2013–2018 DEMOGRAPHIC EXPERIENCE STUDY
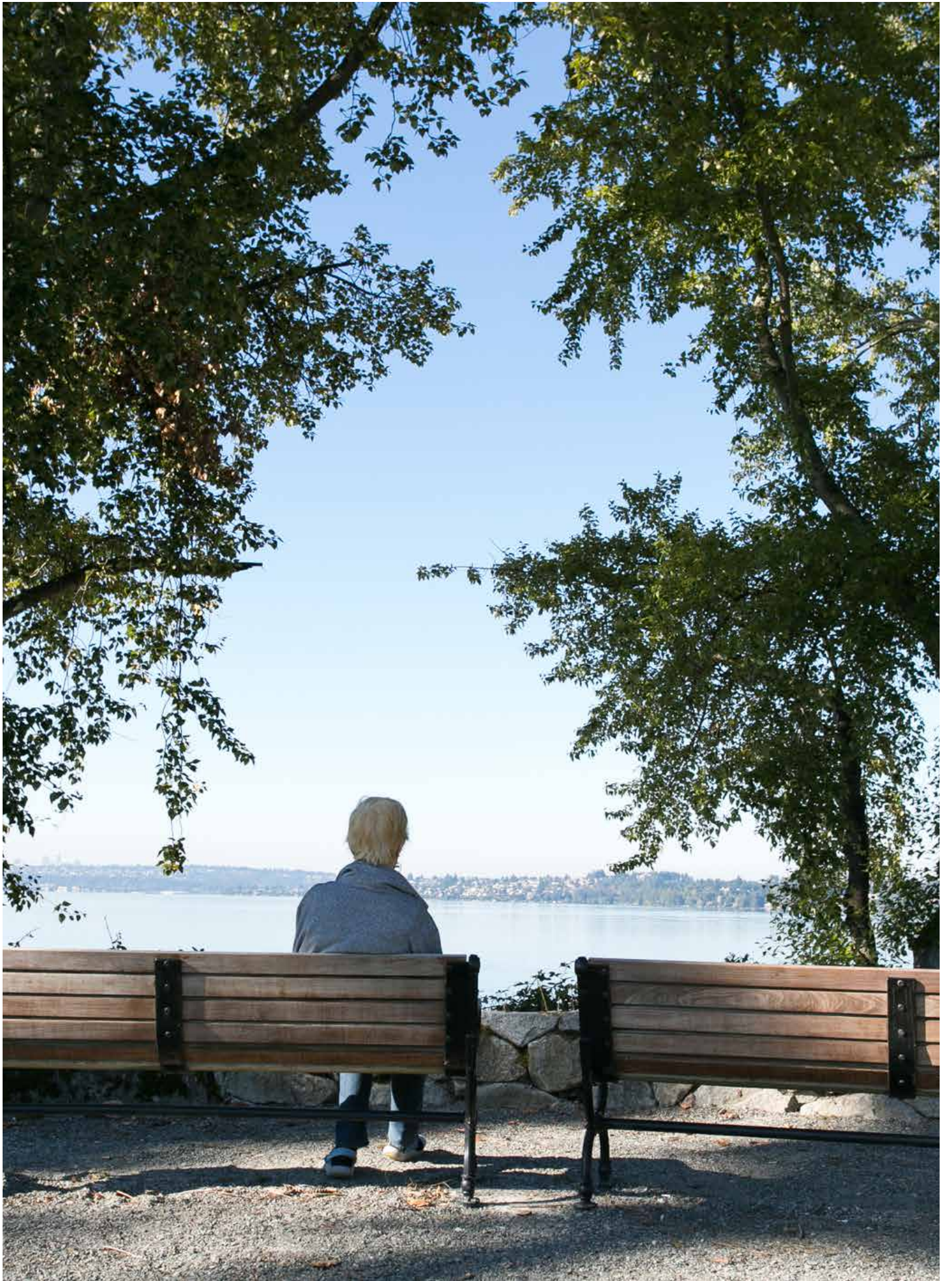
Washington State
Public Retirement Systems

June **2020**

Office of the State Actuary
"Supporting financial security for generations."

PERS • TRS
SERS • LEOFF
WSPRS • PSERS

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CONTENTS

Office of the State Actuary

"Supporting financial security for generations."

Letter of Introduction
Experience Study Report
As of June 30, 2018

June 2020

As required under the Revised Code of Washington (RCW) 41.45.090, this report documents the results of an experience study of the following Washington State retirement systems.

- ❖ Public Employees' Retirement System (PERS).
- ❖ Teachers' Retirement System (TRS).
- ❖ School Employees' Retirement System (SERS).
- ❖ Public Safety Employees' Retirement System (PSERS).
- ❖ Law Enforcement Officers' and Fire Fighters' Retirement System (LEOFF).
- ❖ Washington State Patrol Retirement System (WSPRS).

The primary purpose of this experience study is to determine if any adjustments are required to ensure our assumptions remain a reasonable estimate of future plan experience. We organized this report in the following four sections.

- ❖ Executive Summary.
- ❖ Development of Demographic Assumptions.
- ❖ Appendices.
- ❖ Glossary.

The **Executive Summary** section provides a high-level summary of the study results for all systems. The **Development of Demographic Assumptions** and **Appendices** provide detailed information for each assumption by system and plan. The **Glossary** provides definitions of actuarial terms used throughout this report.

We encourage you to submit any questions you might have concerning this report to our mailing address or our e-mail address at state.actuary@leg.wa.gov. We also invite you to visit our website (leg.wa.gov/osa) for further information regarding the actuarial funding of the Washington State retirement systems.

Sincerely,

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2013-2018 Demographic Experience Study   **iii**
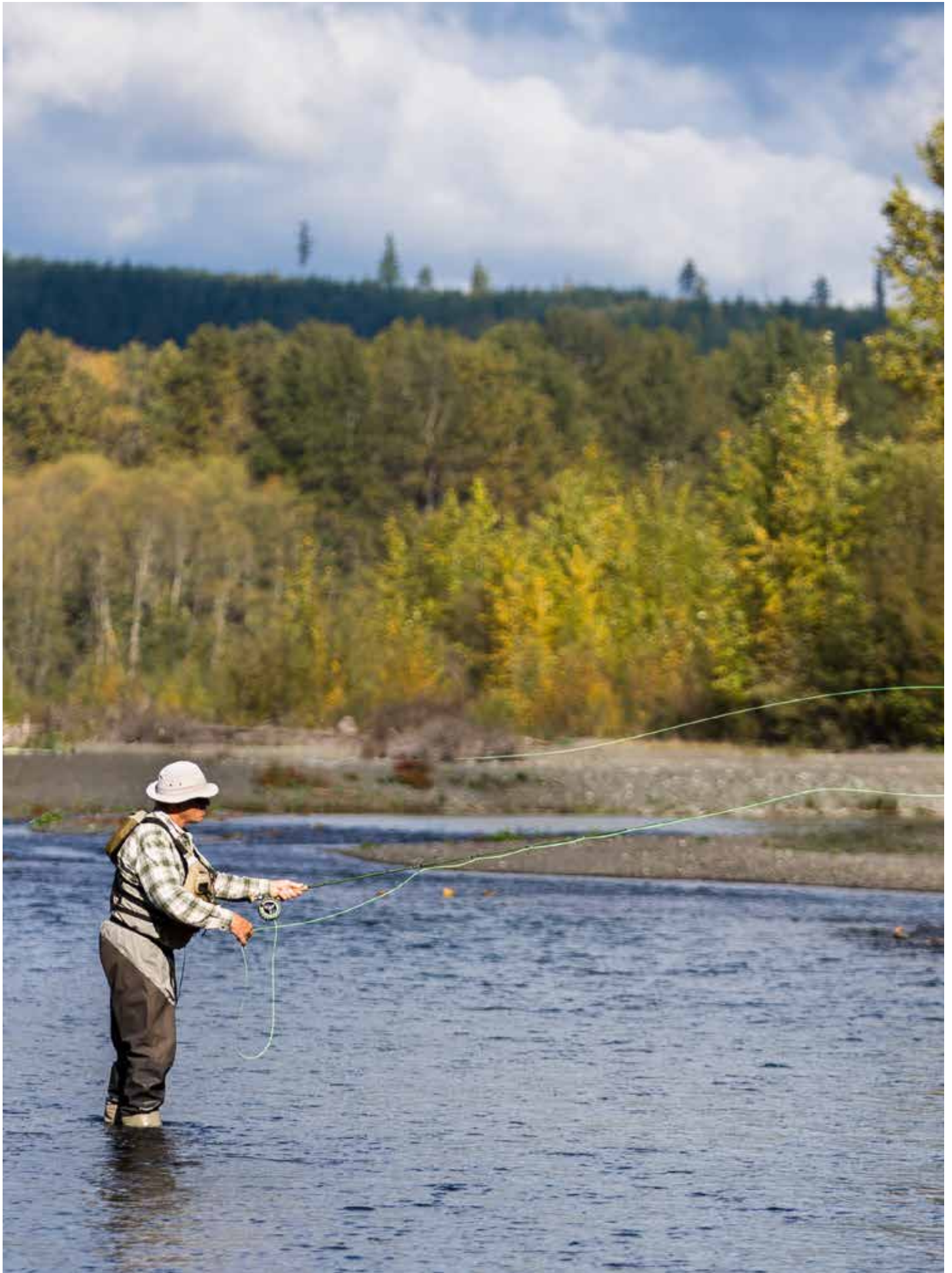
ONE
EXECUTIVE SUMMARY

ONE: EXECUTIVE SUMMARY

The Office of the State Actuary (OSA) prepared this actuarial experience study on the Washington State retirement plans as required under the (RCW) 41.45.090. This experience study covers plan experience through 2018 and includes an analysis of all demographic assumptions used to develop contribution rates, administrative factors, and estimated fiscal costs (fiscal notes) associated with the retirement plans[1]. The study does not consider impacts to demographic assumptions from the COVID-19 health crisis. These impacts may be relatively short-term in nature, and this study sets assumptions that are reasonable over a longer time frame, generally the next ten to twenty years. However, for all pension measurements that rely on these assumptions, we will consider if assumption adjustments are necessary to reflect potential COVID-19 impacts.

Intended Use

The primary purpose of this experience study is to determine if any adjustments are required to ensure our assumptions remain a reasonable estimate of future plan experience. This report also discloses the data and methods we used to compare and adjust the prior demographic assumptions. Readers should not use this study for other purposes. We also advise readers to seek professional guidance as to its content and interpretation and not to rely upon this communication without such guidance. Distribution of, or reliance on, only parts of this study could result in its misuse and may be misleading.

This analysis will become outdated with the release of our next experience study report. Please replace this report with our next report when available.

Our Approach

We gathered data, made assumptions where necessary, and established study methods for each assumption to evaluate how well our current demographic assumptions compare to actual experience. Before using data to study an assumption, we considered the relevance of the data, the materiality of the assumption, and how much credible data was available to be studied. For certain assumptions, we combined data across similar systems and plans to improve credibility. For more information on credibility analysis please see the actuarial standard of practice on Credibility Procedures. We also reviewed whether different assumption formats (i.e., assumptions by gender, age, or plan selection, etc.) would provide a better fit to past experience than the current formats. Lastly, we set expectations for the future and applied our professional judgment to update the assumptions where necessary. Please see the report for additional information.

Fiscal Impact

Actuaries use demographic and economic assumptions to estimate the cost of future plan benefits, which determines the timing and amount of plan contributions. The actual cost of benefits is determined by actual benefit payments plus expenses paid, less returns on invested contributions.

Furthermore, we will review all demographic assumptions again within six years and will likely make further updates at that time. Therefore, any assumption changes from this experience study impact short-term financing costs only. We plan to provide preliminary, short-term fiscal impacts outside this report.

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[1]*This study does not include mortality experience specific to members who purchased additional lifetime annuities. Limited plan experience is available as this group is relatively small in size, however it is growing. We therefore may not collect sufficient, credible experience for another ten to twenty years. We expect to review this group in future experience studies and include analysis as plan experience grows.*

ONE: EXECUTIVE SUMMARY

Economic Assumptions

We review the economic assumptions for the plans every two years as part of the contribution rate-setting process under RCW 41.45.030. The current economic assumptions, prescribed by the Legislature, follow:

Inflation	2.75 percent
General salary growth	3.50 percent
Annual investment return	7.50 percent (7.40 percent in LEOFF 2)
Growth in system membership	0.95 percent (1.25 percent in TRS)

The latest economic experience study is available on our website. Except for the annual investment return assumption for all plans but LEOFF 2 and the TRS growth in system membership assumption, the currently prescribed assumptions match OSA's recommended best estimate assumptions from our most recent study.

Demographic Assumptions

The following information summarizes the results for the major categories of demographic assumptions that comprise this report. Please see the report for additional information.

Disability Rates

In general, the new experience showed fewer disability retirements than expected under the prior assumptions. To reflect this experience, we lowered the disability rates for all plans.

We set gender-neutral disability rates for all systems after observing little difference in the rate of male and female disablement. While we observed non-public safety Plan 3 members select disabled retirement benefits at lower rates than Plan 2 members, we observed few disabled retirement benefit selections relative to total experience in each non-public safety plan. Therefore, we set Plan 2 and Plan 3 disability rates by combining experience across all non-public safety systems. We did not combine experience across public safety plans due to fundamental differences in disability benefit provisions.

Mortality Rates

In general, we observed improvements in mortality (i.e., members living longer), and updated our mortality base tables and mortality improvement assumptions with recently published mortality tables and improvement scales developed by the Society of Actuaries (SOA).

While we observed members living longer, our new mortality assumptions generally project a decrease in the average life expectancy from our prior assumptions. The exception is TRS, which saw an increase in the average member life expectancy.

We selected the Pub.H-2010 tables developed by SOA as our new base table mortality assumption. This includes separate tables developed for teachers, public safety, and general public employees. Released in January of 2019, these tables are the most recent publication from SOA on the mortality rates of public retirement plan participants at the time of this study. We also selected the long-term rates of the MP-2017 mortality improvement scale to project future improvements at a generally lower rate than previously assumed.

Further, we changed how we apply the mortality rates assumption. We now set and apply a different mortality assumption to members currently active, retired, or in beneficiary status. This change in methodology reflects evolving practice in this area.

ONE: EXECUTIVE SUMMARY

Retirement Rates

Our experience data shows that members are continuing to defer retirement since the Great Recession (2008-17). As a result, we lowered the prior retirement rate assumptions toward the level of actual retirements.

We observed similar retirement behavior between male and female members for all plans. We expect this behavior to continue in future years and set gender-neutral retirement rates for all plans. This was also the first study to provide sufficient experience to consider separate rates for Plan 2 and Plan 3. We confirmed that Plan 2 members exhibit different retirement behavior from Plan 3 members and set plan-specific retirement rates.

Service-Based Salary Increases

To estimate future salaries, we model two types of salary growth – general salary increases and service-based salary increases. General salary increases fall under the economic assumption category, while service-based salary increases fall under the demographic assumption category. This demographic experience study analyzes the demographic portion of our salary growth assumption – service-based salary increases.

In most systems, we observed service-based salary increases higher than our expectations. As a result, we increased the assumed rates of service-based salary increases at most service levels. The exception is LEOFF, which experienced similar service-based increases to that of our prior assumption. For this system, we only made minor adjustments to our prior assumption. We also examined the impact of recent legislation that increased the salaries of Washington teachers, school workers, and state patrol officers. In general, we raised the service-based salary increases assumption for these members.

Termination Rates

For most systems, we observed terminations that were higher than expected since the last experience study. Only the LEOFF system showed fewer terminations than expected.

Similar to retirement rates, we observed different termination behavior between members of Plan 2 and Plan 3. Given the amount of plan experience available in this study, we set separate termination rates for Plans 2 and 3 members. We set higher termination rates for Plan 3 than Plan 2 consistent with experience. We also observed not all members that leave employment while eligible for retirement would collect their retirement benefit immediately. Based on this data, we set a new termination assumption to assume some members will leave work and defer commencement of their retirement benefit.

Miscellaneous Assumptions

In addition to the major demographic assumptions described above, we use numerous other demographic assumptions in our actuarial valuation model to estimate the costs of the plans. We include each miscellaneous assumption, and its analysis, in this report. Overall, we recommend updates, where appropriate, and each update generally has a small impact on the plans.

TWO
DEVELOPMENT OF DEMOGRAPHIC ASSUMPTIONS

Office of the State Actuary

"Supporting financial security for generations."

Actuarial Certification Letter
Experience Study Report
As of June 30, 2018

June 2020

This report documents the results of an experience study of the retirement plans defined under Chapters 41.26, 41.32, 41.35, 41.37, 41.40, and 43.43 of the Revised Code of Washington (RCW). The primary purpose of this experience study is to determine if any adjustments are required to ensure our assumptions remain a reasonable estimate of future plan experience. This report should not be used for other purposes.

This analysis will become outdated with the release of our next experience study report. Please replace this report with our next report when available.

The experience study results summarized in this report involve methods for analyzing past demographic experience and setting new demographic assumptions for the plans. We believe that the methods used and assumptions developed in this study are reasonable and are in conformity with generally accepted actuarial principles and standards of practice as of the date of this publication.

The Pension Funding Council hired an outside actuarial firm, Milliman, to audit the actuarial analysis we performed in this study including the new assumptions. They found our work to be reasonable. Milliman's full audit report is available on our website.

The Department of Retirement Systems provided member and beneficiary data to us. We also received data from the Office of the Superintendent of Public Instruction.

We checked the data for reasonableness as appropriate based on the purpose of this study. An audit of the data was not performed. We relied on all the information provided as complete and accurate. In our opinion, this information is adequate and substantially complete for the purposes of this study.

The undersigned, with actuarial credentials, meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein. While this report is intended to be complete, we are available to offer additional advice and explanations as needed.

Sincerely,

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6 leg.wa.gov/osa

TWO: DEVELOPMENT OF DEMOGRAPHIC ASSUMPTIONS

DISABILITY RATES

What is the Disability Rates Assumption and How Do We Use it?

The Disability Rates assumption represents the probability that an eligible active service individual will experience a disabling incident and select a disability pension benefit immediately. Members that experience a disabling incident may not immediately leave employment, or when they leave, may not immediately retire. This assumption focuses only on members that select a disability pension benefit, the goal of which is to project when members will leave employment and move into disabled retirement. We then use the assumed disablement behavior, along with other assumptions, to estimate how much and for how long members will collect their disabled retirement benefits for purposes of plan funding.

This assumption generally varies by plan and age. However, where appropriate, we set an assumption by combining the experience of similar plans. We also set an assumption that varies by years of service credit where appropriate.

High-Level Takeaways

In general, disabled retirement data available since the Great Recession (2008-2017) showed consistently lower rates of disabled retirement than prior to the recession (1995 2007). In the prior experience study, we had removed 2008-2012 data for PERS, TRS, and SERS Plans 2 and 3 because of impacts from the recession. We removed the recession data because we did not think there was sufficient experience after the recession in which to observe an economic recovery. Economic cycles can impact the selection aspect of disabled retirements because the benefit may be less affordable during poor economic times. We included 2008-2017 data in this study due to the continued trend of lower disabled retirement. As a result, observed rates of disability in the study period were lower than old disability rates, and in general, we lowered our assumed rates.

The following list demonstrates some of the economic and demographic changes that may have impacted disabled retirement behavior – specifically the selection or choice aspect of the benefit – over the last decade:

❖ **Life Expectancy** – Washington State employees are living longer than in the past. Members could be deferring disabled retirement to save money and build a larger retirement benefit instead of retiring earlier with a reduced benefit.

❖ **Plan 3 Retirement Accounts** – The Great Recession heavily affected Plan 3 Defined Contribution (DC) retirement account balances. When a member experiences a disability, the size of their Plan 3 DC account may impact their decision to choose a disabled retirement benefit. If their DC account is large enough to provide sufficient financial support, members may choose to terminate employment and defer service retirement, rather than choose a disabled retirement benefit. Over the last decade, Plan 3 DC accounts have recovered since the 2008 09 market downturn.

❖ **Cost of Health Insurance** – Some members may continue working prior to Medicare eligibility in order to retain employer provided health insurance that is typically cheaper than other options.

Due to data credibility concerns, we made several changes to the disability rates assumption. For all retirement systems, we now use gender-neutral rates. Further, we combined rates for PERS, TRS, and SERS Plan 2, and similarly for Plan 3. Experience shows that Plan 3 members select disabled retirement at lower rates than Plan 2 members, in general. We believe that occurs because Plan 3 members can elect to retire from the defined contribution portion of the plan and defer commencement of their defined benefit. However, we don't have sufficient data to set experienced-based rates in Plan 3. To set separate Plan 3 rates, we applied our professional judgment to reflect lower rates of selection of the immediate disability retirement benefit than Plan 2.

While we also observed few disabled retirements in LEOFF Plan 2, PSERS Plan 2, and WSPRS, we did not combine these public safety plans with the other, larger systems because public safety occupations, and many of the systems' disability benefits, are fundamentally different. Likewise, we set rates for LEOFF 2, PSERS Plan 2, and WSPRS separate from each other due to population and benefit structure differences. For example, in PSERS Plan 2, many of its members transferred from PERS so we expect its experience will be similar to that of PERS. However, we expect a different rate of selection between PERS and PSERS due to the more generous disability benefit in PSERS.

DISABILITY RATES

Data and Assumptions

We looked at 23 years of experience study records, from 1995-2017. No special data was added for this assumption, but some data was removed as noted below.

Consistent with prior studies, we removed valuation years 2001 and 2007 because the valuation date changed in those years. Including data for 2001 and 2007 would lead to valuation periods of unequal length. We also removed 2000 data for SERS Plans 2/3 because the plan was created in 2000. SERS experienced relatively few disabled retirements in 2000 compared to subsequent years. We do not believe the year 2000 disability experience is representative of expected long-term experience.

For PERS, TRS, and LEOFF Plans 1, we considered a 1995-2017 study period for setting rates in these closed plans. However, we believe recent rates of disablement are more indicative of future rates of disablement for the relatively small group of remaining actives in these closed plans. Therefore, we relied on data after the end of the last experience study, 2013-2017, to set new assumptions. For LEOFF Plan 2, we excluded data prior to 2005 due to significant changes in benefits during and beyond that year.

Because PSERS is a relatively new system, we do not have sufficient data to set a credible disability rates assumption for PSERS from plan experience. Instead, we relied on the PERS-TRS-SERS Plan 2 disability rates assumption to inform the PSERS Plan 2 assumption and then made subsequent adjustments based on differences in disability benefit provisions between these plans and PSERS.

Additionally, SERS is another relatively new system. However, we were able to gather SERS data prior to the creation of the plan by selectively pulling data for PERS members employed at school districts that would have been eligible for SERS had it been in place at that time.

We set no assumption for disability recovery. In the context of disabled retirement benefits, a recovery represents a member recovering from the incurred disability and returning to work, resulting in a suspension of the benefit. Over the entire study period (1984-2017), we observed very few instances of recovery. We believe an assumption based on this experience would be immaterial to any retirement system.

Law Changes

There were two law changes since the last study that could impact member disability behavior:

❖ **HB 2592 (2016)** – Allows disability coverage for LEOFF 2 members that become totally incapacitated as a result of certain federal emergency management service.

❖ **SSB 6214 (2018)** – Adds Post-Traumatic Stress Disorder (PTSD) to the list of occupational diseases and creates a rebuttable presumption for LEOFF members that PTSD is an occupational disease.

We have not yet accumulated sufficient experience under HB 2592 or SSB 6214 to update our assumptions. We will continue to monitor the situation and make adjustments as necessary.

General Methodology

For most retirement plans, we calculated the actual disability rate by dividing the number of members that experience a disabling incident and selected a disabled retirement benefit by the total number of members who were ineligible to retire. We assume retirement-eligible members in most plans, if offered the choice would select a service retirement over a disabled retirement. For LEOFF and WSPRS, we included all members regardless of retirement eligibility. In some instances, their tax-free disability benefits may exceed their after-tax service retirement benefits, thus we assume members of these systems may select a disabled retirement benefit over a retirement benefit if presented the option.

We compared the number of actual disablements (observations) to our expected number of disablements based on our old assumed rates. To determine the expected number, we applied the old assumption to the eligible population over the study period, by age. We considered this actual-to-expected measurement on an annual basis and as a whole over the entire study period. This helped us identify trends in the data where the assumption was over or underestimating disabled retirement behavior. In general, to set the new assumed rates, we divided observed disabled retirements by retirement-ineligible active members over five-year age bands. We then considered historical trend experience and applied professional judgment about future expectations to determine our final assumed rates.

TWO: DEVELOPMENT OF DEMOGRAPHIC ASSUMPTIONS

DISABILITY RATES *continued*

It is important to note that not all eligible members who experience a disabling incident will choose to receive a disability benefit. Some will choose to keep working, while others will choose a traditional service retirement or choose a new career and withdraw their contributions. As noted above, Plan 3 members may elect to retire from their defined contribution portion of their benefit and defer the commencement of their defined benefit. This selection aspect of the disability assumption produces a disconnect between the disabling incident and the decision to retire based on that incident. Many individual factors unrelated to the actual incident may drive a member's decision, such as overall health, job satisfaction, financial security, and the general state of the economy.

We considered an alternate approach of studying disability rates weighted by salary instead of headcount. We created salary-weighted rates by dividing the salary that left the system through disabled retirement by the total salary ineligible for retirement. This approach attempts to set rates that better model the salary leaving the system. We studied PERS using salary-weighted rates because of the large dispersion in member salaries in the system. Overall, we did not see a large enough difference in rates to justify a method change. We decided to maintain our prior approach of using headcount weighted rates and did not pursue the salary-weighted approach in PERS or with other systems.

Results

For most plans, we reduced the disability rates assumption to reflect experience and behavior. In PERS, TRS, and LEOFF Plans 1, we removed disability rates. Nearly all members in these systems are at or near service retirement eligibility and we believe they would select a retirement benefit if they experience a disability in the future. Recent experience also shows very few disabled retirements in PERS, TRS, and LEOFF Plans 1.

We calculated an Actual-to-Expected (A/E) ratio to better understand how our assumptions compare to plan experience in our study period. The "actual" represents the number of disabled retirements we observed during the study period and the "expected" represents the number of disabled retirements our assumption produced based on the number of eligible members. In general, an A/E ratio less than 1.00 indicates lower actual rates of disability relative to our assumption. We see a ratio above 1.00 when members disable at higher rates than we assume.

In the following table, note that the A/E ratio under the old assumptions for PERS, TRS, and LEOFF Plans 1 represents a study period of 2013-2017. The ratio under the new assumptions shows Not Applicable (N/A) because we removed disability rates for these plans. Please see the **Disability Rates Appendix** for additional information on how we set this assumption.

Summary of A/E Ratios		
	Under Current Assumptions	**Under New Assumptions**
PERS 1	0.63	N/A
PERS 2	0.72	0.86
PERS 3	0.35	0.65
TRS 1	0.78	N/A
TRS 2	1.08	0.86
TRS 3	0.44	0.65
SERS 2	0.73	0.86
SERS 3	0.31	0.65
PSERS 2	0.49	0.48
LEOFF 1	0.00	N/A
LEOFF 2	0.73	0.87
WSPRS 1/2	0.81	0.93

TWO: DEVELOPMENT OF DEMOGRAPHIC ASSUMPTIONS

MORTALITY RATES

What is the Mortality Rates Assumption and How Do We Use it?

The Mortality Rates assumption is primarily used to estimate how long pension benefits will be paid after retirement. We also use these assumptions to determine the probability that a member will survive until retirement. This assumption is generally gender and age based.

The goal of this assumption is to estimate the probability of death in a given year for both the member and any eligible survivors. We also set assumptions for how we expect mortality rates to improve over time.

High-Level Takeaways

In general, we are still observing improvements in mortality (i.e., members living longer). To project future improvements in mortality, we use a mortality improvement scale. Based on the results of our study, we believe the long-term MP-2017 rates provide a better fit and predictor of long-term mortality improvement. The long-term MP-2017 rates predict an approximate 1 percent per year improvement for both males and females over most ages. By comparison, our current assumption of Scale BB estimates mortality improvement for certain age groups in excess of 1 percent.

To determine appropriate mortality rates for our plans, we start with a published mortality table as a base and adjust it to reflect our experience. Our latest experience supports updating to the newer Pub.H-2010 tables.[1] The Pub.H-2010 tables we select by system may vary depending on the type of jobs that comprise the system. From there, we apply appropriate age adjustments, if necessary, to better tailor the mortality rates to the demographics of each system. For most systems, we found age adjustments are no longer necessary with our updated tables with the exception of some public safety plans. In other words, our experience generally indicated that the mortality rates for the populations of the Washington State retirements systems are similar to aggregated nationwide public retirement systems experience studied by SOA when establishing these tables. The following table summarizes the new base mortality tables and age offsets used by system.

New Healthy Mortality Assumptions by System			
System	Base Table	Offsets Males	Offsets Females
PERS	PubG.H-2010 (General)	0	0
TRS	PubT.H-2010 (Teachers)	0	0
SERS	PubG.H-2010 (General)	0	0
PSERS	PubS.H-2010 (Safety)	0	0
LEOFF	PubS.H-2010 (Safety)	(1)	0
WSPRS	PubS.H-2010 (Safety)	(1)	0

Consistent with our prior methodology, we chose to apply age offsets directly to the Pub.H-2010 tables and use the long-term MP-2017 generational improvement scale to project mortality rates every year thereafter. Another approach would be to apply age offsets after the projected mortality improvements.

[1]*Released in January of 2019, these tables are the most recent publication from SOA on the mortality rates of public retirement system plan participants at the time of this study.*

TWO: DEVELOPMENT OF DEMOGRAPHIC ASSUMPTIONS

MORTALITY RATES

Our new mortality assumption – incorporating the updated base tables, age offsets, and mortality improvement scale – predicts both lower and higher rates of mortality than the old assumption dependent on the system, gender, and age examined. Illustrated below is an example of how assumed life expectancy, as of 2018, changes under two different ages in the PERS Plan 2.

Difference in Life Expectancy Under Select Ages				
	Age 45		Age 65	
	Male	**Female**	**Male**	**Female**
New Assumptions	85.9	89.4	85.8	88.8
Old Assumptions	86.9	89.2	86.8	89.0
Difference	(1.0)	0.1	(1.0)	(0.2)

Note: Age 45 Life Expectancies under the New Assumptions rely on PERS 2 retirement rates. Differences may not agree due to rounding.

Data and Assumptions

We looked at 34 years of data, from 1984-2017. No special data was added for this assumption, but some data was removed. Consistent with prior studies, we removed valuation years 2001 and 2007 because the valuation date changed in those years. Including data for 2001 and 2007 would lead to valuation periods of unequal length.

Law Changes

No law changes impacted our analysis of this assumption.

General Methodology

Actual mortality rates are calculated as follows. For each year and retirement plan, we counted the number of deaths during the year and divided it by the number of members alive at the beginning of the year. This underlying data serves as the basis for setting our mortality assumptions.

We approached this analysis in three steps.

❖ First, we looked for a trend in the data to determine how mortality rates are improving over time. The results of this analysis, outside expert opinions, and our own professional judgment were used in selecting a mortality improvement scale.

❖ Next, we reviewed published base mortality tables to determine which tables would be the best fit for our retirement systems.

❖ Finally, we compared our actual mortality rates during the 2006-2017 period to our new base tables (projected to the mid-point of the period) for purposes of establishing age offset assumptions for each retirement system.

At each step of the process we gave consideration to our amount of data. Data is considered more credible the larger the available sample size. When very precise assumptions are set, such as a mortality rate at a specific age, full credibility in the data becomes harder to obtain. With insufficient credibility, analysis of the data can be a misleading or an inaccurate representation of the population as a whole. To increase the reliability of our results, we used a published mortality table as a basis for our mortality tables, grouped our data when appropriate, and withheld making individualized assumptions for certain plans.

MORTALITY RATES
continued

Results

Healthy Mortality

Mortality Improvement Scale

We considered our expectations for the future and how those expectations may impact the observed trends. Then, we compared our conclusions with the available mortality scales and picked the scale that, in our opinion, best reflects long-term mortality trends for the Washington State retirement systems. For this study we elected to replace our current assumption of Scale BB with RPEC's MP-2017 long-term rates applied using a generational approach.

We agree with RPEC that underlying mortality rates can vary by year of birth in addition to gender. We also agree that anticipated rates of mortality improvement can change with the addition of new experience data. However, our analysis indicated that the greater precision of the two-dimensional scale will not always provide additional value. For example, from 2008 to 2017 we found the long-term rates were better a predictor of mortality improvement than the variable rates in the full MP-2017 table that varies by year. In addition, the high level of complexity of the two-dimensional scale could pose problems. The precision of the scale can create a false sense of accuracy, and it hinders an actuary's ability to summarize the effects of mortality. It also has the potential to introduce volatility in actuarial measurements when the scale is updated annually. Furthermore, the reasons behind these periodic changes can be unclear and difficult for the actuary to explain.

MP-2017 Long-Term Rates					
Age	**Male & Female**	**Age**	**Male & Female**	**Age**	**Male & Female**
<86	0.0100	**95**	0.0085	**105**	0.0043
86	0.0099	**96**	0.0081	**106**	0.0038
87	0.0097	**97**	0.0077	**107**	0.0034
88	0.0096	**98**	0.0072	**108**	0.0030
89	0.0094	**99**	0.0068	**109**	0.0026
90	0.0093	**100**	0.0064	**110**	0.0021
91	0.0091	**101**	0.0060	**111**	0.0017
92	0.0090	**102**	0.0055	**112**	0.0013
93	0.0088	**103**	0.0051	**113**	0.0009
94	0.0087	**104**	0.0047	**114**	0.0004
				>114	0.0000

Base Table

Based on our analysis, we selected the headcount-weighted public plan mortality tables with separate rates for employees, retirees, and contingent survivors differing by the primary job categories in each system for our healthy populations. The Pub-2010 tables were developed using more recent data than our current base table of RP-2000 and focus on public plan data. Within the Pub-2010 tables, we considered the use of liability weighted tables but found the headcount weighted tables provided a better fit to our plan experience, even when measuring liability experience. For more information on our considerations, please see the **Mortality Rates Appendix**.

For PERS and SERS, we selected the general headcount-weighted public plans mortality tables, PubG.H-2010. As expected, the general mortality tables provided the best fit for our experience in PERS. For SERS, we selected the PubG.H-2010 tables for two primary reasons: (1) the general public plan mortality table provided a better fit to SERS experience, and (2) the PubT.H-2010 tables were developed using experience from instructors only, not general school employees. We will continue to monitor this assumption and may make a change in the future.

For TRS, we selected the teachers headcount-weighted public plans mortality tables, PubT.H-2010. Teachers tend to live longer than other occupations and the PubT.H-2010 tables reflect longer assumed lifespans.

TWO: DEVELOPMENT OF DEMOGRAPHIC ASSUMPTIONS

MORTALITY RATES

Lastly, for the public safety systems, PSERS, LEOFF, and WSPRS, we selected the public safety headcount-weighted public plans mortality tables, PubS.H-2010. Since our data is limited for PSERS and WSPRS, we relied on LEOFF experience and the list of occupations that make up the various Pub-2010 tables. A large portion of PSERS is correctional officers. We concluded the PubS.H-2010 would be a better predictor for PSERS, compared to the general population table, because correctional officers were included in the experience data SOA used to establish this table. We will continue to monitor this assumption and may make a change in the future.

The following table illustrates the new assumed life expectancies, by system, of a 65-year-old retiree using the Pub.H-2010 tables.

New Assumed Retiree Life Expectancy as of 2018		
	Age 65	
	Male	Female
PERS & SERS (PubG.H-2010)	85.7	88.7
TRS (PubT.H-2010)	87.8	90.3
PSERS (PubS.H-2010)	85.4	87.9
LEOFF & WSPRS (PubS.H-2010)*	86.3	87.9

Includes a (1) age offset for males.

The base mortality tables we selected for beneficiaries across all retirement systems blend the Pub.H-2010 single contingent survivor table and the retiree mortality rates corresponding to the member's retirement system. We believe mortality is generally higher for widow(er)s, which is consistent with the contingent survivor table developed by RPEC that was based on survivor data after the death of the primary annuitant. However, since our valuation system requires a single table to model beneficiary mortality both before and after a member's death, we created blended tables for beneficiary mortality. More weight is given to the Pub.H-2010 contingent survivor table at older ages, whereas, more weight is given to the system specific retiree mortality rates at younger ages. This approach is used to approximate a method of applying different rates of mortality before and after a member's death (that is currently unavailable due to software restraints).

MORTALITY RATES *continued*

Age Offsets

Generally, we observed the Washington State retirement systems' mortality experience as similar to nationwide public plans mortality experience. For some of the public safety plans, we observed the mortality experience was similar to those in the new base table (projected to 2011) who are a year younger ([1] age offset). Some plans had relatively little experience in terms of total deaths over the period. As a result, we relied on their general relationship to the larger plans where appropriate when setting these assumptions for males and females.

The following table summarizes the new age offset assumptions. For active members, we assume the gender of the beneficiaries is of the opposite sex as the member. Please note that a comparison to the prior age offset assumptions is less relevant because we changed the underlying base mortality tables.

Offset Assumptions						
Analysis of Mortality Table Offsets	**PERS** All Plans		**TRS** All Plans		**SERS** Plan 2/3	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
Old Assumption	(1)	(1)	(3)	(2)	(1)	(1)
New Assumption	0	0	0	0	0	0
Analysis of Mortality Table Offsets	**PSERS** Plan 2		**LEOFF** All Plans		**WSPRS** Plan 1/2	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
Old Assumption	(1)	(1)	(1)	1	(1)	1
New Assumption	0	0	(1)	0	(1)	0

When selecting our assumptions, we gave careful consideration to the credibility of our data. The results of our analysis for larger systems, such as PERS and TRS, are more reliable than the smaller systems with less experience. As such, we believe we have insufficient data to set experience-based mortality tables for all systems.

For PERS, the largest system, we selected our age offsets based on our analysis which indicated no age offset for both males and females would provide the best fit. Likewise, our analysis for TRS, the second largest system, indicated the use of no age offset for males and females provides the best fit as well. Although the age offset selection is the same for PERS and TRS, the general employee base mortality rates are higher than the teachers' base mortality rates. In other words, we still expect members of TRS to live longer than members of PERS. For example, a 65-year-old female retiree in TRS is expected to live 1.5 years longer than a 65-year-old female retiree of PERS.

For SERS, we believe the current assumption (i.e., applying the same age offsets as PERS) remains reasonable and our limited experience supports this conclusion. However, we will continue to monitor this assumption and may make a change in the future when we have sufficient data for SERS.

For LEOFF, we selected a (1) age offset for males and no age offset for females. Our experience indicated that male members of LEOFF live longer than suggested by the PubS.H-2010 tables. Contrary to males, the observed mortality rates for LEOFF females over our study period is slightly higher than expected under the PubS.H-2010 table. However, this difference decreases when excluding survivor experience. With this in mind, and given the limited amount of LEOFF female member data, we decided to apply no age offsets for LEOFF females.

We believe we have insufficient data to set experience-based mortality tables for WSPRS. However, we expect members in this system to have similar rates of mortality to law enforcement members of LEOFF given the occupational similarities. This notion is supported by the limited amount of data we do have for WSPRS and law enforcement officers in LEOFF. Therefore, we selected a (1) age offset for males of WPSRS and no age offsets to females.

MORTALITY RATES

Similar to WSPRS, PSERS lacked sufficient experience to set experience-based mortality rates. However, we see less similarity in the job duties between PSERS and LEOFF members than between WSPRS and law enforcement officers in LEOFF. We have little reason to believe PSERS mortality rates will differ from those predicted by the general public safety PubS.H-2010 base table and selected no age offsets. Similar to SERS, we will continue to monitor this assumption and may make a change in the future when we have sufficient data.

Examples

The following examples will help illustrate how we combine the mortality improvement scale with the base mortality rates adjusted for age offsets. Let's calculate the mortality rate as of the year 2011 for a male LEOFF employee aged 25 and a male LEOFF retiree aged 70, reflecting the selected age offsets for that system. Note that this concept can be extrapolated for each year in the future.

A (1) age offset means an age 25 male LEOFF employee is assumed to have mortality experience consistent with a 24-year-old male public safety employee; similarly, the age 70 male LEOFF retiree with that of a 69-year-old male public safety retiree. As of the year 2010, the age 24 (= 25 - 1) male employee and age 69 (= 70 - 1) male retiree mortality rates are 0.0430 percent and 1.5440 percent, respectively. This means that we expect there is a 0.0430 percent chance that a LEOFF male employee age 25 would die by the end of the year, while the LEOFF male retiree age 70 is assumed to have 1.5440 percent chance of dying before the end of the year.

The MP-2017 long-term mortality improvements for both of these example members is 1 percent per year. In other words, the mortality rate at these same ages is expected to decrease by 1 percent each year in the future. The following shows one year of this calculation. Projected to 2011, an age 25 male LEOFF employee and an age 70 male LEOFF retiree will have corresponding mortality rates of: 0.0426% [= 0.0430% x (1 - 1%)] and 1.5286% [= 1.5440% x (1 - 1%)].

Disabled Mortality

Similar to the healthy mortality base tables, in order to reflect more recent experience in mortality, we updated our disabled mortality assumption to the Pub.H-2010 disabled tables. We selected two sets of assumptions dependent on whether the system is public safety or not. Giving consideration to the amount of data available on disabled mortality, we opted to use no age offsets in these assumptions.

Fit of Pub.H-2010 Disabled Tables (2006-2017)			
System/Table	LEOFF 1	LEOFF 2, WSPRS	PERS, SERS, TRS
General PUB.H Disabled	0.56	0.48	1.17
Safety PUB.H Disabled	0.94	1.11	1.88
Number of Deaths (2006 - 2017)	1,059	42	2,204

For PERS, TRS, and SERS, we selected the PubG.H-2010 disabled table with no age offsets as the new disabled mortality assumption. For our public safety plans, LEOFF, PSERS, and WSPRS, we selected the PubS.H-2010 disabled table with no age offsets.

Since we chose to use MP-2017 long-term rates with the healthy mortality tables, and in light of our limited actual disabled mortality experience, we decided to apply the same mortality improvement rates for all disabled mortality. Persons with disabilities are subject to the same factors that drive mortality improvement in a healthy population such as new medical technology and innovation, new treatments of diseases, changes in nutrition, etc. Put another way, we expect they will experience higher rates of mortality than the non-disabled population, but we still expect their rates of mortality to improve in the future consistent with our long-term improvement assumption.

Please see the **Mortality Rates Appendix** for additional information on how we set this assumption.

TWO: DEVELOPMENT OF DEMOGRAPHIC ASSUMPTIONS

RETIREMENT RATES

What is the Retirement Rates Assumption and How Do We Use it?

The Retirement Rates assumption represents the probability that a retirement-eligible individual will stop working and start collecting their pension benefit immediately. The goal of this assumption is to project when members will leave employment and move into retirement. We then use the assumed retirement behavior, along with other assumptions, to estimate how long members will collect their retirement benefits for purposes of plan funding.

This assumption generally varies by amount of service and age. However, where appropriate, we also varied the assumption by plan selection.

High-Level Takeaways

In general, retirement data available since the Great Recession (2008-2017) showed consistently lower rates of retirement than prior to the recession (1995-2007). When members work longer, we see fewer actual retirements annually and lower rates of retirement. In the prior experience study, we had removed 2008-2012 data for PERS, TRS, and SERS systems because of impacts from the recession. We removed the recession data because we did not think there was sufficient experience after the recession in which to observe an economic recovery. We included 2008-2017 data in this study due to the continued trend of later retirements. As a result, we lowered the old retirement rate assumption toward the level of retirements observed in the study period.

The following list demonstrates some of the economic and demographic changes that possibly changed retirement behavior over the last decade:

❖ **Life Expectancy** – Washington State employees are living longer than in the past. Members could be deferring retirement to save money and build a larger retirement benefit instead of retiring earlier with a reduced benefit.

❖ **Plan 3 Retirement Accounts** – The Great Recession heavily affected Plan 3 Defined Contribution (DC) retirement account balances. The size of their Plan 3 DC account may impact their decision to retire. If a Plan 3 member's DC account is large enough, they may choose to retire earlier. Plan 3 members could still be recovering from the market downturn.

❖ **Cost of Health Insurance** – Some members may continue working prior to Medicare eligibility in order to retain employer provided health insurance that is typically cheaper than other options.

Two significant changes were made to PERS, TRS, and SERS retirement rates assumptions: gender-neutral rates and plan-specific rates. Overall, we observed male and female members to have similar retirement behavior. We expect the similar retirement behavior to continue in future years. We believe Plan 2 and Plan 3 members of PERS, TRS, and SERS systems will have different retirement behavior and we confirmed this with the data from this experience study. The additional data available in this study provided us enough evidence to move from combined Plan 2/3 rates to plan-specific rates.

RETIREMENT RATES

Data and Assumptions

We looked at 23 years of experience study records, from 1995-2017. No special data was added for this assumption, but some data was removed as noted below.

Consistent with prior studies, we removed valuation years 2001 and 2007 because of a shortened valuation year. Including data for 2001 and 2007 would lead to valuation periods of unequal length. We also removed 2000 data for SERS Plans 2/3 because the plan was created in 2000. SERS experienced a low number of retirements in 2000 compared to subsequent years. We do not believe the 2000 retirement experience is representative of expected longer-term experience.

For PERS, TRS, and LEOFF Plans 1, we considered a 1995-2017 study period for setting rates in these closed plans. However, we believe recent rates of retirement are more indicative of future rates of retirement for the relatively small group of remaining actives in these closed plans. Therefore, we relied on data after the end of the last experience study, 2013-2017, to set new assumptions.

Because PSERS is a relatively new system, we do not have sufficient data to set a credible retirement rates assumption for PSERS from plan experience. Instead, we relied on the PERS Plan 2 retirement rates assumption to inform the PSERS Plan 2 assumption and then made subsequent adjustments based on differences in plan provisions between PERS and PSERS. PSERS was created for PERS members meeting certain job specifications and has similar retirement provisions as PERS.

Additionally, SERS is another relatively new system. However, we were able to gather SERS data prior to the creation of the plan by selectively pulling data for PERS members employed at school districts that would have been eligible for SERS had it been in place at that time.

