity over the past four years than we predicted at the time of our last study. We recommend using 105% of the PubG-2010 healthy retiree mortality table for males. This reduces the actual to proposed ratio from 104% to 101%.

For females over the past four years, the actual mortality on a benefit-weighted basis (representing $93,000 of monthly benefits) was 74% of what was predicted based on the old assumptions ($126,000 of monthly benefits) We recommend using 100% of the PubG-2010 healthy retiree mortality table for females. This increases the actual to proposed ratio from 74% to 93%.

In previous actuarial valuations, we have used the same mortality assumptions for beneficiaries as we used for service retirees. We recommend continuing this practice. It is impractical to study beneficiary mortality, because we can obtain reliable data only for beneficiaries who survive the related retiree, not for beneficiaries who predecease the related retiree. A study using such incomplete data may give misleading results. Moreover, there is no reason to believe that the mortality of beneficiaries should be significantly different from that of service retirees of the same sex.

For all healthy retirees and beneficiaries, we are recommending assumptions based on 105% of the male and 100% of the female PubG-2010 healthy retiree tables. For disabled retirees, our sample size is quite small. We believe it is appropriate to adjust the current assumption (RP-2014 male disabled mortality table) to 105% of the male and 100% of the female PubG-2010 disabled retiree mortality tables to be consistent with the mortality assumptions for healthy retirees.

The sample size for active members is relatively small. We recommend updating from the current RP-2014 tables to the PubG-2010 employee tables with males adjusted by 105% and no adjustment to the female table, similar to the proposed retiree mortality assumptions.

Projection Scale for mortality improvement

There is a strong consensus in the actuarial community that future improvements in mortality should be reflected in the valuation assumptions. There is less consensus, however, about how much mortality improvement should be reflected. The projection scale (which projects future improvements in mortality) published by the Society of Actuaries incorporates a complex matrix of rates of improvement that vary by both age and birth year.

The Society of Actuaries issued the MP-2014 mortality improvement projection scale in 2014 and has updated the table every year. The most recent scale is the MP-2019 projection scale issued in October 2019. The MP-2014 and MP-2019 projection scales reflect a technically complex method which assumes that for any given age and gender combination that mortality will improve by different amounts in different future years. Additionally, the methodology assumes that future male and female improvement will differ, with the differences varying depending on respective members' years of birth. In the short-term, MP-2019 implies substantially less mortality improvement than what was predicted by the MP-2014 table.

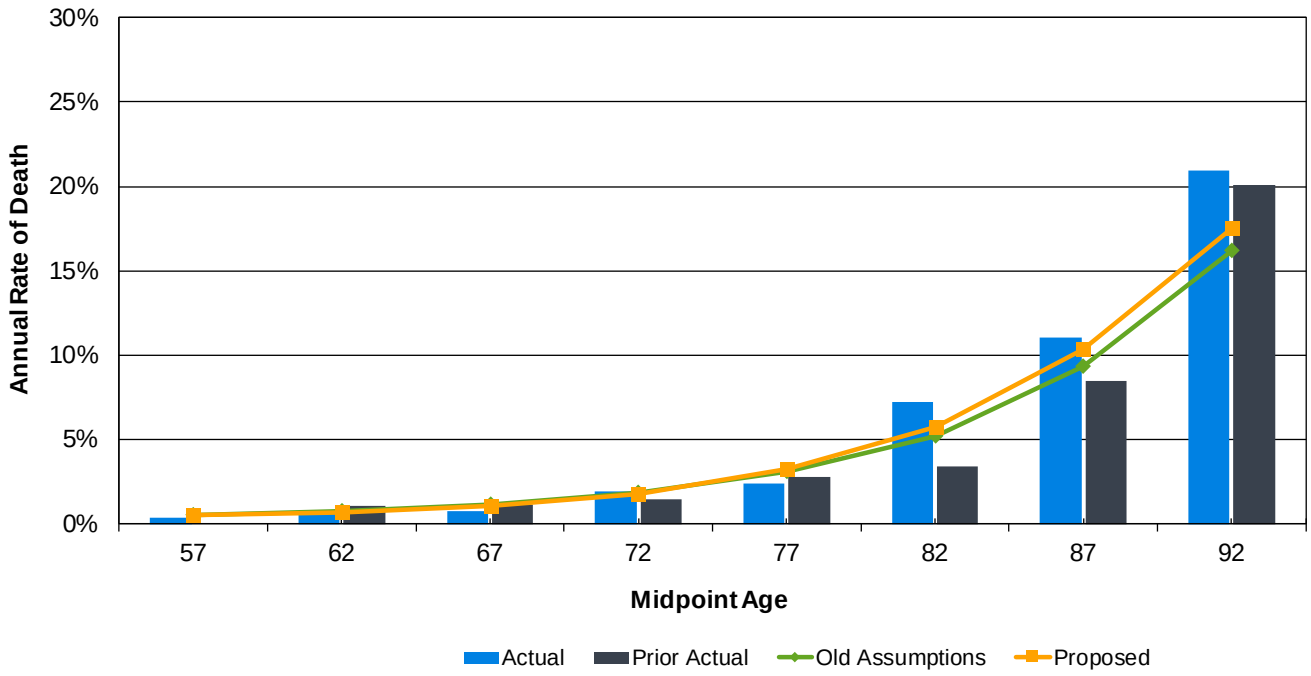
MP-2019 represents a reasonable assumption, but in our opinion its very high level of complexity creates several significant issues:

- The complexity of MP-2019 means that its effects cannot be summarized by the actuary for the understanding of policy makers and other non-actuarial stakeholders, and MP-2019 can have markedly different effects on two seemingly similar plans.
- An MP-2019-style approach may be subject to significant and unexpected changes when it is periodically updated by the Society of Actuaries. Since there is no clear line from the data used to the conclusions reached in the complex model, any significant and unexpected changes cannot be anticipated in advance or understandably explained by the actuary after measured.
- MP-2019 has an implicit assumption about which gender will have better future mortality improvement, even though there is no consensus on this issue and the gender with superior improvement has differed in the past.

Since no one knows how rapidly mortality will improve, we believe it is likely that the MP-2019 approach, or a similarly complex approach, adds precision without adding accuracy. Therefore we are recommending an alternative method which is designed to cause a minimum of disruption in future actuarial calculations while providing calculations which are just as accurate, easier for the actuary to apply, and for policy makers and other non-actuarial stakeholders to understand. We are continuing to recommend a unisex mortality projection scale which varies by age and is based on the last 60 years of Social Security Administration (SSA) mortality data. We recommend updating the mortality projection scale with the most recently available data. The current mortality projection scale is based on 1953-2013 data. We are recommending updating this to a mortality projection scale based on 1957-2017 data, the most recent data available from the SSA. The SSA data is a large, credible, and publicly available database. Although the rate of mortality improvement has gone both up and down repeatedly in the last 60 years, the 60-year average should change slowly over time. This is consistent with the goals of generational mortality to provide calculations which are more stable over time and which anticipate the effects of continuing future improvement. The specific numbers used in this projection scale are documented in the summary of assumptions at the back of this report.

Exhibit 5

Mortality Among Service Retirees – Males

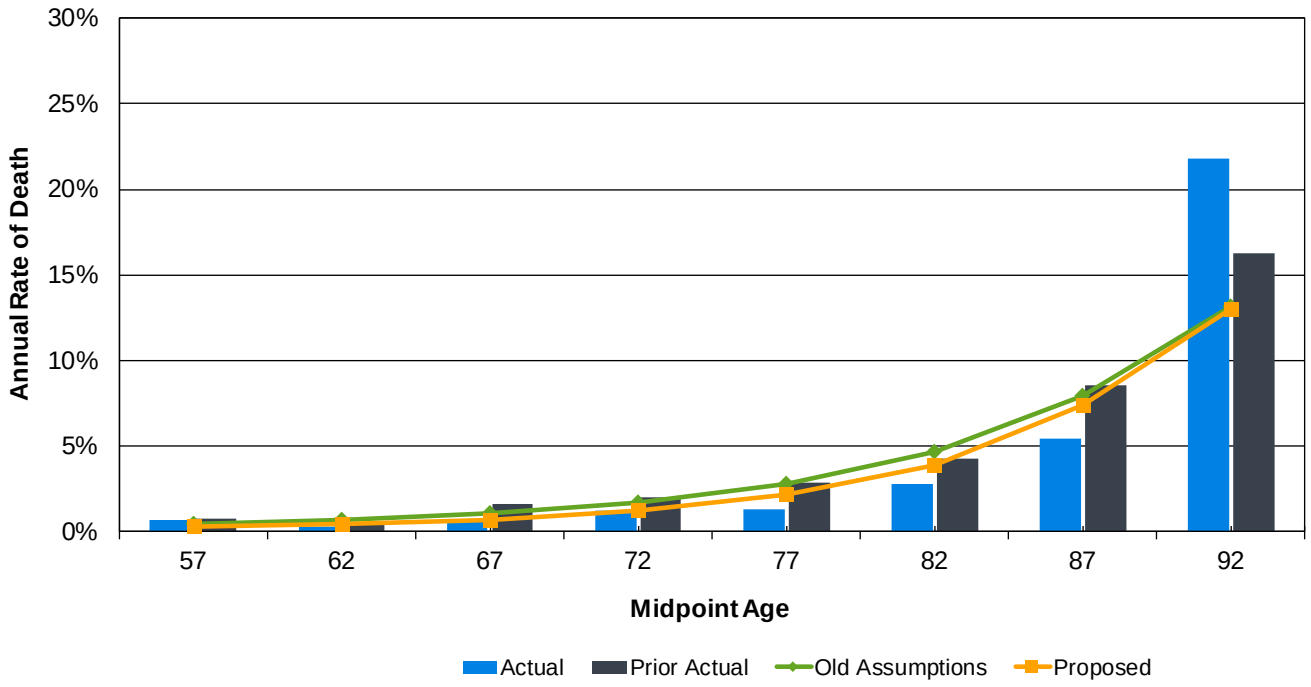


	Old Assumptions	Actual	Proposed
Total*	$390	$404	$401
Actual / Expected	104%		101%

*Weighted by benefit. Total monthly benefits in thousands of dollars for people dying.
Expected Mortality = RP 2014 Mortality Table for Males, blended 50% Blue Collar and 50% White Collar, projected with a unisex table based on Social Security Administration data from the most recent 60 years available, 1953 to 2013 (Generational)
Proposed Mortality = 105% PubG-2010 Mortality Table for Males, projected with a unisex table based on Social Security Administration data from the most recent 60 years available, 1957 to 2017 (Generational)

Exhibit 6

Mortality Among Service Retirees – Females

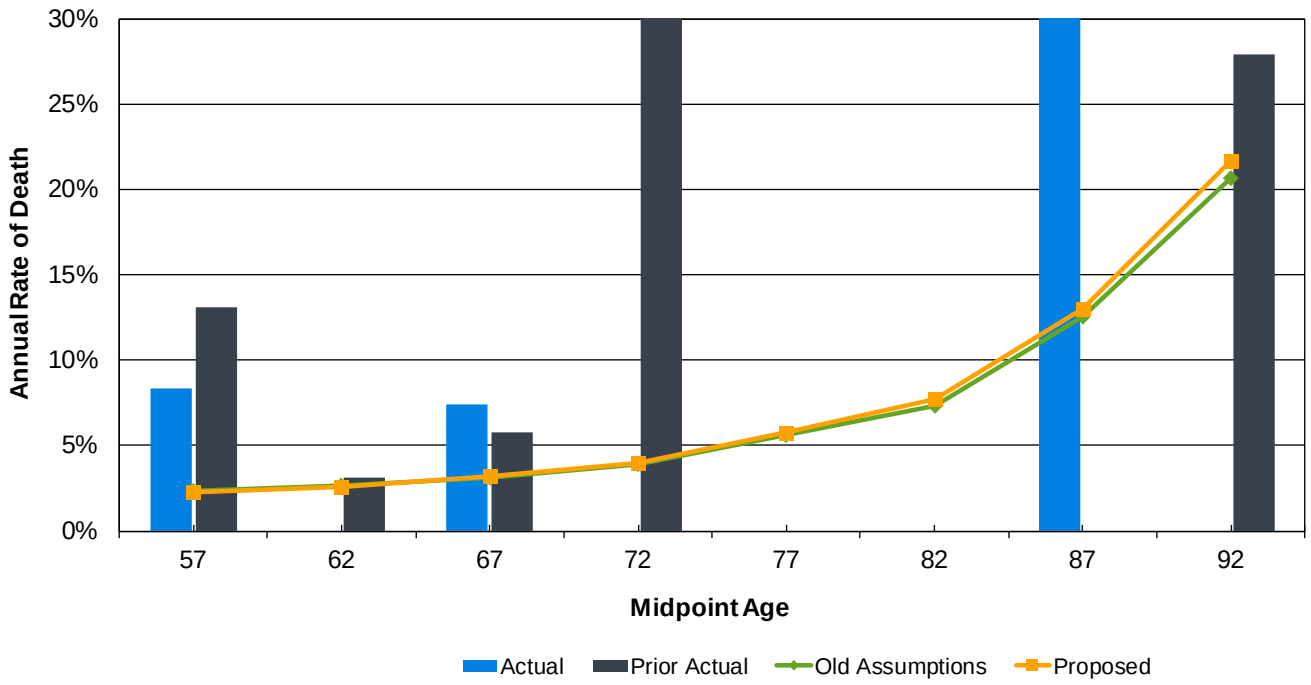


	Old Assumptions	Actual	Proposed
Total*	$126	$93	$100
Actual / Expected	74%		93%

*Weighted by benefit. Total monthly benefits in thousands of dollars for people dying.
Expected Mortality = RP 2014 Blue Collar Mortality Table for Females projected with a unisex table based on Social Security Administration data from the most recent 60 years available, 1953 to 2013 (Generational)
Proposed Mortality = 100% PubG-2010 Mortality Table for Females, projected with a unisex table based on Social Security Administration data from the most recent 60 years available, 1957 to 2017 (Generational)

Exhibit 7

Mortality Among Disabled Retirees – Males and Females



	Old Assumptions	Actual	Proposed
Total Count	4	6	4
Actual / Expected	150%		150%

Expected Mortality = RP 2014 Disabled Mortality Table for Males projected with a unisex table based on Social Security Administration data from the most recent 60 years available, 1953 to 2013 (Generational)

Proposed Mortality = 105% PubG-2010 Disabled Retiree Mortality Table for Males, 100% PubG-2010 Disabled Retiree Mortality Table for Females, projected with a unisex table based on Social Security Administration data from the most recent 60 years available, 1957 to 2017 (Generational)

5. Salary Increases Due to Promotion and Longevity

As discussed in Section 3, estimates of future salaries are based on assumptions for two types of increases:

1. Increases in each individual's salary due to promotion or longevity, which occur even in the absence of inflation; and
2. Increases in the general wage level of the membership, which are directly related to inflation and increases in productivity.

In this section we discuss the first type, increases due to merit. The second type, increases in the general wage level, was discussed in Section 3.

Assumption Format

We recommend maintaining the current format which bases merit salary increases on length of service alone. This study reinforces our conclusion that pay increases are larger early in a member's career and smaller as time progresses.

Results and Recommendation

For this study, we computed the total salary increases for each member covered for any two consecutive years during the four-year period. We backed out the average salary growth for each period to isolate the impact of merit and longevity increases. Adjustments were made for the number of new entrants each year. Using the current salary assumption for promotions and longevity and not including the observed general wage inflation cited above, we compared the shape of the curve to the actual experience. As shown in Exhibit 8, the general shape of the current assumption follows the total increases fairly well.

For the entire group, the actual experience for merit and longevity salary increases of the past four years is generally consistent with the current assumptions. Accordingly, we are proposing that assumed salary increases remain unchanged from the current assumptions.