Law Changes

There were four law changes since the last study that could impact member retirement behavior:

- ❖ **SB 5046 (2013)** – Modifies mandatory retirement provision for judges of PERS.
- ❖ **E2SSB 6455 (2016)** – Opens a window for TRS 2/3 retirees selecting a lower early retirement benefit reduction to return to work as a substitute teacher.
- ❖ **E2SHB 2872 (2016)** – Provides WSPRS members a recruitment and retention bonus.
- ❖ **SB 5274 (2017)** – Allows voluntary overtime to be included in salaries for calculating retirement benefits of WSPRS members.

We did not see a significant impact to retirement behavior resulting from SB 5046 or E2SSB 6455. E2SHB 2872 and SB 5274 do not directly impact WSPRS retirement provisions, but the additional benefits provided in the bills potentially changed retirement behavior at later ages. In general, we saw some older members of WSPRS defer retirement to presumably take advantage of the new provisions.

RETIREMENT RATES   *continued*

General Methodology

For each retirement plan, we calculated the actual retirement rate by dividing the number of members that retired by the total number of members eligible to retire. We then compared the actual rate of retirement to our expected rate of retirement based on our last experience study. We considered this actual to expected measurement over the full time period and on an annual basis. This helped us identify trends in the data where the assumption was over or underestimating retirement behavior.

We then developed new retirement rates, based on historical experience as well as professional judgment on future retirement behavior.

We considered an alternate approach of studying retirement rates weighted by salary instead of headcount. We created salary-weighted rates by dividing the salary that left the system through retirement by the total salary eligible for retirement. This approach attempts to adjust the rates to better model the salary leaving the system. We studied PERS using salary-weighted rates because of the large dispersion in member salaries in the system. Overall, we did not see a large enough difference in rates to justify a method change. We decided to maintain our prior approach of using headcount weighted rates and did not pursue the salary-weighted approach with other systems.

Results

For most plans, we reduced the retirement rates assumption to reflect longer working careers and older retirement ages. The notable exception is WSPRS Plans 1/2, where younger members generally elect retirement upon reaching 25 years of service. However, we reduced rates for older WSPRS members because of delayed retirements similar to the other retirement systems.

We calculated an Actual-to-Expected (A/E) ratio to better understand how our assumptions compare to plan experience in our study period. The "actual" represents the number of retirements we observed during the study period, and the "expected" represents the number of retirements our assumption produced based on the number of eligible members. In general, an A/E ratio less than 1.00 indicates lower actual rates of retirement relative to our assumption. We see a ratio above 1.00 when members retire at higher rates than we assume. Please see the **Retirement Rates Appendix** for additional information on how we set this assumption.

Summary of A/E Ratios		
	Under Old Assumptions	**Under New Assumptions**
PERS 1	0.81	0.99
PERS 2/3	0.80	0.93
TRS 1	0.90	0.98
TRS 2/3	0.52	0.89
SERS 2/3	0.67	0.83
PSERS 2*	N/A	N/A
LEOFF 1	1.00	1.00
LEOFF 2	0.88	0.92
WSPRS 1/2	1.14	1.03

*PSERS lacks sufficient retirement experience to compare with assumptions.

TWO: DEVELOPMENT OF DEMOGRAPHIC ASSUMPTIONS

SERVICE-BASED SALARY INCREASE

What is Service-Based Salary Increase and How Do We Use it?

Assumptions about salary growth help us project salaries to determine the size of the members' future benefits and calculate contribution rates, which are collected as a percentage of payroll.

The salary increases a member will receive over their career depend on both economic and demographic factors. Likewise, our total salary growth assumption consists of two parts.

❖ **Service-Based Salary Increase** – We assume active members in each system will receive Service-Based Salary (SBS) increases in the future, as long as they remain active in their plan. This assumption includes increases in salary due to step (or merit increases), promotion, overtime, or extra contracts. This assumption captures the increases to salary applicable to the plan demographics. We would expect this portion of members' salary increases to remain relatively consistent during economic swings.

❖ **General Salary Growth** – The General Salary Growth (GSG) assumption is a combination of inflation and real wage growth (or productivity). It is the portion of salary increases due to economic factors. We would expect this portion of members' salary increases to fluctuate during economic swings.

For this demographic study, we focused on the SBS increases. For more information on our GSG assumption, please see the 2019 Economic Experience Study.

Please note that the salary increases due to the National Board Certification bonuses for teachers is addressed separately in the **TRS Salary Bonus Assumption** section.

High-Level Takeaways

In general, we have seen a rebound in total salary increases from the Great Recession since our prior study. Across most systems, we observed higher-than-expected SBS increases for members over most service levels. The exception is LEOFF, which experienced SBS increases at a similar rate to our prior assumptions.

Generally, we increased our assumed rates of SBS increases at most service levels. For PERS and PSERS, we slightly extended the service levels at which members receive SBS increases from 17 years of service to 20 years of service.

There have also been recent substantial changes to salary allocations for Washington teachers, school workers, and state patrol officers that impacted our new assumptions. Please see the **Law Changes** section for more information.

Data and Assumptions

We looked at 23 years of experience study records, from 1995-2017, for active members who worked full time for at least two consecutive years. No special data was added for this assumption. We included two years of data, 2001 and 2007, with shortened valuation years because, unlike other assumptions, we aggregate the data over the entire study period.

In the prior experience study, we removed 2008-2012 data for the Great Recession. We included all Great Recession years in this study due to the experienced economic recovery and the expected relatively minor impact that economic swings have on our demographic projections.

We considered a longer study period (1984-2017) for setting rates. However, we believe more recent SBS increases are more indicative of future SBS increases. This is a change from our prior study in which we used historical data from 1984-2009.

Because PSERS is a relatively new system, we do not have sufficient data to set a credible SBS increase assumption for PSERS from plan experience. Instead, we relied on the PERS SBS increase assumption to inform the PSERS assumption.

SERVICE-BASED SALARY INCREASE   *continued*

We adjusted the counting method for some of the TRS and SERS members in valuation years 2008-2017. We found that the full-time members in their first year of employment appeared to receive less than a full valuation year of service. This is because TRS and SERS members begin their first year at the beginning of the school year (late August or early September), but the valuation cut-off date is June 30. We adjusted our counting method to compensate.

We also gathered Consumer Price Index (CPI) data of urban wage earners and clerical workers from the Bureau of Labor Statistics (BLS) for the Seattle-Tacoma-Bremerton area to help inform historical inflation.

We assume the SBS increase for new entrants (service equal to zero) will match the SBS increase for members with one year of service.

Law Changes

TRS/SERS

Following the State Supreme Court's decision in *McCleary v. State of Washington* (2012), the Legislature has been making systemic changes to K-12 funding; much of which includes changes to salary allocations. For example, EHB 2242 (2017) and E2SSB 6362 (2018) made many changes to education funding. One of these changes was an increase to salary allocations, subject to a phase-in period and regionalization factors.

We will know the full extent of the salary increases when fully allocated and reflected in our data. Until that time arrives, it is difficult for us to predict the full impacts of these changes. This is because salary allocations are the amounts the state provides to each school for each position, but the schools can determine how those funds are actually proportioned. In other words, the increase in allocations could go toward hiring more staff, paying existing staff higher salaries, or some combination thereof. Salaries may also be affected by local collective bargaining agreements.

WSPRS

The Legislature passed a number of bills since our prior study that may influence future salary increases for members of WSPRS:

- ❖ **E2SHB 2872** **(2016)** – Requires that future salaries remain competitive with other law enforcement agencies in the state.
- ❖ **SB 5274** **(2017)** – Allows a certain amount of voluntary overtime to be included in salaries for purposes of calculating retirement benefits in WSPRS.
- ❖ **SHB 2692** **(2018)** – Makes permanent the process used for setting competitive minimum salaries under 2016 Legislation (E2SHB 2872).

General Methodology

We began our study by examining the salaries of active members who worked full time for two consecutive years from 1995-2017. By comparing aggregated salaries at the beginning and end of each year, we were able to determine total salary increases over different time periods and service levels for each retirement system.

After determining total salary increases at each level of service, we isolated historical SBS increases from our range of estimated historical GSG. This was performed by dividing the total salary increase at each service level by our estimates for inflation and real wage growth.

Furthermore, we examined recent, or anticipated, changes in salary allocations that would cause future experience to deviate from historical trends. After considering historical experience and anticipated trends, we applied professional judgement to set new rates by system.

TWO: DEVELOPMENT OF DEMOGRAPHIC ASSUMPTIONS

SERVICE-BASED SALARY INCREASE

Results

We generally increased our assumed rate of SBS increases at most service levels. The exception is LEOFF and WSPRS, where we made only minor adjustments to our prior assumption.

Based on our combined economic assumptions for GSG and SBS increases, we anticipate long-term future salaries will grow at a rate higher than experienced from 1995-2017 for all systems. In particular, we anticipate TRS and SERS to receive higher salary increases in the future due in part to the State Supreme Court's decision in *McCleary v. State of Washington* (2012).

We did not rely on historical experience when setting the PSERS and WSPRS SBS increases assumptions. PSERS is a relatively young plan and does not have enough credible experience to set assumptions. Instead, we relied on assumptions developed for PERS. Recent legislation altered WSPRS salaries to remain competitive with members of other law enforcement agencies. As a result, we believe historical experience is no longer a good indicator of future experience and instead relied on assumptions developed for LEOFF.

We calculated an Actual-to-Expected (A/E) ratio to better understand how our assumptions compare to plan experience in our study period. The "actual" is the average total salary increase a member received during a single year of service and the "expected" is the total average increase in salary we expect a member to receive during a single year of service. We include both demographic and economic salary assumptions in this comparison.

The calculated A/E ratio for total salary growth is helpful for understanding how our combined assumptions for GSG and SBS increases compare to historical experience. If we anticipated future experience to match our study period exactly, we would select new assumptions that had an A/E ratio of one. When determining total salary growth, we look at both historical experience and expectations for the future. Therefore, the following table can inform if our assumptions are reasonable, but it does not necessarily determine the best estimate projections for the future. For example, the total historical A/E for PERS worsened under our new assumptions because we anticipate future salary increases will be higher than both historical experience and our prior assumptions. Please see the **Service-Based Salary Increases Appendix** for additional information on how we set this assumption.

Total Average Annual Salary Increase (1995-2017)					
System	Actual	Under Old Assumptions*	Old A/E	Under New Assumptions**	New A/E
PERS	4.4%	4.8%	0.93	4.8%	0.92
TRS	5.0%	5.3%	0.93	5.5%	0.90
SERS	4.9%	5.0%	0.97	5.2%	0.94
LEOFF	5.1%	5.5%	0.93	5.4%	0.94

Includes the current 3.5 percent GSG assumption and SBS assumptions developed as part of the 2007-2012 Demographic Experience Study.

**Includes the current 3.5 percent GSG assumption and the new SBS assumptions.

TWO: DEVELOPMENT OF DEMOGRAPHIC ASSUMPTIONS

TERMINATION RATES

What is the Termination Rates Assumption and How do we Use it?

The Termination Rates assumption represents the probability that a member will leave active employment status without becoming disabled or retiring. The goal of this assumption, along with the **Probability of Withdrawing Contributions Assumption**, is to estimate the number of terminated members who defer commencement of their retirement benefit. We assume that members who do not defer the commencement of their retirement benefits will immediately withdraw their accumulated contributions.

This assumption generally varies by retirement plan and service (or age).

High-Level Takeaways

In general, we observed terminations that were higher than expected since the last experience study. The LEOFF System was the only one that showed terminations less than expected since the last experience study.

In prior studies, we developed a combined termination assumption for Plans 2/3. When looking at each plan separately, the recent experience showed Plan 2 terminations were typically less than expected and Plan 3 terminations were typically higher than expected. Looking back further, we observed Plan 3 members tend to show higher termination rates than Plan 2. This is most pronounced in PERS where we have the longest history of members having the option to choose between Plan 2 and Plan 3. We believe we have credible experience to prepare different termination assumptions for Plan 2 and Plan 3 for early career employees.

We also observed not all active members who are retirement eligible and leave work will collect their retirement benefit immediately. Based on this data, we modified our termination assumption to now assume some members who are retirement eligible will leave work and defer commencing their retirement benefit. In the prior report, this behavior was modeled by a probability applied to retirements.

Data and Assumptions

We looked at 21 years of experience study records, from 1995-2015. No special data was added for this assumption, but some data was removed as noted in the **Valuation Data Excluded** section.

Because PSERS is a relatively new system, we do not have sufficient data to set a credible termination rates assumption for PSERS Plan 2 from plan experience. Instead, we relied on the PERS Plan 2 termination rates assumption to inform the PSERS Plan 2 assumption. PSERS was created for PERS members meeting certain job specifications and has similar retirement provisions as PERS.

Additionally, SERS is another relatively new system. However, we were able to gather SERS data prior to the creation of the plan by selectively pulling data for PERS members employed at school districts that would have been eligible for SERS had it been in place at that time.

TERMINATION RATES

Valuation Data Excluded

Consistent with the prior experience study, we excluded specific valuation year data if the year included events that would result in significantly under-estimating (or over-estimating) terminations for that year. Examples include shortened valuation years, plan creation years, and experience that we believe to be an outlier. We summarized the valuation data removed in the following table.

Plan	Valuation Year	Why Valuation Year Removed?
TRS Plan 3	1997	Plan created
TRS Plan 2 and Plan 3	1998	Plan 3 transfer incentive
SERS Plan 2 and Plan 3	2000	Plan 2 and Plan 3 created
All Plans	2001	Shortened valuation years
PERS Plan 3	2002	Plan created
PSERS Plan 2	2007	Plan created
PERS (All Plans)	2007	Transfer incentive to move to PSERS
All Plans	2007	Shortened valuation years
WSPRS (All Plans)	2014 and 2015	Outliers in data

Data Adjustments

A member is considered terminated if they leave active employment status without becoming disabled or retiring in a given valuation year. Some examples of termination include quitting the job, being fired, or transferring to another retirement system.

We look ahead and perform an adjustment to certain member records under some scenarios. One such scenario is that a member who returns to work within two years will be considered active during their period of absence. The purpose of this adjustment is to remove termination experience that is inconsistent with the purpose of our termination rates assumption. For this reason, we have not included valuation data from 2016 or 2017 in our analysis, since a member who left employment in the last two years could still reasonably return to work in the near future.

Law Changes

There were two law changes and one budget bill since the last study that could impact member termination behavior:

- ❖ **E2SHB 2872** **(2016)** – Addresses WSPRS members recruitment and retention.
- ❖ **SB 5274** **(2017)** – Allows voluntary overtime to be included in salaries for calculating retirement benefits of WSPRS members.
- ❖ **ESSB 6032** **(2018)** – Increases state funding for basic education.

In valuation years 2014 and 2015, we observed a trend of increasing WSPRS terminations. After that period, the Legislature passed two WSPRS bills during the 2016 and 2017 Legislative Session intended to improve recruitment and retention in WSPRS. Collective bargaining during this time lead to WSPRS members receiving significant salary increases and we expect them to be more in line with market salaries for these positions.   The recent legislation and salary increases could improve retention in WSPRS.

Recent increases in state funding for basic education has led to higher than expected short-term salary increases for members of TRS and SERS. The salary increases could improve retention in TRS and SERS.

TERMINATION RATES *continued*

General Methodology

For each retirement plan, we counted the number of active members at the beginning of the year, which we call exposures, and the number of terminations during the year, simply referred to as terminations. We divided the number of terminations by the number of exposures to arrive at the actual rate of termination. The actual rate of termination was calculated for both members not eligible for retirement and members eligible for retirement.

We then compared the actual number of terminations to the number of terminations we expect based on our old assumed rates. To determine how many terminations we expect to occur, we applied our old assumption to the population over the study period. We analyzed this actual-to-expected measurement both on an annual basis, and over the entire study period. This helped us identify trends in the data where the assumption was over or underestimating termination behavior.

We then developed a new termination rates assumption, based on historical actual-to-expected measurements and applied professional judgment on future termination behavior.

Results

For members not eligible for retirement, we mostly increased termination rates to reflect higher historical terminations. The most pronounced increases were for early career Plan 3 members.

We calculated an Actual-to-Expected (A/E) ratio to better understand how our assumptions compare to plan experience in our study period. The "actual" represents the number of terminations we observed during the study period, and the "expected" represents the number of terminations our assumption produced based on the number of eligible members. In general, an A/E ratio less than 1.00 indicates lower actual rates of termination relative to our assumption. We see a ratio above 1.00 when members terminate at higher rates than we assume.

The following table summarizes the A/E ratios, by plan, under our old and new assumptions. The table only includes members not eligible for retirement.

Not Eligible for Retirement		
Summary of A/E Ratios		
	Under Old Assumptions	Under New Assumptions
PERS 2/3	1.01	1.00
TRS 2/3	1.04	1.02
SERS 2/3	1.03	1.02
PSERS 2	0.93	0.97
LEOFF 2	0.96	0.98
WSPRS 1/2	1.04	1.02

We excluded Plans 1 from the table above because of the relatively few remaining active members in those plans. We still include a termination assumption for Plan 1 members not eligible for retirement, however we don't believe the Plans 1 A/E metric is a useful target for this study.

TERMINATION RATES   *continued*

We created a new termination assumption for retirement eligible members. The following table summarizes the A/E ratios, by plan, under our old and new assumptions. The table only includes members eligible for retirement.

Eligible for Retirement*		
Summary of A/E Ratios		
	Under Old Assumptions*	Under New Assumptions
PERS 2	N/A	1.10
PERS 3	N/A	1.21
TRS 2	N/A	1.20
TRS 3	N/A	1.05
SERS 2	N/A	1.56
SERS 3	N/A	1.11
PSERS 2	N/A	1.82

*We did not previously assume retirement
eligible members would terminate and defer
commencement of their retirement benefit.*

While the A/E ratios are relatively high for this new assumption, retirement eligible terminations do not occur frequently so the historical data can be somewhat volatile. We expect these ratios to move closer to 100 percent as more data is collected in future studies. We continue to assume no terminations for members eligible for retirement in Plans 1, LEOFF 2, and WSPRS 1/2. Please see the **Termination Rates Appendix** for additional information on how we set this assumption.

THREE
APPENDICES

THREE: APPENDICES

DISABILITY RATES

Methodology

The disability rates assumption represents the combination of our expected probability of disablement and the selection of a disabled retirement benefit by service retirement ineligible members. We define this rate as the disability rate or the rate of disablement. We compared the actual rate of disablements against what we expected to determine the accuracy of our disablement rate assumptions over the study period. For each year and retirement plan, we counted the number of members who did not meet the service retirement eligibility requirements at the beginning of the year (exposures). We also counted the number of members who disabled, were not service retirement eligible, and started receiving disability retirement benefits during the year (disablements). We then divided the number of disablements by the number of exposures to arrive at the actual rates of disablement. We compared the actual rate to expected rate of disablement over the full period and on an annual basis. This helped us identify trends in the data where our assumption differed from what actually happened.

We developed new disability rate assumptions by adjusting the old assumptions to more closely reflect historical experience. We analyzed the relationship between actual to expected disability rates in light of economic and demographic trends and applied our professional judgment to set new assumptions. In most cases, we did not develop a new assumption to perfectly replicate the study period. We targeted a smaller move than the study experience would indicate to account for future experience not exactly matching the past and the relatively few number of observations in this decrement. We also considered various plan combinations and different assumption formats. For example, we considered combing Plans 2 and 3 in PERS, TRS, and SERS, and considered combing LEOFF Plan 2 and WSPRS. We also considered gender-specific rates and splitting LEOFF Plan 2 by profession, law enforcement officers and firefighters. Ultimately, we do not believe those combinations or different assumption formats offer a significant increase above the old assumption formats in the modeling accuracy.

DISABILITY RATES

Analysis

We divided our analysis into the following two sections:

Review of Historical Data: Relying on historical data to set forward-looking disablement assumptions requires us to consider if that historical experience will be a good indicator of the future. In other words, we considered whether or not past experience might represent non-typical disablement experience and if we should exclude that experience from the study. In this assessment, we considered data from 1995-2017 to include in the study.

Review of Key Demographic Factors: With the historical data period selected, we considered population demographics that could influence disablement behavior. Some of the demographics we studied included gender and retirement plan selection. With consideration for the credibility of our experience data and the key components of a specific population, we determined group-specific rates. In certain cases, we considered changing our old assumption format by subdividing groups by gender or job classification, but we determined that this approach both detracted from the credibility of the data used to develop the assumption and did not significantly impact the results.

To review the historical data and demographic factors, we compared the actual number of disablements to our old expectation. We calculated an A/E ratio to help us determine trends in the data. An A/E ratio of less than 1.00 generally indicates members are experiencing a disability and selecting a disabled retirement benefit later or at lower rates than the old assumption projects. While an A/E ratio of greater than 1.00 tells us members are experiencing a disability and selecting a disabled retirement benefit earlier or at higher rates than we assume. In general, we developed a new assumption so that the A/E ratio moved closer to 1.00. Please see the **Exhibits** section for a comparison of A/E ratio between the old and new assumptions for each system.

The following sections summarize our observations of the review of historical data and key demographic factors:

Review of Historical Data

We looked at different periods of data to determine how the systems have changed over time and what data we would include in the study. As noted in the **Summary** section, we excluded data for 2001 and 2007 because the valuation date changed in those years.

Plans 1: PERS, TRS, LEOFF

PERS, TRS, and LEOFF Plan 1 show a trend of decreasing A/E ratios moving from 1995 toward 2017. In recent years, we see very few, if any, disabled retirements. We're also observing fewer Plan 1 members not eligible for retirement. Over the 2017 study period year, there were 291 PERS 1 and 9 TRS 1 active members not eligible for retirement, and 58 LEOFF 1 members in total. We believe these members will likely act more like recently disabled retirees than historical disability retirees. We further believe all remaining active members are very likely to select a service retirement benefit if they experience a disability in the future. With this in mind and in expectation of future experience, we removed disability rates for each of these plans.

Plan 1 Retirement Experience by Year									
	PERS 1			TRS 1			LEOFF 1		
Year	Actual	Expected	A/E	Actual	Expected	A/E	Actual	Expected	A/E
1995-2012*	881	954	0.92	265	292	0.91	1,183	1,518	0.78
2013-2017	14	22	0.63	1	1	0.78	0	51	0
Total	**895**	**976**	**0.92**	**266**	**294**	**0.91**	**1,183**	**1,569**	**0.75**

Does not include data from 2001 and 2007 because of changing valuation date.

Plans 2/3: PERS, TRS, SERS

In addition to excluding 2001 and 2007 data from the study, we also removed 2000 data from SERS. The Legislature created SERS in the year 2000 for school employees that were previously members of PERS. This year of data shows a large dip in the number of SERS actual disabled retirements, which we believe is an outlier. We were able to gather SERS data prior to 2000 by selectively pulling data for PERS members employed at school districts that would have been eligible for SERS.

The prior experience study (2007-2012 Demographic Experience Study) used data from 1995 2006 to set assumptions for the Plans 2/3. We removed the 2008-2012 data from the prior study because of the large impact the Great Recession appeared to have on disabled retirement selection behavior. In order to include this data, we needed additional experience to show either the system's recovery from the recession or a continuation of the lower trend set during the recession. As of the current study (*2013-2018 Demographic Experience Study*), this data is now available and indicates the latter. The data shows the continuation of a lower disabled retirement selection rate through 2013-2017. Including the Great Recession data, the experience from 2008-2017 accounts for approximately 40 percent of the observed disabled retirements over the entire study period. This demonstrates a lower trend in the more recent years and supports lower assumed rates of disablement.

Experience between PERS, TRS and SERS appeared consistent; however, experience between plans did not. Plan 2 experience consistently showed a higher rate of disabled retirement than Plan 3. We set Plan 2 rates on combined experiences of PERS, TRS, and SERS Plans 2, and applied a scaling factor of 40 percent to these rates to produce Plan 3 disability rates. We believe Plan 3 members generally follow this pattern because they can elect to retire from the defined contribution portion of the plan and defer commencement of their defined benefit. However, we don't have sufficient data to set experienced-based rates in Plan 3. To set separate Plan 3 rates at 40 percent of Plan 2 rates, we applied our professional judgment to reflect lower rates of selection of the immediate disability retirement benefit than Plan 2.

To conclude, we observed a trend of decreasing A/E ratios when comparing the 1995-2006 period to the 2008-2012 and 2013-2017 periods for the Plans 2/3, most prominently in PERS. We saw a consistent trend of fewer disabled retirements than expected since 2008. With this in mind, we chose to set an assumption using data from 1995-2017 to address the observed trend.

Plan 2 Retirement Experience by Year									
	PERS			TRS			SERS		
Year	Actual	Expected	A/E	Actual	Expected	A/E	Actual	Expected	A/E
1995-2006*	1,320	1,329	0.99	82	54	1.51	275	284	0.97
2008-2012	543	870	0.62	17	22	0.76	101	139	0.73
2013-2017	344	851	0.40	6	21	0.29	55	164	0.34
Total	2,207	3,050	0.72	105	98	1.08	431	587	0.73

Does not include data from 2001 and 2007 because of changing valuation date. SERS 2 analysis also excludes the plan creation year 2000.

Plan 3 Retirement Experience by Year									
	PERS			TRS			SERS		
Year	Actual	Expected	A/E	Actual	Expected	A/E	Actual	Expected	A/E
1995-2006*	48	56	0.86	46	66	0.69	42	89	0.47
2008-2012	37	111	0.33	19	58	0.32	35	136	0.26
2013-2017	20	130	0.15	13	51	0.25	29	118	0.24
Total	105	296	0.35	78	176	0.44	106	344	0.31

Does not include data from 2001 and 2007 because of changing valuation date. SERS 3 analysis also excludes the plan creation year 2000.

THREE: APPENDICES

DISABILITY RATES

Public Safety Plans: LEOFF 2, WSPRS 1/2, PSERS 2

The prior experience study used data from 2005 2012 to set assumptions for LEOFF 2, and from 1995-2012 to set assumptions for WSPRS 1/2. Unlike Plans 2/3, we did not exclude 2008-2012 because we did not observe a change in disabled retirement selection resulting from the Great Recession. The following table summarizes how the retirement behavior has changed since the prior experience study.

Public Safety Retirement Experience by Year									
	LEOFF 2			WSPRS 1/2			PSERS 2		
Year	Actual	Expected	A/E	Actual	Expected	A/E	Actual	Expected	A/E
1995-2006*	55	54	1.03	12	7	1.61	0	0	N/A
2008-2012	128	179	0.72	1	4	0.24	6	11	0.56
2013-2017	143	217	0.66	0	4	0.00	9	20	0.45
Total	326	449	0.73	13	16	0.81	15	31	0.49

In LEOFF 2, we observed fewer disabled retirements than expected but at a relatively similar rate to that of the prior study. Conversely, in WSPRS we observed both fewer disabled retirements than expected and at a far lower rate than the prior study.

PSERS 2 opened July 1, 2006 and provided the option for eligible PERS 2/3 members to move into the new system. PSERS experienced 15 disabled retirements during the study period. This experience represents insufficient data to set standalone PSERS disability rates. Instead, we relied on the combined PERS, TRS, and SERS 2 rates to help inform our PSERS 2 disability rates assumption and made subsequent adjustments to reflect differences in plan designs between the systems. We will continue to monitor the appropriateness of the PSERS 2 disability rates going forward and will make any necessary adjustments when needed.

Review of Key Demographic Factors

1. **PERS, TRS, and LEOFF Plans 1 Active Members**
   The remaining Plan 1 active members are generally older than members of past studies and nearly all eligible for service retirement. Considering recent disability experience, of which there is little, we removed all PERS, TRS, and LEOFF Plan 1 rates. We believe few remaining members in any of these plans will both experience a disabling incident and choose a disabled retirement benefit.

2. **Male Versus Female Disability Experience**
   We previously assumed gender-specific disability rates for all plans in PERS, TRS, SERS, and PSERS. The prior experience study had shown a trend of females typically disabling at a lower rate than males.

Plans 2/3: PERS, TRS, SERS
The new Plan 2/3 data indicated the difference in male and female rates is generally similar over the time periods from 1995-2007, and from 2008-2017. We see the largest difference between male and female disabled retirement rates in SERS 2/3. However, that difference decreases when we include 2008-2017.

Plan 2 Disability Rates by Gender								
	PERS			TRS			SERS		
Year	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
1995-2007*	0.0011	0.0010	0.0001	0.0005	0.0005	0.0000	0.0017	0.0007	0.0010
2008-2017	0.0010	0.0008	0.0002	0.0002	0.0002	0.0000	0.0014	0.0007	0.0008

Does not include data from 2001 and 2007 because of changing valuation date. SERS 2 analysis also excludes the plan creation year 2000.

DISABILITY RATES

Plan 3 Disability Rates by Gender								
	PERS			TRS			SERS		
Year	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
1995-2007*	0.0005	0.0006	(0.0001)	0.0001	0.0001	0.0000	0.0005	0.0003	0.0002
2008-2017	0.0003	0.0002	0.0001	0.0001	0.0001	0.0000	0.0004	0.0002	0.0001

*Does not include data from 2001 and 2007 because of changing valuation date. SERS 3 analysis also excludes the plan creation year 2000.

In the future, we expect males and females to have similar incidences of disablement and selection, so we combined male and female data to set a gender-neutral set of disability rates.

Public Safety Plans: LEOFF 2, WSPRS 1/2, PSERS 2
We maintained the single set of gender-neutral retirement rates in LEOFF 2 and WSPRS 1/2 because of the heavy population weighting of the systems toward males. At this time, we do not have sufficient data to set gender-specific rates. We also created gender-neutral rates for PSERS 2 for consistency with PERS, TRS, and SERS 2/3 rates.

3. **Plan 2 Versus Plan 3 Disability Experience**
   We studied retirement experience for Plan 2 and Plan 3 individually. The plans have fundamental differences in design, which we expected would lead to different disabled retirement selection behavior. Plan 2 is a defined benefit plan, while Plan 3 is a hybrid of defined benefit and defined contribution. In prior studies, we had observed a difference in rates by plan, but lacked sufficient experience to set credible plan-specific rates. While we do observe a difference between Plans 2 and 3, we continue to lack experience to set plan-specific assumptions. However, in our opinion, the plan design difference and the observed experience are sufficient to set plan-specific rates. To set Plan 3 rates, we relied on Plan 2 data and applied an adjustment factor.

   The following table displays the disability experience between Plans 2 and 3.

Plan 2 vs. Plan 3 Disability Experience (1995-2017)*									
	PERS			TRS			SERS		
Year	Actual	Expected	A/E	Actual	Expected	A/E	Actual	Expected	A/E
Plan 2	2,207	3,050	0.72	105	98	1.08	431	587	0.73
Plan 3	105	296	0.35	78	176	0.44	106	344	0.31
Total	2,312	3,346	0.69	183	274	0.67	537	931	0.58

*Does not include data from 2001 and 2007 because of changing valuation date. SERS 2/3 analysis also excludes the plan creation year 2000.

We observed lower Plan 3 disabled retirement selection rates than Plan 2 for all three systems. This trend also persists across almost every year of data in the study period. One reason may be due to the Plan 3 hybrid design which may prompt members to withdraw their DC contributions upon disablement and defer the DB portion of their benefit. However, as noted, we lack experience to set Plan 3 assumptions based solely on Plan 3 data, so we used Plan 2 data and applied an adjustment to set the assumptions for Plan 3.

4. **LEOFF 2 Law Enforcement Officer and Firefighter Disability Experience**
   Experience indicates differences between disabled retirements of law enforcement officers and firefighters may exist. Law enforcement officers experience disabilities and select disabled retirements at a slightly higher rate than firefighters, averaging approximately 20 percent more disablements per year over the study period. We considered separate rates for each group, but ultimately decided blended disability assumptions remain reasonable and provide, in our opinion, sufficient accuracy without further complicating the model.

THREE: APPENDICES

DISABILITY RATES

Rate of Disablement by Profession	
	LEOFF 2
Law Enforcement Officer	0.0017
Fire Fighter	0.0015

Note: Rates calculated over the study period 2005-2017, excluding 2007.

Average Number of Disabilities Per Year by Profession		
	LEOFF 2	**Percent of Active Members**
Law Enforcement Officer	15.50	0.17%
Fire Fighter	11.67	0.14%

Notes: Average Number of Disabilities for the study period 2005-2017, excluding 2007. Percent of active membership as of June,30 2017.

New Assumptions

For all old and new assumptions, note that rates are shown in five-year increments consistent with the format of the new assumptions. For old assumptions, rates are not shown between these five-year increments but can generally be interpolated.

Plans 1: PERS, TRS, LEOFF

We believe recent plan experience is a good indicator for future disabled retirement selection. Members in these systems are all near, or at, retirement eligibility so we expect few, if any, to select disabled retirement. We applied our professional judgment and no longer apply assumed disability rates to these plans. Please see the individual system tables in the **Exhibits** section for a comparison between the new, old, and actual rates.

Plans 2/3: PERS, TRS, SERS

We assume Plan 2 members will have similar experience across PERS, TRS, and SERS. Likewise, we assume Plan 3 members will have similar experience across these three retirement systems. We combined male and female experience across plans and systems to develop a single set of rates, by plan. We believe experience for any one system was too limited to set a gender-specific assumption, but that experience also showed a significant selection difference between plans. Please see the individual system tables in the **Exhibits** section for a comparison between the new, old, and actual rates.

Public Safety Plans: LEOFF 2, WSPRS 1/2, PSERS 2

We assume member disabled retirement selection differs between each plan. Disability provisions and benefits, as well as plan demographics, vary amongst each plan. For each plan, we combined male and female experience to develop our new assumed rates. We set LEOFF 2 rates on plan experience and simplified WSPRS rates given the small number of observed disablements in this relatively small plan. In PSERS 2, disability benefits differ once members earn 10 years of service credit. We also believe the plan demographics are similar to that of non-public safety plans like PERS. We have very limited experience and few disabled retirement observations, so we relied on PERS, TRS, and SERS Plan 2 rates to set our assumption for members with less than 10 years of service. For PSERS members with over ten years of service, we applied professional judgment and increased rates to account for the increase in benefits a member could receive upon attaining this service level. Please see the individual system tables in the **Exhibits** section for a comparison between the new, old, and actual rates.

DISABILITY RATES

Exhibits

Actual to Expected Disabled Retirements

PERS, TRS, and LEOFF Plans 1

PERS Plan 1 Disability Counts by Year			
(Males and Females)			
Year	Actual	Expected	Ratio
1995	108	99	1.09
1996	86	98	0.88
1997	83	96	0.87
1998	101	92	1.10
1999	95	87	1.09
2000	71	82	0.87
2001	68	76	0.89
2002	63	69	0.91
2003	69	62	1.11
2004	60	57	1.05
2005	40	51	0.78
2006	34	45	0.75
2007	13	39	0.33
2008	17	33	0.51
2009	19	28	0.68
2010	16	22	0.72
2011	16	18	0.90
2012	3	13	0.23
2013	7	9	0.79
2014	1	6	0.17
2015	5	4	1.31
2016	1	2	0.44
2017	0	1	0.00
Total	**976**	**1,092**	**0.89**

PERS Plan 1 Disability Counts by Age			
(Males and Females)			
Age	Actual	Expected	Ratio
20-24	0	0	0.00
25-29	0	0	0.00
30-34	0	0	0.00
35-39	0	0	0.00
40-44	0	0	0.00
45-49	0	0	0.00
50-54	0	1	0.00
55-59	14	20	0.71
60-64	0	2	0.00
65+	0	0	0.00
Total	**14**	**22**	**0.63**

Note: By age A/E ratios reflect a 2013-2017 study period.

DISABILITY RATES

Actual to Expected Disabled Retirements

PERS, TRS, and LEOFF Plans 1 *(continued)*

TRS Plan 1 Disability Counts by Year			
(Males and Females)			
Year	Actual	Expected	Ratio
1995	37	33	1.13
1996	31	33	0.94
1997	32	32	0.99
1998	37	32	1.15
1999	30	31	0.98
2000	19	29	0.65
2001	38	26	1.46
2002	20	23	0.87
2003	21	20	1.05
2004	11	17	0.65
2005	10	14	0.72
2006	8	11	0.71
2007	5	9	0.59
2008	3	6	0.49
2009	2	5	0.44
2010	2	3	0.62
2011	2	2	0.93
2012	0	1	0.00
2013	0	1	0.00
2014	1	0	3.05
2015	0	0	0.00
2016	0	0	0.00
2017	0	0	0.00
Total	**309**	**328**	**0.94**

TRS Plan 1 Disability Counts by Age			
(Males and Females)			
Age	Actual	Expected	Ratio
20-24	0	0	0.00
25-29	0	0	0.00
30-34	0	0	0.00
35-39	0	0	0.00
40-44	0	0	0.00
45-49	0	0	0.00
50-54	0	0	0.00
55-59	1	1	0.98
60-64	0	0	0.00
65+	0	0	0.00
Total	**1**	**1**	**0.78**

Note: By age A/E ratios reflect a 2013-2017 study period.

DISABILITY RATES

Actual to Expected Disabled Retirements
PERS, TRS, and LEOFF Plans 1 *(continued)*

LEOFF Plan 1 Disability Counts by Year			
(Males and Females)			
Year	Actual	Expected	Ratio
1995	157	181	0.87
1996	213	175	1.22
1997	154	164	0.94
1998	181	153	1.18
1999	130	139	0.94
2000	123	127	0.97
2001	93	111	0.83
2002	68	102	0.67
2003	57	92	0.62
2004	42	82	0.51
2005	18	72	0.25
2006	25	63	0.40
2007	10	53	0.19
2008	10	46	0.22
2009	4	38	0.10
2010	0	32	0.00
2011	0	28	0.00
2012	1	23	0.04
2013	0	17	0.00
2014	0	13	0.00
2015	0	10	0.00
2016	0	7	0.00
2017	0	4	0.00
Total	1,286	1,733	0.74

LEOFF Plan 1 Disability Counts by Age			
(Males and Females)			
Age	Actual	Expected	Ratio
20-24	0	0	0.00
25-29	0	0	0.00
30-34	0	0	0.00
35-39	0	0	0.00
40-44	0	0	0.00
45-49	0	0	0.00
50-54	0	0	0.00
55-59	0	13	0.00
60-64	0	28	0.00
65+	0	10	0.00
Total	0	51	0.00

Note: By age A/E ratios reflect a 2013-2017 study period.

DISABILITY RATES

Actual to Expected Disabled Retirements

PERS, TRS, and SERS Plans 2 and Plans 3

PERS, TRS, and SERS Plans 2 Disability Counts by Year			
(Males and Females)			
Year	Actual	Expected	Ratio
1995	91	118	0.77
1996	128	128	1.00
1997	105	139	0.75
1998	150	146	1.03
1999	166	155	1.07
2000	142	152	0.93
2001	154	156	0.99
2002	179	156	1.15
2003	175	164	1.07
2004	195	171	1.14
2005	186	179	1.04
2006	173	185	0.93
2007	133	187	0.71
2008	133	197	0.68
2009	124	206	0.60
2010	136	211	0.65
2011	150	210	0.71
2012	118	207	0.57
2013	109	204	0.53
2014	90	205	0.44
2015	86	207	0.42
2016	74	209	0.35
2017	46	212	0.22
Total	3,043	4,103	0.74

PERS, TRS, and SERS Plans 2 Disability Counts by Age			
(Males and Females)			
Age	Actual	Expected	Ratio
20-24	0	0	0.00
25-29	4	8	0.49
30-34	10	33	0.31
35-39	45	80	0.56
40-44	88	136	0.65
45-49	264	301	0.88
50-54	510	647	0.79
55-59	850	1,109	0.77
60-64	948	1,383	0.69
65+	24	37	0.65
Total	2,743	3,734	0.73

Note: By age A/E ratios reflect a 1995-2017 study period, excluding 2001 and 2007 for PERS, TRS, and SERS, and 2000 in SERS.

Actual to Expected Disabled Retirements

PERS, TRS, and SERS Plans 2 and Plans 3 *(continued)*

PERS, TRS, and SERS Plans 3 Disability Counts by Year			
(Males and Females)			
Year	Actual	Expected	Ratio
1995	0	0	0.00
1996	0	0	0.00
1997	0	0	0.00
1998	2	5	0.43
1999	3	6	0.54
2000	3	16	0.19
2001	11	19	0.57
2002	25	30	0.83
2003	17	34	0.50
2004	32	38	0.83
2005	24	43	0.55
2006	30	48	0.62
2007	15	52	0.29
2008	15	57	0.27
2009	15	60	0.25
2010	24	63	0.38
2011	22	63	0.35
2012	15	63	0.24
2013	17	61	0.28
2014	18	60	0.30
2015	13	60	0.22
2016	6	59	0.10
2017	8	59	0.14
Total	315	897	0.35

PERS, TRS, and SERS Plans 3 Disability Counts by Age			
(Males and Females)			
Age	Actual	Expected	Ratio
20-24	0	0	0.00
25-29	0	4	0.00
30-34	4	14	0.29
35-39	3	28	0.11
40-44	17	46	0.37
45-49	59	106	0.56
50-54	131	235	0.56
55-59	36	173	0.21
60-64	33	194	0.17
65+	6	17	0.35
Total	289	816	0.35

Note: By age A/E ratios reflect a 1995-2017 study period, excluding 2001 and 2007 for PERS, TRS, and SERS, and 2000 in SERS.

DISABILITY RATES

Actual to Expected Disabled Retirements

Public Safety Plans: LEOFF 2, WSPRS 1/2, PSERS 2

LEOFF Plan 2 Disability Counts by Year			
(Males and Females)			
Year	Actual	Expected	Ratio
1995	0	10	0.00
1996	2	11	0.18
1997	0	13	0.00
1998	1	14	0.07
1999	2	15	0.13
2000	13	17	0.77
2001	3	18	0.17
2002	13	20	0.66
2003	6	22	0.28
2004	18	24	0.75
2005	24	26	0.93
2006	31	28	1.12
2007	18	29	0.62
2008	26	31	0.83
2009	30	34	0.89
2010	24	36	0.67
2011	25	38	0.66
2012	23	40	0.58
2013	39	41	0.95
2014	25	42	0.59
2015	27	43	0.62
2016	26	45	0.58
2017	26	45	0.57
Total	402	641	0.63

LEOFF Plan 2 Disability Counts by Age			
(Males and Females)			
Age	Actual	Expected	Ratio
20-24	0	0	0.00
25-29	1	4	0.23
30-34	4	16	0.25
35-39	19	37	0.51
40-44	38	59	0.65
45-49	46	81	0.57
50-54	106	109	0.97
55-59	83	93	0.89
60-64	27	45	0.59
65+	2	4	0.48
Total	326	449	0.73

Note: By age A/E ratios reflect a 2005-2017 study period, excluding 2007.

DISABILITY RATES

Actual to Expected Disabled Retirements

Public Safety Plans: LEOFF 2, WSPRS 1/2, PSERS 2 *(continued)*

WSPRS Plans 1/2 Disability Counts by Year			
(Males and Females)			
Year	Actual	Expected	Ratio
1995	4	1	5.71
1996	3	1	4.60
1997	1	1	1.57
1998	1	1	1.52
1999	1	1	1.50
2000	0	1	0.00
2001	0	1	0.00
2002	1	1	1.47
2003	0	1	0.00
2004	1	1	1.40
2005	0	1	0.00
2006	0	1	0.00
2007	1	1	1.41
2008	0	1	0.00
2009	0	1	0.00
2010	1	1	1.18
2011	0	1	0.00
2012	0	1	0.00
2013	0	1	0.00
2014	0	1	0.00
2015	0	1	0.00
2016	0	1	0.00
2017	0	1	0.00
Total	14	17	0.81

WSPRS 1/2 Disability Counts by Age			
(Males and Females)			
Age	Actual	Expected	Ratio
20-24	0	0	0.00
25-29	1	0	3.29
30-34	1	1	1.16
35-39	0	2	0.00
40-44	2	3	0.68
45-49	4	5	0.86
50-54	5	4	1.20
55-59	0	1	0.00
60-64	0	0	0.00
65+	0	0	0.00
Total	13	16	0.81

Note: By age A/E ratios reflect a 1995-2017 study period, excluding 2001 and 2007.

DISABILITY RATES

Actual to Expected Disabled Retirements

Public Safety Plans: LEOFF 2, WSPRS 1/2, PSERS 2 *(continued)*

PSERS Plan 2 Disability Counts by Year			
(Males and Females)			
Year	Actual	Expected	Ratio
1995	0	0	0.00
1996	0	0	0.00
1997	0	0	0.00
1998	0	0	0.00
1999	0	0	0.00
2000	0	0	0.00
2001	0	0	0.00
2002	0	0	0.00
2003	0	1	0.00
2004	0	1	0.00
2005	0	1	0.00
2006	0	1	0.00
2007	1	1	1.19
2008	0	1	0.00
2009	2	2	1.08
2010	1	2	0.45
2011	0	3	0.00
2012	3	3	1.05
2013	1	3	0.31
2014	1	4	0.28
2015	0	4	0.00
2016	3	5	0.63
2017	4	4	0.93
Total	16	37	0.44

PSERS Plan 2 Disability Counts by Age			
(Males and Females)			
Age	Actual	Expected	Ratio
20-24	0	0	0.00
25-29	0	1	0.00
30-34	0	1	0.00
35-39	0	2	0.00
40-44	0	3	0.00
45-49	3	5	0.59
50-54	4	7	0.58
55-59	4	10	0.39
60-64	4	6	0.70
65+	0	0	0.00
Total	15	35	0.42

Note: By age A/E ratios reflect a 2008-2017 study period.

DISABILITY RATES

Actual, Old, and New Disabled Retirement Rates

PERS

PERS Plan 1 Disability Rates				
	Actual		Old		New
Age	Male	Female	Male	Female	Male/Female
20-24	0.0000	0.0000	0.0000	0.0000	0.0000
25-29	0.0000	0.0000	0.0000	0.0000	0.0000
30-34	0.0000	0.0000	0.0000	0.0000	0.0000
35-39	0.0000	0.0000	0.0004	0.0005	0.0000
40-44	0.0000	0.0000	0.0010	0.0011	0.0000
45-49	0.0000	0.0000	0.0019	0.0018	0.0000
50-54	0.0000	0.0000	0.0039	0.0042	0.0000
55-59	0.0017	0.0066	0.0103	0.0070	0.0000
60-64	0.0000	0.0000	0.0049	0.0017	0.0000
65-69	0.0000	0.0000	0.0014	0.0002	0.0000
70-74	0.0000	0.0000	0.0004	0.0000	0.0000
75-79	0.0000	0.0000	0.0001	0.0000	0.0000
80	0.0000	0.0000	0.0000	0.0000	0.0000

PERS Plan 2 Disability Rates				
	Actual		Old		New
Age	Male	Female	Male	Female	Male/Female
20-24	0.0000	0.0000	0.0000	0.0000	0.0000
25-29	0.0000	0.0000	0.0001	0.0000	0.0001
30-34	0.0000	0.0000	0.0001	0.0001	0.0001
35-39	0.0001	0.0001	0.0002	0.0002	0.0002
40-44	0.0002	0.0002	0.0003	0.0003	0.0002
45-49	0.0005	0.0006	0.0006	0.0006	0.0005
50-54	0.0012	0.0011	0.0014	0.0015	0.0015
55-59	0.0032	0.0029	0.0043	0.0043	0.0030
60-64	0.0064	0.0056	0.0096	0.0086	0.0060
65-69	0.0020	0.0007	0.0037	0.0033	0.0020
70-74	0.0045	0.0012	0.0008	0.0008	0.0020
75-79	0.0110	0.0034	0.0002	0.0002	0.0020
80	0.0000	0.0000	0.0000	0.0000	0.0000

Actual, Old, and New Disabled Retirement Rates

PERS *(continued)*

	PERS Plan 3 Disability Rates				
	Actual		Old		New
Age	Male	Female	Male	Female	Male/Female
20-24	0.0000	0.0000	0.0000	0.0000	0.0000
25-29	0.0000	0.0000	0.0001	0.0000	0.0001
30-34	0.0000	0.0000	0.0001	0.0001	0.0001
35-39	0.0001	0.0000	0.0002	0.0002	0.0001
40-44	0.0000	0.0002	0.0003	0.0003	0.0001
45-49	0.0003	0.0005	0.0006	0.0006	0.0002
50-54	0.0008	0.0009	0.0014	0.0015	0.0006
55-59	0.0013	0.0006	0.0043	0.0043	0.0012
60-64	0.0019	0.0013	0.0096	0.0086	0.0024
65-69	0.0028	0.0000	0.0037	0.0033	0.0008
70-74	0.0000	0.0000	0.0008	0.0008	0.0008
75-79	0.0000	0.0000	0.0002	0.0002	0.0008
80	0.0000	0.0000	0.0000	0.0000	0.0000

DISABILITY RATES
continued

Actual, Old, and New Disabled Retirement Rates
TRS

TRS Plan 1 Disability Rates				
	Actual		Old		New
Age	Male	Female	Male	Female	Male/Female
20-24	0.0000	0.0000	0.0000	0.0000	0.0000
25-29	0.0000	0.0000	0.0001	0.0001	0.0000
30-34	0.0000	0.0000	0.0002	0.0002	0.0000
35-39	0.0000	0.0000	0.0004	0.0004	0.0000
40-44	0.0000	0.0000	0.0006	0.0006	0.0000
45-49	0.0000	0.0000	0.0012	0.0012	0.0000
50-54	0.0000	0.0000	0.0022	0.0023	0.0000
55-59	0.0323	0.0000	0.0038	0.0039	0.0000
60-64	0.0000	0.0000	0.0059	0.0060	0.0000
65-69	0.0000	0.0000	0.0035	0.0036	0.0000
70-74	0.0000	0.0000	0.0009	0.0009	0.0000
75-79	0.0000	0.0000	0.0002	0.0002	0.0000
80	0.0000	0.0000	0.0000	0.0000	0.0000

TRS Plan 2 Disability Rates				
	Actual		Old		New
Age	Male	Female	Male	Female	Male/Female
20-24	0.0000	0.0000	0.0000	0.0000	0.0000
25-29	0.0000	0.0000	0.0000	0.0000	0.0001
30-34	0.0000	0.0000	0.0001	0.0001	0.0001
35-39	0.0002	0.0002	0.0001	0.0001	0.0002
40-44	0.0000	0.0000	0.0002	0.0001	0.0002
45-49	0.0002	0.0002	0.0003	0.0003	0.0005
50-54	0.0005	0.0003	0.0006	0.0005	0.0015
55-59	0.0023	0.0019	0.0016	0.0011	0.0030
60-64	0.0034	0.0032	0.0035	0.0028	0.0060
65-69	0.0000	0.0000	0.0013	0.0009	0.0020
70-74	0.0000	0.0000	0.0002	0.0002	0.0020
75-79	0.0000	0.0000	0.0000	0.0000	0.0020
80	0.0000	0.0000	0.0000	0.0000	0.0000

DISABILITY RATES

Actual, Old, and New Disabled Retirement Rates

TRS *(continued)*

		TRS Plan 3 Disability Rates			
	Actual		**Old**		**New**
Age	**Male**	**Female**	**Male**	**Female**	**Male/Female**
20-24	0.0000	0.0000	0.0000	0.0000	0.0000
25-29	0.0000	0.0000	0.0000	0.0000	0.0001
30-34	0.0000	0.0000	0.0001	0.0001	0.0001
35-39	0.0000	0.0000	0.0001	0.0001	0.0001
40-44	0.0001	0.0000	0.0002	0.0001	0.0001
45-49	0.0002	0.0001	0.0003	0.0003	0.0002
50-54	0.0003	0.0003	0.0006	0.0005	0.0006
55-59	0.0006	0.0005	0.0016	0.0011	0.0012
60-64	0.0005	0.0012	0.0035	0.0028	0.0024
65-69	0.0000	0.0000	0.0013	0.0009	0.0008
70-74	0.0000	0.0000	0.0002	0.0002	0.0008
75-79	0.0000	0.0000	0.0000	0.0000	0.0008
80	0.0000	0.0000	0.0000	0.0000	0.0000

Actual, Old, and New Disabled Retirement Rates

SERS

SERS Plan 2 Disability Rates				
	Actual		Old		New
Age	Male	Female	Male	Female	Male/Female
20-24	0.0000	0.0000	0.0000	0.0000	0.0000
25-29	0.0000	0.0000	0.0000	0.0000	0.0001
30-34	0.0000	0.0000	0.0000	0.0001	0.0001
35-39	0.0002	0.0001	0.0001	0.0002	0.0002
40-44	0.0001	0.0001	0.0004	0.0001	0.0002
45-49	0.0005	0.0003	0.0008	0.0003	0.0005
50-54	0.0012	0.0006	0.0017	0.0010	0.0015
55-59	0.0037	0.0021	0.0040	0.0028	0.0030
60-64	0.0074	0.0036	0.0084	0.0057	0.0060
65-69	0.0021	0.0010	0.0035	0.0030	0.0020
70-74	0.0000	0.0000	0.0008	0.0013	0.0020
75-79	0.0000	0.0000	0.0002	0.0006	0.0020
80	0.0000	0.0000	0.0000	0.0000	0.0000

SERS Plan 3 Disability Rates				
	Actual		Old		New
Age	Male	Female	Male	Female	Male/Female
20-24	0.0000	0.0000	0.0000	0.0000	0.0000
25-29	0.0000	0.0000	0.0000	0.0000	0.0001
30-34	0.0000	0.0001	0.0000	0.0001	0.0001
35-39	0.0000	0.0000	0.0001	0.0002	0.0001
40-44	0.0001	0.0001	0.0004	0.0001	0.0001
45-49	0.0001	0.0003	0.0008	0.0003	0.0002
50-54	0.0012	0.0004	0.0017	0.0010	0.0006
55-59	0.0003	0.0005	0.0040	0.0028	0.0012
60-64	0.0010	0.0008	0.0084	0.0057	0.0024
65-69	0.0007	0.0000	0.0035	0.0030	0.0008
70-74	0.0041	0.0000	0.0008	0.0013	0.0008
75-79	0.0000	0.0000	0.0002	0.0006	0.0008
80	0.0000	0.0000	0.0000	0.0000	0.0000

DISABILITY RATES

Actual, Old, and New Disabled Retirement Rates

PERS-TRS-SERS

	PERS-TRS-SERS Plans 2 Disability Rates			
	Actual	Old		New
Age	Male/Female	Male	Female	Male/Female
20-24	0.0000	0.0000	0.0000	0.0000
25-29	0.0000	0.0001	0.0000	0.0001
30-34	0.0000	0.0001	0.0001	0.0001
35-39	0.0001	0.0002	0.0002	0.0002
40-44	0.0002	0.0003	0.0003	0.0002
45-49	0.0005	0.0006	0.0006	0.0005
50-54	0.0010	0.0013	0.0013	0.0015
55-59	0.0028	0.0042	0.0037	0.0030
60-64	0.0056	0.0092	0.0075	0.0060
65-69	0.0015	0.0035	0.0029	0.0020
70-74	0.0022	0.0008	0.0008	0.0020
75-79	0.0059	0.0002	0.0002	0.0020
80	0.0000	0.0000	0.0000	0.0000

	PERS-TRS-SERS Plans 3 Disability Rates			
	Actual	Old		New
Age	Male/Female	Male	Female	Male/Female
20-24	0.0000	0.0000	0.0000	0.0000
25-29	0.0000	0.0000	0.0000	0.0001
30-34	0.0000	0.0001	0.0001	0.0001
35-39	0.0000	0.0001	0.0002	0.0001
40-44	0.0001	0.0003	0.0002	0.0001
45-49	0.0002	0.0006	0.0003	0.0002
50-54	0.0005	0.0012	0.0008	0.0006
55-59	0.0006	0.0032	0.0023	0.0012
60-64	0.0011	0.0069	0.0049	0.0024
65-69	0.0009	0.0027	0.0022	0.0008
70-74	0.0018	0.0006	0.0008	0.0008
75-79	0.0000	0.0001	0.0003	0.0008
80	0.0000	0.0000	0.0000	0.0000

DISABILITY RATES

Actual, Old, and New Disabled Retirement Rates
PSERS

PSERS Plan 2 Disability Rates								
	Actual		Old				New	
			MS < 10		MS >= 10		MS < 10	MS >= 10
Age	Male	Female	Male	Female	Male	Female	Male/Female	
20-24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25-29	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0002
30-34	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002
35-39	0.0000	0.0000	0.0002	0.0002	0.0002	0.0003	0.0002	0.0003
40-44	0.0000	0.0000	0.0002	0.0003	0.0004	0.0004	0.0002	0.0003
45-49	0.0005	0.0000	0.0005	0.0005	0.0008	0.0008	0.0005	0.0008
50-54	0.0006	0.0013	0.0009	0.0010	0.0018	0.0019	0.0015	0.0025
55-59	0.0016	0.0013	0.0026	0.0028	0.0057	0.0056	0.0030	0.0045
60-64	0.0062	0.0078	0.0079	0.0077	0.0000	0.0000	0.0060	0.0090
65-69	0.0000	0.0000	0.0061	0.0053	0.0000	0.0000	0.0020	0.0030
70-74	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0020	0.0030
75-79	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0020	0.0030
80	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

DISABILITY RATES

Actual, Old, and New Disabled Retirement Rates

LEOFF

LEOFF Plan 1 Disability Rates				
	Actual		**Old**	**New**
Age	**Male**	**Female**	**Male/Female**	**Male/Female**
20-24	0.0000	0.0000	0.0008	0.0000
25-29	0.0000	0.0000	0.0032	0.0000
30-34	0.0000	0.0000	0.0090	0.0000
35-39	0.0000	0.0000	0.0154	0.0000
40-44	0.0000	0.0000	0.0231	0.0000
45-49	0.0000	0.0000	0.0440	0.0000
50-54	0.0000	0.0000	0.0657	0.0000
55-59	0.0000	0.0000	0.0790	0.0000
60-64	0.0000	0.0000	0.0840	0.0000
65-69	0.0000	0.0000	0.0480	0.0000
70-74	0.0000	0.0000	0.0000	0.0000
75-79	0.0000	0.0000	0.0000	0.0000
80	0.0000	0.0000	0.0000	0.0000

LEOFF Plan 2 Disability Rates				
	Actual		**Old**	**New**
Age	**Male**	**Female**	**Male/Female**	**Male/Female**
20-24	0.0000	0.0000	0.0001	0.0000
25-29	0.0001	0.0000	0.0003	0.0001
30-34	0.0001	0.0009	0.0006	0.0002
35-39	0.0004	0.0024	0.0011	0.0010
40-44	0.0009	0.0022	0.0015	0.0010
45-49	0.0011	0.0036	0.0023	0.0020
50-54	0.0037	0.0059	0.0041	0.0040
55-59	0.0058	0.0095	0.0069	0.0060
60-64	0.0063	0.0119	0.0119	0.0070
65-69	0.0039	0.0000	0.0039	0.0036
70-74	0.0000	0.0000	0.0000	0.0036
75-79	0.0000	0.0000	0.0000	0.0036
80	0.0000	0.0000	0.0000	0.0000

Actual, Old, and New Disabled Retirement Rates

WSPRS

WSPRS Plans 1/2 Disability Rates			
	Actual		Old	New
Age	Male	Female	Male/Female	Male/Female
20-24	0.0000	0.0000	0.0001	0.0003
25-29	0.0005	0.0000	0.0001	0.0003
30-34	0.0003	0.0000	0.0002	0.0003
35-39	0.0000	0.0000	0.0003	0.0003
40-44	0.0003	0.0033	0.0006	0.0003
45-49	0.0011	0.0000	0.0011	0.0015
50-54	0.0028	0.0000	0.0019	0.0015
55-59	0.0000	0.0000	0.0015	0.0015
60-64	0.0000	0.0000	0.0003	0.0015
65-69	0.0000	0.0000	0.0000	0.0015
70-74	0.0000	0.0000	0.0000	0.0015
75-79	0.0000	0.0000	0.0000	0.0015
80	0.0000	0.0000	0.0000	0.0000

THREE: APPENDICES

MORTALITY RATES

Methodology

Actual mortality rates are calculated as follows. For each year and retirement plan, we counted the number of deaths during the year and divided it by the number of members alive at the beginning of the year. This underlying data serves as the basis for setting our mortality assumptions.

We approached this analysis in three steps.

- ❖ First, we looked for a trend in the data to determine how mortality rates are improving over time. The results of this analysis, outside expert opinions, and our own professional judgment were used in selecting a mortality improvement scale.

- ❖ Next, we reviewed published base mortality tables to determine which tables would be the best fit for our retirement systems.

- ❖ Finally, we compared our actual mortality rates during the 2006-2017 period to our new base tables (projected to the mid-point of the period) for purposes of establishing age offset assumptions for each retirement system.

At each step of the process we gave consideration to our amount of data. Data is considered more credible the larger the available sample size. When very precise assumptions are set, such as a mortality rate at a specific age, full credibility in the data becomes harder to obtain. With insufficient credibility, analysis of the data can be a misleading or an inaccurate representation of the population as a whole. To increase the reliability of our results, we used a published mortality table as a basis for our mortality tables, grouped our data when appropriate, and withheld making individualized assumptions for certain plans.

Analysis

Mortality Improvement Scale

To select a mortality improvement scale, we relied on our professional judgment, expert opinion, and analysis on historical mortality improvement. Due to the volatility of mortality improvement over the past few decades, it is insufficient to rely on historical experience alone when setting this assumption.

We began our analysis by reviewing our actual mortality experience from 1984-2017 and looking at the improvement in mortality by age. We primarily focused our analysis on data combined from all systems. We also examined PERS and TRS separately, since those two systems accounted for more than 90 percent of deaths across all time-frames studied.

We found that the experienced rate of mortality improvement, or decrease in mortality rates, has varied significantly over time. There was a noticeable peak in mortality improvement in the early 2000s followed by a steady decline. This mirrors the trend seen in national data.[1] Below is an illustration on how annual mortality improvement for Washington plans has changed under various time frames. For more information on historical trends in mortality, please see the **Brief History of Mortality Improvement**.

All Observations		
Data Range		Annualized Improvement
1984	**2017**	0.86%
1990	**2017**	0.96%
1996	**2017**	1.36%
2002	**2017**	1.48%
2008	**2017**	1.03%

[1]*Institute and Faculty of Actuaries, Longevity Bulletin: Is the tide turning? (July 2017).*

MORTALITY RATES

After examining the mortality improvement in our data, we compared the results of our analysis to our current assumption of Scale BB and the more recent published scales by SOA.

The SOA's Retirement Plans Experience Committee (RPEC) has developed numerous scales including: Scale AA, Scale BB, and a series of yearly two-dimensional (i.e., rates that vary by age and calendar year) mortality improvement scales. At the time this study began, the MP-2017 Scale was the most recently published scale.

Scale BB was published in 2012 to provide a temporary replacement of Scale AA. This was considered necessary because the rates of mortality improvement in the US differed significantly from those predicted by Scale AA in the early 2000s. RPEC developed Scale BB to provide an intermediary improvement scale before the publication of the two-dimensional MP-2014 scale.[2] The rates predicted by Scale BB differ depending on a person's age and gender. Below is an illustration of the annual mortality improvement rates predicted by Scale BB over various ages.

Scale BB
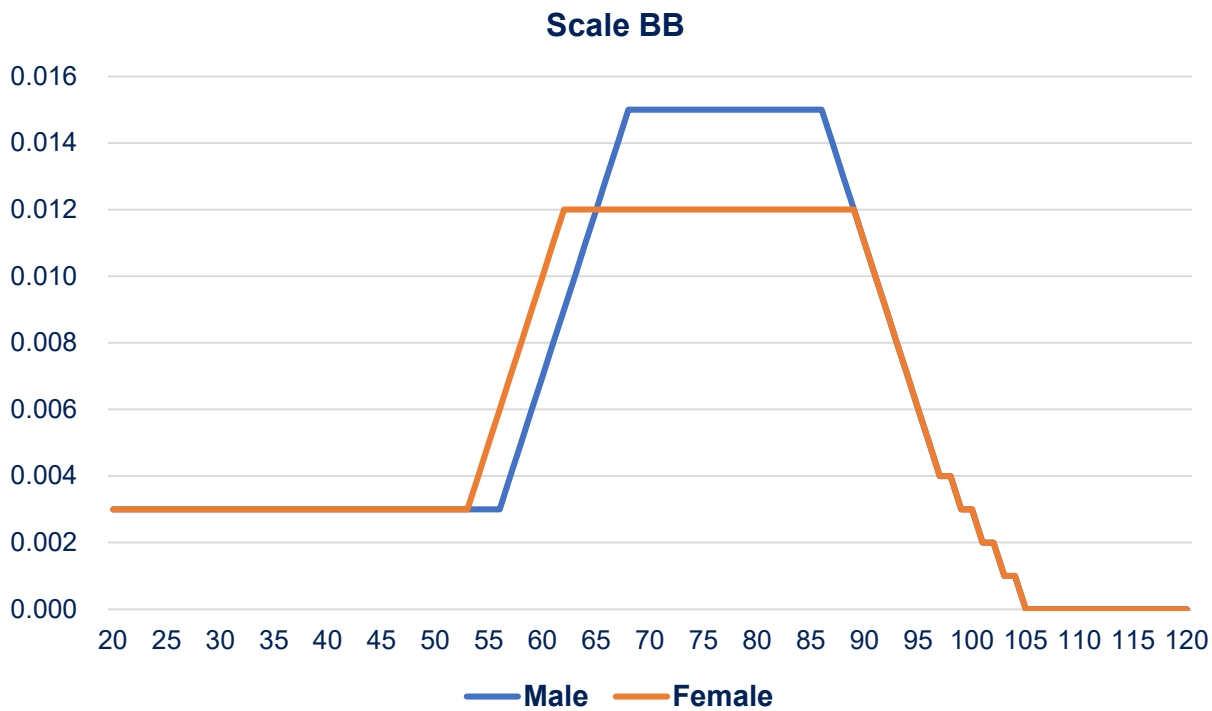
The newest two-dimensional mortality improvement scales project future mortality improvement by gender, age, and calendar year before merging into a single long-term expected rate by age.[3] The short-term mortality improvements in the MP-2017 scale rely more heavily on recent experience, and the long-term rates are based on expert opinion. The convergence from short-term to long-term rates is done over a time period of 20 years.[4] The two-dimensions of the short-term MP-2017 rates are a change from less recent scales which only differentiated by age and gender. The mortality improvement rates for each calendar year can fluctuate from the long-term rate as illustrated below. For more information on the history of mortality improvement scales, please see the **Brief History of Mortality Improvement**.

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[2] *SOA, Mortality Improvement Scale BB Report (September 2012).*
[3] *SOA, Mortality Improvement Scale MP-2017 (October 2017).*
[4] *SOA, Mortality Improvement Scale MP-2014 Report (October 2014).*

MORTALITY RATES
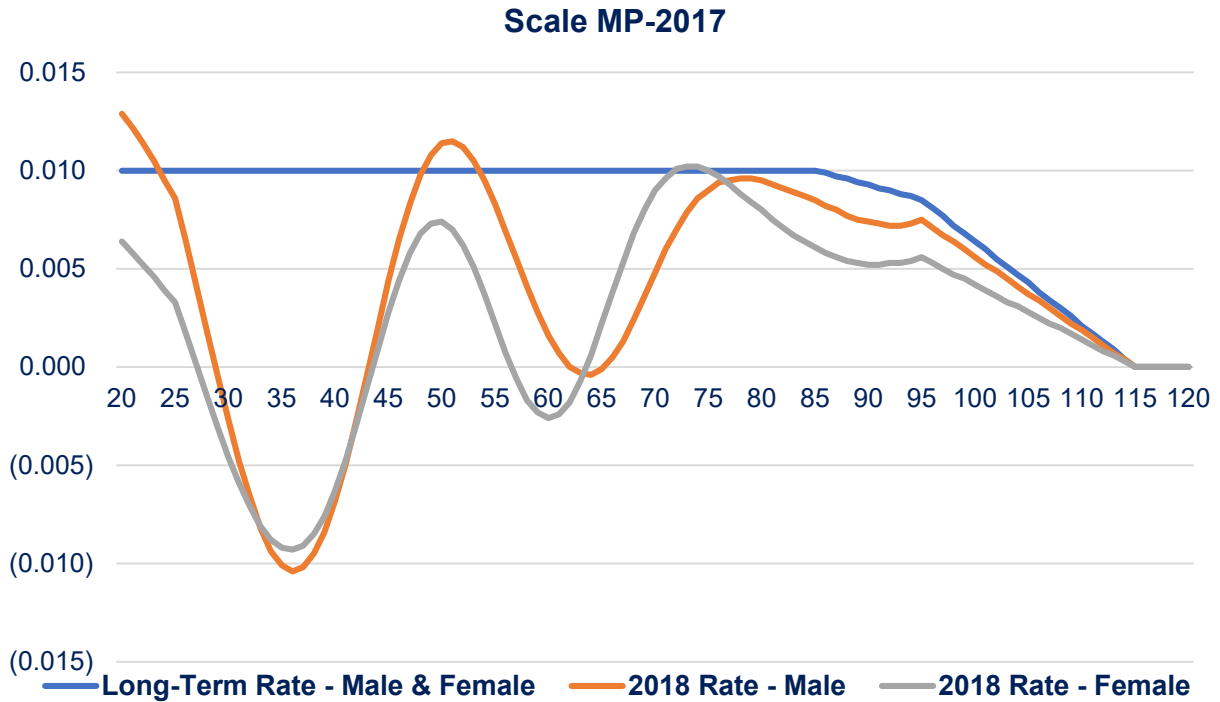
Scale MP-2017

In selecting the appropriate mortality improvement scale for our systems, we examined how our historical trends compared to Scale BB, the long-term rates predicted by MP 2017, and the two-dimensional MP-2017.

We focused our historical analysis on ages 40 to 94, the ages in which more than 90% of deaths occur. We performed our analysis by looking at the average annualized mortality improvement over several time periods weighted by the number of deaths at each age. To compare our results to the two-dimensional MP-2017, we took the predicted average mortality improvement over the applicable time frame. We considered our result at each age in addition to grouped ages by increments of five. We determined that the difference between the two approaches would not change our conclusions.

For the one-dimensional Scale BB and MP-2017 long-term rates, we compared how well the scales fit actual mortality improvement in our data using the five-year incremental grouping technique. Below is a chart of the various fits over different time frames. Please note that an A/E ratio less than 1.00 indicates actual mortality improvement was less than predicted by the applicable scale, and an A/E ratio greater than 1.00 indicates actual mortality improvement outpaced the rates of the applicable scale.

MORTALITY RATES *continued*

	All Observations		
Data Range	**Annualized Improvement**	**Actual/ Expected Scale BB**	**Actual/Expected MP-2017 Long-Term Rate**
1984 2017	**0.86%**	80%	85%
1990 2017	**0.96%**	91%	96%
1996 2017	**1.36%**	123%	137%
2002 2017	**1.48%**	130%	148%
2008 2017	**1.03%**	80%	103%

The past performance of the full MP-2017 scale to actual experience offers less insight into future performance. The yearly calendar rates are based on actual year-to-year performance of mortality improvement based on social security data. However, future predictions made by the MP-2017 scale do not have this benefit of hindsight. Therefore, the fit of this scale to our actual experience can indicate whether actual experience matches that of the nation as a whole, but it does not offer much insight into future performance. We found the fit of the two-dimensional scale comparable to the fit of the one-dimensional scales summarized in the prior table. To determine whether a two dimensional scale would be an appropriate scale for Washington State plans, we considered our analysis, expert opinion, and the drawbacks of using a more complex scale.

Based on our analysis, and additional considerations, we selected the long-term MP-2017 rates as our new mortality improvement scale. Using the long-term MP-2017 rates incorporates expert opinion on long-term trends without the downside of using an overly complex two-dimensional scale. Additionally, we found the simpler long-term rates did a better job predicting mortality improvement than the two-dimensional scale in recent years.

Over the course of our study, SOA published the MP-2018 Scale. The long-term improvement rate of 1 percent, however, remains the same between MP-2017 and MP 2018. Due to the reasons outlined above, we determined our final recommendation would not change if we updated our analysis to examine the fit of the MP-2018 Scale. For more information on our selection, please see the **Results** section below.

Once a mortality improvement scale is selected, it can be applied in one of two ways. The first, a "static" approach, anticipates a fixed level of mortality for all current and future annuitants receiving benefits from a retirement plan. The second, a "generational" approach, assigns a unique mortality table to every future year that reflects the forecasted improvements. There is a general trend in the retirement industry of moving more towards the latter approach. We apply our current mortality improvement scale on a generational basis and will continue to do so.

Base Mortality Table

Since our prior experience study, SOA has published two new groups of mortality tables. These newer tables both incorporate the more recent nationwide experience in mortality but differ in the populations studied. The first publication in 2014 was the RP 2014 Mortality Tables (RP-2014) Report. This study was based on data collected from private sector entities only.[1] As a result of comments received, RPEC initiated a new study of US public pension plans in January 2015 to develop tables based exclusively on public-sector pension experience.[2] The final publication of the Pub-2010 Public Retirement Plans Mortality Tables Report was in January 2019. In our analysis we examined the use of our old RP-2000 tables and the RP-2014 tables, but primarily focused on the new Pub-2010 tables developed using nationwide public plan mortality experience. For more information on the RP-2014 tables, please see the **Additional Considerations**.

To determine the overall fit of the different mortality base tables to our observations, we compared the number of actual deaths by age to the amount of expected deaths using the various base mortality tables. If the actual deaths match closely to the expected deaths as predicted by the table, it means the table is a good fit for our population. We observed how well the base table matched our mortality experience from 2006 to 2017. To take into account mortality improvement during this window, we projected the base mortality table to the mid-point of the time period using our selected mortality improvement scale.

The Pub-2010 group of tables contain rates developed under both a "headcount" weighted basis, denoted with an addition of H in the name (Pub.H-2010), and a "liability" weighted basis with no additional notation. The headcount-weighted tables give equal weight to each observed death. The liability-weighted tables, however, give more weight to the deaths of retired members who received larger benefits or active members with higher salaries. A liability-weighted table therefore could potentially be a better representation of how liabilities are impacted by mortality. For instance, if members with larger benefits lived longer, on average, than members with smaller benefits, a liability-weighted table could be a better match for predicting the amount of funds needed to provide future benefits to members. The mortality rates themselves will differ under these two methods but not the way in which the mortality rates are applied. We considered using a liability-weighted table but determined the headcount-weighted tables are more appropriate.

The Pub-2010 tables also vary by a number of factors, including:

- ❖ The type of retirement system employment: teachers, public safety, or general;
- ❖ The status of the plan participant: employee, retiree, or contingent survivor; and
- ❖ Whether the table is applied to a member with a disability.

[1]_SOA, RP-2014 Mortality Table Report (October 2014)._
[2]_SOA, Pub-2010 Public Retirement Plans Mortality Tables Report (January 2019)._

MORTALITY RATES

When developing the new Pub-2010 tables, RPEC observed a significant difference in mortality based on the participants' job type.[2] As such, they developed separate employee and retiree mortality tables for teachers, public safety, and general employees detonated with a T (PubT-2010), S (PubS-2010), and G (PubG-2010), respectively. The contingent survivor tables are the same across the three job categories. The table below outlines the types of data used by RPEC in the development of each category.

Pub-2010 Tables	
Table	**Job Categories**
PubT-2010	School teachers and college/university professors
PubS-2010	Police officers, firefighters, and correctional officers
PubG-2010	All other types of public plan members

We reviewed the fit of the various tables to our systems to find the best overall fit. To analyze these tables, we calculated an A/E ratio to understand how they compare to plan experience during our study period. The "actual" represents the actual number of deaths we observed during the study period, and the "expected" represents the number of deaths predicted by the applicable table based on the number of members (exposures). When calculating a total A/E ratio for each job category, we applied the employee mortality table to our active and term-vested experience, the retiree table to our retiree experience, and the contingent survivor table to our survivor experience. In general, an A/E ratio less than 1.00 indicates lower actual rates of death relative to the mortality predicted by the tables. We see a ratio above 1.00 when the number of deaths are higher than predicted by the tables.

Fit of Pub.H-2010 Tables (2006-2017)*				
System/Table	**PERS**	**TRS**	**SERS**	**LEOFF**
PubT.H-2010	N/A	99%	128%	N/A
PubS.H-2010	N/A	N/A	N/A	96%
PubG.H-2010	102%	81%	99%	93%

PSERS and WSPRS have limited mortality experience. For a discussion on setting those systems' assumptions, please see the **Results section.*

RPEC also noticed a notable difference in mortality rates for members of the same age dependent on their member status.[2] Most significantly, retired members tended to have higher rates of mortality than employed members of the same age. We reviewed the use of either separate tables for employees, retirees, and contingent survivors or a single blended table by age. We concluded separate tables are most suitable for our plans.

When developing the contingent survivor table, RPEC used data from beneficiaries after the death of the retiree. We examined whether these rates were appropriate to use for all beneficiaries and determined a blended table of retiree and contingent survivor mortality rates would provide a more reasonable fit. Please see the **Additional Considerations** section for more details.

The Pub-2010 disabled mortality rates vary by whether the member disables from a public safety job or not. The disabled mortality rates for former members of public safety jobs is generally lower. This may seem unintuitive at first, but public safety jobs tend to have lower requirements for disability due to the higher physical demands needed to perform the job duties. We examined the appropriateness of each table to our disabled mortality experience and found the job-delineated tables are reasonable. This includes LEOFF 1 in which we previously assumed healthy mortality rates for disabled retirees. We found the new public safety specific disabled mortality table provided a better fit than using healthy mortality rates.

[2]SOA, Pub-2010 Public Retirement Plans Mortality Tables Report (January 2019).

THREE: APPENDICES

MORTALITY RATES

Age Offsets

Age offsets are the result of analyzing the difference between our actual mortality experience and the underlying base tables to produce a better fit of our population demographics. In other words, we use our new Pub.H-2010 base tables as a base reference point, then adjust the table to better model our experience. For example, we might determine that the experience of our plans is more similar to the rates in the new base table of individuals who are a year younger (a negative age offset).

To analyze the fit of different age offsets, we project the base Pub.H-2010 tables to the midpoint of the 12-year study period (2011) using the chosen mortality improvement scale. Similar to selecting our base tables, we calculated an A/E ratio to understand how our assumptions compare to plan experience in our study period. In general, an A/E ratio less than 1.00 indicates lower actual rates of death relative to our assumption. We see a ratio above 1.00 when the number of deaths are higher than we assume. The following table provides a high-level overview of the A/E experience under a variety of age offsets.

Weighted Average A/E Experience*							
PERS (PubG.H-2010 Base Tables)				TRS (PubT.H-2010 Base Tables)			
Offsets	Male	Offsets	Female	Offsets	Male	Offsets	Female
(1)	1.12	(1)	1.16	(1)	1.11	(1)	1.12
0	1.00	0	1.04	0	0.98	0	0.99
1	0.90	1	0.93	1	0.88	1	0.88
SERS (PubG.H-2010 Base Tables)				LEOFF (PubS.H-2010 Base Tables)			
Offsets	Male	Offsets	Female	Offsets	Male	Offsets	Female
(1)	1.13	(1)	1.11	(2)	1.11	(1)	1.18
0	1.01	0	0.98	(1)	0.99	0	1.07
1	0.90	1	0.87	0	0.89	1	0.96

Age offsets applied uniformly to each employee, retiree, or contingent survivor table.

Note: We did not include PSERS and WSPRS in this table due to the lack of data.

It is useful to consider the amount of data we have available when selecting age offsets by system. Please note that the analysis for larger systems, such as PERS and TRS, have more data than the smaller systems such as WSPRS and SERS. For more information on our considerations into the credibility of our analysis, please see the **Results** section.

The following table outlines the number of deaths during our 2006-2017 study period.

Observed Deaths in Non-Disabled Population							
2006-2007	PERS	TRS	SERS	PSERS	LEOFF	WSPRS	Total
Male	15,197	5,241	860	28	1,091	146	22,563
Female	18,858	7,527	1,368	9	791	62	28,615
Total	**34,055**	**12,768**	**2,228**	**37**	**1,882**	**208**	**51,178**

We also conducted this analysis for our disabled mortality using the selected base mortality tables. We examined LEOFF 1 independently because we historically found the published disabled retiree tables were not a good fit for this system. This no longer is the case with the public plan tables. For more information, please see the **Base Mortality Table** section. The following table illustrates a high-level overview of the A/E experience under a variety of age offsets.

MORTALITY RATES
continued

Weighted Average A/E Experience - Disabled Retiree Tables							
LEOFF 1 (PubH.S-2010)		LEOFF 2 & WSPRS (PubH.S-2010)		PERS, SERS, & TRS (PubH.G-2010)			
Offsets	Male	Offsets	Male	Offsets	Male	Offsets	Female
(2)	1.14	(2)	1.36	0	1.16	0	1.17
(1)	1.04	(1)	1.25	1	1.10	1	1.10
0	0.95	0	1.16	2	1.03	2	1.03
1	0.86	1	1.05	3	0.97	3	0.97
Deaths	**1049**		**41**		**1009**		**1195**

The following table shows the counts of actual deaths of members with disabilities in the plans between 2006 and 2017.

Observed Death of Persons with Disabilites							
2006-2017	PERS	TRS	SERS	LEOFF 1	LEOFF 2	WSPRS	Total
Male	824	135	50	1,049	27	14	2,099
Female	899	223	73	10	0	1	1,206
Total	**1,723**	**358**	**123**	**1,059**	**27**	**15**	**3,305**

Brief History of Mortality Improvement

For many decades, there has been a steady decline in mortality rates. However, the actual rate of mortality improvement has been volatile and difficult to predict based on historical experience. In an attempt to pin down future mortality rates, numerous mortality improvement scales have been published in recent history.

Scale AA was the first mortality improvement scale used to capture future mortality improvements for Washington State plans. First developed by SOA in 1994, it has been widely used in recent years to forecast improvement for the RP-2000 tables. Scale AA was based entirely on the historic mortality experience of the Social Security Administration and the Civil Service Retirement System (CSRS) between 1977 and 1993.[1]

In September 2012, RPEC released a paper with Scale BB based on data up to 2007. An analysis performed by RPEC showed "that the rates of mortality improvement in the U.S. over the recent past have differed quite substantially from those predicted by Scale AA."[1] In particular, a study published by SOA in November 2011, Report of the Group Annuity Experience Committee Mortality Experience for 2003-06, found that overall mortality rates improved 2.5 percent faster than Scale AA from 2001 to 2006 by lives.[2] In response, RPEC wished to provide a short-term alternative to Scale AA based on more recent data, and newly developed techniques, before the release of the next generation two-dimensional pension mortality improvement scales.[1] Scale BB is the mortality improvement scale used for Washington State plans prior to this study.

Using the same conceptual framework as Scale BB, RPEC released MP-2014 in October 2014 as a companion to the RP-2014 mortality tables.[3] The MP-2014 table varies by both gender and calendar year. Developed using the CMI Mortality Projections model, the new mortality improvement scale was based on three key concepts:

- ❖ "Recently observed experience is the best predictor of future near-term mortality improvement rates.
- ❖ Long-term rates of mortality improvement should be based on 'expert opinion' and analysis of longer-term mortality patterns.
- ❖ Near-term rates should transition smoothly into the assumed long-term mortality improvement rates over appropriately selected convergence periods."

[1]*SOA, Mortality Improvement Scale BB Report (September 2012).*
[2]*Report of the Group Annuity Experience Committee Mortality Experience for 2003-06; November 2011.*
[3]*SOA, Mortality Improvement Scale MP-2014 Report (October 2014).*

MORTALITY RATES

Since 2014, RPEC has released annual updates to the two-dimensional scale that incorporates newer data provided by SSA. The most recent scale at the time of this study, MP-2017, reflects historical U.S. population mortality experience through 2015.[4]

Recent national data shows a trend of mortality improvement slowdown. In 2017, SOA, the Institute and Faculty of Actuaries (United Kingdom), and the Canadian Institute of Actuaries jointly published a study on recent mortality improvement, Longevity Bulletin: Is the tide turning?[5] The study found that mortality improvement was significantly slower from 2011-2015 compared to 2000-2011. In the U.S., it was reported that average annual rise in life expectancy for age 65 fell 66 percent between these two time frames. Below is a table from the report illustrating changes in life expectancy and how mortality improvement in the U.S. has slowed in recent years.
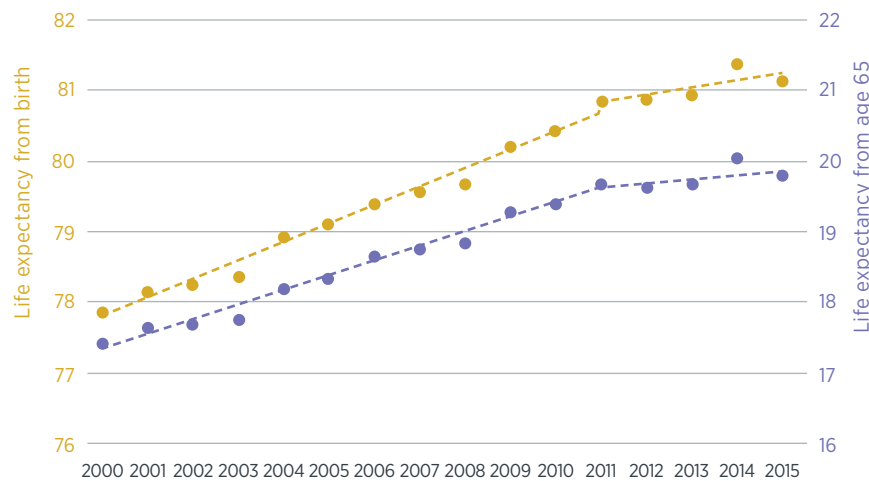
Note: Table shows U.S. period life expectancy at birth and age 65, males and females combined, based on 2000 to 2015 data from the Human Mortality Database.

The mortality improvement slowdown reinforces our decision to move to the long-term rates of MP-2017 given the high mortality improvement predicted for some ages under Scale BB.

[4]*SOA, Mortality Improvement Scale MP-2017 (October 2017).*
[5]*Institute and Faculty of Actuaries, Longevity Bulletin: Is the tide turning? (July 2017).*

Additional Considerations

Mortality Improvement Scale

We ultimately selected our new mortality improvement scale based on combined data for all of the retirement systems. However, we also examined PERS and TRS separately as our two largest systems. We concluded our selection would remain the same under each scenario. The following table illustrates the annualized mortality improvement for ages 40 to 94 for PERS, TRS, and all of the retirement systems combined.

Annualized Mortality Improvement			
Data Range	**PERS**	**TRS**	**All Systems**
1984 2017	0.83%	0.80%	0.86%
1990 2017	0.87%	1.02%	0.96%
1996 2017	1.40%	1.16%	1.36%
2002 2017	1.45%	1.38%	1.48%
2008 2017	0.88%	1.35%	1.03%

Furthermore, we tested the sensitivity of the results to the weighting method selected. Under our selected approach, we apply more credibility to age groups that experience more deaths. Specifically, we base our weighting on the number of deaths experienced from 2006-2017. We analyzed the sensitivity of our results using different timeframes to develop our weights. We found the annualized mortality improvements under different weighting techniques did not differ significantly. For example, from 1984 to 2017, the combined annual mortality improvement of all systems fluctuated from 0.87 percent to 0.91 percent using different weighting techniques.

Base Table Type

In determining which base table to select, we performed analysis on PERS to examine the utility of a liability-weighted approach, rather than a headcount-weighted approach for the healthy population. We studied PERS because of the large dispersion in member salaries and benefits in the system. It also has the largest amount of experience data and thus the most credible analysis.

Under the liability-weighted approach our basic methodology remained the same. However, instead of assigning a value of one to each observation, we assigned the corresponding salary for employees or the pension benefit amounts for annuitants. Therefore, this method assigns more weight to members who receive higher salaries or pension benefits. For annuitants, this method assigns weight dependent on the liabilities carried by each member. Another method would be using the final average salary of annuitants. Using a member's final average salary rather than pension benefit could be a better indication of mortality in terms of socioeconomic status. For example, a member could have high pre-retirement income but a low pension benefit if they weren't members of the retirement systems for very many years.

For liability-weighted assumptions, we followed the same process for determining the base mortality tables, and the appropriate age offsets, as outlined in the **General Methodology** section of the **Mortality Rates Summary**. To select a base mortality table, we examined the Pub-2010 group of mortality tables. We determined we would select the PubG-2010 base table with separate employee, retiree, and contingent survivor tables.

THREE: APPENDICES

MORTALITY RATES

Similar to the headcount-weighted approach, to determine appropriate age offsets under the liability-weighted approach, we projected the PubG-2010 tables to the midpoint of the 12-year study period (2011) using the long-term MP-2017 rates. We then compared our actual experience to our expected experience using different age offsets. The following table provides a high-level overview of the Actual to Expected (A/E) experience under a variety of age offsets for PERS.

Weighted Average A/E Experience			
PERS Using Liability-Weighted Method			
Offsets	Male	Offsets	Female
(1)	1.19	(1)	1.22
0	1.08	0	1.10
1	0.97	1	0.99

As indicated by this analysis, we would select an age offset under this method of +1 for both males and females for all PERS plans. In other words, we expect both males and females to have higher rates of mortality than those suggested by the PubG-2010 tables. This differs from the headcount mortality tables and analysis which indicated no age offsets provided the best fit.

After determining the corresponding age offsets that we would apply, we ran both best estimate assumptions under the two methodologies in our valuation model to evaluate the relative liability impact to PERS of selecting one approach over another. Using the liability-weighted approach, we observed a roughly 0.2 percent lower present value of future benefits for PERS 2/3 compared to the headcount-weighted approach.

That said, we found the PubG.H-2010 rates approach provided a better fit to our liability-weighted observed mortality experience than the PubG-2010 tables when removing any age offsets. Furthermore, when you consider the large degree of uncertainty in each underlying assumption, we do not believe the difference is large enough to warrant a change in method.

Additionally, we have lower quality data for the liability-weighted analysis than the headcount-weighted analysis. We find the headcount-weighted approach less complex and easier to explain to policymakers and other stakeholders, while still providing a reasonable estimate for future mortality experience. Separately, we considered the use of blended employee and retiree mortality assumptions but found our experience data has a better overall fit with status specific rates. We will continue to revisit this method in future mortality studies.

Beneficiary Mortality Rates

RPEC describes three different approaches for applying the beneficiary mortality rates in the Pub-2010 Public Retirement Mortality Tables Report,

1. Assume the same mortality basis as the retiree except using the rates applicable to the beneficiary's gender.
2. Use the retiree basis while the retiree is alive but use the contingent survivor mortality rates after the death of the retiree.
3. Assume the contingent survivor mortality rates for the beneficiary both before and after the death of the retiree.

We believe the second approach to be the most appropriate but, due to current software limitations, we are unable to adopt this method. In order to approximate this method, we developed contingent survivor mortality tables by major occupation category using this approach for non-public safety plans,

❖ For beneficiaries less than 70 years old, we will use the occupation-specific retiree table using the beneficiary's gender.

❖ For beneficiaries between 70 and 79 years old, we will use a linearly-interpolated blend of the occupation-specific retiree and contingent survivor tables. In other words, the earlier ages would receive greater weight to the retiree table, and as the age approaches 79, greater weight would be given to the contingent survivor table.

❖ For beneficiaries greater than or equal to 80 years old, we will use the public plan contingent table.

For beneficiary mortality in public safety plans, we will use the same approach but blend the rates over the ages 60-69 and take into consideration any age offsets we selected. We chose younger ages for this transition period with public safety plans primary due to differences in plan design that may lead to higher levels of widow(er)s receiving benefits at earlier ages.

RP-2014 Base Tables

When selecting our new mortality tables, we primarily focused on SOA tables developed using public plan mortality data. However, we also compared our experience to the RP-2014 tables developed using data from private sector entities.

The RP-2014 tables include projections from 2006 to 2014 using the MP-2014 mortality improvement scale. When analyzing the fit of the various RP-2014 mortality tables, we adjusted the tables back to their base year of 2006 and then projected the tables forward using our new mortality improvement scale assumption. Pub-2010 does not include projections, and therefore a preliminary adjustment to the base year was not necessary in our analysis of Pub-2010.