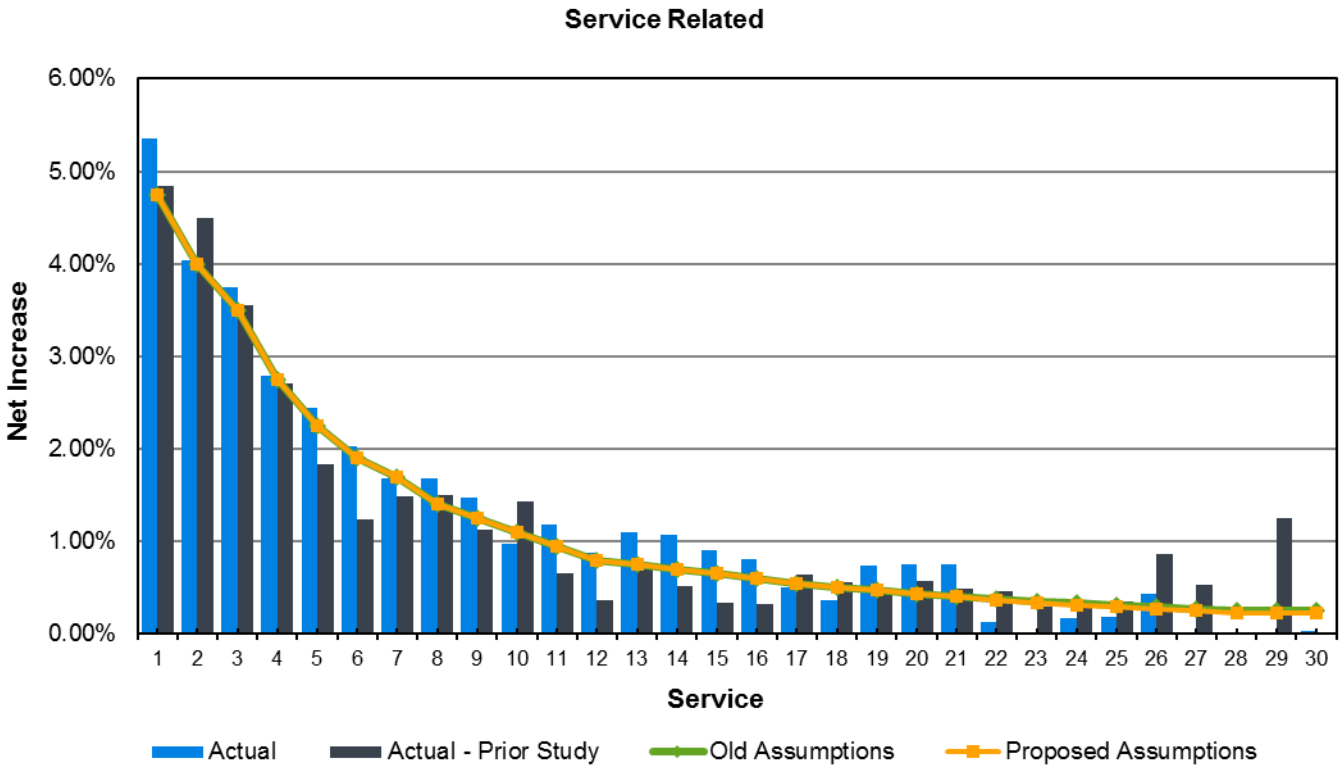
Please see Section 10 for a summary of our recommended merit salary increases by years of service.

Note that we will continue to assume that salary increases will occur at the end of each year. Our discussion with the System indicates that most salary adjustments occur at January 1 and are reflected in the data files received.

Exhibit 8

Merit Salary Increases

General Wage Inflation Removed from Actual and Assumptions



6. Retirements

Exhibits in this section present comparisons of actual retirements during the study period with those expected to retire according to the actuarial assumptions used in our January 1, 2020 valuation.

Assumption Format

We recommend that the current format based on age be maintained.

Experience was examined separately for years where members were eligible for:

- Reduced retirement benefits (less than full 2.0% multiplier),
- Full unreduced retirement benefits (2.0% multiplier) in the first year of eligibility, and
- Full unreduced retirement benefits after the first year of eligibility.

Comments from Gabriel, Roeder, Smith & Company regarding Decrement Timing

We reviewed comments made by GRS during its actuarial audit with respect to rounding and the timing of decrements and decided not to make a change to Milliman's methodology. Milliman rounds each person's age to the nearest whole number and then applies midyear decrements. GRS expressed preference to round to the age half a year after a whole number, and then apply decrements in the whole years that follow.

To illustrate how this works, consider a person 49.3 years of age who will be eligible for retirement at age 50. Milliman would round the person to age 49. A person age 50 is assumed to decrement at mid-year, or age 50.5. The person in this example would be assumed to decrement 1.5 years after the valuation date under Milliman's methodology. Under GRS's proposed methodology, the person would be rounded to age 49.5 and then retire at age 50, 0.5 years after the valuation date. Note that if you assume midyear decrements, the reality is that the person would wait 1.2 (50.5-49.3) years until retirement, 0.3 years sooner than assumed by Milliman, but 0.7 years later than assumed by GRS.

Now, consider a person age 49.7 years of age. In this case, Milliman will round to age 50. Once again, the person will be assumed to retire at age 50.5. The person in this example would be assumed to decrement 0.5 years after the valuation date under Milliman's methodology. Under GRS's proposed methodology, the person would be rounded to age 49.5 and then retire at age 50, 0.5 years after the valuation date. Therefore, both methods result in decrements 0.5 years after the valuation date in this example. Note that if you assume midyear decrements, the reality is that the person would wait 0.8 years (50.5-49.7) until retirement, 0.3 years later than assumed by Milliman or GRS.

We believe that having one person retire 0.3 years later than the assumption without rounding and one 0.3 years earlier than the assumption is preferable and roughly offsetting. GRS's methodology will result in retirement earlier than an unrounded version in both cases.

Results and Recommendation

The results of this experience study continue to show significant differences between those eligible for full benefits and those only eligible for reduced benefits. There also continue to be differences between males and females.

We did not see a greater incidence of retirement in the first year eligible for unreduced benefits than we saw in subsequent years. This is the fourth consecutive study where that was the case. Therefore, we recommend that the same assumptions be applied both during and after the first year of eligibility for full benefits, consistent with current practice.

The following pages describe the results of our study for the following groups:

1. Retirement with Reduced Benefits (Early)
2. Retirement with Full Benefits

For each type of retirement there are separate graphs for males and females.

The requirements for early retirement with a reduced benefit are age 55 with 10 years of service or age 40 with 20 years of service. The requirements for retirement with a full 2.0% benefit multiplier are 30 years of service, age 60, or the time at which the member's age plus years of credited service equals 80 (Rule of 80).

Generally, our proposed rates are a fine-tuning of the current assumptions to reflect the most recent actual experience. This is done at each age, but at some ages our proposed rates appear to not reflect actual experience closely. Disparities such as this usually occur at ages at which there are very few members eligible for retirement. Because of the small number of members in the group, we do not give full credibility to the actual experience for the period.

Ages 70 and Over

All exhibits exclude retirees after age 70. We continue to recommend an assumption of immediate retirement for members aged 70 and older.

Please See Section 10 for a summary of our recommended assumptions for retirement rates.

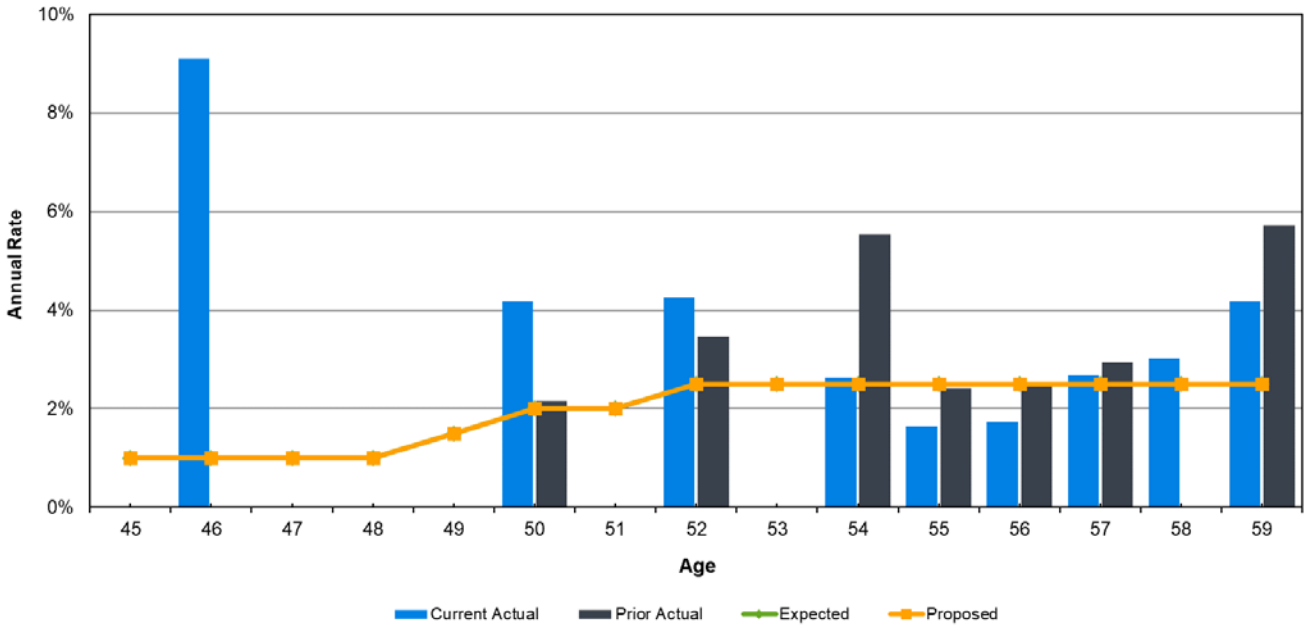
Retirement with Reduced Benefits

The next two pages illustrate the rates of retirement for members who elected to retire early with a reduced benefit. There were more early retirements than expected for males. For females, the current assumptions were in line with actual experience. We recommend that the retirement rates remain unchanged for both males and females. The results for the aggregate groups are summarized below:

Retirement with Reduced Benefits (less than 2.0% multiplier)						
	Number of Retirements				Actual/Expected	
	Exposures	Old Assumptions	Actual	Proposed Assumptions	Old	Proposed
Male	892	20	20	20	100%	100%
Female	501	22	24	22	109%	109%
Total	1,393	42	44	42	105%	105%

Exhibit 9

Retirement with Reduced Benefits (less than 2% multiplier) – Males

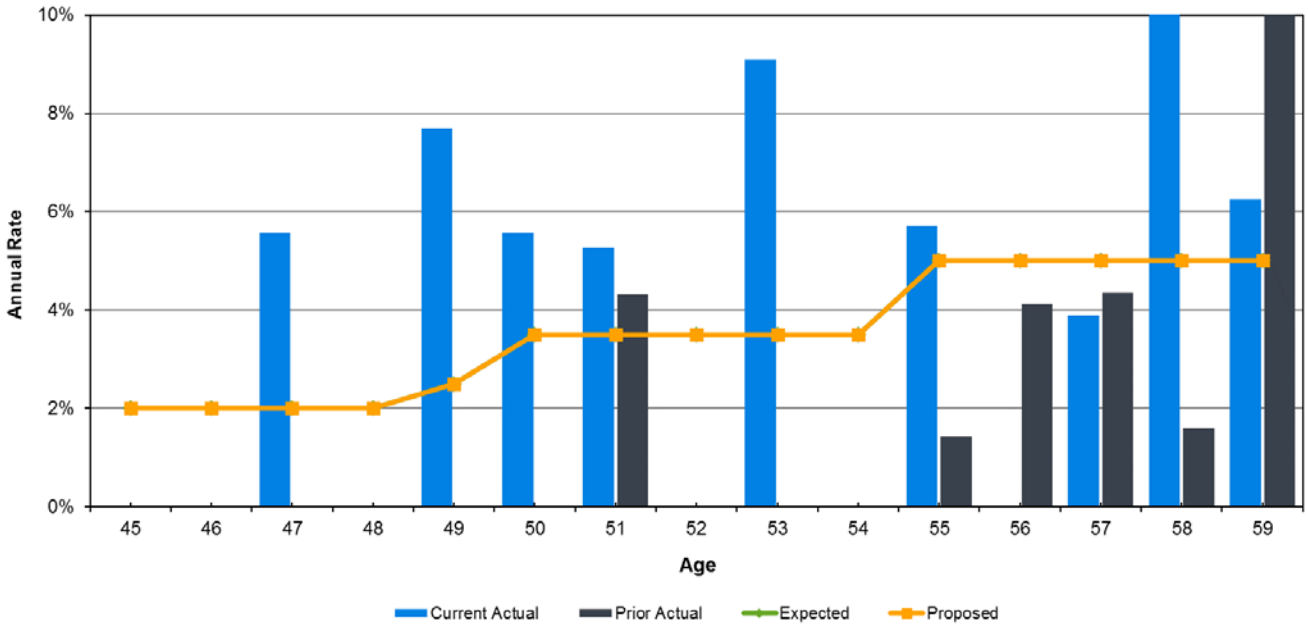


Current Actual			
All Ages	Old Assumptions	Actual	Proposed
Total Count	20	20	20
Actual / Expected	100%		100%

Prior Actual			
All Ages	Old Assumptions	Actual	Proposed
Total Count	21	19	21
Actual / Expected	90%		90%

Exhibit 10

Retirement with Reduced Benefits (less than 2% multiplier) – Females



Current Actual			
All Ages	Old Assumptions	Actual	Proposed
Total Count	22	24	22
Actual / Expected	109%		109%

Prior Actual			
All Ages	Old Assumptions	Actual	Proposed
Total Count	30	14	23
Actual / Expected	47%		61%

Retirement with Full Benefits

The retirement rates with full benefits are shown in the next two pages. We saw higher numbers than expected for both males and females, as well as higher rates than seen during the 2012 – 2015 period.

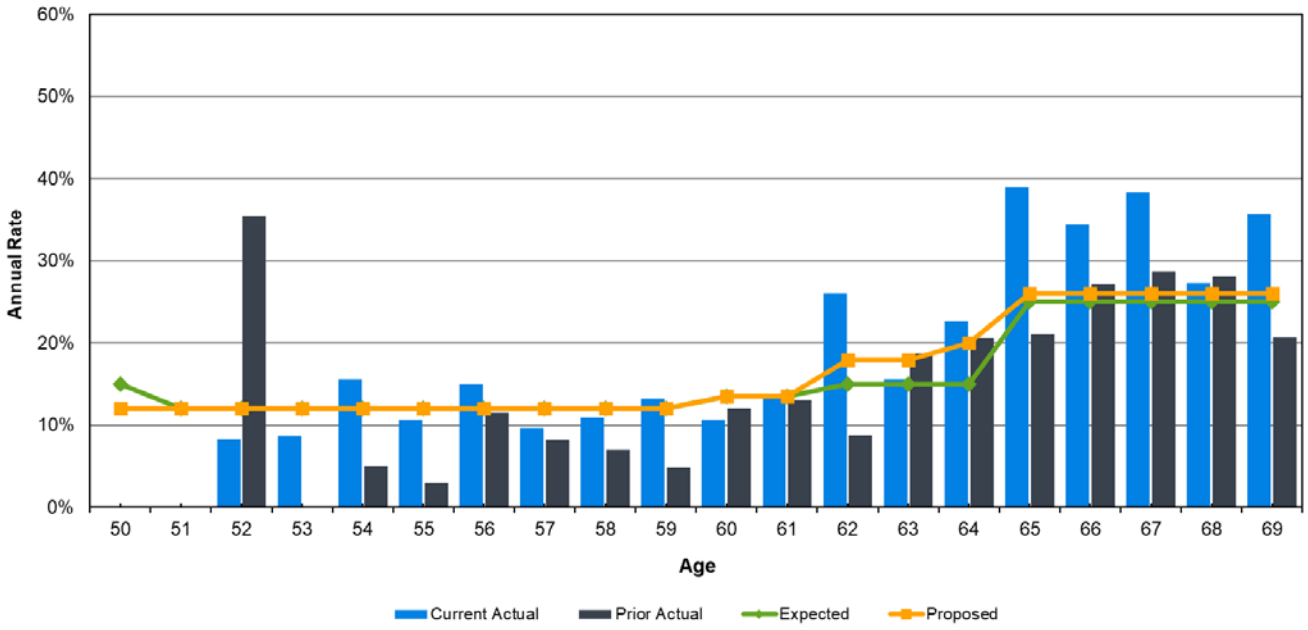
We did not see a greater incidence of retirement in the first year eligible for unreduced benefits than we saw in subsequent years. This is the fifth consecutive study where that was the case. Therefore, we recommend that the same assumptions be applied both during and after the first year of eligibility for full benefits. The table below and Exhibits 11 and 12 show data for all unreduced retirements, without regard to year of eligibility.

Retirement for Full Benefits (2% multiplier)						
	Number of Retirements				Actual/Expected	
	Exposures	Old Assumptions	Actual	New Assumptions	Old	New
Male	1,501	234	286	251	122%	114%
Female	976	139	163	142	117%	115%
Total	2,477	373	449	393	120%	114%

The actual retirements were higher than what was predicted by the previous assumptions for both males and females. In accordance with our philosophy of making gradual changes, we recommend raising the retirement rates, but not increasing them as much as suggested by the experience for the past four years alone. In addition, there were a very large number of retirements in December 2019. We believe that this was influenced by the fact that the annuity purchase rates for converting account balances into monthly annuities changed effective January 1, 2020. This meant that the monthly benefits would have been lower in 2020 for some retirees than they were in December 2019. That is another reason that we did not increase the rates to fully reflect the past four years of experience.