The RP-2014 mortality tables can vary by a number of factors including:

❖ Headcount-weighted and liability-weighted,

❖ The status of the member: annuitant or employee,

❖ The group characteristics: blue collar, white collar, or the total dataset, and

❖ Whether the member is disabled.

We reviewed the use of both headcount-weighted and liability-weighted approaches, and the use of either blue collar or white-collar mortality rates. For illustrative purposes, the following table compares the fit of the total dataset RPH-2014 tables (with blended active and annuitant rates based on a cumulative normal approximation) and no age offsets to the new, employment type, Pub.H-2010 tables. In general, a ratio less than 1.00 indicates lower actual rates of death relative to the mortality predicted by the tables. We see a ratio above 1.00 when the number of deaths are higher than predicted by the tables.

Fit of SOA Tables (2006-2017)*				
System/Table	PERS	TRS	SERS	LEOFF
Pub.H-2010	1.02	0.99	0.99	0.96
RPH-2014	0.90	0.72	0.68	0.87

The comparative analysis we performed supported our decision to use the Pub.H-2010 tables developed using public plan mortality data.

MORTALITY RATES

The new base mortality rates are summarized in the following tables. A complete list of our new base mortality tables can be found on our [website](). Please note these rates do not incorporate any mortality improvement or age offsets.

Selection of New Active and Terminated Vested Mortality Rates								
PERS & SERS (PubG.H-2010)			TRS (PubT.H-2010)			LEOFF, PSERS, & WSPRS (PubS.H-2010)		
Age	Male	Female	Age	Male	Female	Age	Male	Female
20	0.00039	0.00014	20	0.00036	0.00013	20	0.00043	0.00016
25	0.00035	0.00013	25	0.00022	0.00010	25	0.00043	0.00020
30	0.00045	0.00019	30	0.00028	0.00015	30	0.00048	0.00028
35	0.00059	0.00028	35	0.00035	0.00022	35	0.00054	0.00039
40	0.00081	0.00043	40	0.00048	0.00034	40	0.00067	0.00054
45	0.00118	0.00065	45	0.00076	0.00053	45	0.00092	0.00075
50	0.00177	0.00097	50	0.00126	0.00080	50	0.00133	0.00103
55	0.00261	0.00142	55	0.00193	0.00117	55	0.00195	0.00143
60	0.00376	0.00210	60	0.00294	0.00178	60	0.00300	0.00198
65	0.00543	0.00327	65	0.00484	0.00294	65	0.00480	0.00273
70	0.00815	0.00528	70	0.00796	0.00505	70	0.00880	0.00533
75	0.01275	0.00861	75	0.01206	0.00921	75	0.01615	0.01040
80	0.02027	0.01405	80	0.02345	0.01826	80	0.02963	0.02030
81+	Retiree Rates		81+	Retiree Rates		81+	Retiree Rates	

Selection of New Retiree Mortality Rates								
PERS & SERS (PubG.H-2010)			TRS (PubT.H-2010)			LEOFF, PSERS, & WSPRS (PubS.H-2010)		
Age	Male	Female	Age	Male	Female	Age	Male	Female
<50	Active Rates		<55	Active Rates		<45	Active Rates	
50	0.00503	0.00388	55	0.00295	0.00258	50	0.00275	0.00186
55	0.00634	0.00400	60	0.00419	0.00316	55	0.00375	0.00311
60	0.00808	0.00465	65	0.00649	0.00454	60	0.00625	0.00519
65	0.01125	0.00682	70	0.01156	0.00800	65	0.01031	0.00868
70	0.01822	0.01161	75	0.02181	0.01511	70	0.01736	0.01451
75	0.03102	0.02009	80	0.04086	0.02877	75	0.03149	0.02425
80	0.05391	0.03549	85	0.07551	0.05509	80	0.05703	0.04054
85	0.09385	0.06473	90	0.13749	0.10395	85	0.10313	0.06842
90	0.15781	0.12123	95	0.23152	0.18812	90	0.16904	0.11815
95	0.24131	0.19884	100	0.33591	0.29436	95	0.24754	0.19111
100	0.33591	0.29436	105	0.43069	0.39892	100	0.33591	0.29436
105	0.43069	0.39892	110	0.50000	0.48705	105	0.43069	0.39892
110	0.50000	0.48705	115	0.50000	0.50000	110	0.50000	0.48705
115	0.50000	0.50000	120	1.00000	1.00000	115	0.50000	0.50000
120	1.00000	1.00000				120	1.00000	1.00000

MORTALITY RATES

Selection of New Survivor Mortality Rates											
PERS & SERS			**TRS**			**PSERS**			**LEOFF & WSPRS**		
Age	**Male**	**Female**	**Age**	**Male**	**Female**	**Age**	**Male**	**Female**	**Age**	**Male**	**Female**
<60	Retiree Rates		**<60**	Retiree Rates		**<60**	Retiree Rates		**<60**	Retiree Rates	
60	0.00808	0.00465	**60**	0.00419	0.00316	**60**	0.00672	0.00540	**60**	0.00610	0.00540
65	0.01125	0.00682	**65**	0.00649	0.00454	**65**	0.01324	0.00992	**65**	0.01284	0.00992
70	0.01870	0.01200	**70**	0.01264	0.00872	**70**	0.02347	0.01587	**70**	0.02347	0.01587
75	0.03383	0.02249	**75**	0.02964	0.02023	**75**	0.03617	0.02449	**75**	0.03617	0.02449
80	0.05711	0.03958	**80**	0.05711	0.03958	**80**	0.05711	0.03958	**80**	0.05711	0.03958
85	0.09206	0.06761	**85**	0.09206	0.06761	**85**	0.09206	0.06761	**85**	0.09206	0.06761
90	0.14705	0.11912	**90**	0.14705	0.11912	**90**	0.14705	0.11912	**90**	0.14705	0.11912
95	0.23276	0.19502	**95**	0.23276	0.19502	**95**	0.23276	0.19502	**95**	0.23276	0.19502
100	0.33591	0.29436	**100**	0.33591	0.29436	**100**	0.33591	0.29436	**100**	0.33591	0.29436
105	0.43069	0.39892	**105**	0.43069	0.39892	**105**	0.43069	0.39892	**105**	0.43069	0.39892
110	0.50000	0.48705	**110**	0.50000	0.48705	**110**	0.50000	0.48705	**110**	0.50000	0.48705
115	0.50000	0.50000	**115**	0.50000	0.50000	**115**	0.50000	0.50000	**115**	0.50000	0.50000
120	1.00000	1.00000	**120**	1.00000	1.00000	**120**	1.00000	1.00000	**120**	1.00000	1.00000

Selection of New Disabled Retiree Mortality Rates					
PERS, TRS, & SERS (Pub.H-2010)			**LEOFF, PSERS, & WSPRS (PubS.H-2010)**		
Age	**Male**	**Female**	**Age**	**Male**	**Female**
20	0.004120	0.002330	**20**	0.00146	0.00053
25	0.00318	0.00177	**25**	0.00146	0.00065
30	0.00405	0.00270	**30**	0.00163	0.00089
35	0.00522	0.00407	**35**	0.00185	0.00121
40	0.00723	0.00629	**40**	0.00229	0.00166
45	0.01094	0.00985	**45**	0.00314	0.00229
50	0.01700	0.01484	**50**	0.00455	0.00317
55	0.02228	0.01742	**55**	0.00644	0.00545
60	0.02722	0.02040	**60**	0.00938	0.00873
65	0.03390	0.02457	**65**	0.01415	0.01245
70	0.04338	0.03151	**70**	0.02220	0.01892
75	0.05721	0.04354	**75**	0.03634	0.03229
80	0.08069	0.06428	**80**	0.06044	0.05323
85	0.11775	0.09913	**85**	0.10313	0.08139
90	0.16957	0.14492	**90**	0.16904	0.12602
95	0.24514	0.20373	**95**	0.24754	0.19704
100	0.33591	0.29436	**100**	0.33591	0.29436
105	0.43069	0.39892	**105**	0.43069	0.39892
110	0.50000	0.48705	**110**	0.50000	0.48705
115	0.50000	0.50000	**115**	0.50000	0.50000
120	1.00000	1.00000	**120**	1.00000	1.00000

THREE: APPENDICES

RETIREMENT RATES

Methodology

The retirement rates assumption represents our expected probability of retirement for eligible members. We compared the actual rate of retirement against what we expected to determine the accuracy of our retirement rates assumption over the study period. For each year and retirement plan, we counted the members who met the eligibility requirements at the beginning of the year (exposures) and the members who retired and started receiving retirement benefits during the year (retirements). We divided the number of retirements by the number of exposures to arrive at the actual rate of retirement. We compared the actual rate to the expected rate of retirement over the full period and on an annual basis. This helped us identify trends in the data where our assumption differed from what actually happened.

We developed new retirement rate assumptions by adjusting the old assumptions to more closely reflect historical experience. We analyzed the relation of actual to expected retirement rates in light of economic and demographic trends and applied our professional judgment to set new assumptions. In most cases, we did not develop a new assumption to perfectly replicate the study period. We targeted a smaller move than the study experience would indicate to account for future experience not exactly matching the past. We also considered simplifications to the assumption where we believe the additional complexity does not offer a significant increase in the modeling accuracy.

Analysis

We divided our analysis into the following two sections:

Review of Historical Data – Relying on historical data to set forward-looking retirement assumptions requires us to consider if that historical experience will be a good indicator of the future. In other words, if we believe historical data represents an outlier compared to what we think future retirement experience will be, we would consider excluding it from the study. In this assessment, we considered data from 1995-2017 to include in the study.

Review of Key Demographic Factors – With the historical data period selected, we considered population demographics that could influence retirement behavior. Some of the demographics we studied included amount of service, gender, and retirement plan selection. We developed rates for a specific population if we determined that a demographic factor had a large impact on retirement rates. In certain cases, we considered simplifying our assumption by removing specific rates for a demographic factor if we determined the factor did not significantly impact retirement behavior.

To review the historical data and demographic factors, we compared the actual number of retirements to our old expectation. We calculated an A/E ratio to help us determine trends in the data. An A/E ratio less than 1.00 generally indicates members are retiring later or at lower rates than the old assumption projects. While an A/E ratio of greater than 1.00 tells us members are retiring earlier or at higher rates than we assume. We developed a new assumption so that the A/E ratio moved closer to 1.00. Please see the **Exhibits** section for a comparison of A/E ratio between the old and new assumptions for each system.

THREE: APPENDICES

The following sections summarize our observations of the review of historical data and key demographic factors.

Review of Historical Data

We looked at different periods of data to determine how the systems have changed over time and what data we would include in the study. As noted in the **Summary** section, we excluded data for 2001 and 2007 because the valuation date changed in those years.

Plans 1 – PERS, TRS, LEOFF.

PERS and TRS Plan 1 show a trend of decreasing A/E ratios moving from 1995 toward 2017. In more recent years, LEOFF 1 members have retired at almost identical rates to our old assumption.

Plan 1 Retirement Experience by Year									
	PERS 1			**TRS 1**			**LEOFF 1**		
Year	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
1995-2012*	26,373	26,558	0.99	16,986	17,650	0.96	1,503	1,663	0.90
2013-2017	3,997	4,920	0.81	2,233	2,482	0.90	146	146	1.00
Total	**30,370**	**31,478**	**0.96**	**19,219**	**20,131**	**0.95**	**1,649**	**1,809**	**0.91**

*Does not include data from 2001 and 2007 because of changing valuation dates.

As of June 30, 2017, there were 2,597 PERS, 698 TRS 1, and 40 LEOFF 1 active members. We believe these members will likely act more similarly to recent retirees that have delayed retirement beyond our expectation. With this in mind, we developed the Plan 1 assumptions using the last five years of data (2013-2017).

Plans 2/3 – PERS, TRS, SERS.

In addition to excluding 2001 and 2007 data from the study, we also removed 2000 data from SERS. The Legislature created SERS in the year 2000 for school employees that were previously members of PERS. This year of data shows a large dip in the number of SERS actual retirements, which we believe is an outlier. We were able to gather SERS data prior to 2000 by selectively pulling data for PERS members employed at school districts that would have been eligible for SERS.

The prior experience study (2007-2012 Experience Study) used data from 1995-2006 to set assumptions for the Plans 2/3. We removed the 2008-2012 data from the prior study because of the large impact the Great Recession appeared to have on retirement behavior. In order to include this data, we needed additional experience to show either the system's recovery from the recession or a continued trend of later retirements. As of the current study (2013-2018 Experience Study), this data is now available, and it indicates the general trend of later retirements has continued through 2013-2017. Plans 2/3 are still relatively young plans and we are just now beginning to observe retirements for longer service employees (i.e., with at least 30 years of service). The inclusion of 2008-2017 is approximately 80 percent of the observed retirement experience for the entire study period.

Plan 2/3 Retirement Experience by Year									
	PERS 2/3			**TRS 2/3**			**SERS 2/3**		
Year	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
1995-2006*	7,050	7,187	0.98	1,432	1,786	0.80	2,887	2,988	0.97
2008-2012	9,518	12,690	0.75	2,638	5,903	0.45	3,318	5,708	0.58
2013-2017	16,320	21,235	0.77	5,745	11,331	0.51	6,159	9,710	0.63
Total	**32,888**	**41,113**	**0.80**	**9,815**	**19,020**	**0.52**	**12,364**	**18,407**	**0.67**

*Does not include data from 2001 and 2007 because of changing valuation dates. SERS 2/3 analysis also excludes the plan creation year 2000.

We observed a trend of decreasing A/E ratios when comparing the 1995-2006 period to the 2008-2012 and 2013-2017 periods for the Plans 2/3. We saw a consistent trend of fewer retirees than expected since 2008. With this in mind, we chose to set an assumption using data from 1995-2017 to address the observed trend of later retirements.

THREE: APPENDICES

RETIREMENT RATES *continued*

Public Safety Plans – LEOFF 2, WSPRS 1/2, PSERS 2.
The prior experience study (2007-2012 Experience Study) used data from 1995-2012 to set assumptions for LEOFF 2 and WSPRS 1/2. Unlike Plans 2/3, we did not exclude 2008-2012 because we did not observe a change in retirement behavior resulting from the Great Recession. The following table summarizes how the retirement behavior has changed since the prior experience study

Public Safety Retirement Experience by Year									
	LEOFF 2			WSPRS 1/2			PSERS 2		
Year	Actual	Expected	A/E	Actual	Expected	A/E	Actual	Expected	A/E
1995-2006*	522	705	0.74	352	329	1.07	0	0	0.00
2008-2012	1,089	1,440	0.76	127	118	1.07	15	6	2.45
2013-2017	2,122	2,115	1.00	226	173	1.31	117	77	1.52
Total	3,733	4,260	0.88	705	621	1.14	132	83	1.59

Does not include data from 2001 and 2007 because of changing valuation dates.

We observed more retirements in public safety plans than we had expected from 2013-2017. We believe this most recent data may represent a new trend in retirement behavior and is reasonable to include in our new assumption.

PSERS 2 opened July 1, 2006, and provided the option for eligible PERS 2/3 members to move into the new system. PSERS experienced 132 retirements during the study period. This experience represents insufficient data to set standalone PSERS retirement rates. Instead, we relied on PERS 2 to help inform our PSERS 2 retirement rates assumption and made subsequent adjustments to reflect differences in plan designs between the two systems. We will continue to monitor the appropriateness of the PSERS 2 retirement rates going forward and will make any necessary adjustments when needed.

Review of Key Demographic Factors

1. **Male versus Female Retirement Experience.**
   We previously assumed gender-specific retirement rates for all plans in PERS, TRS, SERS, and PSERS. The prior experience study (2007-12 Experience Study) had shown a trend of females typically retiring earlier than males.

   Plans 1 – PERS, TRS, LEOFF.
   The remaining Plan 1 active members are generally older than past retirees. Moving forward, we expect age to be the best indicator of retirement behavior and do not believe Plan 1 males and females will have different retirement behavior. Additionally, future retirements will have a small impact on the system funding due to the relatively small number of active members in the plans. We opted for a simplified approach of blending Plan 1 male and female rates and experience.

   Plans 2/3 – PERS, TRS, SERS.
   The new Plan 2/3 data indicated the difference in male and female rates is narrowing or even reversing compared to prior studies. The following table contains the average retirement age for 1995-2007 and 2008-2017.

Plan 2/3 Average Retirement Ages									
	TRS 2/3			PERS 2/3			SERS 2/3		
Year	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
1995-2007	62.9	62.6	0.35	64.9	64.7	0.18	65.4	63.7	1.73
2008-2017	63.4	63.9	-0.48	64.3	64.3	-0.02	66.1	64.8	1.28

In the future, we expect males and females to have similar retirement behavior and believe other population demographics are more indicative of retirement behavior. For purposes of assumption setting, we combined male and female data to set a gender-neutral set of retirement rates.

Public Safety Plans – LEOFF 2, WSPRS 1/2, PSERS 2.
We maintained the single set of gender-neutral retirement rates in LEOFF 2 and WSPRS 1/2 because of the heavy population weighting of the systems toward males. At this time, we do not have sufficient data to set gender-specific rates. We also created gender-neutral rates for PSERS 2 for consistency with PERS rates.

2. **Plan 2 versus Plan 3 Retirement Experience.**
   We studied retirement experience for Plan 2 and Plan 3 individually. The plans have fundamental differences in design, which we expected would lead to different retirement behavior. Plan 2 is a defined benefit plan, while Plan 3 is a hybrid of defined benefit and defined contribution. In prior studies, we had observed a difference in rates by plan, but lacked sufficient experience to set credible plan-specific rates.

Plan 2 vs. Plan 3 Retirement Experience (1995-2017)*									
	TRS 2/3			**PERS 2/3**			**SERS 2/3**		
Year	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
Plan 2	3,147	4,056	0.78	29,959	36,610	0.82	6,566	7,635	0.86
Plan 3	6,668	14,964	0.45	2,929	4,503	0.65	5,798	10,772	0.54
Total	**9,815**	**19,020**	**0.52**	**32,888**	**41,113**	**0.80**	**12,364**	**18,407**	**0.67**

*Does not include data from 2001 and 2007 because of changing valuation date. SERS 2/3 analysis also excludes the plan creation year 2000.

We observed Plan 3 members retiring later than Plan 2 members for all three systems. This trend also persists across almost every year of data in the study period. Given this strong trend, we developed separate retirement rates for Plan 2 and Plan 3 due to the different retirement behavior.

3. **LEOFF 2 Law Enforcement Officer and Firefighter Retirement Experience.**
   Experience indicates slightly different retirement behavior between law enforcement officers and firefighters. Both professions have the same options for normal and early retirement eligibility within the LEOFF 2 retirement plan. On average, firefighters were observed to retire later during our study period (1995-2017). We considered separate rates for each group but felt a blended retirement rates assumption applied to both populations remains reasonable.

Average Retirement Age by Profession	
LEOFF 2	
Law Enforcement Officer	56.6
Fire Fighter	57.3

Note: Average retirement ages from 1995-2017 excluding 2001 and 2007 because of changing valuation dates.

4. **Service-Based Retirement Experience.**
   Members at different service levels may exhibit different retirement behavior. We typically observe higher retirement rates once members qualify for subsidized early retirement. We set retirement rates in the following ways for the systems below.

THREE: APPENDICES

RETIREMENT RATES

Plans 1 – PERS, TRS, LEOFF.

We currently have retirement rates in TRS and LEOFF Plan 1 for members with 30 years of service and separate rates for members with greater than 30 years of service. The current average Plan 1 member is 65 or older and beyond the normal retirement age. Based on this older and longer service population, we believe that age is now a better indicator of future behavior than level of service. As a result, we removed retirement rates by service level and will use a single set of rates applied to members of all service levels. There was no change to PERS 1 as the old assumption already uses a single set of rates. This simplification in the Plans 1 assumptions had a small impact because of the high levels of service and the relatively smaller number of remaining active members in these closed plans.

Plans 2/3 – PERS, TRS, SERS.

Between the ages of 55 and 65, we observed higher rates of retirement for members of the Plans 2/3 with at least 30 years of service. A Plan 2/3 member is eligible for subsidized early retirement if they accrue 30 years of service and are at least 55 years of age. Plan experience confirms our assumption of separate rates by service greater than or equal to 30 and less than 30.

Average Retirement Age by Service Level			
	PERS	**TRS**	**SERS**
Service < 30	64.9	64.1	65.1
Service >= 30	61.8	61.9	63.9

Note: Average retirement ages from 1995-2017 excluding 2001 and 2007 because of changing valuation dates.

Our old assumption assumes an additional set of rates at service equal to 30 for TRS 2/3. We removed this set of rates because we did not observe a significant increase in TRS retirements at 30 years of service. Additionally, the data is limited at this service level because the members first became eligible for subsidized early retirement in 2007.

TRS 2/3 Average Retirement Age and Observations		
	Retirement Age	**Observations**
Service = 30	62.0	492
Service > 30	61.9	1,727

Note: Average retirement ages from 1995-2017 excluding 2001 and 2007 because of changing valuation dates.

Public Safety Plans – LEOFF 2, WSPRS 1/2.
Members of the public safety plans have access to retirement eligibility at earlier ages than Plans 2/3. LEOFF 2 members are eligible for subsidized early retirement at 20 years of service and age 50. WSPRS members are eligible for normal retirement at 25 years of service or age 55. However, data is limited for members who retire with low service. We believe it is reasonable to continue with one set of retirement rates applied to all amounts of service for both LEOFF 2 and WSPRS 1/2.

Public Safety Retirements by Service	
LEOFF 2	
Service < 20	672
Service >= 20	3,061
WSPRS 1/2	
Service < 25	31
Service >= 25	674

Note: Average retirement ages from 1995-2017 excluding 2001 and 2007 because of changing valuation dates.

New Assumptions

Plans 1 – PERS, TRS, LEOFF.
We believe our old assumptions reasonably approximated more recent plan experience. We believe recent plan experience is a good indicator for future plan member retirement behavior. We applied our professional judgment and blended the male and female rates. Please see the individual system tables in the **Exhibits** section for comparisons between the new and old rates.

Age	TRS 1	PERS 1	LEOFF 1
	Male/Female		
55	0.15	0.20	0.20
56	0.15	0.15	0.20
57	0.15	0.10	0.20
58	0.15	0.10	0.20
59	0.15	0.15	0.20
60	0.15	0.15	0.25
61	0.15	0.15	0.25
62	0.25	0.20	0.25
63	0.25	0.15	0.25
64	0.25	0.15	0.25
65	0.35	0.30	0.25
66	0.35	0.35	0.25
67	0.35	0.25	0.25
68	0.35	0.25	0.25
69	0.35	0.25	0.25
70-79	0.35	0.25	1.00
80	1.00	1.00	1.00

New Plan 1 Retirement Rates

RETIREMENT RATES

Plans 2/3 – PERS, TRS, SERS.
For developing rates, we assume Plan 2 members would have similar retirement behavior across PERS, TRS, and SERS. We assumed the same for Plan 3 members across these systems. For this reason, we relied on the plan with the most plan experience to develop a plan-specific retirement rates assumption across PERS, TRS, and SERS. This led us to developing rates for Plan 2 from PERS experience and Plan 3 from TRS experience. We considered and reviewed combining all Plan 2 or Plan 3 data across systems to set plan-specific rates. We found that rates under this approach were similar to rates developed from the method outlined above.

We then compared the new PERS or TRS plan-specific assumption to the other system's matching plan to review fit. In general, we observed that the new rates fit well for each system's plan experience. The only exception occurred when we compared the new assumption to the plans with the smallest amount of experience. This led to the rates underestimating retirements for the study period. This occurred in PERS Plan 3 and SERS/TRS Plan 2 with service greater than 30. However, we believe the fit of the new rates is still within an acceptable range. Please see the individual system tables in the **Exhibits** section for comparisons between the new and old rates.

New PERS, TRS, and SERS Plan 2/3 Retirement Rates				
	MS<30		MS>=30	
	Male & Females		Male & Females	
Age	**Plan 2**	**Plan 3**	**Plan 2**	**Plan 3**
55	0.01	0.01	0.08	0.04
56	0.01	0.01	0.08	0.04
57	0.02	0.01	0.08	0.04
58	0.02	0.01	0.08	0.05
59	0.04	0.02	0.10	0.10
60	0.05	0.02	0.15	0.12
61	0.08	0.06	0.20	0.15
62	0.15	0.12	0.40	0.35
63	0.20	0.12	0.30	0.25
64	0.40	0.20	0.35	0.30
65	0.35	0.35	0.45	0.45
66	0.30	0.30	0.40	0.40
67	0.27	0.27	0.30	0.30
68-79	0.25	0.25	0.30	0.30
80	1.00	1.00	1.00	1.00

Members hired after May 1, 2013, do not receive the same level of subsidized early retirement benefit at 30 years of service as members hired before this date. We believe the lower benefit will create a lower incentive for these members to retire prior to the normal retirement age. We do not have retirement experience for this group, so we made a downward adjustment to our new retirement rates for members with at least 30 years of service and hired before May 1.

RETIREMENT RATES

	PERS, TRS, and SERS Plan 2/3 Retirement New Rates—MS>=30			
	Hired Before May 1, 2013		Hired After May 1, 2013	
	Male & Females		Male & Females	
Age	Plan 2	Plan 3	Plan 2	Plan 3
55	0.08	0.04	0.01	0.01
56	0.08	0.04	0.02	0.01
57	0.08	0.04	0.03	0.02
58	0.08	0.05	0.03	0.02
59	0.10	0.10	0.06	0.04
60	0.15	0.12	0.10	0.08
61	0.20	0.15	0.12	0.10
62	0.40	0.35	0.20	0.17
63	0.30	0.25	0.25	0.20
64	0.35	0.30	0.35	0.30
65	0.45	0.45	0.45	0.45
66	0.40	0.40	0.40	0.40
67	0.30	0.30	0.30	0.30
68-79	0.30	0.30	0.30	0.30
80	1.00	1.00	1.00	1.00

Public Safety Plans – LEOFF 2, WSPRS 1/2, PSERS 2.
The public safety plans saw modest changes to their retirement rates assumptions. For WSPRS 1/2, we increased rates for ages 46-54 to reflect additional members retiring once they reach 25 years of service. We observed delayed retirements for ages 60 and beyond. We believe this was related to recently passed legislation that added an occupational retention salary increase and voluntary overtime into a member's pension calculation. We do not anticipate these bills to have a long-term impact on retirement behavior when members have access to these benefits through the majority of their working careers.

For LEOFF 2, we observed members deferring retirement in their early and mid-50's. We made a downward adjustment to the old rates for ages 50-58 to reflect this experience.

We do not have enough data to set a PSERS 2 assumption from plan experience since the plan opened in 2007. Instead, we relied on PERS 2 rates to inform the PSERS 2 rates and made subsequent adjustments to reflect differences in plan designs between the two systems. We believe this approach is reasonable because PSERS 2 and PERS 2 plan provisions provide similar retirement benefits.

RETIREMENT RATES

We believe retirement behavior will be similar for PERS 2 and PSERS members dependent upon their retirement eligibility:

❖ **Eligible for Subsidized Early Retirement[1]** – Members eligible for subsidized early retirement for PERS 2 and PSERS receive similar reductions in retirement benefits. We relied on the PERS 2 subsidized early retirement rates and shifted them forward two years to account for the earlier PSERS subsidized early retirement provision.

❖ **Not Eligible for Subsidized Early Retirement[2]** – PERS 2 and PSERS members not eligible for subsidized early retirement also receive similar retirement benefits, however PSERS provisions allow for earlier retirement. To account for this difference in plan provisions, we shifted the PERS rates forward four years to reflect the earlier retirement eligibility of PSERS members.

❖ **Age 65 and Beyond** – For PSERS rates beyond age 65, we assume they follow the respective PERS rates for normal or subsidized retirement.

We relied on our professional judgment and lowered the new PSERS rates for ages 53-64. We believe fewer PSERS members will retire at these ages relative to the corresponding older PERS rates. PSERS members retiring earlier will have a lower overall benefit from fewer years of service and must wait longer until Medicare and Social Security eligibility. Please see the individual system tables in the **Exhibits** section for comparisons between the new and old rates.

[1]*PERS 2 subsidized early retirement defined as at least 30 years of service and age 55. PSERS subsidized early retirement defined as at least 20 years of service and age 53.*
[2]*PERS 2 normal retirement defined as at least five years of service and age 65. PSERS members may retire with ten years of PSERS service and age 60 or five years of total service and age 65.*

RETIREMENT RATES

	New Public Safety Retirement Rates			
	WSPRS 1/2	LEOFF 2	PSERS 2	
			MS<20	MS>=20
Age	**Male/Female**			
45	0.50	N/A	N/A	N/A
46	0.38	N/A	N/A	N/A
47	0.38	N/A	N/A	N/A
48	0.38	N/A	N/A	N/A
49	0.33	N/A	N/A	N/A
50	0.33	0.03	N/A	N/A
51	0.27	0.03	N/A	N/A
52	0.27	0.05	N/A	N/A
53	0.27	0.09	N/A	0.06
54	0.27	0.09	N/A	0.06
55	0.20	0.09	N/A	0.06
56	0.20	0.09	N/A	0.06
57	0.20	0.10	N/A	0.08
58	0.20	0.14	N/A	0.12
59	0.33	0.15	N/A	0.16
60	0.33	0.15	0.32	0.32
61	0.33	0.19	0.24	0.24
62	0.33	0.23	0.28	0.28
63	0.33	0.20	0.22	0.24
64	0.50	0.20	0.20	0.24
65	1.00	0.30	0.25	0.30
66-69	N/A	0.30	0.25	0.30
70+	N/A	1.00	1.00	1.00

RETIREMENT RATES

Exhibits

PERS

	PERS Retirement Experience by Year—Old Assumptions					
	Plan 1 (Males & Females)			Plan 2/3 (Males & Females)		
Age	Actual	Expected	A/E	Actual	Expected	A/E
1995	1,576	1,378	1.144	311	243	1.282
1996	1,604	1,404	1.143	329	271	1.213
1997	1,749	1,465	1.194	377	313	1.203
1998	1,806	1,545	1.169	441	367	1.202
1999	2,018	1,656	1.219	545	462	1.180
2000	2,129	1,723	1.235	568	516	1.100
2001						
2002	2,124	1,823	1.165	670	711	0.942
2003	1,905	1,840	1.035	790	850	0.929
2004	1,832	1,864	0.983	901	966	0.933
2005	1,811	1,930	0.939	1,005	1,153	0.871
2006	1,713	1,912	0.896	1,113	1,335	0.834
2007						
2008	1,345	1,844	0.729	1,264	1,773	0.713
2009	1,241	1,735	0.715	1,548	2,156	0.718
2010	1,272	1,626	0.782	1,867	2,511	0.743
2011	1,201	1,464	0.821	2,338	2,902	0.806
2012	1,047	1,351	0.775	2,501	3,348	0.747
2013	945	1,243	0.760	2,955	3,734	0.791
2014	884	1,115	0.792	3,325	4,009	0.829
2015	838	995	0.842	3,274	4,264	0.768
2016	722	845	0.854	3,389	4,514	0.751
2017	608	721	0.843	3,377	4,715	0.716
Total	**30,370**	**31,478**	**0.965**	**32,888**	**41,113**	**0.800**

RETIREMENT RATES

PERS *(continued)*

PERS 1 Retirement Experience by Age Old Assumptions*

Plan 1 (Males & Females)			
Age	Actual	Expected	A/E
45-49	0	0	N/A
50-54	12	24	0.508
55-59	332	518	0.641
60-64	1,864	2,642	0.706
65-69	1,493	1,443	1.035
70-75	237	218	1.086
75-79	46	51	0.909
80+	13	25	0.520
Total	**3,997**	**4,920**	**0.812**

Data summarized for years 2013-2017.

PERS 1 Retirement Experience by Age New Assumptions*

Plan 1 (Males & Females)			
Age	Actual	Expected	A/E
45-49	0	0	N/A
50-54	12	0	0.000
55-59	332	328	1.013
60-64	1,864	1,866	0.999
65-69	1,493	1,522	0.981
70-75	237	248	0.956
75-79	46	58	0.800
80+	13	25	0.520
Total	**3,997**	**4,047**	**0.988**

Data summarized for years 2013-2017

PERS 2 Retirement Experience by Age Old Assumptions*

Plan 2 (Males & Females)			
Age	Actual	Expected	A/E
55-59	2,414	4,516	0.535
60-64	10,997	15,397	0.714
65-69	14,309	14,137	1.012
70-75	1,819	1,820	1.000
75-79	332	373	0.890
80+	88	363	0.242
Total	**29,959**	**36,606**	**0.818**

Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

PERS 3 Retirement Experience by Age Old Assumptions*

Plan 3 (Males & Females)			
Age	Actual	Expected	A/E
55-59	572	1,000	0.572
60-64	1,289	2,330	0.553
65-69	952	1,021	0.933
70-75	97	112	0.865
75-79	14	25	0.566
80+	5	18	0.278
Total	**2,929**	**4,506**	**0.650**

Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

PERS 2 Retirement Experience by Age New Assumptions*

Plan 2 (Males & Females)			
Age	Actual	Expected	A/E
55-59	2,414	2,793	0.864
60-64	10,997	12,634	0.870
65-69	14,309	14,420	0.992
70-75	1,819	1,915	0.950
75-79	332	392	0.847
80+	88	363	0.242
Total	**29,959**	**32,518**	**0.921**

Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

PERS 3 Retirement Experience by Age New Assumptions*

Plan 3 (Males & Females)			
Age	Actual	Expected	A/E
55-59	572	384	1.489
60-64	1,289	1,220	1.056
65-69	952	1,041	0.915
70-75	97	117	0.826
75-79	14	26	0.544
80+	5	18	0.278
Total	**2,929**	**2,806**	**1.044**

Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

THREE: APPENDICES

PERS *(continued)*

PERS Plan 1 Retirement Rates			
PERS 1			
	Old*		**New**
Age	**Male**	**Female**	**Male/Female**
55	0.17	0.28	0.20
56	0.17	0.16	0.15
57	0.17	0.16	0.10
58	0.17	0.16	0.10
59	0.20	0.30	0.15
60	0.16	0.16	0.15
61	0.23	0.21	0.15
62	0.30	0.26	0.20
63	0.22	0.20	0.15
64	0.28	0.28	0.15
65	0.34	0.36	0.30
66	0.30	0.22	0.35
67	0.26	0.22	0.25
68-79	0.22	0.22	0.25
80	1.00	1.00	1.00

*Please see our website for old rates prior to age 55.

RETIREMENT RATES *continued*

PERS *(continued)*

PERS Plan 2/3 Retirement Rates								
	Old—MS<30 Plan 2 & Plan 3		New—MS<30 Male & Females		Old—MS>=30 Plan 2 & Plan 3		New—MS>=30 Male & Females	
Age	Males	Females	Plan 2	Plan 3	Males	Females	Plan 2	Plan 3
55	0.02	0.02	0.01	0.01	0.12	0.12	0.08	0.04
56	0.03	0.02	0.01	0.01	0.12	0.12	0.08	0.04
57	0.04	0.02	0.02	0.01	0.12	0.12	0.08	0.04
58	0.05	0.02	0.02	0.01	0.12	0.12	0.08	0.05
59	0.06	0.04	0.04	0.02	0.16	0.24	0.10	0.10
60	0.07	0.06	0.05	0.02	0.12	0.12	0.15	0.12
61	0.08	0.13	0.08	0.06	0.20	0.20	0.20	0.15
62	0.24	0.20	0.15	0.12	0.28	0.28	0.40	0.35
63	0.22	0.18	0.20	0.12	0.26	0.26	0.30	0.25
64	0.56	0.56	0.40	0.20	0.56	0.56	0.35	0.30
65	0.40	0.40	0.35	0.35	0.40	0.40	0.45	0.45
66	0.24	0.24	0.30	0.30	0.24	0.24	0.40	0.40
67	0.24	0.24	0.27	0.27	0.24	0.24	0.30	0.30
68-79	0.24	0.24	0.25	0.25	0.24	0.24	0.30	0.30
80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

PERS, TRS, and SERS Plan 2/3 Retirement New Rates—MS>=30				
	Hired Before May 1, 2013 Male & Females		Hired After May 1, 2013 Male & Females	
Age	Plan 2	Plan 3	Plan 2	Plan 3
55	0.08	0.04	0.01	0.01
56	0.08	0.04	0.02	0.01
57	0.08	0.04	0.03	0.02
58	0.08	0.05	0.03	0.02
59	0.10	0.10	0.06	0.04
60	0.15	0.12	0.10	0.08
61	0.20	0.15	0.12	0.10
62	0.40	0.35	0.20	0.17
63	0.30	0.25	0.25	0.20
64	0.35	0.30	0.35	0.30
65	0.45	0.45	0.45	0.45
66	0.40	0.40	0.40	0.40
67	0.30	0.30	0.30	0.30
68-79	0.30	0.30	0.30	0.30
80	1.00	1.00	1.00	1.00

RETIREMENT RATES

TRS

TRS Retirement Experience by Year—Old Assumptions						
	Plan 1 (Males & Females)			Plan 2/3 (Males & Females)		
Age	Actual	Expected	A/E	Actual	Expected	A/E
1995	980	966	1.014	20	19	1.041
1996	988	1,010	0.979	28	25	1.134
1997	1,043	1,084	0.962	42	32	1.296
1998	1,346	1,154	1.166	56	57	0.983
1999	1,376	1,204	1.143	98	84	1.174
2000	1,469	1,282	1.146	124	113	1.099
2001						
2002	1,469	1,050	1.399	146	165	0.885
2003	1,233	1,078	1.144	143	208	0.686
2004	1,319	1,187	1.112	218	291	0.750
2005	1,247	1,208	1.032	256	360	0.711
2006	1,179	1,173	1.005	301	432	0.697
2007						
2008	286	1,124	0.255	228	632	0.361
2009	861	1,177	0.732	404	898	0.450
2010	628	1,073	0.586	451	1,163	0.388
2011	854	1,010	0.846	733	1,467	0.500
2012	708	870	0.814	822	1,743	0.472
2013	602	739	0.815	969	2,000	0.484
2014	548	613	0.893	1,202	2,189	0.549
2015	456	482	0.946	1,279	2,310	0.554
2016	370	371	0.999	1,274	2,385	0.534
2017	257	277	0.927	1,021	2,447	0.417
Total	**19,219**	**20,131**	**0.955**	**9,815**	**19,020**	**0.516**

RETIREMENT RATES

TRS *(continued)*

TRS 1 Retirement Experience by Age Old Assumptions*

Plan 1 (Males & Females)			
Age	Actual	Expected	A/E
47-49	0	0	N/A
50-54	0	0	N/A
55-59	107	174	0.614
60-64	1,125	1,352	0.832
65-69	866	838	1.034
70-75	114	86	1.322
75-79	18	14	1.261
80+	3	17	0.176
Total	2,233	2,482	0.900

Data summarized for years 2013-2017.

TRS 1 Retirement Experience by Age New Assumptions*

Plan 1 (Males & Females)			
Age	Actual	Expected	A/E
45-49	0	0	N/A
50-54	0	0	N/A
55-59	107	111	0.960
60-64	1,125	1,137	0.990
65-69	866	864	1.002
70-75	114	121	0.944
75-79	18	23	0.768
80+	3	17	0.176
Total	2,233	2,273	0.982

Data summarized for years 2013-2017.

TRS 2 Retirement Experience by Age Old Assumptions*

Plan 2 (Males & Females)			
Age	Actual	Expected	A/E
55-59	231	514	0.450
60-64	1,269	1,852	0.685
65-69	1,494	1,540	0.970
70-75	130	143	0.911
75-79	21	21	0.982
80+	2	2	1.325
Total	3,147	4,071	0.773

Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

TRS 3 Retirement Experience by Age Old Assumptions*

Plan 3 (Males & Females)			
Age	Actual	Expected	A/E
55-59	913	3,887	0.235
60-64	3,023	7,940	0.381
65-69	2,560	2,864	0.894
70-75	157	183	0.859
75-79	14	19	0.747
80+	1	1	0.909
Total	6,668	14,894	0.448

Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

TRS 2 Retirement Experience by Age New Assumptions*

Plan 2 (Males & Females)			
Age	Actual	Expected	A/E
55-59	231	260	0.888
60-64	1,269	1,415	0.897
65-69	1,494	1,341	1.114
70-75	130	110	1.178
75-79	21	14	1.463
80+	2	6	0.333
Total	3,147	3,147	1.000

Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

TRS 3 Retirement Experience by Age New Assumptions*

Plan 3 (Males & Females)			
Age	Actual	Expected	A/E
55-59	913	1,249	0.731
60-64	3,023	3,958	0.764
65-69	2,560	2,520	1.016
70-75	157	141	1.111
75-79	14	13	1.107
80+	1	5	0.200
Total	6,668	7,886	0.846

Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

TRS *(continued)*

TRS Plan 1 Retirement Rates					
	Old*				New
	MS <> 30		MS = 30		
Age	**Male**	**Female**	**Male**	**Female**	**Male/Female**
55	0.22	0.20	0.36	0.30	0.15
56	0.22	0.20	0.36	0.30	0.15
57	0.22	0.20	0.36	0.30	0.15
58	0.22	0.20	0.39	0.30	0.15
59	0.22	0.26	0.42	0.30	0.15
60	0.22	0.20	0.42	0.30	0.15
61	0.22	0.23	0.42	0.40	0.15
62	0.35	0.26	0.56	0.50	0.25
63	0.30	0.22	0.48	0.46	0.25
64	0.25	0.29	0.40	0.46	0.25
65	0.36	0.36	0.70	0.55	0.35
66	0.36	0.36	0.70	0.55	0.35
67	0.32	0.28	0.70	0.55	0.35
68	0.28	0.28	0.70	0.55	0.35
69	0.28	0.28	0.70	0.55	0.35
70	0.22	0.28	1.00	0.55	0.35
71	0.22	0.28	1.00	0.55	0.35
72-79	0.22	0.21	1.00	1.00	0.35
80	1.00	0.21	1.00	1.00	1.00

*Please see our website for old rates prior to age 55.

RETIREMENT RATES

TRS *(continued)*

TRS Plan 2/3 Retirement Rates						
	Old—MS<30 Plan 2 & Plan 3		New—MS<30 Male & Females		Old—MS=30 Plan 2 & Plan 3	
Age	Males	Females	Plan 2	Plan 3	Males	Females
55	0.02	0.02	0.01	0.01	0.22	0.19
56	0.02	0.03	0.01	0.01	0.22	0.21
57	0.02	0.04	0.02	0.01	0.22	0.23
58	0.02	0.05	0.02	0.01	0.28	0.25
59	0.04	0.06	0.04	0.02	0.34	0.27
60	0.06	0.07	0.05	0.02	0.41	0.29
61	0.14	0.15	0.08	0.06	0.48	0.41
62	0.22	0.23	0.15	0.12	0.55	0.53
63	0.20	0.21	0.20	0.12	0.50	0.49
64	0.55	0.48	0.40	0.20	0.55	0.53
65	0.48	0.40	0.35	0.35	0.48	0.40
66	0.41	0.32	0.30	0.30	0.41	0.32
67	0.34	0.24	0.27	0.27	0.34	0.24
68	0.27	0.24	0.25	0.25	0.27	0.24
69	0.27	0.42	0.25	0.25	0.27	0.42
70	0.27	0.30	0.25	0.25	0.27	0.30
71	0.41	0.30	0.25	0.25	0.41	0.30
72-79	0.55	0.30	0.25	0.25	0.55	0.30
80	1.00	1.00	1.00	1.00	1.00	1.00

TRS Plan 2/3 Retirement Rates (Continued)				
	Old—MS>30 Plan 2 & Plan 3		New—MS>=30 Male & Females	
Age	Males	Females	Plan 2	Plan 3
55	0.13	0.12	0.08	0.04
56	0.15	0.14	0.08	0.04
57	0.17	0.16	0.08	0.04
58	0.19	0.18	0.08	0.05
59	0.21	0.22	0.10	0.10
60	0.23	0.20	0.15	0.12
61	0.25	0.22	0.20	0.15
62	0.36	0.32	0.40	0.35
63	0.33	0.30	0.30	0.25
64	0.55	0.49	0.35	0.30
65	0.48	0.40	0.45	0.45
66	0.41	0.32	0.40	0.40
67	0.34	0.24	0.30	0.30
68	0.27	0.24	0.30	0.30
69	0.27	0.42	0.30	0.30
70	0.27	0.30	0.30	0.30
71	0.41	0.30	0.30	0.30
72-79	0.55	0.30	0.30	0.30
80	1.00	1.00	1.00	1.00

RETIREMENT RATES

SERS

SERS Retirement Experience by Year Old Assumptions			
Plan 2/3 (Males & Females)			
Age	Actual	Expected	A/E
1995	109	87	1.259
1996	153	110	1.385
1997	148	114	1.293
1998	198	138	1.432
1999	181	157	1.152
2000			
2001			
2002	308	350	0.879
2003	368	405	0.909
2004	462	478	0.966
2005	467	534	0.875
2006	493	615	0.802
2007			
2008	461	799	0.577
2009	538	954	0.564
2010	550	1,120	0.491
2011	822	1,318	0.624
2012	947	1,518	0.624
2013	1,076	1,676	0.642
2014	1,189	1,821	0.653
2015	1,337	1,959	0.682
2016	1,348	2,064	0.653
2017	1,209	2,190	0.552
Total	**12,364**	**18,407**	**0.672**

RETIREMENT RATES

continued

SERS *(continued)*

SERS 2 Retirement Experience by Age Old Assumptions*			
Plan 2 (Males & Females)			
Age	Actual	Expected	A/E
55-59	272	422	0.645
60-64	2,028	2,929	0.692
65-69	3,500	3,495	1.001
70-75	574	522	1.100
75-79	147	116	1.264
80+	45	140	0.321
Total	**6,566**	**7,624**	**0.861**

Data summarized for years 1995-2017 excluding data for 2000, 2001, and 2007 consistent with our analysis.

SERS 3 Retirement Experience by Age Old Assumptions*			
Plan 3 (Males & Females)			
Age	Actual	Expected	A/E
55-59	519	1,442	0.360
60-64	2,290	5,983	0.383
65-69	2,522	2,904	0.868
70-75	376	346	1.087
75-79	73	62	1.181
80+	18	58	0.310
Total	**5,798**	**10,794**	**0.537**

Data summarized for years 1995-2017 excluding data for 2000, 2001, and 2007 consistent with our analysis.