Exhibit 11

Retirement with Full Benefits (2% multiplier) – Males

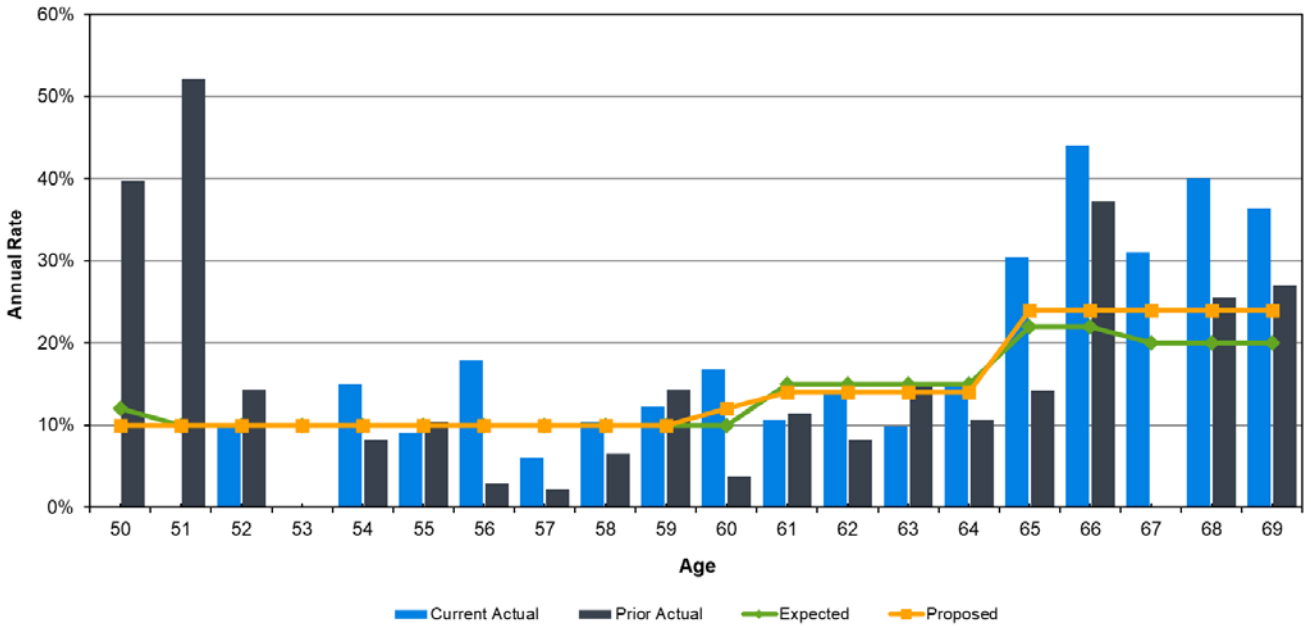


Current Actual			
All Ages	Old Assumptions	Actual	Proposed
Total Count	234	286	251
Actual / Expected	122%		114%

Prior Actual			
All Ages	Old Assumptions	Actual	Proposed
Total Count	290	215	248
Actual / Expected	74%		87%

Exhibit 12

Retirement with Full Benefits (2% multiplier) – Females



Current Actual			
All Ages	Old Assumptions	Actual	Proposed
Total Count	139	163	142
Actual / Expected	117%		115%

Prior Actual			
All Ages	Old Assumptions	Actual	Proposed
Total Count	144	81	111
Actual / Expected	56%		73%

7. Disability Retirement

The exhibit in this section compares actual disabled retirements during the study period with those expected by the actuarial assumptions used in the January 1, 2020 valuation.

Assumption Format

Disability rates are currently based on one factor:

- Age

The requirement for disability retirement is five years of service credited within the past 10 years preceding disability retirement. If disabled while on the job, there is no minimum service requirement.

Although the data is very small to use in developing new age-by-age rates, we believe the shape of the disability curve to be reasonable as increased incidence of disability at older ages is expected.

Results and Recommendation

The number of disabilities was smaller than what was expected. Disability retirements are uncommon. We are recommending that the assumed disabilities are decreased slightly.

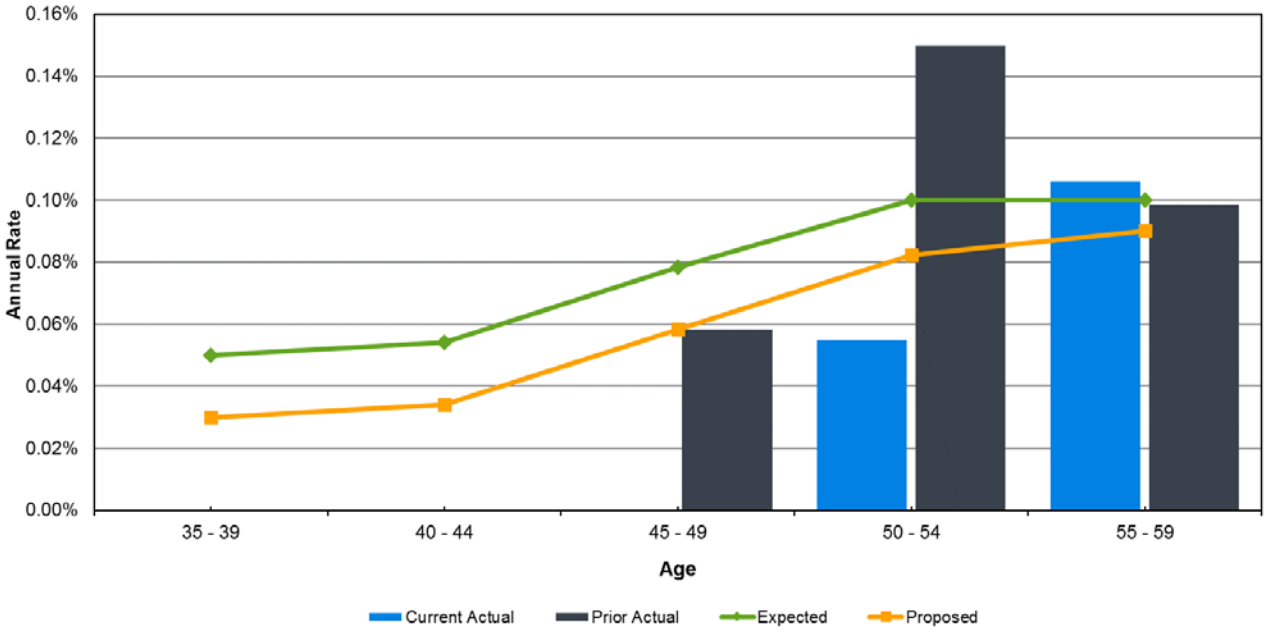
Following is a summary of the disability retirement exposures and A/E ratios.

			Proposed Assumptions	
	Exposures	Actual Retirements	Expected Retirements	A/E Ratio
Total	11,763	3	5	60%

Please see Section 10 for the recommended assumptions by age.

Exhibit 13

Disability Retirement



Current Actual			
All Ages	Old Assumptions	Actual	Proposed
Total Count	7	3	5
Actual / Expected	43%		60%

Prior Actual			
All Ages	Old Assumptions	Actual	Proposed
Total Count	8	6	7
Actual / Expected	75%		86%

8. Other Terminations of Employment

The exhibits in this section compare actual terminations (for reasons other than retirement, death and disability) during the study period with those expected by the actuarial assumptions used in the January 1, 2020 actuarial valuation.

Assumption Format

The termination assumptions are based on service. Our experience with this System and other systems shows that service is a better predictor of the likelihood of the termination of employment than age. Therefore, we have recommended that the System continue to base its assumptions on the level of service.

Results and Recommendations

We are recommending increases in the probability of termination for females with more than two years of service. For males, we do not recommend any changes to the current assumptions. Changes to termination assumptions for those with short service do not have much impact on the liability calculations.

Our proposed rates slightly increase termination for females, consistent with our philosophy of gradually changing rates over time.