SERS 2 Retirement Experience by Age New Assumptions*			
Plan 2 (Males & Females)			
Age	Actual	Expected	A/E
55-59	272	299	0.909
60-64	2,028	2,335	0.868
65-69	3,500	3,831	0.914
70-75	574	705	0.814
75-79	147	175	0.840
80+	45	140	0.321
Total	**6,566**	**7,485**	**0.877**

Data summarized for years 1995-2017 excluding data for 2000, 2001, and 2007 consistent with our analysis.

SERS 3 Retirement Experience by Age New Assumptions*			
Plan 3 (Males & Females)			
Age	Actual	Expected	A/E
55-59	519	634	0.818
60-64	2,290	2,942	0.778
65-69	2,522	3,198	0.789
70-75	376	463	0.812
75-79	73	93	0.789
80+	18	58	0.310
Total	**5,798**	**7,388**	**0.785**

Data summarized for years 1995-2017 excluding data for 2000, 2001, and 2007 consistent with our analysis.

RETIREMENT RATES

SERS *(continued)*

SERS Plan 2/3 Retirement Rates								
	Old—MS<30 **Plan 2 & Plan 3**		**New—MS<30** **Male & Females**		**Old—MS>=30** **Plan 2 & Plan 3**		**New—MS>=30** **Male & Females**	
Age	Males	Females	Plan 2	Plan 3	Males	Females	Plan 2	Plan 3
55	0.01	0.02	0.01	0.01	0.12	0.12	0.08	0.04
56	0.02	0.02	0.01	0.01	0.12	0.12	0.08	0.04
57	0.03	0.02	0.02	0.01	0.12	0.12	0.08	0.04
58	0.04	0.03	0.02	0.01	0.12	0.12	0.08	0.05
59	0.05	0.04	0.04	0.02	0.16	0.25	0.10	0.10
60	0.06	0.05	0.05	0.02	0.12	0.12	0.15	0.12
61	0.15	0.13	0.08	0.06	0.21	0.20	0.20	0.15
62	0.24	0.21	0.15	0.12	0.30	0.28	0.40	0.35
63	0.22	0.20	0.20	0.12	0.28	0.26	0.30	0.25
64	0.56	0.52	0.40	0.20	0.57	0.48	0.35	0.30
65	0.39	0.36	0.35	0.35	0.39	0.36	0.45	0.45
66	0.22	0.24	0.30	0.30	0.22	0.24	0.40	0.40
67	0.22	0.23	0.27	0.27	0.22	0.23	0.30	0.30
68	0.22	0.22	0.25	0.25	0.22	0.22	0.30	0.30
69	0.22	0.21	0.25	0.25	0.22	0.21	0.30	0.30
70	0.22	0.20	0.25	0.25	0.22	0.20	0.30	0.30
71	0.20	0.19	0.25	0.25	0.20	0.19	0.30	0.30
72	0.18	0.18	0.25	0.25	0.18	0.18	0.30	0.30
73-79	0.16	0.17	0.25	0.25	0.16	0.17	0.30	0.30
80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

LEOFF

LEOFF Retirement Experience by Year—Old Assumptions						
	Plan 1 (Males & Females)			Plan 2/3 (Males & Females)		
Age	Actual	Expected*	A/E	Actual	Expected*	A/E
1995	106	98	1.085	9	12	0.760
1996	107	103	1.042	5	15	0.324
1997	120	114	1.049	15	20	0.742
1998	126	123	1.021	11	24	0.458
1999	115	121	0.952	24	32	0.749
2000	121	121	0.997	25	44	0.568
2001						
2002	95	120	0.790	42	69	0.610
2003	97	120	0.806	61	86	0.710
2004	100	119	0.837	84	108	0.780
2005	104	117	0.889	112	135	0.833
2006	97	112	0.865	134	161	0.833
2007						
2008	84	99	0.845	141	211	0.667
2009	63	86	0.730	170	252	0.674
2010	55	78	0.709	201	289	0.696
2011	52	71	0.729	276	330	0.835
2012	61	59	1.034	301	357	0.844
2013	42	44	0.962	346	378	0.916
2014	25	34	0.727	395	403	0.979
2015	37	29	1.282	412	428	0.963
2016	20	20	0.981	478	448	1.068
2017	22	19	1.167	491	459	1.071
Total	1,649	1,809	0.911	3,733	4,260	0.876

THREE: APPENDICES

RETIREMENT RATES

LEOFF *(continued)*

LEOFF 1 Retirement Experience by Age Old Assumptions*			
Plan 1 (Males & Females)			
Age	**Actual**	**Expected**	**A/E**
50-54	0	0	N/A
55-59	31	28	1.113
60-64	71	68	1.042
65-69	40	36	1.111
70+	4	14	0.286
Total	**146**	**146**	**0.999**

Data summarized for years 2013-2017.

LEOFF 2 Retirement Experience by Age Old Assumptions*			
Plan 2 (Males & Females)			
Age	**Actual**	**Expected**	**A/E**
50-54	1,284	1,583	0.811
55-59	1,500	1,707	0.879
60-64	760	805	0.944
65-69	179	138	1.295
70+	10	27	0.370
Total	**3,733**	**4,260**	**0.876**

Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

LEOFF 2 Retirement Experience by Age New Assumptions*			
Plan 2 (Males & Females)			
Age	**Actual**	**Expected**	**A/E**
50-54	1,284	1,433	0.896
55-59	1,500	1,606	0.934
60-64	760	805	0.944
65-69	179	166	1.079
70+	10	27	0.370
Total	**3,733**	**4,037**	**0.925**

Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

LEOFF *(continued)*

LEOFF Plan 1 Retirement Rates			
	Old		New
	MS<30	MS>=30	All MS
Age	Male & Females		
50	0.07	0.12	0.12
51	0.07	0.12	0.12
52	0.07	0.12	0.12
53	0.07	0.12	0.12
54	0.10	0.16	0.16
55	0.10	0.20	0.20
56	0.10	0.20	0.20
57	0.13	0.20	0.20
58	0.13	0.20	0.20
59	0.13	0.20	0.20
60-69	0.23	0.25	0.25
70	1.00	1.00	1.00

LEOFF Plan 2 Retirement Rates		
	Old	New
Age	Male & Females	
50	0.03	0.03
51	0.04	0.03
52	0.05	0.05
53	0.10	0.09
54	0.10	0.09
55	0.10	0.09
56	0.10	0.09
57	0.10	0.10
58	0.15	0.14
59	0.15	0.15
60	0.15	0.15
61	0.19	0.19
62	0.23	0.23
63	0.20	0.20
64	0.20	0.20
65-69	0.25	0.30
70	1.00	1.00

THREE: APPENDICES

RETIREMENT RATES

WSPRS

WSPRS Retirement Experience by Year Old Assumptions			
Plan 1/2 (Males & Females)			
Age	**Actual**	**Expected***	**A/E**
1995	48	39	1.233
1996	43	32	1.349
1997	27	36	0.754
1998	33	36	0.922
1999	35	37	0.943
2000	34	36	0.956
2001			
2002	23	23	0.996
2003	24	19	1.264
2004	29	23	1.283
2005	36	27	1.310
2006	20	22	0.903
2007			
2008	16	16	0.999
2009	11	17	0.653
2010	21	19	1.104
2011	35	32	1.106
2012	44	35	1.263
2013	54	36	1.515
2014	38	29	1.303
2015	45	34	1.305
2016	55	36	1.549
2017	34	38	0.894
Total	**705**	**621**	**1.136**

THREE: APPENDICES

RETIREMENT RATES

WSPRS *(continued)*

WSPRS 1/2 Retirement Experience by Age Old Assumptions*			
Plan 1/2 (Males & Females)			
Age	Actual	Expected	A/E
44-49	265	217	1.222
50-54	283	235	1.202
55-59	130	130	1.000
60-64	24	35	0.680
65+	3	3	1.000
Total	705	621	1.136

*Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

WSPRS 1/2 Retirement Experience by Age New Assumptions*			
Plan 1/2 (Males & Females)			
Age	Actual	Expected	A/E
44-49	265	245	1.081
50-54	283	271	1.045
55-59	130	130	1.000
60-64	24	37	0.646
65+	3	3	1.000
Total	705	686	1.028

*Data summarized for years 1995-2017 excluding data for 2001 and 2007 consistent with our analysis.

WSPRS Plan 1/2 Retirement Rates		
	Old	New
Age	Males	& Females
45	0.50	0.50
46	0.33	0.38
47	0.33	0.38
48	0.33	0.38
49	0.30	0.33
50	0.27	0.33
51	0.24	0.27
52	0.24	0.27
53	0.24	0.27
54	0.24	0.27
55	0.20	0.20
56	0.20	0.20
57	0.20	0.20
58	0.20	0.20
59	0.33	0.33
60	0.33	0.33
61	0.33	0.33
62	0.33	0.33
63	0.33	0.33
64	0.33	0.50
65	1.00	1.00

RETIREMENT RATES

PSERS

	PSERS Retirement Rates			
	Old		New	
	All Service		MS<20	MS>=20
Age	Males	Females	Males & Females	
53	0.02	0.02	N/A	0.06
54	0.02	0.02	N/A	0.06
55	0.02	0.02	N/A	0.06
56	0.05	0.04	N/A	0.06
57	0.08	0.06	N/A	0.08
58	0.11	0.08	N/A	0.12
59	0.14	0.10	N/A	0.16
60	0.30	0.34	0.32	0.32
61	0.26	0.26	0.24	0.24
62	0.30	0.34	0.28	0.28
63	0.50	0.52	0.22	0.24
64	0.70	0.70	0.20	0.24
65	0.50	0.35	0.25	0.30
66-69	0.30	0.35	0.25	0.30
70	1.00	1.00	1.00	1.00

THREE: APPENDICES

SERVICE-BASED SALARY INCREASE

Methodology

We receive salary data annually on a total salary basis. In order to estimate SBS increases we need to reduce total salary by estimates for GSG (or the summation of inflation and real wage growth). We develop assumptions for future GSG as part of our economic experience study. These assumptions, however, are forward-looking and may not be consistent with historical experience.

Inflation

To determine historical inflation, we use the BLS Seattle-Tacoma-Bremerton CPI (renamed in 2018 to Seattle-Tacoma-Bellevue) for Urban Wage Earners & Clerical Workers. The CPI measures a weighted average price of a basket of consumer goods and services, such as transportation, food and medical care. Yearly inflation is calculated by taking the increase in CPI from one year to the next.

We considered two methods for estimating an inflation rate appropriate for our study period:

1. Take the geometric average of historical inflation over our entire study period (1995-2017).
2. Use a weighted geometric average of historical inflation over our study period (1995-2017). The weights were assigned based on the active member headcounts in the given year. This method gives more weights to the inflation occurring in the years when more members worked.

The following table summarizes annual experienced inflation by system under our two methods from 1995-2017.

Inflation from 1995 (or Plan Inception) to 2017			
System	**Weighted**	**Unweighted**	**Difference**
PERS	2.53%	2.55%	(0.02%)
TRS	2.53%	2.55%	(0.02%)
SERS	2.44%	2.55%	(0.11%)
LEOFF	2.51%	2.55%	(0.04%)
WSPRS	2.53%	2.55%	(0.02%)
PSERS	2.14%	2.37%	(0.24%)
All Systems	2.50%	2.55%	(0.04%)

Real Wage Growth

Real wage growth, or the overall economic growth in wages above inflation, can be a difficult figure to isolate. These increases are experienced by the population as a whole, and are independent of individual member service or performance. We can estimate historical real wage growth by measuring how average salaries have increased as a whole above inflation. The average annual salary changes removes some of the impact from SBS growth. Specifically, we examined the yearly increase, or decrease, in average salaries above inflation to determine an estimation for yearly real wage growth.

This measurement, however, represents an approximation and is sensitive to population changes. The approximation improves when a population remains stable and enough data is available. For example, if the average age and years of service for active members remain constant from one year to the next, we can approximate GSG in that year with less influence from SBS increases. In reality, most retirement plans mature with average ages and service levels increasing over time. As such, we examined a range of the possible real wage growth experienced by system based on our estimation.

Ultimately, we settled on a range of reasonable historical real wage growth that varied by system anywhere from 0.00 percent to 1.50 percent. We used this range when selecting our new SBS rates.

SERVICE-BASED SALARY INCREASE *continued*

Review of Key Demographic Factors

We reviewed several demographic factors and considered alternate formats for this assumption, but ultimately decided not to make any changes. For reference, we considered, but did not adopt:

❖ **Salary Increases by Age.**
   We think salary is more strongly tied to service than to age, so we chose not to use age-based salary increase assumptions.

❖ **Salary Increase Assumptions by Plan.**
   We studied the total salary increase at each service level for Plans 2/3 and observed similar salary increase trends. Based on this observation, we don't believe plan selection is correlated with future salary increases. Likewise, we don't believe Plans 1 would have different SBS trends than Plans 2/3.

❖ **Salary Increase Assumptions by Gender.**
   We studied the total salary increases by valuation year, for males and females, and observed similar increases.

❖ **Lagged Inflation.**
   We considered implementing a lagged (or delayed) inflation to observe whether inflation had a delayed effect on salary. We did not find a consistently stronger correlation between lagged inflation and salary increase than non-lagged inflation and salary increase. The correlation between inflation and total salary increase under different time lags is illustrated in the following table for PERS.

PERS All Plans	
Correlation of Salary Increase & Inflation	
3 Years Lagged	0.02
2 YearsLlagged	0.37
1 Year Lagged	0.51
No Lag	0.54

Analysis

Historical Data

We observed total salary increases by year for all active employees. As illustrated in the graph below, total salary increases can fluctuate quite significantly year-to-year. We estimate most of this volatility is due to economic, rather than demographic, changes. For instance, we observed a decline in salary following the Great Recession (2008-2009).

All Systems - Total Salary Increase by Year

— Observed Salary Increase
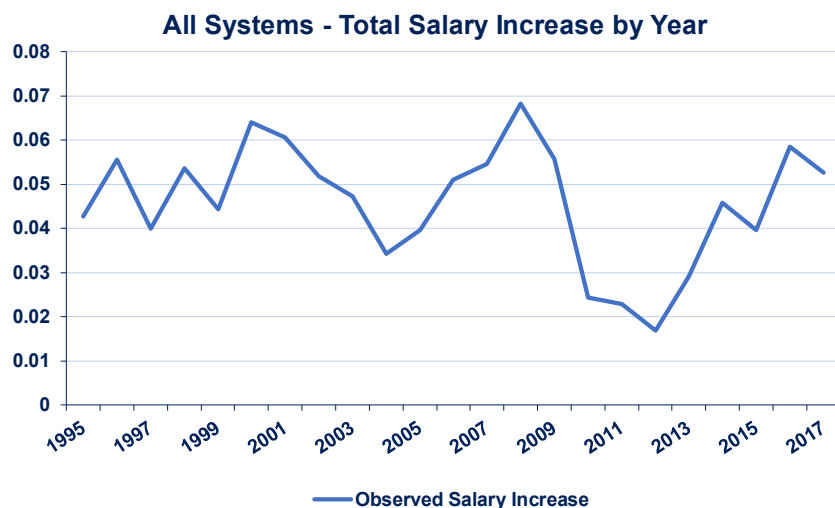
THREE: APPENDICES

SERVICE-BASED SALARY INCREASE *continued*

Inflation

We have observed a downward trend in inflation in more recent years. Generally, we expect times of low inflation to decrease total salary growth and times of high inflation to increase total salary growth.

Historical Inflation	
Time Period	Annual Increase
1995-1999	3.0%
2000-2004	2.4%
2005-2009	3.1%
2010-2014	1.9%
2015-2017	2.2%

When determining the range of historical SBS increases we used the unweighted historical inflation over our study period.

Real Wage Growth

The observed real wage growth ranges are generally lower than expected over the 1995-2017 study period with the exception of the public safety plans. This is primarily driven by the inclusion of Great Recession data and the approximate nature of the measurement. Our current assumption for future real wage growth is 0.75 percent. Please see the 2019 Economic Experience Study for more information. We used the ranges of historical real wage growth in the following table to isolate SBS increases.

1995-2017 Annual Real Wage Growth		
System	High Estimate	Low Estimate
PERS	0.8%	0.0%
TRS	0.5%	0.0%
SERS	0.5%	0.0%
LEOFF	1.5%	0.7%
PSERS	0.9%	0.1%
WSPRS	1.2%	0.4%

SBS Increases

Using our estimates of inflation and real wage growth, we developed a range of historical SBS increases by service level from 1995-2017. We determined low and high estimates for SBS increases by dividing the historical total salary increases by the estimated GSG. For example, members of PERS with four years of service credit had an average total salary increase of 6.0 percent. To determine the lower range of the SBS we divided by the highest estimates for GSG (inflation = 2.55 percent, real wage growth estimation = 0.80 percent). Our lowest estimate for SBS increases would therefore be:

$$\frac{(1+6\%)}{(1+0.80\%+2.55\%)} - 1 = 2.6\%.$$

THREE: APPENDICES

SERVICE-BASED SALARY INCREASE

PERS

Generally, we found PERS actual SBS increases match expected increases fairly closely. We relied on PERS experience to set rates for PSERS. Please see the **New Assumption** section for more information.

	Total Salary Increase	SBS Increase Portion		
Service Level	**Historical**	**Low Estimate**	**High Estimate**	**Old Assumption**
1	0.094	0.059	0.067	0.060
2	0.078	0.043	0.052	0.047
3	0.068	0.034	0.042	0.036
4	0.060	0.026	0.034	0.029
5	0.054	0.020	0.028	0.022
10	0.038	0.005	0.013	0.005
15	0.035	0.002	0.010	0.002
20	0.031	0.000	0.005	0.000
25	0.030	0.000	0.005	0.000
30	0.030	0.000	0.005	0.000

PERS–All Plans

TRS

We saw higher than expected SBS increases across most service levels, particularly for new members and those with ten to fifteen years of service.

	Total Salary Increase	SBS Increase Portion		
Service Level	**Historical**	**Low Estimate**	**High Estimate**	**Old Assumption**
1	0.087	0.055	0.060	0.051
2	0.067	0.036	0.041	0.039
3	0.067	0.035	0.041	0.039
4	0.065	0.033	0.038	0.035
5	0.062	0.031	0.036	0.030
10	0.057	0.026	0.031	0.022
15	0.044	0.013	0.018	0.009
20	0.029	0.000	0.004	0.001
25	0.028	0.000	0.003	0.001
30	0.028	0.000	0.002	0.000

TRS–All Plans

THREE: APPENDICES

SERS

The SBS increases for SERS were historically higher than expected across most service levels, particularly at the start of members' careers.

	Total Salary Increase	SBS Increase Portion		
Service Level	**Historical**	**Low Estimate**	**High Estimate**	**Old Assumption**
1	0.127	0.094	0.100	0.066
2	0.073	0.041	0.047	0.039
3	0.062	0.031	0.037	0.028
4	0.055	0.023	0.029	0.023
5	0.052	0.021	0.027	0.021
10	0.042	0.011	0.017	0.009
15	0.039	0.008	0.014	0.002
20	0.031	0.001	0.006	0.001
25	0.032	0.001	0.007	0.000
30	0.031	0.001	0.006	0.000

SERS–All Plans

LEOFF

Generally, we found LEOFF actual SBS increases match expected increases fairly closely. SBS increases were historically marginally higher than expected in early years and lower than expected for members with around ten years of service.

	Total Salary Increase	SBS Increase Portion		
Service Level	**Historical**	**Low Estimate**	**High Estimate**	**Old Assumption**
1	0.150	0.105	0.114	0.107
2	0.109	0.066	0.074	0.075
3	0.090	0.048	0.056	0.059
4	0.071	0.029	0.037	0.037
5	0.059	0.017	0.026	0.026
10	0.048	0.007	0.015	0.017
15	0.047	0.007	0.015	0.012
20	0.043	0.003	0.011	0.010
25	0.040	0.000	0.007	0.005
30	0.035	0.000	0.003	0.000

LEOFF–All Plans

THREE: APPENDICES

SERVICE-BASED SALARY INCREASE

WSPRS

Due to recent legislative changes in WSPRS, we believe historical experience is no longer a good indicator of future experience. As part of our 2016 Actuarial Valuation Report, we updated the WSPRS SBS scale to mirror the LEOFF scale. For more information on recent legislation, please see the **Law Changes** section.

For informational purposes only, the SBS increases for WSPRS were generally higher than expected in early and late career service levels and lower than expected during mid-career service levels using the SBS rates developed as part of the *2007-2012 Demographic Experience Study*.

WSPRS–All Plans				
	Total Salary Increase	**SBS Increase Portion**		
Service Level	**Historical**	**Low Estimate**	**High Estimate**	**Old Assumption***
1	0.169	0.127	0.136	0.107
2	0.121	0.081	0.090	0.075
3	0.093	0.053	0.062	0.059
4	0.089	0.050	0.058	0.037
5	0.088	0.049	0.057	0.026
10	0.038	0.001	0.009	0.017
15	0.038	0.001	0.009	0.012
20	0.041	0.004	0.012	0.010
25	0.043	0.005	0.013	0.005
30	0.047	0.009	0.017	0.000

As part of the 2016 Actuarial Valuation Report, these rates were set equal to LEOFF to reflect passed legislation impacting salaries (C 28 L16).

THREE: APPENDICES

SERVICE-BASED SALARY INCREASE

New Assumptions

PERS

We found our prior SBS increase rates were generally too low and stopped too early in a member's career. Therefore, we extended the scale and increased our assumed SBS increase rates at most service levels.

PERS Service-Based Salary Increase					
	Historical Rates		Assumed Rates		
Service Level	Low Estimate	High Estimate	Old	New	Change
1	0.059	0.067	0.060	0.060	0.000
2	0.043	0.052	0.047	0.045	(0.002)
3	0.034	0.042	0.036	0.037	0.001
4	0.026	0.034	0.029	0.030	0.001
5	0.020	0.028	0.022	0.022	0.000
6	0.015	0.023	0.015	0.017	0.002
7	0.011	0.019	0.012	0.015	0.003
8	0.009	0.017	0.009	0.010	0.001
9	0.007	0.015	0.007	0.010	0.003
10	0.005	0.013	0.005	0.007	0.002
11	0.003	0.011	0.004	0.005	0.001
12	0.002	0.010	0.003	0.005	0.002
13	0.001	0.009	0.003	0.005	0.002
14	0.001	0.009	0.002	0.003	0.001
15	0.002	0.010	0.002	0.003	0.001
16	0.001	0.009	0.002	0.003	0.001
17	0.001	0.009	0.001	0.003	0.002
18	0.000	0.007	0.000	0.001	0.001
19	0.000	0.006	0.000	0.001	0.001
20	0.000	0.005	0.000	0.001	0.001
21+	0.000	0.005	0.000	0.000	0.000

THREE: APPENDICES

SERVICE-BASED SALARY INCREASE

TRS

We anticipate total salary increases for TRS members will be volatile in the short term due to the *McCleary v. State of Washington* decision. Long term, we anticipate our historical experience to continue to be a good indication of future experience but expect the salary increases to be marginally higher. We will continue to monitor this assumption for reasonableness as we acquire more data coming out of the McCleary decision.

Our new rates for TRS are notably higher for new members and members with five to seventeen years of service.

TRS Service-Based Salary Increase					
Historical Rates			**Assumed Rates**		
Service Level	**Low Estimate**	**High Estimate**	**Old**	**New**	**Change**
1	0.055	0.060	0.051	0.055	0.004
2	0.036	0.041	0.039	0.037	(0.002)
3	0.035	0.041	0.039	0.037	(0.002)
4	0.033	0.038	0.035	0.035	0.000
5	0.031	0.036	0.030	0.032	0.002
6	0.029	0.034	0.027	0.030	0.003
7	0.030	0.036	0.027	0.030	0.003
8	0.031	0.036	0.026	0.030	0.004
9	0.028	0.033	0.024	0.030	0.006
10	0.026	0.031	0.022	0.027	0.005
11	0.024	0.029	0.020	0.025	0.005
12	0.020	0.025	0.018	0.022	0.004
13	0.019	0.024	0.015	0.020	0.005
14	0.015	0.020	0.012	0.017	0.005
15	0.013	0.018	0.009	0.015	0.006
16	0.008	0.013	0.005	0.010	0.005
17	0.002	0.008	0.002	0.005	0.003
18	0.001	0.006	0.001	0.002	0.001
19	0.000	0.005	0.001	0.001	0.000
20	0.000	0.004	0.001	0.001	0.000
21	0.000	0.004	0.001	0.001	0.000
22	0.000	0.004	0.001	0.001	0.000
23	0.000	0.005	0.001	0.001	0.000
24	0.000	0.004	0.001	0.001	0.000
25	0.000	0.003	0.001	0.001	0.000
26+	0.000	0.004	0.000	0.000	0.000

SERVICE-BASED SALARY INCREASE

SERS

Overall, we found our old rates were too low over all service levels. Based on observed SBS and expectations for future salary changes, we increased most of the SBS rates for SERS.

	SERS Service-Based Salary Increase				
	Historical Rates		Assumed Rates		
Service Level	Low Estimate	High Estimate	Old	New	Change
1	0.094	0.100	0.066	0.080	0.014
2	0.041	0.047	0.039	0.040	0.001
3	0.031	0.037	0.028	0.030	0.002
4	0.023	0.029	0.023	0.025	0.002
5	0.021	0.027	0.021	0.020	(0.001)
6	0.017	0.023	0.016	0.017	0.001
7	0.015	0.021	0.012	0.015	0.003
8	0.015	0.021	0.012	0.015	0.003
9	0.013	0.019	0.009	0.012	0.003
10	0.011	0.017	0.009	0.012	0.003
11	0.009	0.015	0.007	0.010	0.003
12	0.006	0.012	0.005	0.005	0.000
13	0.006	0.012	0.004	0.007	0.003
14	0.006	0.012	0.003	0.007	0.004
15	0.008	0.014	0.002	0.007	0.005
16	0.005	0.010	0.002	0.005	0.003
17	0.004	0.010	0.002	0.005	0.003
18	0.003	0.009	0.002	0.002	0.000
19	0.004	0.010	0.001	0.002	0.001
20	0.001	0.006	0.001	0.001	0.000
21+	0.001	0.007	0.000	0.000	0.000

THREE: APPENDICES

PSERS

PSERS was created on July 1, 2006, and eligible members of PERS were given the option to transfer. The data we have for PSERS is rather limited due to the plan's relatively short history. Therefore, we set our PSERS rates equal to PERS. We reviewed the rates for reasonableness using the limited PSERS data available and found similar rates of SBS increases between the two systems.

Please see the **PERS** section for more information on the old and new PSERS rates.

LEOFF

Generally, we found our prior assumption close to actual experience over our study period. We only made minor adjustments to our new rates for LEOFF.

	LEOFF Service-Based Salary Increase				
	Historical Rates		**Assumed Rates**		
	Low Estimate	**High Estimate**	**Old**	**New**	**Change**
1	0.105	0.114	0.107	0.110	0.003
2	0.066	0.074	0.075	0.075	0.000
3	0.048	0.056	0.059	0.060	0.001
4	0.029	0.037	0.037	0.040	0.003
5	0.017	0.026	0.026	0.025	(0.001)
6	0.008	0.017	0.018	0.020	0.002
7	0.002	0.011	0.014	0.015	0.001
8	0.002	0.010	0.013	0.010	(0.003)
9	0.002	0.010	0.012	0.010	(0.002)
10	0.007	0.015	0.017	0.015	(0.002)
11	0.002	0.010	0.012	0.010	(0.002)
12	0.002	0.010	0.012	0.010	(0.002)
13	0.000	0.008	0.012	0.010	(0.002)
14	0.003	0.011	0.012	0.010	(0.002)
15	0.007	0.015	0.012	0.015	0.003
16	0.000	0.008	0.010	0.010	0.000
17	0.001	0.009	0.010	0.010	0.000
18	0.000	0.008	0.010	0.010	0.000
19	0.000	0.009	0.010	0.010	0.000
20	0.003	0.011	0.010	0.010	0.000
21	0.000	0.005	0.005	0.005	0.000
22	0.000	0.005	0.005	0.005	0.000
23	0.000	0.005	0.005	0.005	0.000
24	0.000	0.006	0.005	0.005	0.000
25	0.000	0.007	0.005	0.005	0.000
26+	0.000	0.003	0.000	0.000	0.000

SERVICE-BASED SALARY INCREASE

continued

WSPRS

We expect recent legislative changes will impact future WPSRS salaries. We will not know the full impact of these legislative changes for a few years. However, we anticipate future WSPRS SBS increases will be more similar to LEOFF SBS increases than historical rates. As such, we set our new WSPRS rates equal to LEOFF.

WSPRS Service-Based Salary Increase			
Assumed Rates			
Service Level	Old*	New	Change
1	0.107	0.110	0.003
2	0.075	0.075	0.000
3	0.059	0.060	0.001
4	0.037	0.040	0.003
5	0.026	0.025	(0.001)
6	0.018	0.020	0.002
7	0.014	0.015	0.001
8	0.013	0.010	(0.003)
9	0.012	0.010	(0.002)
10	0.017	0.015	(0.002)
11	0.012	0.010	(0.002)
12	0.012	0.010	(0.002)
13	0.012	0.010	(0.002)
14	0.012	0.010	(0.002)
15	0.012	0.015	0.003
16	0.010	0.010	0.000
17	0.010	0.010	0.000
18	0.010	0.010	0.000
19	0.010	0.010	0.000
20	0.010	0.010	0.000
21	0.005	0.005	0.000
22	0.005	0.005	0.000
23	0.005	0.005	0.000
24	0.005	0.005	0.000
25	0.005	0.005	0.000
26+	0.000	0.000	0.000

*This assumption was updated as part of the 2016 Actuarial Valuation Report to reflect passed legislation impacting salaries (C 28 L1 6).

THREE: APPENDICES

SERVICE-BASED SALARY INCREASE

Exhibits

Actual to Expected Total Salary Increases from 1995-2017

The following tables illustrate the actual total average salary increases experienced from 1995-2017 by service level compared to our expected total salary increases under our old and new SBS increase assumptions. We calculate the old expected value using the SBS increase assumptions developed during the *2007-2012 Demographic Experience Study* along with our 3.5 percent assumed GSG developed as part of the *2019 Economic Experience Study*. We calculate the new expected value using the SBS increase assumptions developed in this report along with the same GSG.

When determining total salary growth, we look at both historical experience and expectations for the future. Therefore, the following tables can inform if our assumptions are reasonable, but it does not necessarily determine the best estimate projections for the future.

PERS Total Salary Increase					
Service Level	Actual	Old Expected	Old A/E	New Expected	New A/E
1	0.094	0.097	0.970	0.097	0.970
2	0.078	0.084	0.936	0.082	0.960
3	0.068	0.072	0.943	0.073	0.930
4	0.060	0.065	0.927	0.066	0.912
5	0.054	0.058	0.938	0.058	0.938
6	0.049	0.051	0.962	0.053	0.924
7	0.045	0.047	0.951	0.051	0.893
8	0.043	0.044	0.970	0.045	0.948
9	0.041	0.042	0.966	0.045	0.900
10	0.038	0.040	0.955	0.042	0.908
11	0.036	0.039	0.932	0.040	0.908
12	0.035	0.038	0.928	0.040	0.880
13	0.034	0.038	0.904	0.040	0.858
14	0.035	0.037	0.935	0.038	0.910
15	0.035	0.037	0.953	0.038	0.927
16	0.035	0.037	0.944	0.038	0.919
17	0.035	0.036	0.962	0.038	0.909
18	0.033	0.035	0.930	0.036	0.903
19	0.032	0.035	0.901	0.036	0.875
20	0.031	0.035	0.880	0.036	0.855
21	0.031	0.035	0.883	0.035	0.883
22	0.030	0.035	0.866	0.035	0.866
23	0.031	0.035	0.891	0.035	0.891
24	0.031	0.035	0.896	0.035	0.896
25	0.030	0.035	0.864	0.035	0.864
26	0.030	0.035	0.871	0.035	0.871
27	0.030	0.035	0.848	0.035	0.848
28	0.031	0.035	0.893	0.035	0.893
29	0.031	0.035	0.895	0.035	0.895
30	0.030	0.035	0.858	0.035	0.858

THREE: APPENDICES

SERVICE-BASED SALARY INCREASE

TRS Total Salary Increase					
Service Level	Actual	Old Expected	Old A/E	New Expected	New A/E
1	0.087	0.088	0.988	0.092	0.943
2	0.067	0.075	0.894	0.073	0.919
3	0.067	0.075	0.888	0.073	0.913
4	0.065	0.071	0.907	0.071	0.907
5	0.062	0.066	0.938	0.068	0.910
6	0.061	0.063	0.964	0.066	0.919
7	0.062	0.063	0.982	0.066	0.936
8	0.063	0.062	1.010	0.066	0.946
9	0.059	0.060	0.983	0.066	0.891
10	0.057	0.058	0.986	0.063	0.905
11	0.055	0.056	0.988	0.061	0.904
12	0.051	0.054	0.960	0.058	0.891
13	0.050	0.051	0.982	0.056	0.890
14	0.046	0.047	0.973	0.053	0.877
15	0.044	0.044	0.988	0.051	0.867
16	0.038	0.040	0.955	0.045	0.846
17	0.033	0.037	0.891	0.040	0.822
18	0.031	0.036	0.874	0.037	0.849
19	0.031	0.036	0.854	0.036	0.854
20	0.029	0.036	0.812	0.036	0.812
21	0.030	0.036	0.821	0.036	0.821
22	0.029	0.036	0.814	0.036	0.814
23	0.030	0.036	0.843	0.036	0.843
24	0.030	0.036	0.830	0.036	0.830
25	0.028	0.036	0.789	0.036	0.789
26	0.029	0.035	0.838	0.035	0.838
27	0.030	0.035	0.843	0.035	0.843
28	0.031	0.035	0.895	0.035	0.895
29	0.032	0.035	0.916	0.035	0.916
30	0.028	0.035	0.792	0.035	0.792

THREE: APPENDICES

SERVICE-BASED SALARY INCREASE

continued

SERS Total Salary Increase					
Service Level	Actual	Old Expected	Old A/E	New Expected	New A/E
1	0.127	0.103	1.229	0.118	1.078
2	0.073	0.075	0.964	0.076	0.951
3	0.062	0.064	0.970	0.066	0.940
4	0.055	0.059	0.927	0.061	0.896
5	0.052	0.057	0.914	0.056	0.931
6	0.048	0.052	0.936	0.053	0.917
7	0.046	0.047	0.968	0.051	0.908
8	0.046	0.047	0.966	0.051	0.906
9	0.043	0.044	0.981	0.047	0.917
10	0.042	0.044	0.947	0.047	0.885
11	0.040	0.042	0.940	0.045	0.876
12	0.037	0.040	0.913	0.040	0.913
13	0.037	0.039	0.944	0.042	0.875
14	0.037	0.038	0.969	0.042	0.874
15	0.039	0.037	1.039	0.042	0.911
16	0.035	0.037	0.948	0.040	0.874
17	0.035	0.037	0.938	0.040	0.866
18	0.034	0.037	0.919	0.037	0.919
19	0.034	0.036	0.950	0.037	0.923
20	0.031	0.036	0.861	0.036	0.861
21	0.031	0.035	0.888	0.035	0.888
22	0.030	0.035	0.869	0.035	0.869
23	0.032	0.035	0.902	0.035	0.902
24	0.032	0.035	0.917	0.035	0.917
25	0.032	0.035	0.910	0.035	0.910
26	0.031	0.035	0.879	0.035	0.879
27	0.030	0.035	0.867	0.035	0.867
28	0.029	0.035	0.825	0.035	0.825
29	0.026	0.035	0.753	0.035	0.753
30	0.031	0.035	0.886	0.035	0.886

SERVICE-BASED SALARY INCREASE *continued*

Service Level	Actual	Old Expected	Old A/E	New Expected	New A/E
1	0.101	0.097	1.035	0.097	1.035
2	0.073	0.084	0.868	0.082	0.890
3	0.059	0.072	0.817	0.073	0.806
4	0.050	0.065	0.773	0.066	0.761
5	0.047	0.058	0.812	0.058	0.812
6	0.044	0.051	0.870	0.053	0.836
7	0.036	0.047	0.757	0.051	0.710
8	0.036	0.044	0.823	0.045	0.804
9	0.043	0.042	1.020	0.045	0.950
10	0.032	0.040	0.802	0.042	0.763
11	0.032	0.039	0.810	0.040	0.789
12	0.031	0.038	0.819	0.040	0.776
13	0.030	0.038	0.789	0.040	0.748
14	0.030	0.037	0.802	0.038	0.780
15	0.028	0.037	0.749	0.038	0.729
16	0.028	0.037	0.761	0.038	0.741
17	0.032	0.036	0.879	0.038	0.831
18	0.028	0.035	0.791	0.036	0.768
19	0.028	0.035	0.807	0.036	0.783
20	0.021	0.035	0.598	0.036	0.581
21	0.026	0.035	0.734	0.035	0.734
22	0.026	0.035	0.737	0.035	0.737
23	0.026	0.035	0.757	0.035	0.757
24	0.023	0.035	0.666	0.035	0.666
25	0.030	0.035	0.862	0.035	0.862

PSERS Total Salary Increase*

Note: Complete salary data for PSERS is only available from 2008 onwards. Due to the age of the plan, there is limited data for members with higher service levels.

SERVICE-BASED SALARY INCREASE

	LEOFF Total Salary Increase				
Service Level	Actual	Old Expected	Old A/E	New Expected	New A/E
1	0.150	0.146	1.026	0.149	1.005
2	0.109	0.113	0.966	0.113	0.966
3	0.090	0.096	0.938	0.097	0.928
4	0.071	0.073	0.965	0.076	0.926
5	0.059	0.062	0.945	0.061	0.961
6	0.049	0.054	0.919	0.056	0.885
7	0.043	0.049	0.869	0.051	0.851
8	0.043	0.048	0.883	0.045	0.944
9	0.042	0.047	0.890	0.045	0.931
10	0.048	0.053	0.904	0.051	0.941
11	0.042	0.047	0.889	0.045	0.929
12	0.042	0.047	0.895	0.045	0.935
13	0.040	0.047	0.849	0.045	0.888
14	0.043	0.047	0.911	0.045	0.953
15	0.047	0.047	0.996	0.051	0.935
16	0.040	0.045	0.884	0.045	0.884
17	0.041	0.045	0.908	0.045	0.908
18	0.041	0.045	0.896	0.045	0.896
19	0.041	0.045	0.903	0.045	0.903
20	0.043	0.045	0.955	0.045	0.955
21	0.038	0.040	0.937	0.040	0.937
22	0.037	0.040	0.928	0.040	0.928
23	0.037	0.040	0.926	0.040	0.926
24	0.038	0.040	0.943	0.040	0.943
25	0.040	0.040	0.988	0.040	0.988
26	0.035	0.035	1.006	0.035	1.006
27	0.037	0.035	1.064	0.035	1.064
28	0.033	0.035	0.939	0.035	0.939
29	0.033	0.035	0.950	0.035	0.950
30	0.035	0.035	1.001	0.035	1.001

SERVICE-BASED SALARY INCREASE

WSPRS Total Salary Increase					
Service Level	Actual	Old Expected*	Old A/E	New Expected	New A/E
1	0.169	0.123	1.376	0.149	1.137
2	0.121	0.097	1.250	0.113	1.078
3	0.093	0.087	1.069	0.097	0.955
4	0.089	0.087	1.031	0.076	1.171
5	0.088	0.087	1.013	0.061	1.443
6	0.077	0.071	1.078	0.056	1.378
7	0.048	0.041	1.169	0.051	0.953
8	0.039	0.041	0.941	0.045	0.855
9	0.041	0.041	0.992	0.045	0.902
10	0.038	0.041	0.927	0.051	0.756
11	0.042	0.041	1.007	0.045	0.915
12	0.039	0.039	0.993	0.045	0.857
13	0.033	0.039	0.843	0.045	0.728
14	0.034	0.039	0.874	0.045	0.754
15	0.038	0.039	0.974	0.051	0.755
16	0.052	0.039	1.333	0.045	1.150
17	0.043	0.039	1.111	0.045	0.958
18	0.042	0.039	1.074	0.045	0.927
19	0.040	0.039	1.034	0.045	0.893
20	0.041	0.039	1.052	0.045	0.908
21	0.048	0.039	1.232	0.040	1.200
22	0.042	0.039	1.079	0.040	1.051
23	0.037	0.039	0.949	0.040	0.924
24	0.049	0.039	1.249	0.040	1.216
25	0.043	0.039	1.091	0.040	1.062
26	0.044	0.039	1.135	0.035	1.269
27	0.045	0.039	1.162	0.035	1.300
28	0.036	0.035	1.034	0.035	1.034
29	0.048	0.035	1.370	0.035	1.370
30	0.047	0.035	1.343	0.035	1.343

*Based on the rates developed as part of the 2007-2012 Demographic Experience Study.

THREE: APPENDICES

TERMINATION RATES

Methodology

The termination rates assumption represents the probability that a member will leave active employment status without becoming disabled or retiring. We compared the actual rate of termination against what we expected to determine the accuracy of our termination rates assumption over the study period. For each retirement plan, we counted the number of members at the beginning of the year (exposures) and the number of terminations during the year. We divided the number of terminations by the number of exposures to arrive at the actual rate of termination. The actual rate of termination was calculated for both members not eligible for retirement and members eligible for retirement. We compared the actual rate to expected rate of termination over the full period and on an annual basis. This helped us identify trends in the data where our assumption differed from what actually happened.

We developed new termination rate assumptions based on historical actual-to-expected measurements and applied professional judgment on future termination behavior. In most cases, we did not develop a new assumption to perfectly replicate the study period. We targeted a smaller move than the study experience would indicate to account for future experience not exactly matching the past. We also considered simplifications to the assumption where we believe the additional complexity does not offer a significant increase in the modeling accuracy.

Analysis

We consider many factors when developing updated assumptions as part of this study. The discussion that follows divides those factors into two sections, a review of historical data and a review of key demographic factors. When looking at historical data we are determining whether any historical anomalies exist that might skew results and if recent experience suggests any trends in the data. This helps us get a solid foundation on reliable past experience and where it might be headed.

We then consider key demographic factors that may influence behavior. Examples include plan choice, gender, and service. Our goal here is to determine which variables suggest the greatest impact on behavior, as those are the ones we'd want to explicitly model, while also not making our assumption unnecessarily complex.

The following provides details into the analysis and decisions we made regarding historical data and demographic factors.

Review of Historical Data – Relying on historical data to set forward-looking termination assumptions requires us to consider if that historical experience will be a good indicator of the future. In other words, if we believe historical data represents an outlier compared to what we think future termination experience will be, we would consider excluding it from the study. It also helps us identify trends. We considered data from 1995-2015 to include in the study. In addition to the historical data, we considered the impact of recent legislation on future termination behavior.

Review of Key Demographic Factors – With the historical data period selected for each plan, we considered population demographics that could influence termination behavior by plan. Some of the demographics we studied include gender, retirement plan selection, retirement eligibility, and service years (or age). We also considered maintaining simplicity when we observed a demographic factor's impact on termination behavior was not significant.

To review the historical data and demographic factors, we compared the actual number of terminations to our old expectation. We calculated an A/E ratio to help us determine trends in the data. An A/E ratio less than 1.00 generally indicates less members are terminating than the old assumption. While an A/E ratio of greater than 1.00 tells us more members are terminating than we assume. In general, we developed a new assumption so that the A/E ratio moved closer to 1.00. Please see the **Methodology** section for more detail on A/E ratios, and see the **Exhibits** section for a comparison of A/E ratio between the old and new assumptions for each system.

TERMINATION RATES *continued*

The following sections summarize our observations of the review of historical data and key demographic factors:

Review of Historical Data

The prior experience study (*2007-2012 Demographic Experience Study*) relied on data from 1995-2010 to set assumptions. The data following the Great Recession was included in our prior analysis because we did not observe a shift in termination behavior due to the Great Recession, and we felt the time period would still be representative of future behavior.

We compared data gathered since the last experience study (2011-2015) to data used during the prior experience study to determine if trends were emerging. We also considered the impact of recent legislation on termination behavior. As noted in the **Summary** section, some data was excluded from our analysis depending on the plan.

The analysis for the Review of Historical Data will focus on members not eligible for retirement. The data available for retirement-eligible members is limited, so we used the full time period of data (1995-2015) for those members.

Plans 2/3 – PERS, TRS, SERS.
Overall, we observed Plans 2/3 terminations that were higher than expected since the last experience study. The A/E ratio, based on the new data (2011-2015), is above 1.00 for each system. We did not observe any atypical termination experience with the new data, so we chose to set our termination rates assumption using all available data (from 1995-2015).

The following table summarizes how the termination behavior has changed since the prior experience study.

Not Eligible for Retirement									
Plan 2/3 Termination Experience by Year									
PERS 2/3				TRS 2/3			SERS 2/3		
Year	Actual	Expected	A/E	Actual	Expected	A/E	Actual	Expected	A/E
1995-2010*	116,736	118,394	0.99	26,745	25,632	1.04	46,447	45,368	1.02
2011-2015	44,448	41,110	1.08	8,958	8,788	1.02	15,582	14,644	1.06
Total	161,184	159,503	1.01	35,703	34,420	1.04	62,029	60,011	1.03

*See **Summary** section for omitted data.*

Previously, we had developed a combined termination assumption for Plans 2/3; however, retirement plan selection can influence termination behavior. We also considered the plan-specific termination rate trends emerging from the 2011-2015 data.

TERMINATION RATES

For the 2011-2015 data, the annual Plan 2 A/E ratios remained within 10 percent of 1.00; however, the annual Plan 3 A/E ratios show a trend of increasing A/E ratios. Plan 3 terminations have been steadily increasing compared to what we expected during the prior experience study. Further analysis on plan-specific termination rates is contained in the **Review of Demographic Factors** section.