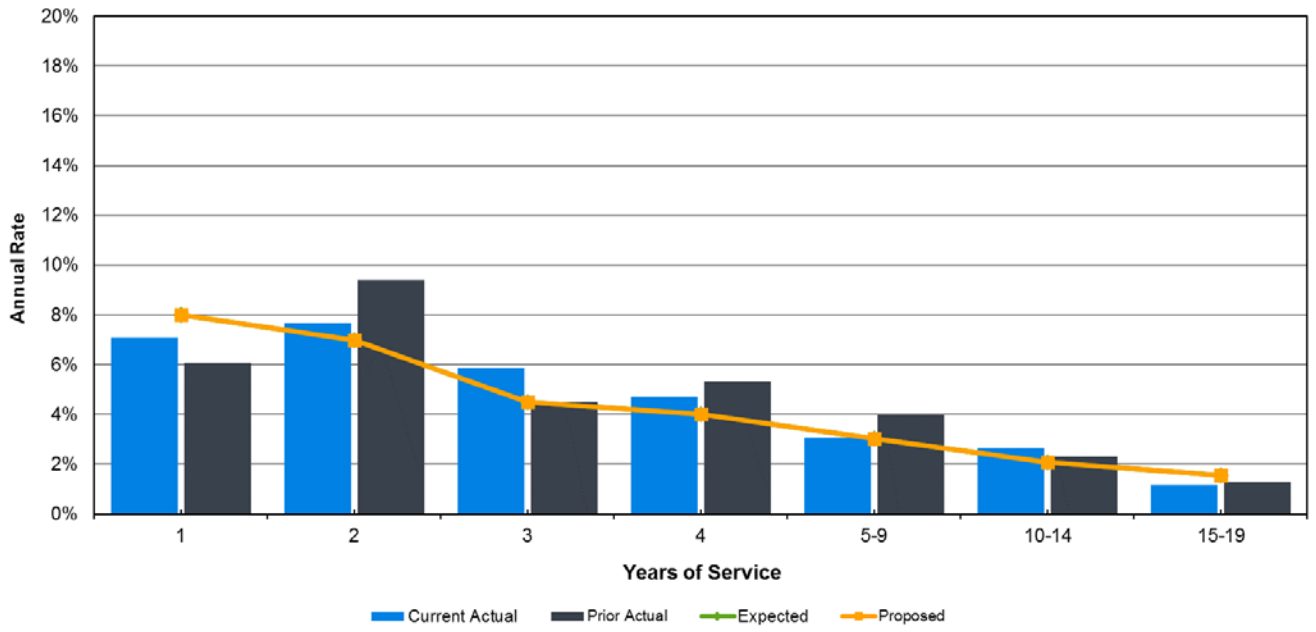
Following is a summary of termination exposures and A/E ratios for all service levels. Note that the graphs on the following pages exclude service less than one year.

			Proposed Assumptions	
	Exposures	Actual Terminations	Expected Terminations	A/E Ratio
Male	4,722	204	215	95%
Female	3,171	237	230	103%
Total	7,893	441	445	99%

Please see Section 10 for the recommended assumptions by years of service for both males and females.

Exhibit 14

Terminations of Employment – Males

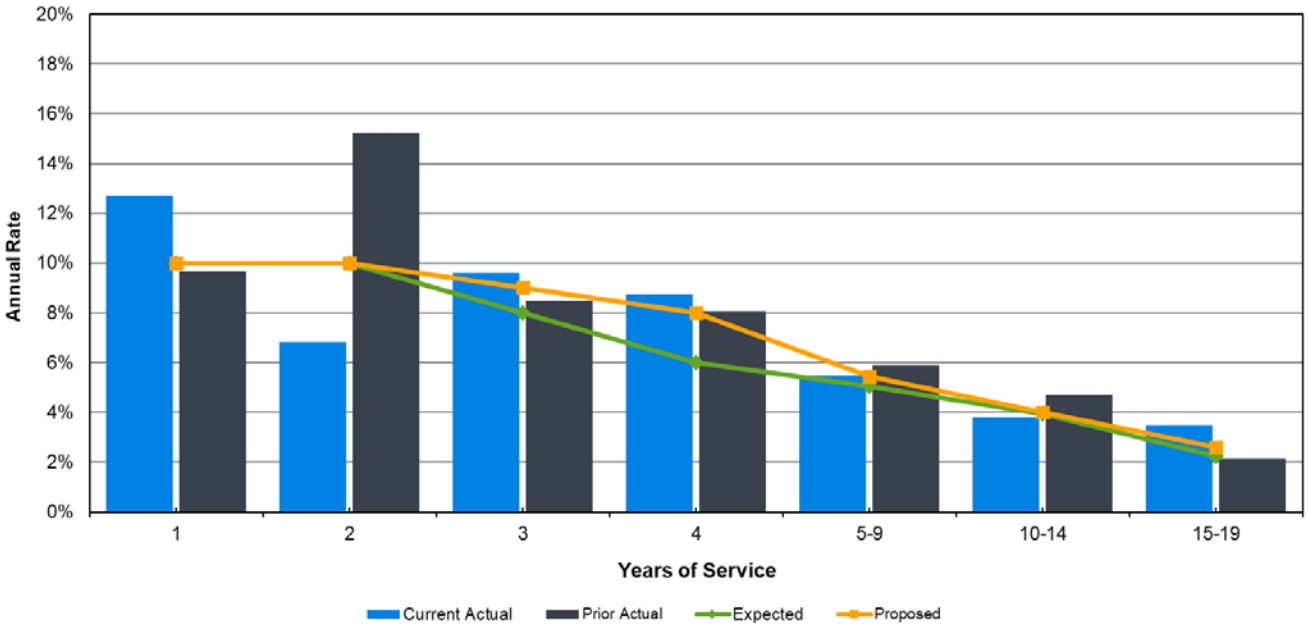


Excluding Service Less Than One			
	Expected Assump	Actual	Proposed
Total Count	165	172	165
Actual / Expected	104%		104%

Excluding Service Less Than One (Prior)			
	Expected Assump	Actual	Proposed
Total Count	141	169	144
Actual / Expected	120%		117%

Exhibit 15

Terminations of Employment – Females



Excluding Service Less Than One			
	Expected Assump	Actual	Proposed
Total Count	176	194	187
Actual / Expected	110%		104%

Excluding Service Less Than One (Prior)			
	Expected Assump	Actual	Proposed
Total Count	150	190	159
Actual / Expected	127%		119%

9. Other Assumptions

This section of the report comments on the portability assumption and the assumption for continued membership among vested terminated employees. We are recommending that the assumption for the impact of portability be lowered to reflect the experience over the past 13 years.

Portability with Other Washington Retirement Systems

Effective January 1, 1994, the System adopted agreements for portability of retirement benefits with the State of Washington. In the second half of 1999, the System expanded its portability provisions to include the benefit percentage factor used in calculating benefits. These number of members retiring with portability has been increasing over time.

We began using specific assumptions for portability in the January 1, 2001 valuation. The current assumptions are:

- A 1% increase to the early retirement liabilities for actives when compared to what the liabilities would be without portability.
- An 18% increase to the deferred vested decrement for actives when compared to what the liabilities would be without portability.
- An 18% increase to the liabilities for vested terminated members when compared to what the liabilities would be without portability.

These assumptions are used to calculate an additional liability load which is applied to members who are projected to retire with deferred or reduced benefits.

In order to utilize more data than the four-year study period, we reviewed the experience for members who retired between January 1, 2007 and December 31, 2019, with some additional emphasis on more recent years. We found that almost 43% of vested terminated members who retired in this period had portability, while less than 7% of active members who retired before eligibility for full benefits retired with portability in a similar period. We looked at the effect that portability had on members' benefits.

We are recommending a 2% increase to the early retirement liabilities for actives when compared to what the liabilities would be without portability, up from the current 1% assumption. We are recommending a 13% increase to the liabilities for vested terminated members when compared to what the liabilities would be without portability, down from the current 18% assumption. Both of these adjustments are based on the impact on the liabilities for retirement since January 1, 2007.

Continued Membership Among Vested Terminated Employees

The current valuation assumption is that the member will take the benefit with the greatest financial value, i.e., the greater of the refund with the 50% employer match, or the deferred vested benefit at age 60 based on final average pay or the money purchase feature (2 x member benefit contributions with interest). Therefore, based on the valuation methods, we do not apply a specific probability to the event that vested members will leave their contributions in the System.

No change recommended.

Probability of Eligible Survivors for Death Benefits of Active Members

For members not currently in pay status, all members are assumed to have eligible survivors (spouses or qualified domestic partners). The current assumptions are:

- Survivors are assumed to be three years younger than male members and three years older than female members.
- Survivors are assumed to be of the opposite sex as the members.

We reviewed the experience for members who retired between January 1, 2007 and December 31, 2019 as well as the current study period of January 1, 2016 through December 31, 2019. The results of each of the periods studied were similar.