A/E Ratios - Plan 2
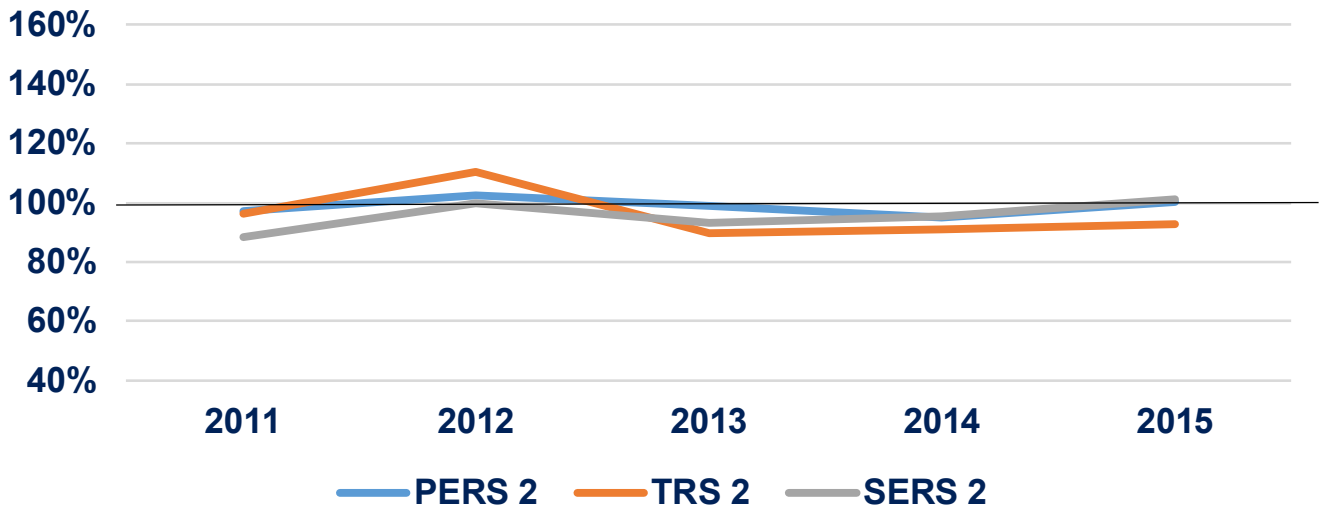
A/E Ratios - Plan 3
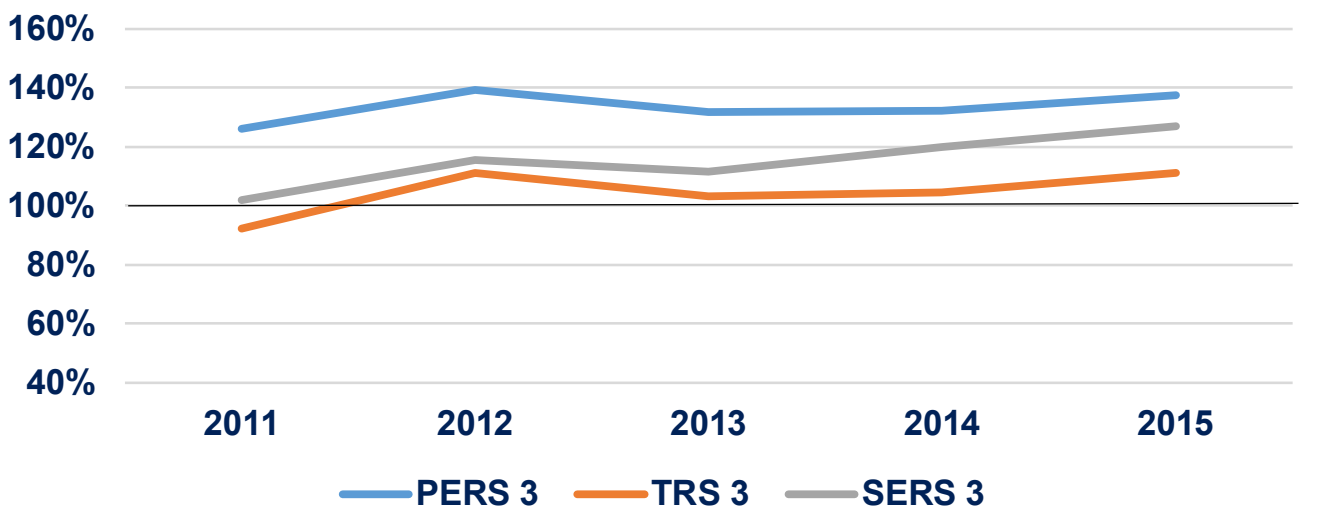
Recent increases in state funding for basic education has led to higher than expected short-term salary increases for members of TRS and SERS. The salary increases could improve retention in TRS and SERS.

TERMINATION RATES

Public Safety Plans – LEOFF 2, WSPRS 1/2, PSERS 2.

For LEOFF 2, we did not observe any atypical termination experience with the new data, however it was less than expected. WSPRS displayed a significant increase in terminations. The number of WSPRS terminations more than doubled our expectations in 2014 and 2015, which lead to the exclusion of this data from our analysis. We believe this high termination behavior was addressed through recent legislation significantly improving WSPRS member salaries, and we don't expect it to continue. For this reason, we chose to set a termination rates assumption using data from 1995-2015 for LEOFF 2 and 1995-2013 for WSPRS.

PSERS 2 opened in 2006 and our analysis only includes 8 years of data (2008-2015). Given the lack of data, we do not believe we have a long enough time period to set termination rates based on PSERS data. We currently rely on PERS 2 for the PSERS termination assumption since PSERS members were previously covered under PERS prior to plan creation. The A/E ratio for historical PSERS data was 0.93, which indicates that PERS 2 was a reasonable assumption for PSERS data. Until we have adequate data to set rates based on PSERS experience, we will continue to rely on PERS 2 to inform the PSERS termination since we expect PSERS to have similar behavior as PERS 2.

The following table summarizes how the termination behavior has changed since the prior experience study.

Not Eligible for Retirement						
Public Safety Plans Termination Experience by Year						
	LEOFF 2			WSPRS 1/2		
Year	Actual	Expected	A/E	Actual	Expected	A/E
1995-2010*	3,427	3,468	0.99	171	163	1.05
2011-2015*	983	1,108	0.89	31	32	0.97
Total	4,410	4,576	0.96	202	195	1.04

*See **Summary** section for omitted data.

The previous table provides a helpful look at the total A/E ratio over multiple years of data, but we also considered annual trends emerging in the public safety plans. No annual trends emerged for LEOFF 2 or PSERS 2. WSPRS displayed significant volatility from one year to the next, which is somewhat normal given its small size. The WSPRS A/E ratio exceeds 1.60 for the excluded valuation years of 2014 and 2015.

A/E Ratios - Public Safety Plans
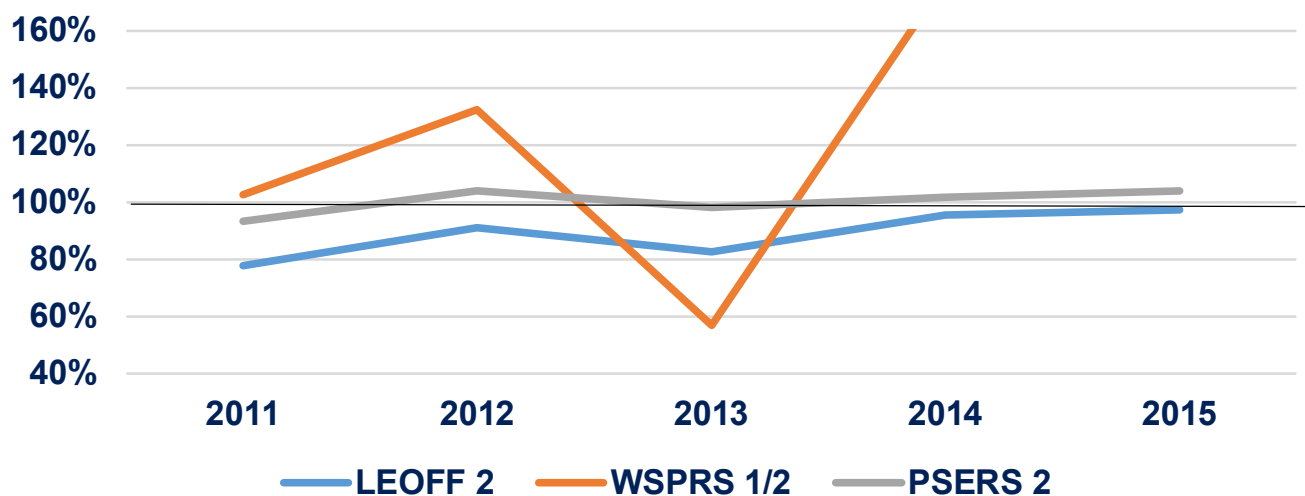
TERMINATION RATES *continued*

Plans 1 – PERS, TRS, LEOFF.
Given the declining size of the Plans 1 and the declining number of annual terminations, we no longer rely on Plans 1 data to develop termination rates assumptions. We also don't believe the termination assumption to be a significant assumption going forward.

The following table summarizes the maturity of Plans 1 by displaying the number of active members to annuitants.

Plan 1 Counts at June 30, 2017*			
	PERS 1	**TRS 1**	**LEOFF 1**
Total Active	**2,597**	**698**	**40**
Eligible for Retirement	2,386	693	40
Not Eligible for Retirement	211	5	0
Total Annuitants	**48,111**	**34,151**	**7,228**

*Source: OSA, 2017 AVR.

Given we don't believe a Plans 1 termination assumption is significant moving forward; we made the following simplifications to our modeling. We rely on PERS Plan 2 and TRS Plan 2 termination assumptions for PERS Plan 1 and TRS Plan 1, respectively. We assume zero future terminations in LEOFF Plan 1 since all members are eligible for retirement.

We do not assume any terminations will occur for Plan 1 members eligible for retirement.

TERMINATION RATES *continued*

Review of Key Demographic Factors

After analyzing the historical data period, and determining any observed trends, we then look at termination behavior by certain demographic characteristics. Our goal is to find the primary characteristics that influence member behavior to help us better model these populations going forward.

1. **Plan 2 versus Plan 3 Termination Experience.**

Plan 2 and Plan 3 have fundamental differences in design, which we expect influences termination behavior. Plan 2 is a defined benefit plan, with five-year vesting, while Plan 3 is a hybrid of defined benefit and defined contribution, with up to ten-year vesting. Selection of retirement plan (or plan choice) may influence termination behavior because their selection may indicate the employee's expected longevity within the plan. For example, an employee may select Plan 3 if they don't intend to stay at the same job for long and prefer the portability of their defined contribution benefit.

In the prior study, we observed higher rates of termination in Plan 3, but lacked sufficient experience to set credible plan specific rates. We added five more years of experience study data since the prior study, and we continue to observe Plan 3 members with higher rates of termination than Plan 2 members. For purposes of assumption setting, we now develop separate Plan 2 and Plan 3 termination assumptions for the first ten years of service (or service years 0-9). PERS, which provided the longest history on plan choice, continued to show higher Plan 3 termination rates than Plan 2 through the first ten years of service. It was not as pronounced in TRS and SERS, and our new assumption reflects more similar plan experience for those systems. Beyond ten years of service, we combined Plan 2 and Plan 3 experience to develop a termination assumption for both plans.

Plan 3 may continue to display higher levels of termination than Plan 2 beyond ten years, but we don't expect plan choice to be as strong of an influence the longer the member remains employed. The data is also limited in the longer service years. We will continue to monitor plan specific rates in future studies and may expand the plan-specific assumption.

The following table compares the Plan 2 and Plan 3 average termination rates for Plans 2/3.

Not Eligible for Retirement								
Plan 2 vs Plan 3 Termination Experience*								
PERS			**TRS**			**SERS**		
1995-2015	**Lives**	**Term**	**Term Rate**	**Lives**	**Term**	**Term Rate**	**Lives**	**Term**	**Term Rate**
Plan 2	1,941,201	132,581	0.068	225,998	9,558	0.042	447,399	34,507	0.077
Plan 3	250,653	28,603	0.114	641,367	26,145	0.041	324,979	27,522	0.085
Total	2,191,854	161,184	0.074	867,365	35,703	0.041	772,378	62,029	0.080

*See **Summary** section for omitted data.*

Some plans have more years of experience study data because of plan creation[1] and restrictions on plan choice.[2] PERS has the longest history of plan choice and also showed the most pronounced difference between Plan 2 and Plan 3 termination rates. Since plan choice wasn't always available in TRS and SERS, that may influence the plan specific results.

We also don't believe plan choice will be as strong an indicator of termination behavior in TRS. Compared to PERS, we believe TRS members are less likely to switch between state employment and the private sector. This is supported by the overall TRS termination rate across both plans and is reflected in our new assumption.

As more plan choice data is collected, we will continue to monitor the plan specific assumptions in future studies.

[1]PERS Plan 2 opened October 1, 1977, and PERS Plan 3 opened March 1, 2002. TRS Plan 2 opened October 1, 1977, and TRS Plan 3 opened July 1, 1996. SERS Plan 2 and Plan 3 opened September 1, 2000.

[2]Newly hired employees in SERS and TRS were placed in Plan 3 prior to 2007. After 2007, newly hired employees have a choice between Plan 2 and Plan 3. PERS employees hired since Plan 3 opened in 2002 have had the choice between Plan 2 and Plan 3.

TERMINATION RATES
continued

2. **Male versus Female Termination Experience.**
We observed the gender specific termination trends using the data determined in the **Review of Historical Data** section.

We previously assumed gender specific termination rates in PERS, TRS, SERS, and PSERS based on observations from the prior experience study (*2007-12 Demographic Experience Study*). All other systems assume gender-neutral termination rates. Historically we've typically observed females to terminate at a higher rate than males.

Plans 2/3 – PERS, TRS, SERS.
While we continue to observe females exhibiting different termination behavior than males, and expect this to continue, we combined male and female data for the purpose of assumption setting. In our opinion, a set of gender-neutral termination rates provides sufficient accuracy without further complicating the model since we do not expect the demographic make-up, i.e., male to female ratio, of these systems to change.

The following table summarizes the gender-specific average termination rate for Plans 2/3.

Not Eligible for Retirement								
Male vs Female Termination Experience*								
PERS 2/3			TRS 2/3			SERS 2/3		
1995-2015	**Lives**	**Term**	**Term Rate**	**Lives**	**Term**	**Term Rate**	**Lives**	**Term**	**Term Rate**
Males	1,037,194	68,681	0.066	248,789	8,360	0.034	167,414	13,787	0.082
Females	1,154,660	92,503	0.080	618,576	27,343	0.044	604,964	48,242	0.080
Total	**2,191,854**	**161,184**	**0.074**	**867,365**	**35,703**	**0.041**	**772,378**	**62,029**	**0.080**

*See **Summary** section for omitted data.

Public Safety Plans – LEOFF 2, WSPRS 1/2, PSERS 2.
We maintain the single set of gender-neutral termination rates in LEOFF 2 and WSPRS 1/2 because of the heavy population weighting of the systems toward males. As of the 2017 AVR, approximately 90 percent of the population is male in LEOFF 2 and WSPRS 1/2.

As discussed in the **Review of Historical Data** section, we will rely on PERS Plan 2 to inform the PSERS termination rate assumption; however, males make up a greater portion of the population in PSERS than PERS. We currently assume 70 percent male in PSERS and only 50 percent male in PERS. Given we expect males to continue to display lower levels of termination than females, we adjusted the PERS 2 combined rates to reflect the difference in the Percent Male ratio of the plans. We multiplied the PERS 2 termination rates by 0.95 to account for the higher population of males in PSERS, and expected lower termination rates than PERS.

To determine the 0.95 adjustment factor, we looked at the observed averaged termination rate in PERS Plan 2. They are .061, .075, and .068 for males, females, and combined genders, respectively. Given PSERS is assumed to have a higher percentage of male members, we estimated a combined termination rate for PERS Plan 2 if it were 70 percent male/30 percent female. This resulted in a combined gender termination rate of .065, which is approximately 0.95 of the PERS 2 combined termination rate of .068.

3. **LEOFF 2 Law Enforcement Officer and Firefighter Termination Experience.**
Experience indicates different termination behavior between Law Enforcement Officers (LEO) and Fire Fighters (FF). LEOs experience higher rates of termination, across all service levels, than FFs. We developed separate rates for each occupation, but ultimately decided a blended termination rates assumption remains reasonable. In our opinion, this provides sufficient accuracy without further complicating the model.

The following table summarizes the termination experience for LEOs and FFs during 1995 through 2015.

Not Eligible for Retirement			
Termination Experience by Occupation			
LEOFF 2			
1995-2015	**Lives**	**Term**	**Term Rate**
FF	106,188	1,068	0.010
LEO	132,444	3,342	0.025
Total	**238,632**	**4,410**	**0.018**

*See **Summary** section for omitted data.*

LEOs are more than twice as likely to terminate as FFs, so we developed separate termination rates for each occupation. To capture a changing demographic, we then blended the occupation specific rates. We relied on the LEOFF Plan 2 percent FF assumption, which assumes a 45 percent/55 percent split between FFs and law enforcement. Blending the rates allows us to simplify modeling as well as rely on expectations of future experience.

4. **Eligibility for Retirement.**
Termination behavior varies depending on the retirement eligibility of members. Experience indicates that members not eligible for retirement will have different termination behavior than members eligible for retirement.

For this report, we now include analysis on termination behavior for members who are eligible for retirement. Upon attaining retirement eligibility, a member who plans to leave the retirement system has three options: (1) Terminate and withdraw accumulated savings, (2) Terminate and defer commencement of retirement benefits, (3) Retire and immediately commence retirement benefits. In this study, we collected data to set terminations rates for retirement eligible members choosing options 1 or 2. This update to the termination rate modeling replaces the Deferred Annuity Assumption developed in the prior study. Based on our Probability of Withdrawing Contributions Assumption analysis, we assume all retirement eligible members that terminate will defer commencement of retirement benefits. The following sections will detail termination assumptions for members eligible for retirement.

Plans 2/3 – PERS, TRS, SERS.
Our data shows that some members elect to defer commencement of retirement benefits even when eligible for retirement. Termination among retirement eligible plan 2/3 members is most prevalent among members who are also eligible for early retirement benefits.[3] Members eligible for normal retirement benefits[4] have relatively lower rates of termination.

Higher rates of termination are occurring for members eligible for early retirement since they can choose to receive a smaller reduction to their retirement benefit if they defer commencement. Deferring commencement until age 65 will provide unreduced retirement benefits for members. For this study, we developed termination rates assumptions for Plan 2 members and Plan 3 members eligible for early retirement.

[1]*Plan 2 members are eligible for early retirement once they accrue 20 years of service and are 55 years old. Plan 3 members are eligible for early retirement once they accrue ten years of service and are 55 years old.*
[2]*Accrue five years of service and are 65 years old.*

TERMINATION RATES

The following table summarizes the Plan 2 and Plan 3 termination behavior.

Eligible for Retirement						
Eligible for Retirement Termination Experience*						
	Early Retirement			Normal Retirement		
1995-2015	**Lives**	**Term**	**Term Rate**	**Lives**	**Term**	**Term Rate**
PERS 2	119,824	1,554	0.013	42,804	222	0.005
PERS 3	26,075	1,070	0.041	2,505	29	0.012
TRS 2	12,804	196	0.015	3,810	8	0.002
TRS 3	86,729	3,112	0.036	5,820	44	0.008
SERS 2	19,281	309	0.016	13,234	81	0.006
SERS 3	63,389	2,298	0.036	9,119	161	0.018

*See **Summary** section for omitted data.*

We see similar termination rates across all Plans 2 and similar termination behavior across all Plans 3. We considered developing termination rates assumptions for Plans 2/3 members eligible for normal retirement. Ultimately, we elected to assume these members would choose to immediately begin commencement of their retirement benefits since there isn't a financial incentive to delay commencement of these benefits like there is with early retirement and the observed frequency was much lower as well.

Public Safety Plans – LEOFF 2, WSPRS 1/2, PSERS 2.

Similar to Plans 2/3, some retirement eligible members of the Public Safety Plans will elect to defer commencement of retirement benefits; however, LEOFF 2 and WSPRS 1/2 had relatively lower levels of termination than Plans 2/3. For this reason, we will continue to assume these members will immediately begin commencement of retirement benefits upon leaving active status.

The PSERS 2 members eligible for retirement displayed similar termination behavior as Plans 2/3. The PSERS data indicates that a termination assumption is appropriate for members eligible for early retirement, but the data is currently limited. Given the lack of data in PSERS, we will rely on PERS 2 to inform the PSERS termination assumption.

The following table summarizes the Public Safety Plans termination behavior between the two retirement eligibilities (Early and Normal).

Eligible for Retirement						
Eligible for Retirement Termination Experience*						
	Early Retirement			Normal Retirement		
1995-2015	**Lives**	**Term**	**Term Rate**	**Lives**	**Term**	**Term Rate**
LEOFF 2	10,713	41	0.004	24,274	76	0.003
WSPRS 1/2	Not Applicable			2,072	1	0.000
PSERS 2	1,051	23	0.022	40	0	0.000

*See **Summary** section for omitted data.*

5. **Service-Based and Age-Based Tables.**
   The methodology for observing termination experience changes based upon the retirement eligibility of members. We used a service-based table for members not eligible for retirement and an age-based table for members eligible for retirement.

   Not Eligible for Retirement.
   We believe service is the best indicator of termination for members not eligible for retirement. Termination rates are highest for early career employees. An early career employee can enter the retirement system at any age, so the service-based table is a reliable measurement for termination behavior.

   Eligible for Retirement.
   We considered both a service-based and an age-based table for members that are retirement eligible. We believe both approaches would be reasonable but elected to use an age-based table for consistency with how retirement rates are developed.

New Assumptions

   Not Eligible for Retirement.
   We assume gender-neutral (Both) termination rates for all systems. The following tables summarize the old and new termination rates assumption for members not eligible for retirement.

TERMINATION RATES

continued

	Not Eligible for Retirement					
	PERS Termination Rates					
	Plan 1 and Plan 2			**Plan 3**		
	Old		**New**	**Old**		**New**
Service	**Males**	**Females**	**Both**	**Males**	**Females**	**Both**
0	0.262	0.262	0.260	0.262	0.262	0.300
1	0.155	0.168	0.150	0.155	0.168	0.190
2	0.101	0.117	0.105	0.101	0.117	0.130
3	0.075	0.093	0.080	0.075	0.093	0.100
4	0.063	0.076	0.065	0.063	0.076	0.085
5	0.054	0.067	0.060	0.054	0.067	0.070
6	0.045	0.058	0.055	0.045	0.058	0.065
7	0.042	0.053	0.050	0.042	0.053	0.060
8	0.039	0.049	0.045	0.039	0.049	0.055
9	0.036	0.045	0.040	0.036	0.045	0.055
10	0.034	0.042	0.040	0.034	0.042	0.040
11	0.031	0.038	0.035	0.031	0.038	0.035
12	0.029	0.035	0.030	0.029	0.035	0.030
13	0.027	0.033	0.030	0.027	0.033	0.030
14	0.025	0.030	0.030	0.025	0.030	0.030
15	0.024	0.028	0.030	0.024	0.028	0.030
16	0.022	0.025	0.025	0.022	0.025	0.025
17	0.020	0.023	0.020	0.020	0.023	0.020
18	0.019	0.022	0.020	0.019	0.022	0.020
19	0.018	0.020	0.020	0.018	0.020	0.020
20	0.015	0.018	0.020	0.015	0.018	0.020
21	0.013	0.016	0.020	0.013	0.016	0.020
22	0.011	0.014	0.015	0.011	0.014	0.015
23	0.010	0.012	0.015	0.010	0.012	0.015
24	0.009	0.011	0.015	0.009	0.011	0.015
25	0.007	0.009	0.015	0.007	0.009	0.015
26	0.006	0.008	0.010	0.006	0.008	0.010
27	0.006	0.007	0.010	0.006	0.007	0.010
28	0.005	0.006	0.010	0.005	0.006	0.010
29	0.004	0.006	0.010	0.004	0.006	0.010
30+	0.004	0.005	0.010	0.004	0.005	0.010

THREE: APPENDICES

TERMINATION RATES   *continued*

	Not Eligible for Retirement					
	TRS Termination Rates					
	Plan 1 and Plan 2			**Plan 3**		
	Old		New	Old		New
Service	**Males**	**Females**	**Both**	**Males**	**Females**	**Both**
0	0.111	0.111	0.120	0.111	0.111	0.120
1	0.090	0.095	0.080	0.090	0.095	0.090
2	0.060	0.072	0.065	0.060	0.072	0.075
3	0.045	0.061	0.050	0.045	0.061	0.060
4	0.041	0.053	0.050	0.041	0.053	0.055
5	0.037	0.047	0.045	0.037	0.047	0.050
6	0.030	0.041	0.040	0.030	0.041	0.045
7	0.027	0.037	0.035	0.027	0.037	0.040
8	0.025	0.033	0.030	0.025	0.033	0.030
9	0.023	0.030	0.030	0.023	0.030	0.030
10	0.021	0.027	0.025	0.021	0.027	0.025
11	0.020	0.024	0.020	0.020	0.024	0.020
12	0.018	0.021	0.020	0.018	0.021	0.020
13	0.017	0.019	0.020	0.017	0.019	0.020
14	0.015	0.017	0.015	0.015	0.017	0.015
15	0.014	0.016	0.015	0.014	0.016	0.015
16	0.013	0.016	0.015	0.013	0.016	0.015
17	0.012	0.015	0.010	0.012	0.015	0.010
18	0.012	0.015	0.010	0.012	0.015	0.010
19	0.011	0.014	0.010	0.011	0.014	0.010
20	0.010	0.013	0.010	0.010	0.013	0.010
21	0.010	0.013	0.010	0.010	0.013	0.010
22	0.009	0.012	0.010	0.009	0.012	0.010
23	0.009	0.011	0.010	0.009	0.011	0.010
24	0.009	0.010	0.010	0.009	0.010	0.010
25	0.008	0.010	0.010	0.008	0.010	0.010
26	0.008	0.009	0.010	0.008	0.009	0.010
27	0.007	0.009	0.010	0.007	0.009	0.010
28	0.007	0.008	0.010	0.007	0.008	0.010
29	0.006	0.008	0.010	0.006	0.008	0.010
30+	0.006	0.007	0.010	0.006	0.007	0.010

TERMINATION RATES

	Not Eligible for Retirement					
	SERS Termination Rates					
	Plan 2			Plan 3		
	Old		New	Old		New
Service	Males	Females	Both	Males	Females	Both
0	0.245	0.199	0.180	0.245	0.199	0.180
1	0.159	0.131	0.130	0.159	0.131	0.150
2	0.117	0.103	0.110	0.117	0.103	0.120
3	0.100	0.079	0.090	0.100	0.079	0.100
4	0.081	0.068	0.070	0.081	0.068	0.080
5	0.066	0.062	0.070	0.066	0.062	0.075
6	0.061	0.056	0.060	0.061	0.056	0.065
7	0.056	0.053	0.055	0.056	0.053	0.060
8	0.051	0.050	0.050	0.051	0.050	0.055
9	0.047	0.047	0.050	0.047	0.047	0.050
10	0.043	0.046	0.045	0.043	0.046	0.045
11	0.039	0.045	0.040	0.039	0.045	0.040
12	0.036	0.044	0.040	0.036	0.044	0.040
13	0.033	0.044	0.040	0.033	0.044	0.040
14	0.030	0.043	0.035	0.030	0.043	0.035
15	0.027	0.043	0.035	0.027	0.043	0.035
16	0.025	0.039	0.035	0.025	0.039	0.035
17	0.025	0.036	0.030	0.025	0.036	0.030
18	0.024	0.035	0.030	0.024	0.035	0.030
19	0.024	0.032	0.025	0.024	0.032	0.025
20	0.023	0.030	0.025	0.023	0.030	0.025
21	0.023	0.028	0.025	0.023	0.028	0.025
22	0.022	0.027	0.020	0.022	0.027	0.020
23	0.021	0.026	0.020	0.021	0.026	0.020
24	0.018	0.025	0.020	0.018	0.025	0.020
25	0.016	0.023	0.010	0.016	0.023	0.010
26	0.014	0.021	0.010	0.014	0.021	0.010
27	0.012	0.019	0.010	0.012	0.019	0.010
28	0.011	0.017	0.010	0.011	0.017	0.010
29	0.009	0.015	0.010	0.009	0.015	0.010
30+	0.008	0.014	0.010	0.008	0.014	0.010

TERMINATION RATES *continued*

	Not Eligible for Retirement						
	Public Safety Plans Termination Rates						
	LEOFF 2		WSPRS 1/2		PSERS 2		
	Old	New	Old	New	Old		New
Service	Both	Both	Both	Both	Males	Females	Both
0	0.107	0.105	0.042	0.045	0.262	0.262	0.250
1	0.048	0.050	0.020	0.020	0.155	0.168	0.140
2	0.024	0.025	0.020	0.020	0.101	0.117	0.100
3	0.019	0.020	0.020	0.020	0.075	0.093	0.075
4	0.019	0.020	0.020	0.020	0.063	0.076	0.060
5	0.018	0.020	0.020	0.020	0.054	0.067	0.060
6	0.017	0.020	0.019	0.020	0.045	0.058	0.050
7	0.017	0.015	0.017	0.020	0.042	0.053	0.050
8	0.016	0.015	0.016	0.015	0.039	0.049	0.040
9	0.015	0.015	0.015	0.015	0.036	0.045	0.040
10	0.015	0.015	0.013	0.010	0.034	0.042	0.040
11	0.014	0.010	0.012	0.010	0.031	0.038	0.035
12	0.014	0.010	0.011	0.010	0.029	0.035	0.030
13	0.013	0.010	0.010	0.010	0.027	0.033	0.030
14	0.012	0.010	0.009	0.010	0.025	0.030	0.030
15	0.012	0.010	0.008	0.010	0.024	0.028	0.030
16	0.011	0.010	0.007	0.005	0.022	0.025	0.025
17	0.010	0.010	0.006	0.005	0.020	0.023	0.020
18	0.010	0.010	0.006	0.005	0.019	0.022	0.020
19	0.009	0.010	0.005	0.005	0.018	0.020	0.020
20	0.008	0.010	0.004	0.005	0.015	0.018	0.020
21	0.008	0.005	0.004	0.005	0.013	0.016	0.020
22	0.007	0.005	0.003	0.005	0.011	0.014	0.015
23	0.006	0.005	0.003	0.005	0.010	0.012	0.015
24	0.006	0.005	0.002	0.005	0.009	0.011	0.015
25	0.005	0.005	0.000	0.000	0.007	0.009	0.015
26	0.004	0.005	0.000	0.000	0.006	0.008	0.010
27	0.004	0.005	0.000	0.000	0.006	0.007	0.010
28	0.003	0.005	0.000	0.000	0.005	0.006	0.010
29	0.002	0.005	0.000	0.000	0.004	0.006	0.010
30+	0.002	0.005	0.000	0.000	0.004	0.005	0.010

Eligible for Retirement.

For this report, we updated our methodology to assume some retirement eligible members will terminate and defer commencement of their retirement benefit. To develop the new recommendation for Plans 2/3, we combined all Plan 2 data and all Plan 3 data to set plan specific rates across PERS, TRS, and SERS.

THREE: APPENDICES

TERMINATION RATES

Eligible for Retirement				
PERS, TRS, and SERS Plans 2/3 Termination Rates				
	Plan 2		**Plan 3**	
	Old	New	Old	New
Age	**Both**	**Both**	**Both**	**Both**
55	0.000	0.015	0.000	0.030
56	0.000	0.015	0.000	0.030
57	0.000	0.015	0.000	0.030
58	0.000	0.015	0.000	0.030
59	0.000	0.015	0.000	0.045
60	0.000	0.015	0.000	0.045
61	0.000	0.015	0.000	0.045
62	0.000	0.015	0.000	0.055
63	0.000	0.005	0.000	0.020
64	0.000	0.005	0.000	0.010
65+	0.000	0.000	0.000	0.000

PSERS assumption relies on PERS Plan 2 to inform the assumption. Because PSERS members are eligible to retire as early as age 53, depending on years of service, we extended the table of rates prior to age 55 and assumed similar termination behavior at ages 53 and 54. PSERS also has earlier normal retirement than PERS Plan 2 because members are eligible to retire at age 60 with ten years of PSERS service. We expect PSERS members will have at least ten years of service at age 60 so we assume no termination for retirement eligible members beginning at age 60.

Eligible for Retirement		
PSERS 2 Termination Rates		
	Old	New
Age	**Both**	**Both**
53	0.000	0.015
54	0.000	0.015
55	0.000	0.015
56	0.000	0.015
57	0.000	0.015
58	0.000	0.015
59	0.000	0.015
60+	0.000	0.000

TERMINATION RATES *continued*

Exhibits

PERS

Not Eligible for Retirement								
PERS Termination Experience by Year - Old Assumptions								
Plan 1 (Males & Females)			Plan 2 (Males and Females)			Plan 3 (Males and Females)		
Age	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
1995	694	1,037	0.67	8,178	8,460	0.97	0	0	N/A
1996	651	919	0.71	7,696	8,260	0.93	0	0	N/A
1997	612	832	0.74	8,394	8,374	1.00	0	0	N/A
1998	576	763	0.75	8,515	8,555	1.00	0	0	N/A
1999	572	693	0.83	9,445	9,193	1.03	0	0	N/A
2000	580	625	0.93	10,815	9,502	1.14	0	0	N/A
2001	378	555	0.68	8,622	9,783	0.88	0	0	N/A
2002	345	493	0.70	8,376	8,986	0.93	200	755	0.26
2003	311	425	0.73	7,266	8,422	0.86	1,267	1,073	1.18
2004	314	375	0.84	6,598	7,701	0.86	1,812	1,553	1.17
2005	263	323	0.81	7,678	7,501	1.02	2,485	1,858	1.34
2006	242	281	0.86	8,694	7,196	1.21	2,732	1,995	1.37
2007	170	249	0.68	5,511	7,213	0.76	1,908	2,098	0.91
2008	183	214	0.86	7,338	7,462	0.98	2,882	2,328	1.24
2009	155	184	0.84	6,672	7,569	0.88	2,846	2,546	1.12
2010	107	145	0.74	5,902	6,767	0.87	2,571	2,284	1.13
2011	92	115	0.80	6,046	6,211	0.97	2,756	2,187	1.26
2012	88	89	0.99	5,942	5,796	1.03	2,844	2,040	1.39
2013	65	65	1.00	5,711	5,781	0.99	2,759	2,094	1.32
2014	45	49	0.92	5,677	5,969	0.95	3,012	2,275	1.32
2015	30	38	0.79	6,332	6,309	1.00	3,369	2,447	1.38
Total	**6,473**	**8,468**	**0.76**	**155,408**	**161,011**	**0.97**	**33,443**	**27,533**	**1.21**

Not Eligible for Retirement						
PERS Termination Experience by Service Level Old Assumptions*						
	Plan 2			Plan 3		
Service	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
0	27,460	28,057	0.98	7,676	6,567	1.17
1	26,288	28,289	0.93	7,006	5,638	1.24
2	15,096	15,839	0.95	3,645	2,772	1.32
3	10,700	11,118	0.96	2,300	1,745	1.32
4	8,100	8,561	0.95	1,656	1,297	1.28
5	6,829	6,941	0.98	1,314	1,009	1.30
6-9	18,466	18,507	1.00	2,852	2,154	1.32
10-14	12,145	12,521	0.97	1,135	857	1.32
15-19	5,758	5,648	1.02	563	434	1.30
20-24	1,353	1,122	1.21	339	175	1.94
25-29	309	192	1.61	95	33	2.89
30+	77	25	3.13	22	4	6.01
Total	**132,581**	**136,819**	**0.97**	**28,603**	**22,685**	**1.26**

*Data summarized for years 1995-2015. Please see **Data** section for years omitted.*

Not Eligible for Retirement						
PERS Termination Experience by Service Level New Assumptions*						
	Plan 2			Plan 3		
Service	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
0	27,460	27,801	0.99	7,676	7,508	1.02
1	26,288	26,218	1.00	7,006	6,623	1.06
2	15,096	15,160	1.00	3,645	3,285	1.11
3	10,700	10,473	1.02	2,300	2,054	1.12
4	8,100	7,940	1.02	1,656	1,572	1.05
5	6,829	6,830	1.00	1,314	1,158	1.13
6-9	18,466	19,043	0.97	2,852	2,720	1.05
10-14	12,145	12,672	0.96	1,135	865	1.31
15-19	5,758	5,920	0.97	563	452	1.24
20-24	1,353	1,464	0.92	339	229	1.48
25-29	309	323	0.96	95	56	1.71
30+	77	58	1.32	22	9	2.51
Total	**132,581**	**133,903**	**0.99**	**28,603**	**26,529**	**1.08**

Data summarized for years 1995-2015. Please see Data section for years omitted.

TERMINATION RATES

PERS *(continued)*

	Plan 2				Plan 3			
	Old		Actual	New	Old		Actual	New
Service	Male	Female	Both	Both	Male	Female	Both	Both
0	0.262	0.262	0.257	0.260	0.262	0.262	0.307	0.300
1	0.155	0.168	0.150	0.150	0.155	0.168	0.201	0.190
2	0.101	0.117	0.105	0.105	0.101	0.117	0.144	0.130
3	0.075	0.093	0.082	0.080	0.075	0.093	0.112	0.100
4	0.063	0.076	0.066	0.065	0.063	0.076	0.090	0.085
5	0.054	0.067	0.060	0.060	0.054	0.067	0.079	0.070
6	0.045	0.058	0.052	0.055	0.045	0.058	0.071	0.065
7	0.042	0.053	0.048	0.050	0.042	0.053	0.064	0.060
8	0.039	0.049	0.043	0.045	0.039	0.049	0.053	0.055
9	0.036	0.045	0.041	0.040	0.036	0.045	0.057	0.055
10	0.034	0.042	0.036	0.040	0.034	0.042	0.052	0.040
11	0.031	0.038	0.034	0.035	0.031	0.038	0.046	0.035
12	0.029	0.035	0.031	0.030	0.029	0.035	0.039	0.030
13	0.027	0.033	0.029	0.030	0.027	0.033	0.041	0.030
14	0.025	0.030	0.029	0.030	0.025	0.030	0.038	0.030
15	0.024	0.028	0.027	0.030	0.024	0.028	0.036	0.030
16	0.022	0.025	0.025	0.025	0.022	0.025	0.027	0.025
17	0.020	0.023	0.023	0.020	0.020	0.023	0.030	0.020
18	0.019	0.022	0.021	0.020	0.019	0.022	0.026	0.020
19	0.018	0.020	0.017	0.020	0.018	0.020	0.023	0.020
20	0.015	0.018	0.018	0.020	0.015	0.018	0.033	0.020
21	0.013	0.016	0.016	0.020	0.013	0.016	0.023	0.020
22	0.011	0.014	0.015	0.015	0.011	0.014	0.024	0.015
23	0.010	0.012	0.015	0.015	0.010	0.012	0.022	0.015
24	0.009	0.011	0.014	0.015	0.009	0.011	0.025	0.015
25	0.007	0.009	0.013	0.015	0.007	0.009	0.027	0.015
26	0.006	0.008	0.012	0.010	0.006	0.008	0.021	0.010
27	0.006	0.007	0.008	0.010	0.006	0.007	0.012	0.010
28	0.005	0.006	0.010	0.010	0.005	0.006	0.022	0.010
29	0.004	0.006	0.009	0.010	0.004	0.006	0.007	0.010
30+	0.004	0.005	0.013	0.010	0.004	0.005	0.025	0.010

Not Eligible for Retirement — PERS Termination Rates

TRS

Not Eligible for Retirement						
TRS Termination Experience by Service Level **Old Assumptions***						
	Plan 2			**Plan 3**		
Service	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
0	536	402	1.33	2,465	2,415	1.02
1	1,996	2,116	0.94	4,289	4,260	1.01
2	1,336	1,374	0.97	3,187	3,006	1.06
3	983	1,037	0.95	2,696	2,394	1.13
4	864	847	1.02	2,260	2,023	1.12
5	658	656	1.00	1,986	1,764	1.13
6-9	1,551	1,513	1.03	5,412	4,875	1.11
10-14	1,012	898	1.13	2,329	2,593	0.90
15-19	536	466	1.15	874	1,062	0.82
20-24	70	77	0.91	463	474	0.98
25-29	15	18	0.82	155	138	1.13
30+	1	2	0.65	29	13	2.29
Total	**9,558**	**9,405**	**1.02**	**26,145**	**25,015**	**1.05**

*Data summarized for years 1995-2015. Please see **Data** section for years omitted.*

Not Eligible for Retirement						
TRS Termination Experience by Service Level **New Assumptions***						
	Plan 2			**Plan 3**		
Service	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
0	536	434	1.24	2,465	2,604	0.95
1	1,996	1,810	1.10	4,289	4,101	1.05
2	1,336	1,300	1.03	3,187	3,281	0.97
3	983	909	1.08	2,696	2,513	1.07
4	864	845	1.02	2,260	2,222	1.02
5	658	663	0.99	1,986	1,988	1.00
6-9	1,551	1,558	1.00	5,412	5,429	1.00
10-14	1,012	865	1.17	2,329	2,511	0.93
15-19	536	404	1.33	874	920	0.95
20-24	70	69	1.02	463	431	1.08
25-29	15	22	0.69	155	165	0.94
30+	1	2	0.43	29	19	1.51
Total	**9,558**	**8,880**	**1.08**	**26,145**	**26,185**	**1.00**

*Data summarized for years 1995-2015. Please see **Data** section for years omitted.*

TERMINATION RATES

TRS *(continued)*

	Not Eligible for Retirement								
	TRS Termination Experience by Year - Old Assumption								
	Plan 1 (Males & Females)			**Plan 2 (Males and Females)**			**Plan 3 (Males and Females)**		
Age	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
1995	168	344	0.49	1,433	1,597	0.90	0	0	N/A
1996	193	315	0.61	1,573	1,642	0.96	0	0	N/A
1997	164	281	0.58	1,461	1,542	0.95	12	82	0
1998	172	254	0.68	981	431	2.28	692	1,257	0.55
1999	161	223	0.72	503	333	1.51	1,441	1,408	1.02
2000	169	197	0.86	387	282	1.37	1,707	1,519	1.12
2001	259	165	1.57	525	249	2.11	2,771	1,641	1.69
2002	134	144	0.93	312	234	1.33	2,392	2,117	1.13
2003	93	120	0.77	225	215	1.05	2,031	2,113	0.96
2004	79	95	0.83	197	193	1.02	1,974	2,047	0.96
2005	71	77	0.93	240	176	1.36	2,155	2,064	1.04
2006	65	59	1.10	203	158	1.28	2,244	2,124	1.06
2007	26	44	0.60	103	144	0.72	1,232	2,160	0.57
2008	31	30	1.03	176	127	1.38	2,150	1,843	1.17
2009	24	22	1.08	271	254	1.07	1,752	1,717	1.02
2010	18	16	1.10	365	332	1.10	1,553	1,595	0.97
2011	10	11	0.91	325	337	0.96	1,310	1,417	0.92
2012	5	6	0.77	440	398	1.11	1,474	1,328	1.11
2013	9	4	2.20	392	437	0.90	1,279	1,240	1.03
2014	3	2	1.51	473	520	0.91	1,275	1,220	1.04
2015	2	1	1.77	582	627	0.93	1,408	1,264	1.11
Total	**1,856**	**2,412**	**0.77**	**11,167**	**10,229**	**1.09**	**30,852**	**30,155**	**1.02**

TRS *(continued)*

	Not Eligible for Retirement							
	TRS Termination Rates							
	Plan 2				**Plan 3**			
	Old		**Actual**	**New**	**Old**		**Actual**	**New**
Service	**Male**	**Female**	**Both**	**Both**	**Male**	**Female**	**Both**	**Both**
0	0.111	0.111	0.148	0.120	0.111	0.111	0.114	0.120
1	0.090	0.095	0.088	0.080	0.090	0.095	0.094	0.090
2	0.060	0.072	0.067	0.065	0.060	0.072	0.073	0.075
3	0.045	0.061	0.054	0.050	0.045	0.061	0.064	0.060
4	0.041	0.053	0.051	0.050	0.041	0.053	0.056	0.055
5	0.037	0.047	0.045	0.045	0.037	0.047	0.050	0.050
6	0.030	0.041	0.040	0.040	0.030	0.041	0.045	0.045
7	0.027	0.037	0.036	0.035	0.027	0.037	0.039	0.040
8	0.025	0.033	0.032	0.030	0.025	0.033	0.032	0.030
9	0.023	0.030	0.027	0.030	0.023	0.030	0.028	0.030
10	0.021	0.027	0.028	0.025	0.021	0.027	0.022	0.025
11	0.020	0.024	0.027	0.020	0.020	0.024	0.020	0.020
12	0.018	0.021	0.024	0.020	0.018	0.021	0.018	0.020
13	0.017	0.019	0.021	0.020	0.017	0.019	0.016	0.020
14	0.015	0.017	0.018	0.015	0.015	0.017	0.016	0.015
15	0.014	0.016	0.016	0.015	0.014	0.016	0.013	0.015
16	0.013	0.016	0.019	0.015	0.013	0.016	0.013	0.015
17	0.012	0.015	0.017	0.010	0.012	0.015	0.011	0.010
18	0.012	0.015	0.015	0.010	0.012	0.015	0.010	0.010
19	0.011	0.014	0.015	0.010	0.011	0.014	0.010	0.010
20	0.010	0.013	0.009	0.010	0.010	0.013	0.012	0.010
21	0.010	0.013	0.014	0.010	0.010	0.013	0.011	0.010
22	0.009	0.012	0.010	0.010	0.009	0.012	0.010	0.010
23	0.009	0.011	0.012	0.010	0.009	0.011	0.011	0.010
24	0.009	0.010	0.006	0.010	0.009	0.010	0.010	0.010
25	0.008	0.010	0.006	0.010	0.008	0.010	0.008	0.010
26	0.008	0.009	0.008	0.010	0.008	0.009	0.009	0.010
27	0.007	0.009	0.005	0.010	0.007	0.009	0.011	0.010
28	0.007	0.008	0.010	0.010	0.007	0.008	0.010	0.010
29	0.006	0.008	0.009	0.010	0.006	0.008	0.010	0.010
30+	0.006	0.007	0.004	0.010	0.006	0.007	0.015	0.010

SERS

Not Eligible for Retirement						
SERS Termination Experience by Service Level Old Assumptions*						
	Plan 2			**Plan 3**		
Service	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
0	6,192	6,225	0.99	4,619	4,808	0.96
1	6,101	6,108	1.00	6,047	5,451	1.11
2	4,073	4,000	1.02	3,793	3,392	1.12
3	3,088	2,899	1.07	2,657	2,323	1.14
4	2,446	2,322	1.05	2,064	1,768	1.17
5	2,073	1,916	1.08	1,548	1,413	1.10
6-9	5,164	4,823	1.07	4,129	3,952	1.04
10-14	3,595	3,656	0.98	1,796	1,957	0.92
15-19	1,584	1,736	0.91	595	775	0.77
20-24	163	175	0.93	221	232	0.95
25-29	26	26	0.99	46	41	1.13
30+	2	3	0.61	7	5	1.32
Total	**34,507**	**33,892**	**1.02**	**27,522**	**26,119**	**1.05**

*Data summarized for years 1995-2015. Please see **Data** section for years omitted.*

Not Eligible for Retirement						
SERS Termination Experience by Service Level New Assumptions*						
	Plan 2			**Plan 3**		
Service	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
0	6,192	5,373	1.15	4,619	4,131	1.12
1	6,101	5,779	1.06	6,047	5,933	1.02
2	4,073	4,153	0.98	3,793	3,834	0.99
3	3,088	3,145	0.98	2,657	2,786	0.95
4	2,446	2,313	1.06	2,064	2,004	1.03
5	2,073	2,122	0.98	1,548	1,675	0.92
6-9	5,164	5,015	1.03	4,129	4,402	0.94
10-14	3,595	3,454	1.04	1,796	1,836	0.98
15-19	1,584	1,585	1.00	595	697	0.85
20-24	163	157	1.04	221	205	1.08
25-29	26	16	1.60	46	25	1.81
30+	2	3	0.62	7	5	1.32
Total	**34,507**	**33,114**	**1.04**	**27,522**	**27,533**	**1.00**

*Data summarized for years 1995-2015. Please see **Data** section for years omitted.*

SERS *(continued)*

	Plan 2 (Males and Females)			Plan 3 (Males and Females)		
Not Eligible for Retirement						
SERS Termination Experience by Year - Old Assumption						
Age	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
1995	3,333	3,516	0.95	0	0	N/A
1996	3,205	3,405	0.94	0	0	N/A
1997	3,580	3,491	1.03	0	0	N/A
1998	3,810	3,678	1.04	0	0	N/A
1999	4,136	3,703	1.12	0	0	N/A
2000	1,086	2,633	0.41	60	1,173	0.05
2001	2,074	2,130	0.97	1,400	1,779	0.79
2002	1,774	1,745	1.02	1,915	2,097	0.91
2003	1,558	1,455	1.07	2,476	2,344	1.06
2004	1,334	1,226	1.09	2,220	2,274	0.98
2005	1,318	1,081	1.22	2,533	2,380	1.06
2006	1,153	966	1.19	2,717	2,471	1.10
2007	749	879	0.85	1,857	2,558	0.73
2008	945	798	1.18	2,658	2,394	1.11
2009	996	1,078	0.92	1,962	2,145	0.91
2010	1,067	1,183	0.90	1,757	1,937	0.91
2011	1,056	1,192	0.89	1,805	1,770	1.02
2012	1,228	1,232	1.00	1,905	1,650	1.15
2013	1,162	1,245	0.93	1,706	1,529	1.12
2014	1,308	1,370	0.95	1,837	1,530	1.20
2015	1,544	1,528	1.01	2,031	1,597	1.27
Total	**38,416**	**39,535**	**0.97**	**30,839**	**31,628**	**0.98**

TERMINATION RATES

SERS *(continued)*

	Not Eligible for Retirement							
	SERS Termination Rates							
	Plan 2				**Plan 3**			
	Old		Actual	New	Old		Actual	New
Service	**Male**	**Female**	**Both**	**Both**	**Male**	**Female**	**Both**	**Both**
0	0.245	0.199	0.207	0.180	0.245	0.199	0.201	0.180
1	0.159	0.131	0.137	0.130	0.159	0.131	0.153	0.150
2	0.117	0.103	0.108	0.110	0.117	0.103	0.119	0.120
3	0.100	0.079	0.088	0.090	0.100	0.079	0.095	0.100
4	0.081	0.068	0.074	0.070	0.081	0.068	0.082	0.080
5	0.066	0.062	0.068	0.070	0.066	0.062	0.069	0.075
6	0.061	0.056	0.062	0.060	0.061	0.056	0.061	0.065
7	0.056	0.053	0.058	0.055	0.056	0.053	0.055	0.060
8	0.051	0.050	0.053	0.050	0.051	0.050	0.051	0.055
9	0.047	0.047	0.048	0.050	0.047	0.047	0.049	0.050
10	0.043	0.046	0.046	0.045	0.043	0.046	0.045	0.045
11	0.039	0.045	0.043	0.040	0.039	0.045	0.041	0.040
12	0.036	0.044	0.041	0.040	0.036	0.044	0.038	0.040
13	0.033	0.044	0.041	0.040	0.033	0.044	0.037	0.040
14	0.030	0.043	0.038	0.035	0.030	0.043	0.034	0.035
15	0.027	0.043	0.036	0.035	0.027	0.043	0.030	0.035
16	0.025	0.039	0.035	0.035	0.025	0.039	0.029	0.035
17	0.025	0.036	0.031	0.030	0.025	0.036	0.025	0.030
18	0.024	0.035	0.027	0.030	0.024	0.035	0.027	0.030
19	0.024	0.032	0.024	0.025	0.024	0.032	0.020	0.025
20	0.023	0.030	0.026	0.025	0.023	0.030	0.027	0.025
21	0.023	0.028	0.026	0.025	0.023	0.028	0.029	0.025
22	0.022	0.027	0.024	0.020	0.022	0.027	0.018	0.020
23	0.021	0.026	0.016	0.020	0.021	0.026	0.021	0.020
24	0.018	0.025	0.022	0.020	0.018	0.025	0.023	0.020
25	0.016	0.023	0.011	0.010	0.016	0.023	0.029	0.010
26	0.014	0.021	0.022	0.010	0.014	0.021	0.010	0.010
27	0.012	0.019	0.016	0.010	0.012	0.019	0.010	0.010
28	0.011	0.017	0.024	0.010	0.011	0.017	0.016	0.010
29	0.009	0.015	0.006	0.010	0.009	0.015	0.020	0.010
30+	0.008	0.014	0.006	0.010	0.008	0.014	0.013	0.010

TERMINATION RATES

PSERS

Not Eligible for Retirement			
PSERS 2 Termination Experience by Service Level Old Assumptions*			
Males and Females			
Service	**Actual**	**Expected**	**A/E**
0	472	576	0.82
1	506	656	0.77
2	342	357	0.96
3	220	230	0.96
4	188	172	1.09
5	134	137	0.98
6-9	294	273	1.08
10-14	157	138	1.13
15-19	85	61	1.39
20-24	25	14	1.78
25-29	3	2	1.76
30+	0	0	N/A
Total	**2,426**	**2,616**	**0.93**

Data summarized for years 2008-2015.

Not Eligible for Retirement			
PSERS 2 Termination Experience by Service Level New Assumptions*			
Males and Females			
Service	**Actual**	**Expected**	**A/E**
0	472	549	0.86
1	506	583	0.87
2	342	342	1.00
3	220	218	1.01
4	188	157	1.20
5	134	143	0.93
6-9	294	287	1.03
10-14	157	146	1.07
15-19	85	66	1.29
20-24	25	19	1.33
25-29	3	3	1.01
30+	0	0	N/A
Total	**2,426**	**2,513**	**0.97**

Data summarized for years 2008-2015.

TERMINATION RATES

PSERS *(continued)*

Not Eligible for Retirement			
PSERS Termination Experience by Year - Old Assumptions			
Plan 2 (Males and Females)			
Age	Actual	Expected	A/E
1995	0	0	N/A
1996	5	24	0.21
1997	10	26	0.38
1998	12	34	0.35
1999	14	39	0.36
2000	24	49	0.49
2001	20	50	0.40
2002	25	55	0.45
2003	24	64	0.38
2004	32	73	0.44
2005	54	86	0.63
2006	5	102	0.05
2007	82	169	0.49
2008	216	268	0.80
2009	302	444	0.68
2010	393	392	1.00
2011	294	316	0.93
2012	290	279	1.04
2013	272	278	0.98
2014	307	302	1.02
2015	352	338	1.04
Total	2,733	3,387	0.81

PSERS *(continued)*

		Not Eligible for Retirement		
		PSERS Termination Rates		
		Plan 2		
	Old		**Actual**	**New**
Service	**Male**	**Female**	**Both**	**Both**
0	0.262	0.262	0.215	0.250
1	0.155	0.168	0.121	0.140
2	0.101	0.117	0.100	0.100
3	0.075	0.093	0.076	0.075
4	0.063	0.076	0.072	0.060
5	0.054	0.067	0.056	0.060
6	0.045	0.058	0.051	0.050
7	0.042	0.053	0.047	0.050
8	0.039	0.049	0.049	0.040
9	0.036	0.045	0.041	0.040
10	0.034	0.042	0.041	0.040
11	0.031	0.038	0.039	0.035
12	0.029	0.035	0.034	0.030
13	0.027	0.033	0.030	0.030
14	0.025	0.030	0.033	0.030
15	0.024	0.028	0.036	0.030
16	0.022	0.025	0.027	0.025
17	0.020	0.023	0.025	0.020
18	0.019	0.022	0.031	0.020
19	0.018	0.020	0.031	0.020
20	0.015	0.018	0.026	0.020
21	0.013	0.016	0.024	0.020
22	0.011	0.014	0.024	0.015
23	0.010	0.012	0.012	0.015
24	0.009	0.011	0.031	0.015
25	0.007	0.009	0.010	0.015
26	0.006	0.008	0.015	0.010
27	0.006	0.007	0.023	0.010
28	0.005	0.006	0.000	0.010
29	0.004	0.006	0.000	0.010
30+	0.004	0.005	0.000	0.010

TERMINATION RATES

LEOFF

Not Eligible for Retirement						
LEOFF 2 Termination Experience by Service Level Old Assumptions*						
	LEO (Males and Females)			FF (Males and Females)		
Service	Actual	Expected	A/E	Actual	Expected	A/E
0	571	442	1.29	164	272	0.60
1	485	391	1.24	184	286	0.64
2	228	186	1.22	86	144	0.60
3	194	145	1.34	59	114	0.52
4	159	144	1.11	50	112	0.45
5	191	137	1.40	49	106	0.46
6-9	628	464	1.35	180	360	0.50
10-14	501	386	1.30	161	321	0.50
15-19	261	231	1.13	91	194	0.47
20-24	108	68	1.58	37	58	0.64
25+	16	6	2.49	7	7	0.96
Total	**3,342**	**2,601**	**1.28**	**1,068**	**1,975**	**0.54**

*Data summarized for years 1995-2015. Please see **Data** section for years omitted.*

Not Eligible for Retirement						
LEOFF 2 Termination Experience by Service Level New Assumptions*						
	LEO (Males and Females)			FF (Males and Females)		
Service	Actual	Expected	A/E	Actual	Expected	A/E
0	571	599	0.95	164	165	0.99
1	485	488	0.99	184	208	0.88
2	228	229	1.00	86	88	0.98
3	194	188	1.03	59	59	1.00
4	159	192	0.83	50	60	0.84
5	191	190	1.01	49	59	0.83
6-9	628	601	1.04	180	166	1.08
10-14	501	458	1.09	161	119	1.36
15-19	261	223	1.17	91	94	0.97
20-24	108	61	1.78	37	40	0.92
25+	16	7	2.31	7	8	0.83
Total	**3,342**	**3,234**	**1.03**	**1,068**	**1,066**	**1.00**

*Data summarized for years 1995-2015. Please see **Data** section for years omitted.*

TERMINATION RATES

LEOFF *(continued)*

	Not Eligible for Retirement											
	LEOFF 2 Termination Experience by Year - Old Assumption											
	Plan 1 (LEO and FF)			Plan 2 (LEO)			Plan 2 (FF)			Plan 2 (LEO and FF)		
Age	Actual	Expected	A/E	Actual	Expected	A/E	Actual	Expected	A/E	Actual	Expected	A/E
1995	5	16	0.31	163	126	1.29	41	87	0.47	204	213	0.96
1996	10	13	0.75	174	135	1.29	39	87	0.45	213	222	0.96
1997	2	9	0.21	168	140	1.20	54	91	0.59	222	231	0.96
1998	1	7	0.14	197	140	1.41	53	96	0.55	250	236	1.06
1999	2	5	0.40	220	141	1.56	70	95	0.74	290	236	1.23
2000	5	3	1.45	230	155	1.49	65	103	0.63	295	257	1.15
2001	0	2	N/A	189	146	1.29	49	100	0.49	238	247	0.96
2002	1	2	0.62	175	146	1.20	65	113	0.58	240	259	0.93
2003	0	1	N/A	162	142	1.14	74	108	0.68	236	250	0.94
2004	0	0	N/A	202	145	1.39	60	113	0.53	262	258	1.01
2005	0	0	N/A	197	137	1.44	62	104	0.59	259	241	1.08
2006	0	0	N/A	206	142	1.45	55	107	0.51	261	250	1.04
2007	0	0	N/A	165	152	1.09	41	114	0.36	206	266	0.77
2008	0	0	N/A	195	154	1.27	70	122	0.57	265	276	0.96
2009	1	0	9.34	177	158	1.12	54	120	0.45	231	278	0.83
2010	0	0	N/A	145	142	1.02	54	118	0.46	199	261	0.76
2011	0	0	N/A	137	125	1.10	44	107	0.41	181	232	0.78
2012	0	0	N/A	137	115	1.19	60	102	0.59	197	217	0.91
2013	0	0	N/A	126	112	1.12	48	99	0.49	174	211	0.82
2014	0	0	N/A	164	119	1.38	44	99	0.44	208	218	0.95
2015	0	0	N/A	167	127	1.32	56	102	0.55	223	229	0.97
Total	**27**	**60**	**0.45**	**3,696**	**2,899**	**1.27**	**1,158**	**2,189**	**0.53**	**4,854**	**5,088**	**0.95**

THREE: APPENDICES

TERMINATION RATES

LEOFF *(continued)*

Not Eligible for Retirement			
LEOFF 2 Termination Rates			
LEO and FF			
Males and Females			
Service	**Old**	**Actual**	**New**
0	0.107	0.110	0.105
1	0.048	0.048	0.050
2	0.024	0.023	0.025
3	0.019	0.019	0.020
4	0.019	0.015	0.020
5	0.018	0.018	0.020
6	0.017	0.018	0.020
7	0.017	0.017	0.015
8	0.016	0.014	0.015
9	0.015	0.016	0.015
10	0.015	0.015	0.015
11	0.014	0.014	0.010
12	0.014	0.012	0.010
13	0.013	0.011	0.010
14	0.012	0.011	0.010
15	0.012	0.010	0.010
16	0.011	0.009	0.010
17	0.010	0.007	0.010
18	0.010	0.007	0.010
19	0.009	0.008	0.010
20	0.008	0.011	0.010
21	0.008	0.007	0.005
22	0.007	0.007	0.005
23	0.006	0.008	0.005
24	0.006	0.007	0.005
25	0.005	0.009	0.005
26	0.004	0.006	0.005
27	0.004	0.006	0.005
28	0.003	0.010	0.005
29	0.002	0.000	0.005
30+	0.002	0.000	0.005

TERMINATION RATES *continued*

LEOFF *(continued)*

Not Eligible for Retirement			
LEOFF 2 Termination Experience by Service Level **Old Assumptions***			
LEO and FF			
Service	**Actual**	**Expected**	**A/E**
0	735	714	1.03
1	669	677	0.99
2	314	330	0.95
3	253	259	0.98
4	209	256	0.82
5	240	243	0.99
6-9	808	824	0.98
10-14	662	708	0.94
15-19	352	425	0.83
20-24	145	126	1.15
25+	23	14	1.68
Total	**4,410**	**4,576**	**0.96**

*Data summarized for years 1995-2015.
Please see **Data** section for years
omitted.*

Not Eligible for Retirement			
LEOFF 2 Termination Experience by Service Level **New Assumptions***			
LEO and FF			
Service	**Actual**	**Expected**	**A/E**
0	735	700	1.05
1	669	704	0.95
2	314	337	0.93
3	253	268	0.94
4	209	273	0.76
5	240	269	0.89
6-9	808	818	0.99
10-14	662	578	1.15
15-19	352	411	0.86
20-24	145	112	1.30
25+	23	15	1.49
Total	**4,410**	**4,485**	**0.98**

*Data summarized for years 1995-2015.
Please see **Data** section for years
omitted.*

continued

WSPRS

Not Eligible for Retirement			
WSPRS 1/2 Termination Experience by Service Level Old Assumptions*			
Males and Females			
Service	Actual	Expected	A/E
0	9	9	1.02
1	5	6	0.82
2	8	12	0.67
3	22	16	1.42
4	15	17	0.89
5	21	17	1.25
6-9	60	54	1.11
10-14	34	39	0.86
15-19	21	18	1.19
20-24	7	8	0.89
25+	0	0	N/A
Total	202	195	1.04

*Data summarized for years 1995-2013.
Please see **Data** section for years omitted.

Not Eligible for Retirement			
WSPRS 1/2 Termination Experience by Service Level New Assumptions*			
Males and Females			
Service	Actual	Expected	A/E
0	9	9	0.96
1	5	6	0.82
2	8	12	0.67
3	22	16	1.42
4	15	17	0.89
5	21	17	1.25
6-9	60	56	1.07
10-14	34	36	0.95
15-19	21	17	1.25
20-24	7	12	0.60
25+	0	0	N/A
Total	202	197	1.02

*Data summarized for years 1995-2013.
Please see **Data** section for years omitted.

TERMINATION RATES

WSPRS *(continued)*

	Not Eligible for Retirement								
	WSPRS Termination Experience by Year - Old Assumption								
	Plan 1 (Males & Females)			**Plan 2 (Males and Females)**			**All Plans**		
Age	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
1995	9	11	0.78	0	0	N/A	9	11	0.78
1996	9	10	0.92	0	0	N/A	9	10	0.92
1997	8	11	0.71	0	0	N/A	8	11	0.71
1998	10	10	0.97	0	0	N/A	10	10	0.97
1999	10	10	0.97	0	0	N/A	10	10	0.97
2000	13	11	1.17	0	0	N/A	13	11	1.17
2001	9	13	0.72	0	0	N/A	9	13	0.72
2002	16	14	1.18	0	0	N/A	16	14	1.18
2003	8	12	0.65	0	0	N/A	8	12	0.65
2004	16	12	1.30	1	1	1.06	17	13	1.29
2005	17	11	1.52	0	1	N/A	17	12	1.37
2006	17	10	1.69	0	2	N/A	17	12	1.45
2007	7	9	0.78	5	2	2.14	12	11	1.06
2008	16	8	1.97	2	3	0.66	18	11	1.61
2009	8	7	1.13	3	6	0.53	11	13	0.86
2010	2	6	0.32	6	5	1.13	8	12	0.69
2011	4	5	0.74	7	5	1.32	11	11	1.03
2012	10	5	2.14	4	6	0.68	14	11	1.32
2013	0	4	N/A	6	7	0.91	6	11	0.57
2014	8	3	2.35	11	7	1.51	19	11	1.77
2015	4	3	1.41	28	8	3.71	32	10	3.08
Total	**201**	**187**	**1.08**	**73**	**53**	**1.38**	**274**	**240**	**1.14**

TERMINATION RATES

WSPRS *(continued)*

	Not Eligible for Retirement		
	WSPRS Termination Rates		
	Plans 1/2		
	Males and Females		
Service	**Old**	**Actual**	**New**
0	0.042	0.043	0.045
1	0.020	0.016	0.020
2	0.020	0.013	0.020
3	0.020	0.028	0.020
4	0.020	0.018	0.020
5	0.020	0.025	0.020
6	0.019	0.023	0.020
7	0.017	0.013	0.020
8	0.016	0.022	0.015
9	0.015	0.016	0.015
10	0.013	0.009	0.010
11	0.012	0.008	0.010
12	0.011	0.013	0.010
13	0.010	0.001	0.010
14	0.009	0.016	0.010
15	0.008	0.008	0.010
16	0.007	0.005	0.005
17	0.006	0.007	0.005
18	0.006	0.012	0.005
19	0.005	0.006	0.005
20	0.004	0.000	0.005
21	0.004	0.002	0.005
22	0.003	0.004	0.005
23	0.003	0.006	0.005
24	0.002	0.003	0.005
25+	0.000	0.000	0.000

TERMINATION RATES *continued*

Eligible for Retirement

For the Plans 2/3, Plan 2 and Plan 3 termination rates were developed using a combined history of PERS, TRS, and SERS (Plans 2/3).

	Eligible for Retirement					
	Plans 2/3 Termination Experience by Age Old Assumptions*					
	Plan 2			**Plan 3**		
Age	**Actual**	**Expected**	**A/E**	**Actual**	**Expected**	**A/E**
55	224	0	0.00	793	0	0.00
56	256	0	0.00	753	0	0.00
57	232	0	0.00	761	0	0.00
58	240	0	0.00	771	0	0.00
59	237	0	0.00	835	0	0.00
60	263	0	0.00	719	0	0.00
61	244	0	0.00	743	0	0.00
62	216	0	0.00	715	0	0.00
63	129	0	0.00	333	0	0.00
64	18	0	0.00	57	0	0.00
65+	311	0	0.00	234	0	0.00
Total	**2,370**	**0**	**0.00**	**6,714**	**0**	**0.00**

*Data summarized for years 1995-2015. Please see **Data** section for years omitted.*

	Eligible for Retirement					
	Plans 2/3 Termination Experience by Age New Assumptions*					
	Plan 2			**Plan 3**		
Age	**Actual**	**Expected**	**Ratio**	**Actual**	**Expected**	**Ratio**
55	224	255	0.88	793	789	1.00
56	256	258	0.99	753	748	1.01
57	232	258	0.90	761	705	1.08
58	240	251	0.96	771	649	1.19
59	237	243	0.98	835	879	0.95
60	263	236	1.11	719	767	0.94
61	244	224	1.09	743	666	1.12
62	216	201	1.08	715	665	1.07
63	129	58	2.23	333	184	1.81
64	18	60	0.30	57	70	0.81
65+	311	0	0.00	234	0	0.00
Total	**2,370**	**2,042**	**1.16**	**6,714**	**6,124**	**1.10**

*Data summarized for years 1995-2015. Please see **Data** section for years omitted.*

For Plan 2 and Plan 3, we observed similar behavioral trends for Plans 2/3 members who are eligible for retirement. The following graphs summarize the observed Plan 2 and Plan 3 experience, by plan, as well as the new assumption.

Eligible for Retirement Termination - Plan 2

PERS 2 ⸺ SERS 2 ⸺ TRS 2 ⸺ All Systems ········ New ─ ─ ─

Eligible for Retirement Termination - Plan 3

PERS 3 ⸺ SERS 3 ⸺ TRS 3 ⸺ All Systems ········ New ─ ─ ─
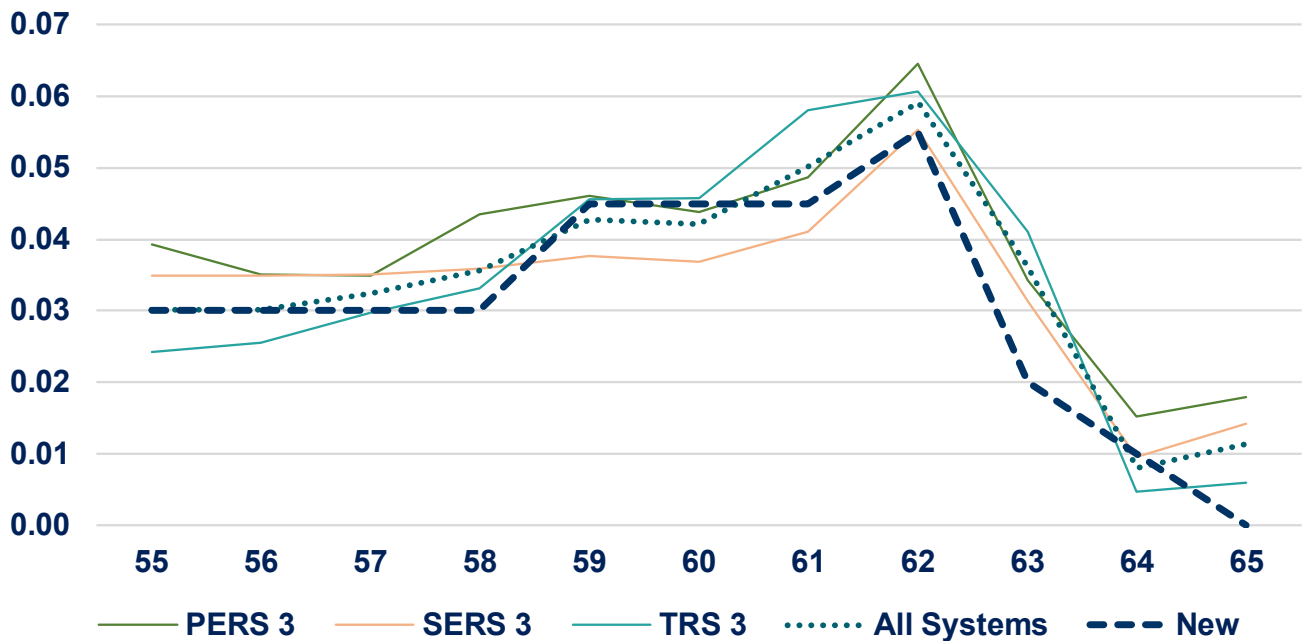
The following table displays the termination experience for Public Safety Plan members eligible for retirement.

Eligible for Retirement									
Public Safety Plans Termination Rates									
	LEOFF 2			WSPRS 1/2			PSERS 2		
Age	Old	Actual	New	Old	Actual	New	Old	Actual	New
50	0.000	0.007	0.000	0.000	0.000	0.000	N/A	N/A	N/A
51	0.000	0.004	0.000	0.000	0.000	0.000	N/A	N/A	N/A
52	0.000	0.001	0.000	0.000	0.000	0.000	N/A	N/A	N/A
53	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.019	0.015
54	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.019	0.015
55	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.035	0.015
56	0.000	0.003	0.000	0.000	0.008	0.000	0.000	0.015	0.015
57	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.018	0.015
58	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.012	0.015
59	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.016	0.015
60+	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.024	0.000

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS

Age Difference

What is the Age Difference Assumption and How Do We Use it?

The Age Difference assumption represents the difference in age between a member and their qualifying beneficiary. This assumption helps us estimate the cost of survivor benefits.

If an active or terminated vested member dies, their qualifying beneficiary is eligible for either a survivor annuity or a refund of the member's contributions. In the event the beneficiary elects to receive a survivor annuity[1], our valuation model needs the age of the beneficiary in order to calculate the survivor benefits that would be payable throughout his or her lifetime.

However, the age of a member's beneficiary is generally not reported for active or terminated members. Therefore, we use the Age Difference assumption to estimate the beneficiary's age relative to the age of the member.

High Level Takeaways

We studied the Age Difference assumption by gender over the retirement systems as a whole. The data we analyzed does not suggest that any particular plan will have experience that is significantly different from the general plan population.

Our current assumption (+3 age difference for male members and -1 age difference for female members) continues to model the plan demographic data well and is reasonable, so we made no change to our current assumption.

Data and Assumptions

We used eight years of valuation data, from 2011 to 2018, to develop this assumption. We restricted the data to members who retired within ten years prior to the given valuation date, and who have a maximum member to beneficiary age difference of 25 years. This was done to remove outliers and ensure our analysis best reflects more current population data.

We assume that all eligible beneficiaries are of the opposite sex as the member. We acknowledge that this assumption does not apply to beneficiaries who are same-sex spouses and domestic partners. However, at this point, all plans combined have less than 1.5 percent same-sex beneficiaries. Given this limited number of occurrences that we have observed so far, we chose not to make an adjustment in this area. We will review this assumption again in our next study.

General Methodology

For each retirement plan, we analyzed the weighted average age difference by gender. We then consolidated these plan-specific averages into a system-wide age difference assumption – one for males and one for females – and rounded the results to the nearest whole number.

Law Changes

Since the last study, no law changes have impacted our analysis of this assumption.

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[1]*See the **Survivors Selecting Annuities Assumption** section for more information about this assumption.*

Analysis and Results

The following tables summarize the age difference data and assumptions by system and gender. This data suggests that all the retirement systems will have age differences that are relatively consistent. For this reason, we did not set system-specific assumptions.

In general, for both males and females, we are seeing a shift toward smaller age differences between members and their beneficiaries. However, this shift is not yet large enough to merit a change in our current assumption of a +3 age difference for male members and a -1 age difference for female members.

Age Difference DataSummary					
		Old		New	
		Count	Age Difference	Count	Age Difference
PERS	Male	10,827	3.2	12,949	3.0
	Female	4,490	(0.9)	6,214	(0.3)
TRS	Male	3,873	2.8	3,128	2.9
	Female	4,143	(1.1)	4,697	(0.7)
SERS	Male	912	3.4	1,667	3.2
	Female	957	(1.4)	2,276	(1.2)
PSERS	Male	4	4.8	59	2.1
	Female	1	(1.0)	12	(2.0)
LEOFF	Male	2,491	3.0	2,840	2.4
	Female	45	(0.9)	98	(0.1)
WSPRS	Male	289	2.8	328	2.3
	Female	12	(1.4)	15	(0.5)
Total	**Male**	**18,396**	**3.1**	**20,971**	**2.9**
	Female	**9,648**	**(1.0)**	**13,312**	**(0.6)**

Age Difference Assumption		
	Old Assumption	New Assumption
Male	3	3
Female	(1)	(1)

Below are some additional considerations we had while studying this assumption.

❖ The average age differences for the Plans 1 have decreased significantly from our prior study. In addition, the active headcounts have declined. When setting averages based on a population, variations in plan experience will be much more impactful for a small population than for a large population. Since the Plans 1 are closed plans with declining populations, the Plan 1 averages will be more volatile from one experience study to the next than they are for the Plans 2/3. With this in mind, we found our current age difference assumptions to be applicable and reasonable for the Plans 1.

❖ We considered using alternate formats for our data. For example, we considered using a longer history and making changes to the restrictions we applied to the data. However, we concluded that the impacts from making these changes either did not significantly change our results or did not best reflect our expectations for the population of the retirement systems moving forward.

Average Final Compensation Load

What is the Average Final Compensation Load Assumption and How Do We Use it?

The Average Final Compensation (AFC) Load assumption is used to estimate the expected cost of certain increases to member benefits near retirement. More specifically, it represents the increase in pensionable salary upon retirement for unknown sources of compensation. For example, certain retirement systems allow cash-out payments for excess vacation leave as a form of pensionable compensation. The pensionable payments included in the retiree AFC consist of payments billable and non-billable to the employer. The AFC Load assumption is meant to estimate the cost to the retirement system associated with the non-billable payments. Employers reimburse the retirement system for billable payments.

We apply the AFC load to the expected retirement benefits for all active members in PERS, TRS, LEOFF, and WSPRS Plans 1. The assumed loads are used to increase the modeled benefits to adjust for either unknown pensionable payments, e.g., cash-outs, or unexpectedly higher salary, e.g., "salary spiking", that members may earn prior to retirement.

High Level Takeaways

In general, we observed declining rates in the experience for PERS 1 and TRS 1, and steady rates for WSPRS 1. We lowered the load assumption for PERS 1 as the decline was more pronounced than in TRS 1. We retained our load assumption for TRS 1 and WSPRS 1.

Additionally, we retained our current load assumption for LEOFF 1 given the few remaining active members.

Data and Assumptions

We looked at 23 years of experience study records, from 1996-2018. No special data was added for this assumption, and no data was excluded.

We assume the amount collected by DRS for billable payments covers the expected cost of those payments to the retirement system.

General Methodology

We analyzed the AFC load by determining the portion of final AFC that is attributable to the non-billable pensionable payments of retired members. Using historical retiree data, we calculated annual loads, and weighted average loads corresponding to aggregated experience over different time periods. We considered the results and relied on professional judgment to set the final loads.

Law Changes

The law listed below expanded the sources of pensionable salary.

❖ **SB 5274 (2017)** – Allows voluntary overtime, up to 70 hours per year, to be included in salaries for purposes of calculating retirement benefits in WSPRS.

Analysis and Results

Analysis

Past Experience

The following tables show the historical AFC loads by year, from 1996 to 2018, as well as weighted average loads for certain time periods. The time periods chosen for the weighted average loads correspond to the prior experience study (1996-2012), the current experience study (2013-2018), and the entire study period (1996-2018). As an example, a load of 5 percent means, on average, a member's AFC increased by 5 percent at retirement due to unexpected payments that would otherwise not have been accounted for in the plan liability without the AFC load.

Historical AFC Loads			
	PERS 1	**TRS 1**	**WSPRS 1**
1996	5.48%	0.93%	1.79%
1997	5.17%	1.61%	2.92%
1998	5.27%	0.99%	5.67%
1999	5.16%	1.08%	4.65%
2000	5.49%	1.12%	7.38%
2001	5.96%	1.06%	7.45%
2002	4.89%	1.00%	6.16%
2003	5.13%	0.87%	7.13%
2004	4.50%	0.97%	7.01%
2005	4.84%	0.81%	6.90%
2006	4.68%	0.76%	7.60%
2007	4.58%	0.71%	10.54%
2008	4.62%	1.00%	6.68%
2009	4.06%	1.04%	7.54%
2010	4.74%	0.89%	6.75%
2011	3.88%	0.72%	6.19%
2012	3.64%	0.70%	6.30%
2013	3.88%	0.65%	7.04%
2014	2.84%	0.59%	6.27%
2015	2.38%	0.57%	7.67%
2016	2.52%	0.35%	6.74%
2017	1.69%	0.53%	6.11%
2018	1.03%	0.08%	4.71%

Weighted Average AFC Loads			
	PERS 1	**TRS 1**	**WSPRS 1**
1996-2012	4.80%	0.95%	6.32%
2013-2018	2.57%	0.53%	6.58%
1996-2018	4.39%	0.90%	6.43%

MISCELLANEOUS ASSUMPTIONS *continued*

Methods and Format of Assumptions

In studying this assumption, we considered the materiality and impact of the LEOFF 1 assumption and the WSPRS Voluntary Overtime law (SB 5274). For reference, we considered the following:

- ❖ We did not perform analysis for LEOFF 1 due to the few number of remaining active members (26 active members as of June 30, 2018). We do not expect this assumption to materially impact our liabilities, so we retained our current assumption of 4.50 percent. Please see the 2007-2012 Demographic Experience Study for information on how this assumption was set.

- ❖ We considered an adjustment to the WSPRS load assumption based on SB 5274 since it expands sources of pensionable salary. Based on information from WSPRS, members participated in voluntary overtime prior to the passage of this bill; that overtime will now be included as pensionable salary. Following the passage of this bill into law, we adjusted our underlying salary growth assumption to reflect the anticipated increase in member salaries. This bill also limits the maximum amount of pensionable overtime salary to 70 hours per year. While it is possible that members will work more voluntary overtime during their years closest to retirement, it is our understanding there are administrative practices in place to prevent salary spiking (i.e., inflating a member's compensation during their AFC period to receive a larger pension benefit at retirement). We will continue to monitor this in future experience studies and if administrative practices change, it may lead to an increase in our load for WSPRS.

Results

Experience shows a steady decline in rates for PERS 1 and TRS 1 based on both recent and long-term experience; we have no reason to expect this trend will not continue in the future. We reduced the PERS 1 load to be more consistent with recent experience. Considering the size and materiality of the TRS 1 load assumption, we retained the old assumption. WSPRS 1 experience is more volatile than the other plans over the study period, and we do not observe a clear trend emerging in the data. However, the experience aligns with our old assumption, so we chose not to change the WSPRS load assumption. We retained the LEOFF 1 assumption as only 26 actives remain in the plan as of June 30, 2018. The following table shows the old and new AFC load assumptions.

AFC Load Assumption			
	PERS 1	**TRS 1**	**WSPRS 1**	**LEOFF 1**
Old	4.00%	0.75%	7.00%	4.50%
New	2.50%	0.75%	7.00%	4.50%

Catastrophic Disability

What are the Catastrophic Disability Assumptions and How Do We Use them?

LEOFF 2 has a more complex disability benefit structure than most public plans in Washington. Disabilities are classified as either duty-related or non-duty related. Duty-related disabilities are further differentiated as either catastrophic or non-catastrophic. The type of disability designation results in access to different levels of benefits. In this section, we focus on assumptions related to duty-related catastrophic disabilities.

If a LEOFF Plan 2 member is deemed unable to perform any substantial gainful activity due to a physical or mental condition incurred in the line of duty, that member qualifies for catastrophic disability benefits under the plan. Catastrophic disabilities benefits include a minimum retirement benefit and reimbursement of medical insurance premiums.

We set the following assumptions for catastrophic disability:

Percent Catastrophic

The Percent Catastrophic assumption represents the likelihood a duty-related disability is also catastrophic. To determine the likelihood, we first model members moving from active to disabled status using our (total) **Disability Rates**. We then multiply our **Duty Disability Probability Assumption** by the number of total disabilities to calculate the number of duty-related disabilities. Finally, we multiply the Percent Catastrophic assumption by the number of duty-related disabilities to determine the number of catastrophic disabilities. The example below illustrates the calculation for the number of catastrophic disabilities for 100 LEOFF 2 active members age 45.

(100 active members) x (0.002 Total Disability Rate) x (0.90 Duty Disability Probability) x (0.12 Percent Catastrophic) = 0.02 Catastrophic Disabilities

Minimum Catastrophic Benefit

Individuals with catastrophic disabilities are eligible for a minimum retirement benefit based on their Final Average Salary (FAS). These members receive the minimum benefit if it is greater than their accrued retirement benefit. The accrued retirement benefit percent of FAS equals 2 percent multiplied by years of service. The minimum benefit starts at 70 percent FAS and is adjusted so that the total of all disability benefits received does not exceed 100 percent of FAS. Members may be eligible for additional disability benefits from sources such as Social Security and Washington State Labor and Industries wage replacement under Title 51. We set an assumption for the expected percent of FAS of the minimum catastrophic benefit after reductions.

Medical Insurance Premium Reimbursement

Retirees with catastrophic disabilities receive premium reimbursement for medical insurance offered through a prior employer, temporary COBRA[1] coverage, or Medicare Parts A and B. Members may also receive reimbursement for extending coverage to spouses and dependent children. After 29 months of retirement, retirees with disabilities become eligible for reimbursement of Medicare Parts A and B premiums. Once eligible for Medicare, members must maintain enrollment in both Parts A and B to continue receiving premium reimbursement. We set assumptions for the expected premium reimbursements members will receive.

High Level Takeaways

Data limitations in the 2012 study constrained how we studied catastrophic disability assumptions. The limitations included the relatively new plan provisions and infrequent occurrences of catastrophic disabilities. Catastrophic disability became a retirement designation in 2005. The additional data available in this study provided us enough plan experience to review our assumptions and identify practical modeling changes.

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[1]*Consolidated Omnibus Budget Reconciliation Act of 1985. It includes a provision allowing separated employees to purchase insurance through the former employer's risk pool. Please see the Department of Labor website for more information.*

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS *continued*

After reviewing our methodology and reflecting current data, we increased the Percent Catastrophic assumption and decreased the Minimum Catastrophic Benefit and Medical Insurance Premium Reimbursement assumptions. In general, we observed more members experiencing catastrophic disabilities than expected and members typically earned a smaller retirement benefit and less premium reimbursement than expected under old assumptions.

Data and Assumptions

We analyzed both the number of catastrophic disabilities and the percent of FAS for the minimum catastrophic benefit from 2005 to 2017. Catastrophic disability experience is relatively limited, so we gathered as much data as possible in order to set a long-term assumption. We found that some members that had retired prior to 2005 were retroactively classified as catastrophically disabled retirements. We removed these members when studying the number of catastrophic disabilities to maintain a consistent study period with other LEOFF 2 disability rates assumptions. We set the percent catastrophic assumption looking at the same eligible population as the **Disability Rates** and **Duty Disability Probability Assumption**. Also consistent with these assumptions, we removed retirements occurring in 2007 due to a shortened valuation year. However, we included all member data to analyze the minimum catastrophic benefit. To study medical premium reimbursements, we restricted our study to the most recent six years of data (2012-2017). Healthcare costs and trends have changed significantly over the last decade so we based our assumptions for future premiums on more recent data.

DRS provided data on the minimum catastrophic benefit. Otherwise, we relied on OSA's historical annual valuation files. The data provided by DRS and our valuation files vary slightly as shown in the **Results** section.

We used the new **Disability Rates** and **Duty Disability Probability Assumption** updated in this study to set the **Percent Catastrophic** assumption. We compared the actual number of catastrophic disabilities to what our assumptions produced over our study period. Please see the sections for each of these assumptions for more details.

General Methodology

We began by comparing each assumption set in the prior demographic experience study to the new historical data collected for this study. We then adjusted the old assumptions, if necessary, to more closely reflect the actual experience in our study period. We used our professional judgment regarding future expectations to make further adjustments, including impacts of legislation described in the **Law Changes** section. In addition, for each assumption, we considered simplifications to our current modeling approach based on observations in the historical data.

Law Changes

The laws listed below expanded access to catastrophic disability benefits for LEOFF 2 members. We considered their potential impact when setting assumptions.

- ❖ **ESHB 1833 (2007)** – This law expanded the duty-related presumption to strenuous physical exertion and heart problems experienced within seventy-two hours of firefighting activities. The law also added four cancers to a list presumed to be from firefighting.
- ❖ **SSB 6214 (2018)** – This law expanded the duty-related presumption to cover Post-Traumatic Stress Disorder (PTSD).

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS *continued*

Analysis and Results

Analysis

Methods and Format of Assumptions

We considered alternate formats for the catastrophic disability assumptions and, ultimately, decided not to make any changes. For reference, we considered, but did not select:

❖ **Separate assumptions for law enforcement officers and firefighters.**
   Given the limited catastrophic disability experience and similar numbers of historical disabilities between police and firefighters, we do not believe a separate assumption for each population is necessary.

❖ **Assumptions that vary by age.**
   The small amount of catastrophic disability experience limited our ability to set credible assumptions that vary by age. We will consider assumption changes by age in future demographic experience studies.

Results

Percent Catastrophic

The following tables shows the actual percent catastrophic as well as our old and new assumptions.

Percent Catastrophic from 2005-2017				
Expected Duty Disabilities*	Actual Catastrophic Disabilities**	Percent Catastrophic	Old Assumption	New Assumption
319	43	13.5%	12.0%	14.0%

*Expected duty disabilities from 2005-2017 data using updated **Disability Rates** *and* **Duty Disability Probability Assumption** *developed in this report.*

**Actual number of catastrophic disabilities from 2005-2017 excluding members that retired prior to 2005 and were retroactively classified as having a catastrophic disability.

We increased our assumption to better reflect the historical experience from our study period and to account for the additional catastrophic disabilities we expect from 2018 Legislation that expanded duty-related disability presumptions to include PTSD.

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS

Minimum Catastrophic Benefit

The following table shows the average annual percent of FAS for the minimum catastrophic benefit.

Minimum Catastrophic Benefit		
Year	Number of Members*	Percent of Final Average Salary
2005	2	35%
2006	6	33%
2007	7	30%
2008	9	33%
2009	11	33%
2010	16	39%
2011	20	38%
2012	26	35%
2013	30	35%
2014	36	37%
2015	39	39%
2016	44	39%
2017	46	41%
	292	38%

Totals may not agree due to rounding.

*Members eligible for a minimum catastrophic benefit from DRS records.

The average percent of FAS from the total historical experience of 38 percent is close to our old assumption of 44 percent. We also observed an upward trend in the percent of FAS in more recent experience. Considering these factors, we made a modest reduction in our assumption from 44 to 42 percent of FAS to more closely reflect historical experience and the recent trend.

Medical Insurance Premium Reimbursement

The following table details the average premium amounts for pre-Medicare and Medicare eligible members.

Medical Insurance Premium Amounts				
	Pre-Medicare		Medicare Eligible	
Year	Members*	Premiums**	Members*	Premiums**
2012	9	$16,300	9	$3,100
2013	18	$15,900	10	$3,200
2014	18	$12,400	13	$3,800
2015	19	$12,400	15	$7,000
2016	19	$11,300	21	$6,400
2017	23	$11,700	20	$7,600
Total/Weighted Average	106	$13,000	88	$5,700

Totals may not agree due to rounding.

*Members receiving premium reimbursement from OSA annual valuation files.

**The premium amounts for 2012-2016 were adjusted to reflect premiums equal to 2017 levels using a 4.6 percent annual medical inflation trend.

MISCELLANEOUS ASSUMPTIONS   *continued*

We made significant changes to the modeling and assumptions of this benefit. Our old approach included premium assumptions for COBRA or prior employer insurance, the probability of spouse coverage, and the number and age of dependent children. After reviewing historical experience, we found that Medicare eligibility had the greatest impact on the cost of premiums. Covered dependents also impacted premiums, however, we don't believe we have sufficient data to set credible assumptions for these groups.

We simplified our model by removing assumptions related to dependents or type of coverage (COBRA or prior employer). Our new modeling approach splits members between two benefits: pre-Medicare and Medicare eligible. We set the assumption for each benefit equal to the observed weighted average premium amounts from the previous table. We retained our method of moving members from pre-Medicare to Medicare benefits 29 months after retirement consistent with Medicare eligibility rules. In general, the new assumptions and modeling reduced the expected cost of these benefits.

For modeling future members with catastrophic disabilities, we combined the premium amounts into a single assumption using a liability-weighted average. We observed this simplification produced the same overall plan liability. To project premiums into the future, we developed a long-term average premium growth assumption based on medical growth trends in our Other Post-Employment Benefits (OPEB) actuarial valuation. We believe this represents a reasonable approximation for the growth in premium reimbursement for catastrophic disability health insurance. We will monitor and update the premium growth assumption as future OPEB valuations become available. Please see the most recent OPEB valuation report on our website for more details.