Based on this experience we are recommending revising the assumptions to assume that survivors are two years younger than male members and one year older than female members. We continue to recommend that survivors are assumed to be of the opposite sex as the members.

Actuarial Cost Method

The actuarial valuation is prepared using the entry age actuarial cost method. We believe that this cost method is appropriate for the valuation. It is also the cost method that is required for financial reporting under GASB Statements 67 and 68. We recommend no change. Note that this is by far the most popular method used for public sector retirement systems, as it results in more stability in normal costs and provides a level allocation of costs over each individual’s working lifetime.

Appendix A Actuarial Procedures and Assumptions

This section of the Investigation of Experience report describes the actuarial procedures and assumptions expected to be used for the January 1, 2021 actuarial valuation, if the Retirement Board adopts the changes recommended in this report.

The actuarial assumptions used in the valuation are intended to estimate the future experience of the members of the System and of the System itself in areas that affect the projected benefit flow and anticipated investment earnings. Any variations in future experience from that expected from these assumptions will result in corresponding changes in the estimated costs of the System's benefits.

Exhibit A.2 presents expected annual rates of salary increases. The other exhibits in this section give probabilities of decrement. The probabilities of decrement are referred to in actuarial literature as the absolute rate of decrement or q'x. Decrements are assumed to occur mid-year.

Actuarial Cost Method

The actuarial valuation was prepared using the entry age actuarial cost method. Under this method, the actuarial present value of the projected benefits of each individual included in the valuation is allocated as a level percentage of the individual's projected compensation between entry age and assumed exit. The portion of this actuarial present value allocated to a valuation year is called the Normal Cost. The portion of this actuarial present value not provided for at a valuation date by the sum of (a) the actuarial value of the assets and (b) the actuarial present value of future normal costs is called the UAAL. The UAAL is amortized as a level percentage of the projected salaries of present and future members of the System.

The Normal Cost for the valuation year was calculated separately for each individual, based on his or her age at entry into the System. The individual normal costs were then aggregated and divided by the total current compensation of the individuals included in the valuation to determine the Normal Cost rate as a percentage of compensation (adopted 1/1/1976).

Records and Data

The data used in the valuation consist of financial information and records of age, service, and income of contributing members, former contributing members, and their survivors. All of the data were supplied by the System and are accepted for valuation purposes without audit (adopted 1/1/1976).

Replacement of Terminated Members

The ages at entry and distribution by sex of future members are assumed to average the same as those of the present members they replace. If the number of active members should increase, it is further assumed that the average entry age of the larger group will be the same, from an actuarial standpoint, as that of the present group. Under these assumptions, the Normal Cost rates for active members will not vary with the termination of present members (adopted 1/1/1976).

Change in Membership

No change in the membership of the System is assumed (adopted 1/1/1985).

Employer Contributions

The Tacoma Municipal Code specifies a total employer contribution rate of 11.34% of members' salaries in 2018 and beyond.

Administrative Expenses

The annual contribution assumed to be necessary to meet administrative expenses of the System is 0.80% of members' salaries. This figure is included in the calculation of the Normal Cost rate (adopted 1/1/2017).

Valuation of Assets

Assets are valued based on their fair value, with a four-year smoothing of all fair value gains and losses. The expected return is determined for each year based on the beginning of year fair value and actual cash flows during the year. Any difference between the expected fair value return and the actual fair value return is recognized evenly over a period of four years. (The method used to value assets was adopted 1/1/1997).

Investment Earnings

The annual rate of investment earnings based on the actuarial value of the assets of the System are assumed to be 6.50% or 6.75% per year, compounded annually and net of investment expenses (expected to be adopted 1/1/2021).

Investment Expenses

It is assumed that future investment expenses will be funded by increased investment return of 0.35% on all assets of the fund (adopted 1/1/2009). Note that the investment earnings assumption above is net of investment expenses.

Postretirement Benefit Increases

Retirement allowances are assumed to increase at a rate of 2.125% per year plus an additional amount to bring the members' indexed benefits to at least 50% of original purchasing power as provided by the System (expected to be adopted 1/1/2021).

Future Salaries

Exhibit A.2 shows a portion of the scale of relative salary values, which is used to estimate future salaries for the purpose of the valuation. In addition to increases in salary due to promotion and longevity, this scale includes an annual rate of increase in the wage growth assumption of 3.00% or 3.25% (expected to be adopted 1/1/2021). Salaries are assumed to increase at year-end.

Service Retirement

Exhibit A.3 shows the assumed annual rates of retirement among members eligible for service retirement or reduced retirement (expected to be adopted 1/1/2021).

Disability

The rates of disability used in this valuation are illustrated in Exhibit A.4 (expected to be adopted 1/1/2021). The rates are for members with five or more years of service. Duty disabilities that occur for members with less than five years of service are recognized as they occur. No specific provision is made for these benefits, as none have occurred during the past 10 years.

Mortality

The mortality rates used in this valuation are illustrated in Exhibit A.5.

Contributing Members	105% of the Male and 100% of the Female PubG-2010 Amount-Weighted Employee Mortality Tables, projected with a unisex table based on Social Security Administration data from the most recent 60 years available (1957-2017) (expected to be adopted 1/1/2021).
Inactive Members, Retired Members and Beneficiaries	105% of the Male and 100% of the Female PubG-2010 Amount-Weighted Healthy Retiree Mortality Tables, projected with a unisex table based on Social Security Administration data from the most recent 60 years available (1957-2017) (expected to be adopted 1/1/2021).
Disabled Members	105% of the Male and 100% of the Female PubG-2010 Amount-Weighted Disabled Retiree Mortality Tables, projected with a unisex table based on Social Security Administration data from the most recent 60 years available (1957-2017) (expected to be adopted 1/1/2021).

Other Terminations of Employment

The rates of assumed future withdrawal from active service for reasons other than death, disability, or service retirement are shown for representative ages in Exhibit A.6 (expected to be adopted 1/1/2021).

Vesting

We assume all members who terminate with less than five years of service withdraw their accumulated contributions. For members who terminate with five or more years of service, the current valuation assumption is that the member will take the benefit with the greatest financial value, i.e., the greater of the refund with the 50% employer match, or the deferred vested benefit at age 60 based on final average pay or the money purchase feature (2 x member benefit contributions with interest). Therefore, based on the valuation methods, we do not apply a specific probability to the event that vested members will leave their contributions in the System.

Interest on Member Contributions

A portion of employee contributions into the retirement fund is credited with interest at a specified rate set by the Retirement Board. That portion is equal to all contributions made before February 1, 2009 and contributions made up to 6.44% of pay after February 1, 2009. Interest on that portion of member contributions is assumed to accrue at an annual rate of 1.5% per quarter, compounded quarterly. This is equivalent to 6.136% per annum, compounded annually (adopted 1/1/1979).

Portability

The estimated cost of portability with other public retirement systems was included in this valuation. The available data to measure the costs of portability is small. As data on portability retirements continues to be collected, more accurate measurements will be possible in the future. For now, we are assuming:

- A 2% increase to the early retirement liabilities for actives when compared to what the liabilities would be without portability.
- An 13% increase to the deferred vested decrement for actives when compared to what the liabilities would be without portability.
- An 13% increase to the liabilities for vested terminated members when compared to what the liabilities would be without portability.

(The above assumptions are expected to be adopted 1/1/2021.)

Probability of Eligible Survivors for Death Benefits of Active Members

For members not currently in pay status, all members are assumed to have eligible survivors (spouses or qualified domestic partners). Survivors are assumed to be two years younger than male members and one year older than female members. Survivors are assumed to be of the opposite sex as the member (expected to be adopted 1/1/2021).

Exhibit A.1
Summary of Valuation Assumptions

(January 1, 2021)

Economic Assumptions - Annual Rates of Growth

A.	Wage inflation	3.00%/3.25%
B.	Investment return	6.50%/6.75%
C.	Membership increase	0.00%
D.	Benefits (postretirement)	2.125%
E.	Member contribution accounts	6.136%
F.	Price inflation	2.25%/2.50%

Non-economic Assumptions

A.	Salary increases due to promotion and longevity	Exhibit A.2
B.	Service retirement	Exhibit A.3
C.	Disability	Exhibit A.4
D.	Mortality among inactive members, service retired members and beneficiaries 105% of the Male and 100% of the Female PubG-2010 Amount-Weighted Retiree Mortality Tables, projected with a unisex table based on Social Security Administration data from the most recent 60 years available (1957-2017).	Exhibit A.5
E.	Mortality among disabled members 105% of the Male and 100% of the Female PubG-2010 Amount-Weighted Disabled Retiree Mortality Tables, projected with a unisex table based on Social Security Administration data from the most recent 60 years available (1957-2017).	Exhibit A.5
E.	Mortality among contributing members 105% of the Male and 100% of the Female PubG-2010 Amount-Weighted Employee Mortality Tables, projected with a unisex table based on Social Security Administration data from the most recent 60 years available (1957-2017).	Exhibit A.6
F.	Other terminations of employment	Exhibit A.7

Exhibit A.2
Future Salaries

Years of Service	Annual Rate of Increase		
	Promotion and Longevity	Total[1]	Total[2]
1	4.75%	7.89%	8.15%
2	4.00	7.12	7.38
3	3.50	6.60	6.86
4	2.75	5.83	6.09
5	2.25	5.32	5.57
6	1.90	4.96	5.21
7	1.70	4.75	5.01
8	1.40	4.44	4.70
9	1.25	4.29	4.54
10	1.10	4.13	4.39
11	0.95	3.98	4.23
12	0.80	3.82	4.08
13	0.75	3.77	4.02
14	0.70	3.72	3.97
15	0.65	3.67	3.92
16	0.60	3.62	3.87
17	0.55	3.57	3.82
18	0.50	3.52	3.77
19	0.47	3.48	3.74
20	0.44	3.45	3.70
21	0.41	3.42	3.67
22	0.38	3.39	3.64
23	0.35	3.36	3.61
24	0.33	3.34	3.59
25	0.31	3.32	3.57
26	0.29	3.30	3.55
27	0.27	3.28	3.53
28 and over	0.25	3.26	3.51

1. Including a 3.00% general wage increase assumption.
2. Including a 3.25% general wage increase assumption.

Exhibit A.3
Service Retirement

	Males		Females	
Age	Eligible for Reduced Benefits	Eligible for Full Benefits	Eligible for Reduced Benefits	Eligible for Full Benefits
45 or younger	1.0%	12.0%	2.0%	10.0%
46	1.0	12.0	2.0	10.0
47	1.0	12.0	2.0	10.0
48	1.0	12.0	2.0	10.0
49	1.5	12.0	2.5	10.0
50	2.0	12.0	3.5	10.0
51	2.0	12.0	3.5	10.0
52	2.5	12.0	3.5	10.0
53	2.5	12.0	3.5	10.0
54	2.5	12.0	3.5	10.0
55	2.5	12.0	5.0	10.0
56	2.5	12.0	5.0	10.0
57	2.5	12.0	5.0	10.0
58	2.5	12.0	5.0	10.0
59	2.5	12.0	5.0	10.0
60		13.5		12.0
61		13.5		14.0
62		18.0		14.0
63		18.0		14.0
64		20.0		14.0
65		26.0		24.0
66		26.0		24.0
67		26.0		24.0
68		26.0		24.0
69		26.0		24.0
70 or older		100.0		100.0

Exhibit A.4
Disability

Annual Probabilities

Age	Males and Females
22	.01%
27	.01
32	.03
37	.03
42	.03
47	.06
52	.08
57	.09

Exhibit A.5
Post-Commencement Mortality

Annual Probabilities

Age	Retired Members and Beneficiaries		Disabled Members		Projection Scale[1]
	Males	Females	Males	Females	Males and Females, Healthy and Disabled
50	0.33%	0.24%	1.77%	1.63%	1.10%
51	0.35	0.26	1.88	1.69	1.11
52	0.38	0.27	2.00	1.75	1.10
53	0.41	0.28	2.11	1.80	1.09
54	0.44	0.30	2.22	1.86	1.07
55	0.47	0.31	2.33	1.92	1.06
56	0.51	0.33	2.42	1.97	1.05
57	0.55	0.35	2.51	2.02	1.05
58	0.59	0.37	2.59	2.06	1.07
59	0.63	0.39	2.67	2.11	1.09
60	0.68	0.42	2.75	2.15	1.11
61	0.73	0.46	2.84	2.20	1.13
62	0.78	0.50	2.94	2.26	1.16
63	0.85	0.55	3.06	2.32	1.19
64	0.92	0.61	3.20	2.40	1.22
65	1.00	0.67	3.35	2.48	1.24
66	1.10	0.75	3.51	2.58	1.26
67	1.22	0.84	3.69	2.70	1.27
68	1.35	0.93	3.88	2.83	1.26
69	1.50	1.05	4.08	2.98	1.25
70	1.68	1.17	4.29	3.15	1.23
71	1.87	1.31	4.52	3.34	1.22
72	2.09	1.47	4.78	3.56	1.20
73	2.34	1.65	5.06	3.81	1.19
74	2.62	1.85	5.37	4.09	1.17
75	2.94	2.07	5.71	4.40	1.15
76	3.29	2.32	6.09	4.75	1.12
77	3.70	2.60	6.51	5.15	1.10
78	4.15	2.92	6.98	5.58	1.09
79	4.67	3.28	7.50	6.07	1.08
80	5.25	3.70	8.08	6.61	1.07
81	5.91	4.17	8.72	7.21	1.04
82	6.66	4.70	9.42	7.87	1.00
83	7.49	5.32	10.18	8.59	0.95
84	8.42	6.02	11.01	9.39	0.90
85	9.45	6.83	11.90	10.26	0.84
86	10.58	7.75	12.85	11.18	0.78
87	11.81	8.79	13.87	12.12	0.73
88	13.14	9.95	14.96	13.07	0.67
89	14.59	11.24	16.35	14.03	0.62
90	16.14	12.64	17.88	15.03	0.57

1. Projection Scale is based on Social Security Administration data from 1957-2017. The projection scale is applied to the annual probabilities listed above. The probabilities above reflect the probabilities in 2010. Therefore, the year 2011 is the first year the improvement scale is applied.

Exhibit A.6
Pre-Commencement Mortality

Annual Probabilities

Age	Contributing Members		Projection Scale[1]
	Males	Females	Males and Females
20	0.04%	0.01%	0.81%
21	0.04	0.01	0.71
22	0.04	0.01	0.62
23	0.03	0.01	0.54
24	0.03	0.01	0.46
25	0.03	0.01	0.37
26	0.03	0.01	0.30
27	0.03	0.01	0.25
28	0.04	0.01	0.23
29	0.04	0.01	0.24
30	0.04	0.02	0.27
31	0.04	0.02	0.30
32	0.04	0.02	0.33
33	0.05	0.02	0.37
34	0.05	0.02	0.41
35	0.05	0.03	0.45
36	0.06	0.03	0.50
37	0.06	0.03	0.56
38	0.06	0.03	0.64
39	0.07	0.04	0.72
40	0.07	0.04	0.81
41	0.08	0.04	0.88
42	0.08	0.05	0.93
43	0.09	0.05	0.97
44	0.10	0.06	1.00
45	0.11	0.06	1.02
46	0.12	0.07	1.04
47	0.13	0.07	1.06
48	0.14	0.08	1.07
49	0.15	0.08	1.08
50	0.16	0.09	1.10
51	0.18	0.10	1.11
52	0.19	0.11	1.10
53	0.21	0.12	1.09
54	0.22	0.12	1.07
55	0.24	0.14	1.06
56	0.26	0.15	1.05
57	0.28	0.16	1.05
58	0.30	0.17	1.07
59	0.33	0.19	1.09
60	0.35	0.20	1.11

1. Projection Scale is based on Social Security Administration data from 1957-2017.

Exhibit A.7
Other Terminations of Employment
Among Members Not Eligible to Retire

Annual Probabilities

Years of Service	Males	Females
0 to 1	20.0%	20.0%
1 to 2	8.0	10.0
2 to 3	7.0	10.0
3 to 4	4.5	9.0
4 to 5	4.0	8.0
5 to 6	3.5	7.0
6 to 7	3.5	6.0
7 to 8	3.0	5.0
8 to 9	2.8	4.8
9 to 10	2.6	4.6
10 to 11	2.4	4.4
11 to 12	2.2	4.2
12 to 13	2.0	4.0
13 to 14	1.9	3.7
14 to 15	1.8	3.4
15 to 16	1.7	3.1
16 to 17	1.6	2.8
17 to 18	1.5	2.5
18 to 19	1.5	2.3
19 to 20	1.5	2.1
20 to 21	1.5	1.9
21 to 22	1.5	1.8
22 or more	1.5	1.5