We considered guidance in the Actuarial Standards of Practice (ASOPs) No. 6 on measuring retiree group benefits regarding this simplified modeling approach. The ASOPs allow approximations when the actuary expects the result to represent a minor part of the overall actuarially determined contribution. Based on the 2017 AVR, we found that these benefits constitute about 0.1 percent of the overall plan liabilities and believe a simplified model is reasonable.

Certain and Life Annuities

What is the Certain and Life Annuities Assumption and How Do We Use it?

In many of the retirement plans, the standard retirement option is a monthly benefit payable for the lifetime of the member. If a retired member dies before their total pension payments received exceed the value of their pre-tax contributions made throughout their career with credited interest (also referred to as the savings fund), the difference is paid to their beneficiary or estate. We estimate the value of this benefit for current and future retirees using a Certain and Life Annuity – a life annuity with a certain payment period.

As the name implies, the certain payment period is the expected length of time that an annuitant is guaranteed to receive benefit payments. The certain period begins upon retirement. If the annuitant dies during the certain period, payments to a beneficiary or estate are assumed to continue until the end of the certain period. This methodology approximates any lump sums that may be paid out to the member's beneficiary or estate under this benefit.

Members of the hybrid Plans 3 don't receive this benefit because they do not contribute to the defined benefit portion of their retirement and thus, they have no savings fund.

High-Level Takeaways

We found that the old certain period assumptions reasonably modeled the length of guaranteed annuity payments in relation to historical savings funds. However, our updated analysis suggests small adjustments for a few plans.

Data

We used records of new retirees from 2014-2017 to study the ratio of their savings fund to annual retirement benefits. To study the certain period of open Plans 2, we also gathered data on the age and service of active members from our 2017 valuation file to estimate the average age members are hired.

General Methodology

To develop the certain and life annuity assumption, we use different approaches for the closed and open plans.

Since the average population of the closed Plans 1 is near retirement, we use recent retiree data to calculate the ratio of accumulated contributions to annual retirement benefits. This ratio is simply the sum of all member savings funds divided by the total annual retirement benefits for all recent retirees.

For the open Plans 2, we include additional forward-looking analysis. We estimate the ratio of accumulated contributions to annual retirement benefits of an average new hire using a new simplified method.

We based our new methodology on the principle that the accumulation of all contributions plus investment returns should equal the value of member pensions upon retirement. With this in mind, we determined the time it would take to recoup the purchase amount of an annuity based on plan-specific mortality assumptions and Cost-of-Living-Adjustment (COLA) provisions at the time of expected retirement. We made adjustments to capture (1) the difference between the savings fund interest rate and the investment return assumption and (2) the 50/50 cost sharing that takes place between Plan 2 employees and employers that pays for a member's pension benefit throughout their career. We anticipate this new method will improve the modeling of long-term expectations and reduce volatility that could emerge as contribution rates fluctuate over time.

Lastly, we compare the results of this analysis to recent retiree data to determine if we need to make any adjustments to reflect actual experience at retirement.

THREE: APPENDICES

Law Changes

Since the last study, no law changes have impacted our analysis of this assumption.

Analysis and Results

Analysis

Closed Plans 1

PERS Plan 1 analysis of recent retiree experience indicated a certain period of roughly four and one half years. This is slightly higher than our old analysis.

TRS Plan 1 is different from other plans. The standard option for most benefits in this plan is a single life benefit with no guarantee of receiving at least the value of their savings fund. The exception is the TRS 1 disability benefit, which provides (1) an actuarial equivalent annuity of the member's savings fund, (2) a 1 percent per years of service pension, and (3) $100 per year lump sum. For the first benefit, the annuitized savings fund, the member is entitled to receive back at least the value of their savings fund from the annuity payments. This benefit structure causes the TRS 1 disability benefit certain period to be longer than other plans.

LEOFF Plan 1 analysis of recent retiree records indicates a certain period of slightly less than two and one-half years. We expect this trend to continue downward since member contribution rates have been zero percent since July 1, 2000 and we expect that rate to continue for the remainder of active members' working careers.

WSPRS Plan 1 analysis of recent retiree records indicates a certain period of three and one-half years.

The following table summarizes our observations from this experience study along with the analysis from our prior report.

Certain Period Observations		
Plan	**Prior Study**	**Recent Experience**
PERS 1	4	4.5
TRS 1*	9.1	9.8
LEOFF 1	2.5	2.3
WSPRS 1	3.6	3.5

Applies to TRS 1 disability only.

Open Plans 2

All Plans 2 analysis indicate a certain period of roughly four to five years. The public safety plans, (PSERS, LEOFF, and WSPRS), with earlier retirement ages, tend to have slightly longer certain periods.

Overall, our new analysis suggests future certain periods are generally consistent with our old assumptions.

The following table summarizes our observations from this experience study along with the analysis from our prior report.

Certain Period Observations			
Plan	**Prior Study**	**Future Expectations**	**Recent Experience**
PERS 2	4.4	4.5	3.1
TRS 2	5.4	4.5	3.4
SERS 2	4.2	4.6	2.7
PSERS 2	4.2	4.7	4.3
LEOFF 2	5.5	4.8	5.1
WSPRS 2	4.5	5	N/A

THREE: APPENDICES

Methods and Format of Assumptions

We round our certain period to a whole number in order to be compatible with our valuation software.

We compared our new methodology to the method used in the prior experience study and found the results of our two methods to be substantially similar. As such, we intend to eliminate the more complicated approach we've used in the past and apply the simpler method going forward.

Results

All-Plan Summary

We found that actual experience was reasonably similar to the old assumptions. However, when taking into account expectations for the future, we adjusted our assumptions, where appropriate, and to have consistency across systems and plans with similar benefit structures.

Overall, this resulted in a certain period assumption of 4 years for PERS, TRS, and SERS Plans 2. For the public safety plans with earlier retirements, PSERS, WSPRS, and LEOFF Plans 2, we selected a certain period assumption of five years. We also set the WSPRS 1 certain period equal to five years but retained the old assumptions for the remaining Plans 1.

By System Considerations

The following are specific impacts and/or changes by plan:

❖ We did not change the certain period assumption for PERS 1, TRS 1 disability, or LEOFF 1 given the size of their remaining populations.

❖ We set the WSPRS 1 certain period equal to our assumption for WSPRS 2 due to the similar plan design. We did not take the same approach as we did for the other Plans 1 because WSPRS 1 was closed to new hires much more recently.

Otherwise, based on our analysis we made some minor adjustments to our assumptions to better model our expectations for the future.

New Certain and Life Annuities Assumption

The following table shows the old and new assumptions by plan.

Certain Period Assumption		
Plan	Old	New
PERS 1	4	4
PERS 2	4	4
TRS 1*	9	9
TRS 2	5	4
SERS 2	4	4
PSERS 2	4	5
LEOFF 1	3	3
LEOFF 2	5	5
WSPRS 1	4	5
WSPRS 2	5	5

Applies to TRS 1 disability only.

Duty Disability Probability

What is the Duty Disability Probability Assumption and How Do We Use it?

The Duty Disability Probability assumption for LEOFF 2 represents the probability that a member disables from active service due to a duty-related cause.

We apply the duty disability probability to the Disability Rates to estimate the number of active members that will disable from duty-related causes and collect a lifetime retirement benefit. Members who experience a duty-related disabling event and select retirement typically receive a larger retirement benefit than they would otherwise, either through service retirement or a non-duty-related disability retirement. We set the duty disability probability assumption as a percent of all disabled retirements.

The example below illustrates the calculation of the number of duty-related disablements for 100 LEOFF 2 active members age 45 using the new assumption.

(100 active members) x (0.002 Total Disability Rate) x (0.90 Duty-Related Probability) = 0.18

High Level Takeaways

Previously, we set age-based assumptions for the duty disability probability, and with this study, we simplified our approach and set a single rate for all ages and job classifications. We found that the complexity of by-age rates did not significantly change results. We also previously set different assumptions for both law enforcement officers and firefighters. However, data shows that law enforcement officers and firefighters disable from duty-related causes at similar rates. For information about the prior assumption, please see the *2007-2012 Demographic Experience Study*.

Data and Assumptions

We looked at 23 years of experience study records, from 1995-2017. No special data was added for this assumption, but some data was removed. We excluded data prior to 2005 due to significant changes in benefits after that point.

We used the new total disability assumption described in the **Disability Rates** section to set the duty disability probability assumption. We compared the actual number of duty-related disabilities with what our new assumptions produced over our study period.

General Methodology

We compared the number of actual duty-related disablements (observations) to our expected number of duty-related disablements based on our old assumed rates. To determine the expected number, we applied the old duty-related probability with the old total disability assumption to the eligible population over the study period, by age. This helped us identify trends in the data where the assumption was over- or underestimating disabled retirement experience. We then performed the same calculation using the new total disability assumption, developed as part of this experience study, to determine its impact. To set the new assumed probability, we divided observed duty disabled retirements by all observed disabled retirements, by-age, over five-year age bands and in aggregate.

Law Changes

The laws listed below expanded access to duty-related disability benefits for LEOFF 2 members. We considered their potential impact when setting assumptions.

- ❖ **HB 2592** **(2016)** – Allows disability coverage for LEOFF 2 members that become totally incapacitated as a result of certain federal emergency management service.
- ❖ **SSB 6214** **(2018)** – Adds Post-Traumatic Stress Disorder (PTSD) to the list of occupational diseases and creates a rebuttable presumption for LEOFF members that PTSD is an occupational disease.
- ❖ **HB 1913** **(2019)** – Allows the presumption of occupational disease for purposes of workers' compensation by certain adding medical conditions to the presumption.

MISCELLANEOUS ASSUMPTIONS
continued

Analysis and Results

Analysis

Past Experience

The following table shows the actual to expected counts under the old duty disability probability when it is applied to both the old and new total disability assumptions. We found that the underlying total disability rates account for most of the change in expected duty disabled retirements because the majority of disabled retirements in LEOFF 2 are duty-related.

Plan 2 Duty Disability Counts by Age					
Old Duty Disability Probability					
		Old Total Disability Rates		**New Total Disability Rates**	
Age	**Actual**	**Expected**	**Ratio**	**Expected**	**Ratio**
20-24	0	0	0.00	0	0.00
25-29	1	4	0.24	1	0.72
30-34	4	15	0.27	5	0.79
35-39	19	34	0.55	33	0.58
40-44	34	53	0.64	35	0.97
45-49	39	71	0.55	62	0.63
50-54	88	93	0.95	93	0.94
55-59	64	78	0.83	70	0.92
60-64	22	38	0.58	24	0.92
65+	2	3	0.58	2	1.24
Total	**273**	**390**	**0.70**	**325**	**0.84**

Methods and Format of Assumptions

We considered alternate formats for the assumptions and, ultimately, decided to simplify the duty disability probability to a single rate for all ages. For reference, we considered, but did not select:

❖ **Separate assumptions for law enforcement officers and firefighters.**
    The data shows a small difference in the by-age and aggregate duty disablement percentages between law enforcement officers and firefighters. However, that difference is small and does not materially add to the accuracy of our model.

❖ **Assumptions that vary by age.**
    We considered setting this assumption similarly to that of total disability rates. While this approach does more accurately reflect the data, we believe it does not materially add to the accuracy of our model.

Results

Experience shows high rates of duty-related disablement at earlier ages, trending downward as age increases. In general, actual rates compared closely to the old rates. With consideration for the materiality and complexity of the assumption, we applied professional judgement to set a single rate for all ages. To account for recent passed legislation, we upwardly adjusted the single rate greater than average historical observations.

Plan 2 Disability Counts by Age			
New Total Disability Rates and New Duty Disability Probability			
Age	Actual	Expected	Ratio
20-24	0	0	0.00
25-29	1	1	0.81
30-34	4	5	0.87
35-39	19	30	0.64
40-44	34	33	1.04
45-49	39	60	0.65
50-54	88	93	0.95
55-59	64	71	0.90
60-64	22	24	0.90
65+	2	2	1.22
Total	273	319	0.86

LEOFF Plan 2 Duty Disability Probability	
All Ages	90%

THREE: APPENDICES

Duty-Related Death

What is the Duty-Related Death Assumption and How Do We Use it?

The Duty-Related Death assumption represents the likelihood that a member dies during or after the course of employment and receives certain duty-related death benefits.

Survivors of active members who suffer a duty-related death receive a one-time lump sum as well as a subsidized survivor annuity. Survivors of inactive members receive only the one-time lump sum benefit, provided the member died due to an occupational disease or infection that arose out of employment.

The survivor annuity is considered subsidized because it does not require any early retirement reductions from the time of the member's death. The survivor annuity is further subsidized in LEOFF and WSPRS because no Joint-and-Survivor reduction is applied. Survivors in LEOFF and WSPRS may also be eligible to receive reimbursement from the pension system for future medical premiums.

In addition to the survivor annuity, the lump sum payment is as follows:

- ❖ $150,000 for PERS, TRS, SERS, and PSERS.
- ❖ $214,000 for LEOFF and WSPRS, indexed for inflation each year beginning in 2008 ($251,352.50 as of July 1, 2018).

High Level Takeaways

Our ability to review this assumption for accuracy is limited given the infrequent occurrence of duty-related deaths. Many systems experienced fewer duty-related deaths than expected under our old assumption. As such, we reduced our duty-related death assumption for all systems except LEOFF and WSPRS. The WSPRS assumption remains unchanged and we increased our assumption for LEOFF primarily because recent legislation continues to expand the duty-related death provisions. Additionally, we simplified our approach to modeling the occupational disease duty-related death benefits for LEOFF.

To get a sense of scale for these benefits, under our old assumptions LEOFF 2 and WSPRS 1/2 duty-related death benefits represent approximately 0.6 percent and 0.2 percent of the present value of future benefits for these plans, respectively. By comparison, all other plans comprise less than 0.02 percent.

We also reviewed the ages at which members died from duty-related causes and did not identify a consistent pattern. This means the observed duty-related death rate for a 50-year-old member was similar to that of a 30-year-old member. For this reason, we assumed the same duty-related death rate across all ages.

Data and Assumptions

The Legislature expanded duty-related death provisions in March 1996 for LEOFF plans and July 2003 for all other plans to include an automatic lump sum benefit. Previously, surviving beneficiaries had the option to elect a lifetime monthly benefit or a refund of member contributions. The data available prior to the expansion only reflect the election of a lifetime benefit, and not the true incidence of duty-related deaths. We therefore excluded data prior to 2004 for all non-LEOFF plans in our analysis.

The LEOFF duty-related death provision was again expanded by the Legislature in 2006 to include members who die from occupational disease. To account for this, we excluded all data prior to the 2006 expansion for LEOFF 2.

We used the new Mortality Rates assumption when applying the new duty-related death assumption to our valuation software.

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS

General Methodology

We began by comparing our old assumption to historical data. Given the limited number of observations, our goal was to assess the reasonableness of the old assumption, and, if necessary, move our future expectations in the direction of the actual experience. We also applied our judgment to establish relationships between retirement systems based on similar patterns of experience.

For information about the old assumption, please see the *2007-2012 Demographic Experience Study*.

Law Changes

- ❖ **SSB 6214** (2018).
    - o Applied to members of LEOFF.
    - o This law expanded the lump sum duty-related death benefit to cover Post-Traumatic Stress Disorder (PTSD).
- ❖ **HB 1913** (2019).
    - o Applied to all members of LEOFF and select members of PERS.
    - o This law expanded the statutory list of presumptive occupational diseases for fire fighters. It also adds some law enforcement, publicly employed EMTs, and fire investigators to the list of workers covered by the occupational disease presumption.

Analysis and Results

Analysis

Past Experience

The following table identifies the number of duty-related deaths by retirement system over the relevant experience study period.

System	Observations 2004-2017
PERS	26
TRS	3
SERS	2
PSERS	0
LEOFF 2*	55
WSPRS	3

*Excludes 2004 and 2005.

Focusing in on the systems or plans with the most events, PERS and LEOFF 2, the following tables show the Actual and Expected counts by year, along with the A/E ratio for the total across all years. The Expected counts are based upon our old assumptions.

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS

PERS Duty-Related Deaths			
Year	Lives	Expected	Actual
2004	156,117	2.8	3
2005	157,691	2.8	4
2006	157,109	2.8	0
2007	156,473	2.8	5
2008	159,370	2.9	1
2009	162,771	2.9	2
2010	160,646	2.9	4
2011	157,723	2.8	4
2012	153,929	2.8	1
2013	152,002	2.7	0
2014	152,240	2.7	0
2015	153,663	2.8	0
2016	154,794	2.8	1
2017	157,209	2.8	1
Total	**2,191,737**	39.5	**26**
		A/E 0.66	

LEOFF 2 Duty-Related Deaths			
Year	Lives	Expected	Actual
2006	15,975	5.6	6
2007	16,379	5.7	3
2008	16,695	5.8	5
2009	17,122	6.0	11
2010	17,388	6.1	4
2011	17,303	6.1	5
2012	17,110	6.0	2
2013	16,948	5.9	5
2014	16,881	5.9	2
2015	16,953	5.9	6
2016	17,151	6.0	2
2017	17,422	6.1	4
Total	**203,327**	71.2	**55**
		A/E 0.77	

The expected columns in the previous tables reflect the number of duty-related deaths we assumed each year for active members. Survivors may still receive a duty-related death benefit if the member passes away after leaving the workforce, as long as the death is due to an occupational disease (or rather, a duty-related illness). This is most prevalent for LEOFF survivors as the list of occupational diseases for LEOFF members is much larger than the rest of the systems given the increased risks these members face as part of their job. Furthermore, there is a presumption in place that if a LEOFF member dies from one of the listed diseases within five years of leaving active service[1], it will result in the payment of a duty-related death benefit.

The actual columns in the previous tables reflect all duty-related death benefit payments, regardless of the member's employment status (active, retired, etc.) when the death occurred. While we also model duty-related death benefits paid to survivors of current inactive members that left service in the last five years, we excluded those expected figures from the previous tables. For more information, please see the **Results** sub-section.

[1]*The occupational disease presumption window is provided to all members (who disable, terminate, or retire) and equals three months per year of plan membership or five years, whichever is less. While survivors are still eligible for duty-related benefits for deaths that occur beyond the presumptive window, it requires more evidence to prove the death was due to occupational disease.*

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS *continued*

Methods and Format of Assumptions

We considered alternate formats for the assumptions and, ultimately, decided not to make any changes. For reference, we considered, but did not adopt:

- ❖ **Separate assumptions for police and fire members of LEOFF.**
  Given the similar demographics of the average police and fire members and the same benefit provisions for active duty-related death benefits, we did not feel a separate assumption was necessary. While other factors, like the nature of the job, may result in higher or lower likelihood of a duty-related death, for simplicity we feel attempting to model the expected aggregate number of deaths across the system is sufficient and reasonable.

- ❖ **Separate assumption for inactive members of non-LEOFF plans.**
  We have only observed five duty-related deaths in PERS inactive members since 2004. We will continue to monitor this assumption and plan to review it again as part of the next experience study.

Results

The following table shows our old assumption, the actual rate, and our new duty-related death assumption for active members in each system.

System	Old Rate	Actual Rate*	New Rate
PERS	0.0018%	0.0012%	0.0015%
TRS	0.0008%	0.0003%	0.0005%
SERS	0.0018%	0.0003%	0.0005%
PSERS	0.0018%	0.0000%	0.0015%
LEOFF 2	0.0350%	0.0271%	0.0450%
WSPRS	0.0200%	0.0203%	0.0200%

Based upon historical experience from 2004-17; 2006-17 for LEOFF 2.

Most systems experienced fewer duty-related deaths than expected under our old rates. We therefore reduced this assumption for most systems.

While historical experience was less than expected for LEOFF 2, we increased our assumption as a result of recent legislation. Based on our analysis for those bills, we assumed an additional four deaths per year would now fall under the duty-related death category. Taking that into account when reviewing the actual to expected historical experience, we increased our LEOFF 2 assumption for both actives and inactives.

- ❖ For current inactive members who left service within the past five years, we model the expected number of occupational disease deaths per year. We adjusted both our assumption and methodology for the portion of duty-related deaths within this window to primarily account for recent legislation. For reference, we observed 11 occupational disease deaths over the last 12 years. Taking all this into consideration, we estimate four additional deaths due to occupational disease over the next five years, which by itself would increase our assumption; however, the number of eligible members expands to include law enforcement officers. As a result, we modified our assumption to now be applied to both fire fighters and law enforcement officers. The next effect is change in assumption from 27.2924 percent to 13 percent.

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS

The analysis showed a downward trend in duty-related deaths for PERS in recent years, which may be due to improvements in technology and/or an emphasis on job safety. However, we did not feel comfortable reducing our old assumption to match historical experience given the limited data. Our new assumption for PERS yields an A/E ratio of 0.79 over the time period studied, up from 0.66. We will continue to adjust the assumption in future studies if experience continues to follow the recent downward trend. The 2019 Legislation is not expected to notably increase the number of duty-related deaths in PERS.

For SERS, we chose to set our new assumption equal to TRS given the similar working conditions and similar incidence rates; we considered moving part way from the old SERS assumption, which was equal to PERS, but decided the significant shift was reasonable given the small impact of the assumption change.

For the remaining public safety plans, we continue to set the PSERS assumption equal to PERS as we do not believe PSERS will exhibit the same levels of duty-related deaths as the other public safety plans. We did not directly review LEOFF 1 experience since these benefits do not materially impact estimated plan costs; we continue to set this assumption equal to LEOFF 2. Finally, we made no change to the WSPRS assumption given actual experience closely mirrored our prior expectations.

MISCELLANEOUS ASSUMPTIONS *continued*

LEOFF Plan 2 Percent Law Enforcement Office/Firefighter

What is the LEOFF Plan 2 Percent Law Enforcement Officer/Firefighter Assumption and How Do We Use it?

The Percent Law Enforcement Officer/Firefighter assumption for LEOFF 2 represents the probability that a member is occupied as a law enforcement officer or a firefighter. We use the assumption to blend occupation specific termination and retirement rates into one set of rates for all members of the plan.

High Level Takeaways

Historically, the percent of LEOFF 2 members identified as law enforcement officers/firefighters decreased/increased over the study period. However, since the *2007-2012 Demographic Experience Study* the more recent data remains steady. As such, we made no change to our prior assumption.

Data

We looked at 23 years of experience study records, from 1984-2017. No special data was added for this assumption, and no data was excluded.

General Methodology

We compared the number of law enforcement officers and the number of firefighters to the total active LEOFF 2 member counts to determine the percentage that are employed in each occupation. We made this comparison by age and by year over the study period.

Law Changes

Since the last study, no law changes have impacted our analysis of this assumption.

Analysis and Results

Analysis

Past Experience

The following table shows the member counts of law enforcement officers and firefighters by age. We found that between ages 25 and 60, the percent of members employed in either occupation as a percentage of total LEOFF 2 active membership remained steady.

MISCELLANEOUS ASSUMPTIONS

LEOFF Plan 2 Member Counts by Age (Males and Females)					
Age	**All**	**LEO**	**FF**	**Percent LEO**	**Percent FF**
20-24	7,823	3,989	3,834	51%	49%
25-29	47,891	27,403	20,488	57%	43%
30-34	77,448	44,001	33,447	57%	43%
35-39	81,724	45,752	35,972	56%	44%
40-44	72,385	40,366	32,019	56%	44%
45-49	55,635	30,816	24,819	55%	45%
50-54	36,237	19,689	16,548	54%	46%
55-59	16,558	8,765	7,793	53%	47%
60-64	4,714	2,653	2,061	56%	44%
65+	628	353	275	56%	44%
Total	**401,043**	**223,787**	**177,256**	**56%**	**44%**

The following table shows the member counts of law enforcement officers and firefighters by year. As noted, the historical percent of members identified as law enforcement officers/firefighters decreased/increased. However, recent data suggests a steady proportion, or leveling-off, of each occupation over the study period.

MISCELLANEOUS ASSUMPTIONS *continued*

		LEOFF Plan 2 Member Counts by Year (Males and Females)			
Year	**All**	**LEO**	**FF**	**Percent LEO**	**Percent FF**
1984	3,262	1,987	1,275	61%	39%
1985	3,676	2,229	1,447	61%	39%
1986	4,142	2,489	1,653	60%	40%
1987	4,544	2,688	1,856	59%	41%
1988	4,977	2,940	2,037	59%	41%
1989	5,616	3,360	2,256	60%	40%
1990	6,183	3,697	2,486	60%	40%
1991	6,940	4,171	2,769	60%	40%
1992	7,700	4,586	3,114	60%	40%
1993	8,218	4,824	3,394	59%	41%
1994	8,813	5,134	3,679	58%	42%
1995	9,568	5,597	3,971	58%	42%
1996	10,237	6,018	4,219	59%	41%
1997	10,872	6,348	4,524	58%	42%
1998	11,452	6,658	4,794	58%	42%
1999	11,975	6,958	5,017	58%	42%
2000	12,755	7,376	5,379	58%	42%
2001	13,183	7,568	5,615	57%	43%
2002	13,641	7,718	5,923	57%	43%
2003	14,116	7,924	6,192	56%	44%
2004	14,665	8,165	6,500	56%	44%
2005	14,875	8,235	6,640	55%	45%
2006	15,262	8,423	6,839	55%	45%
2007	15,789	8,666	7,123	55%	45%
2008	16,187	8,826	7,361	55%	45%
2009	16,705	9,116	7,589	55%	45%
2010	17,036	9,216	7,820	54%	46%
2011	17,006	9,116	7,890	54%	46%
2012	16,865	8,951	7,914	53%	47%
2013	16,767	8,849	7,918	53%	47%
2014	16,741	8,834	7,907	53%	47%
2015	16,838	8,889	7,949	53%	47%
2016	17,073	9,048	8,025	53%	47%
2017	17,364	9,183	8,181	53%	47%
Total	**401,043**	**223,787**	**177,256**	**56%**	**44%**

Results

Based on the member counts by age and by year, and considering the more recent trends in the data, we determined the current assumption for the percent of members occupied as law enforcement officers or firefighters remains reasonable.

MISCELLANEOUS ASSUMPTIONS

Plan 2 Percent Law Enforcement Officer/ Firefighter		
	Old	New
LEO	55%	55%
FF	45%	45%

Military Service Credit Load

What is the Military Service Credit Load Assumption and How Do We Use it?

Under specific conditions, members may receive retirement system service credit for time served in the military. Based on discussions with the plan administrator, many members wait to apply for military service credits until they retire. The Military Service Credit Load assumption represents the increase in member benefits due to unexpected service credit earned at no cost to qualifying members.

In accordance with state law, military service credit is categorized as interruptive (during state employment) or non-interruptive (before state employment). Interruptive service credit may be earned by eligible members of all retirement systems, whereas non-interruptive service credit may be earned only by eligible members of PERS and WSPRS Plans 1.

When members of PERS and WSPRS Plans 1 have non-interruptive military service credit and attain 25 years of service, they may receive up to five years of additional no-cost service credit equivalent to the time served in the military.

The Military Service Credit Load assumption applies to non-interruptive military service only. We discuss analysis of interruptive military service credit in the **Methods and Format of Assumptions** section.

High Level Takeaways

For non-interruptive service credit, we observed a divergence in recent experience between PERS 1 and WSPRS 1. Experience in PERS 1 shows a small decrease in the load and a consistent downward trend over the study period. This is mostly due to fewer eligible retirees earning non-interruptive service credit. Whereas experience in WSPRS 1 shows an increase in the load and a steady trend over the study period, with an upward increase in recent years. More retirees are earning non-interruptive service credit and for longer periods of service. Based on these observations, we retained our assumption in PERS 1 and increased the load in WSPRS 1 to align with what recent experience suggests.

For interruptive service credit, we have historically not applied a load assumption in our valuation to estimate the potential impact of this type of service credit. Interruptive service credit is provided at the time a member returns to work, which means that service is already included in member data and valued in our valuation. As part of this study, we reviewed recent data and believe the impact of unexpected future interruptive service credit is immaterial.

Data

We looked at 18 years of experience study records, from 2001-2018. No special data were added for this assumption, and no data were excluded.

General Methodology

For PERS and WSPRS Plans 1, we analyzed the military service credit load by determining the impact the unexpected service credit had on retired member benefits. Using retiree data, we examined both the percent of members with non-interruptive military service and at least 25 years of service, and the number of years of military service for those members. Using historical retiree data, we calculated annual loads, and weighted average loads corresponding to aggregated experience over different time periods. We considered the results of each method and relied on professional judgment to set the final loads.

The load represents the average increase in service earned by members who reach 25 years of service. We then apply a load (an average increase) to all active members who have reached or could reach 25 years of service at retirement.

MISCELLANEOUS ASSUMPTIONS

For example, over the period 2013-2018, about 39.4 percent of WSPRS 1 male retirees with 25 years of service had, on average, 3.8 years of non-interruptive military service, leading to an average increase of 1.5 years of service across all male retirees (39.4 percent x 3.8 = 1.5). Of all male retirees with at least 25 years of service, retirees had 28.0 years of service on average (which includes military service), producing a load of about 5.6 percent.

$$\textit{Non Interruptive Military Service Credit Load} \ = \ \frac{(28.0 \text{ years of service})}{(28.0 \text{ years of service} - (39.4\% \times 3.8 \text{ years of service}))} - 1 = 5.6\%$$

Law Changes

The law listed below expanded the number of conflicts eligible for interruptive military service. We do not set an assumption for interruptive military service credit and the estimated impact of this law did not produce material results. This law has no impact on the non-interruptive military service credit load assumption.

❖ **ESHB 2701** **(2018)** – Expanded eligibility for no-cost interruptive military service credit by adding newly eligible conflicts and by allowing military service credit to be earned by members for multiple deployments within the same qualifying conflict.

Analysis and Results

Analysis

Past Experience

The following tables show the calculated loads based on the percent of retirees with non-interruptive military service and at least 25 years of service, as well as the number of years of military service for those members over several time periods. The time periods chosen for the weighted average loads correspond to the current experience study (2013-2018), the prior experience study (1996-2012), and the entire study period (1996-2018). Similarly, tables with annual information follow the weighted average tables.

Experience in PERS 1 shows a decrease in the percentage of eligible retirees with non-interruptive military service and a small decrease in the average number of service years earned. In WSPRS 1, we see both an increase in the percentage of eligible retirees with non-interruptive military service and a large increase in the average number of service years earned. This generally resulted in decreasing loads for PERS 1 and increasing loads for WSPRS 1.

This table shows the calculated weighted percent of members with non-interruptive military service, by gender and plan, over different time periods.

Percentage of Members with Non-Interruptive Military Service				
	PERS 1		**WSPRS 1**	
	Male	**Female**	**Male**	**Female**
2001-12	31.20%	0.70%	32.60%	16.70%
2013-18	14.60%	0.40%	39.40%	0.00%
2001-18	28.80%	0.60%	35.60%	11.10%

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS

This table shows the calculated weighted number of years of non-interruptive military service credit earned, by gender and plan, over different time periods.

Non-Interruptive Military Service				
	PERS 1		WSPRS 1	
	Male	Female	Male	Female
2001-12	2.78	2.52	3.14	4.36
2013-18	2.75	2.70	3.76	0.00
2001-18	2.78	2.55	3.44	4.36

This table shows the weighted average years of membership service, including military service, of retirees who attained at least 25 years of plan service credit, by gender and plan, over different time periods.

Retiree Membership Service with at least 25 Years of Service				
	PERS 1		WSPRS 1	
	Male	Female	Male	Female
2001-12	31.72	30.26	28.98	26.58
2013-18	36.25	33.54	28.03	26.26
2001-18	32.35	30.91	28.57	26.47

This table shows the calculated weighted average loads, by gender and plan, over different time periods.

Weighted Average Non-Interruptive Military Service Credit Loads				
	PERS 1		WSPRS 1	
	Male	Female	Male	Female
2001-12	2.80%	0.10%	3.70%	2.80%
2013-18	1.10%	0.00%	5.60%	0.00%
2001-18	2.50%	0.10%	4.50%	1.90%

The following graphs show similar information to that of the weighted average tables, but on an annual basis.

PERS 1 - Calculated Annual Military Service Credit Load
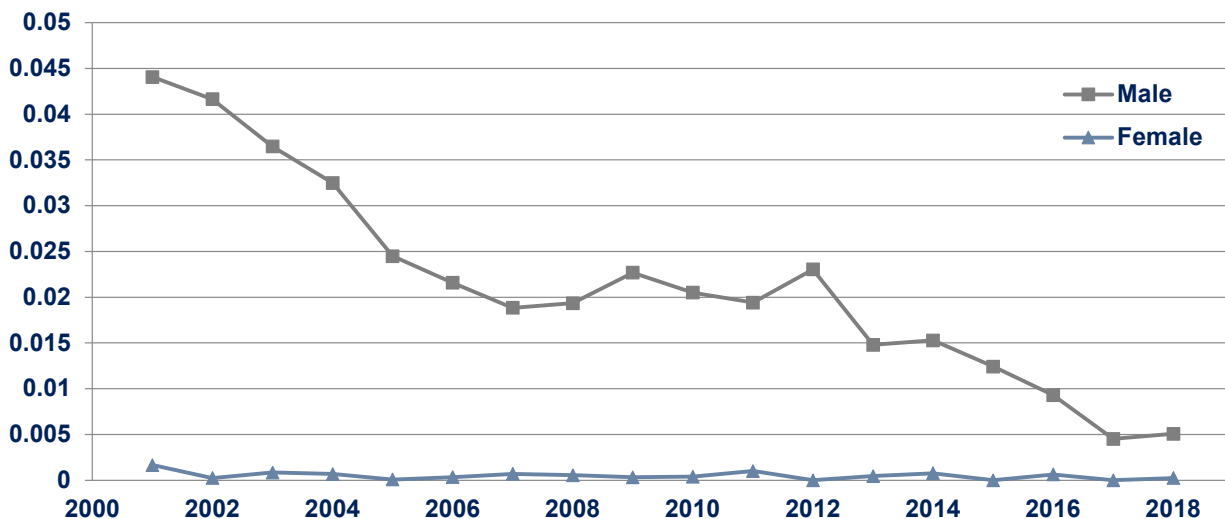
MISCELLANEOUS ASSUMPTIONS

WSPRS 1 - Calculated Annual Military Service Credit Load
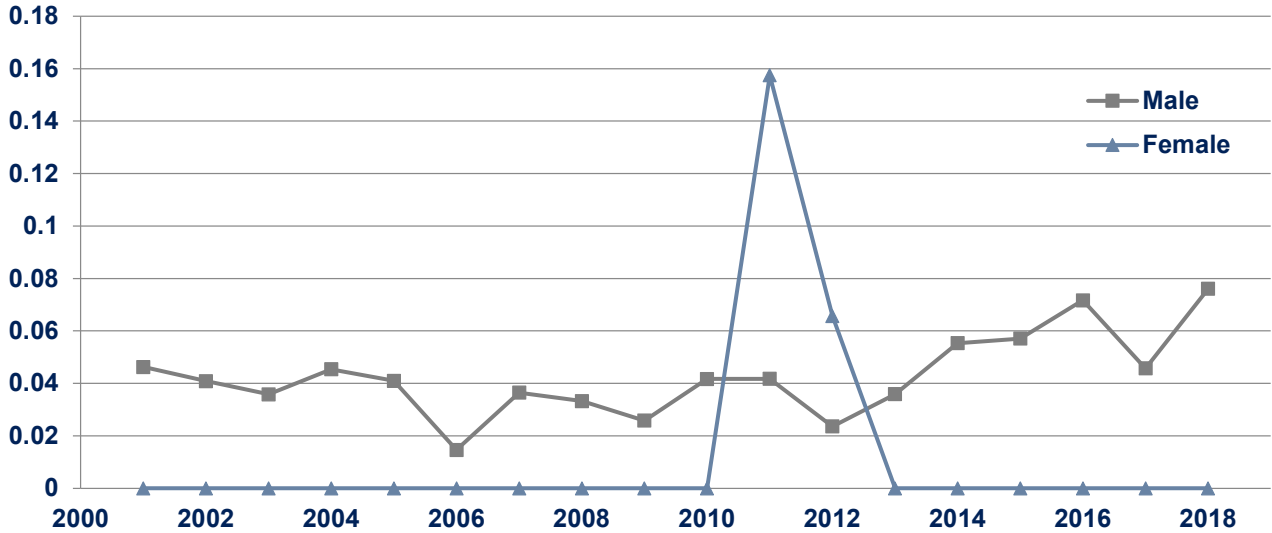
Methods and Format of Assumptions

We considered alternate formats for the assumption and, ultimately, decided to retain our approach to studying and applying this assumption. For reference, we considered, but did not select:

❖ **Assumptions that do not vary by gender.**
  We considered setting this assumption with a single load for each plan applied equally to males and females. While this approach would simplify the assumption, we observed significant differences in the number of members that served in the military between males and females, and therefore set separate assumptions.

❖ **Interruptive Military Service Credit.**
  We considered adding an assumption for interruptive military service credit to our model. This service differs from non-interruptive service in that it applies to all systems and plans, and members are not required to reach a specific state service threshold to receive this credit. However, interruptive service may only be earned for specific conflicts listed in RCW 41.04.005, most of which have ended, and is provided when a member returns to state service. Therefore, we assume most of the free interruptive service for named conflicts is already reflected in our census data. While interruptive service may be earned in future conflicts not yet added to the above RCW, our valuation assumptions reflect current law.

Results

Experience shows declining loads for PERS 1 and increasing loads for WSPRS 1. We considered the materiality of this assumption and future expectations, given the relatively few remaining actives in PERS 1 and the small change the recent experience suggests for the load. We applied professional judgement and retained our old assumptions in PERS 1. WSPRS 1 is a closed plan, but its closure occurred more recently and has approximately equal number of active members to inactive members. In the prior experience study, we reduced our load assumption for WSPRS 1 as it appeared to be trending downward. Since then, experience has supported a higher load. While we do not believe the recent experience is indicative of a long-term trend, we increased the WSPRS 1 load assumption.

Military Service Credit Load				
	Old Assumptions		**New Assumptions**	
	Male	**Female**	**Male**	**Female**
PERS 1	1.50%	0.10%	1.50%	0.10%
WSPRS 1	3.00%	1.00%	4.00%	1.00%

THREE: APPENDICES

Percent Male/Female

What is the Percent Male/Female Assumption and How Do We Use it?

The Percent Male/Female assumption is used to assign a default gender for valuation data records that contain missing gender information. Many of our demographic assumptions, such as mortality, vary by gender. Thus, our valuation requires each plan member be assigned a gender in order to apply the current structure of our assumptions that vary by gender.

High Level Takeaways

We study the Percent Male/Female assumption by system. Our current assumption for each system continues to model the plan demographic data well and is reasonable, so we made no change to our current assumption.

Data

We used active record data from the 1984-2017 valuations to develop this assumption. No special data was added, and no data was excluded.

General Methodology

To develop this assumption, we calculate the ratio of male to female active members by system and round the results to a multiple of ten percent.

Law Changes

Under WAC 246-490-075 and effective January 27, 2018, individuals born in Washington State can change their sex designation to "gender X", which is a gender that is not exclusively male or female. We did not account for gender X when setting our assumption due to a lack of gender X observations, and due to an inability of our valuation software to account for this third gender option properly. Any individual in our valuation data who identifies as gender X will be defaulted to a gender of either male or female based on their respective system's Percent Male/Female assumption. We plan to revisit our approach to gender X data in our next Demographic Experience Study.

Analysis and Results

We did not change the Percent Male/Female assumption for any system since the current assumptions remain reasonable. The following table summarizes these assumptions.

Percent Male/Female Assumptions		
System	Percent Male	Percent Female
PERS	50%	50%
TRS	30%	70%
SERS	20%	80%
PSERS	70%	30%
LEOFF	90%	10%
WSPRS	90%	10%

MISCELLANEOUS ASSUMPTIONS *continued*

Below are some of the system and plan-specific observations we made while studying this assumption.

❖ The Percent Male in both PERS 1 and TRS 1 has been decreasing over the past few decades, while the Percent Male in LEOFF 1 has remained steady at nearly 100 percent. However, since the Plans 1 are closed plans with small and declining active populations, we do not believe they merit their own plan-specific assumptions.

❖ Historical data for the PERS, TRS, and SERS Plans 3 does not exist for the entire study period dating back to 1984, since the Plans 3 were introduced in the late 1990s and early 2000s. However, the existing data for the Plans 3 models the same Percent Male/Female trends as their respective system's Plans 2.

❖ Likewise, historical data for WSPRS Plan 2 does not exist for the entire study period, since the plan was introduced in 2003. However, the existing data for WSPRS Plan 2 models the same Percent Male/Female trends as WSPRS Plan 1.

❖ SERS opened in 2000, but its membership consists of employees in school and educational service districts who would have been in PERS 2 prior to 2000. This allowed us to track SERS data for the entire study period.

❖ PSERS opened in 2006, and we do not have data for the entire study period. The data that we do have has shown that PSERS male membership has increased from approximately 65 percent in 2006 to approximately 75 percent in 2009. Male membership then remained stable from 2009 to 2017. We expect that female membership may increase in the future, so we maintained the current PSERS Percent Male assumption at 70 percent.

Portability with First-Class Cities

What is the Portability with First-Class Cities Assumption and How Do We Use it?

Upon retirement from a DRS-administered pension plan, a member who has earned service in a first-class city (i.e., Seattle, Spokane, or Tacoma) may apply to have that service recognized in the calculation of their pension benefit. Typically, service earned outside of a DRS covered position is not eligible to include in a member's pension calculation, but first-class city service is eligible to include. Such a member is said to have dual membership, also known as portability. Members with portability may combine their DRS service with their first-class city service to determine benefit eligibility, and DRS uses the higher salary of the member's two positions, as applicable, to calculate their Average Final Compensation.

Members who wish to include their portability service must submit a claim at retirement. DRS does not maintain data for members working at a first-class city, so we do not know if a member has portability service while the member is active or terminated in the DRS system. In order to pre-fund the cost associated with the increase in a member's benefit due to first-class city portability, we apply an adjustment factor, or load, to future retiree benefits. This load is the focus of the Portability with First-Class Cities assumption.

High Level Takeaways

We studied the Portability with First-Class Cities assumption by plan. The data we analyzed suggests that PERS 2 is the only plan where enough members retire with first-class city portability to have a material impact on the liabilities. Based on the data we studied, we estimate a load of 1.009 will capture the increased portability salary and service of these members. We applied this load to the retirement benefits applicable for this group.

Data

To develop this assumption, we studied valuation data by plan for members who retired with first-class city portability from 1994 to 2018.

General Methodology

For each retirement plan, we first studied the historical trend of members retiring with first-class city portability. We placed special focus on the last five years of data and on our expectations for the future to ensure our analysis best reflects the population moving forward. If we determined that members retiring with first-class city portability had a material impact on the liabilities of a plan, we developed a load for our model to apply to the applicable retirement benefits. This load reflects the expected percentage of annual retirements with first-class city portability and the expected benefit increase as a result of this portability. The load also reflects the potential for members to become newly eligible for (1) standard retirement from DRS and (2) subsidized early retirement from DRS due to the addition of first-class city service.

Law Changes

Since the last study, no law changes have impacted our analysis of this assumption.

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS
continued

Analysis and Results

We looked at each plan and determined how many members increased their benefit when including first-class city salary and service. We found that the more recent data (past five years) provided consistent headcounts for setting an assumption regarding future expectations.

The data shows that the majority of members receiving an increase to their benefit due to first-class city portability are those who first terminated from a DRS plan and then earned service at a first-class city. For this reason, we develop and apply a load to the retirement benefits linked to terminated vested members.

The following table summarizes the average number of terminated vested members who retire from DRS each year ("Exposures per Year"), the average number of members retiring with first-class city portability ("Observations per Year"), and the average increase in their average final compensation (AFC) over the past five years. A member is included in these counts only if their retirement benefit increased due to portability.

Portability with First-Class Cities Over the Past Five Years				
Plan*	Exposures per Year	Observations per Year**	Percent of Members Receiving Portability	Average AFC Percent Increase
PERS 1	330	1.8	0.55%	95%
PERS 2	1,290	12.4	0.96%	62%
PERS 3	360	0.4	0.11%	59%
TRS 2	320	0.4	0.13%	27%
SERS 2	630	0.2	0.03%	283%

Plans not displayed above had no observations over the past five years.
**Only includes members that received an increase in their AFC from first-class city portability service.*

Based on this data, PERS 1 and 2 are the most prevalent plans for portability with first-class cities. The combined PERS 1 and 2 portability members represent what we expect will be the trend for the future. However, given the decline in the overall Plan 1 population and the decline in Plan 1 portability members, from three in 2015 to zero in 2018, we expect future portability members will be in Plan 2.

For PERS 2, we calculated the load for our model using the following steps.

❖ First, we looked at how much an average member increases their benefit when we include their first-class city salary. To come up with this figure, we multiplied the expected percentage of annual PERS 2 retirements from terminated vested status who have first-class city portability (approximately 0.96 percent) by the expected AFC increase as a result of this portability (approximately 62 percent). This yielded a benefit load of 1.006.

❖ Next, we looked at how many members become eligible for subsidized early retirement due to the addition of their first-class city service. In PERS 2, this count is approximately six members a year. We analyzed retirement age data and the difference between subsidized and non-subsidized early retirement factors at these ages to increase our load to 1.008.

❖ Finally, we looked at how many members were terminated prior to earning a retirement benefit but now become eligible for a standard DRS retirement due to the addition of their first-class city service. In PERS 2, this count is approximately four members annually over the last five years. We estimated the annual liability impact of these members at about $200,000, which increased our benefit load to 1.009.

2013-2018 Demographic Experience Study   **177**

Probability of Withdrawing Contributions

What is the Probability of Withdrawing Contributions Assumption and How Do We Use it?

The Probability of Withdrawing Contributions assumption represents the likelihood that members who leave employment (terminate) will elect to receive a refund of their defined-benefit contributions. Alternatively, a vested member could terminate and choose to receive their earned retirement annuity when eligible.

We use the probability of withdrawing contributions assumption in combination with our termination assumptions to estimate who will or will not collect a deferred lifetime retirement benefit. The probability of withdrawing contributions assumption is generally based on how long a member served, with longer service members less likely to withdraw their contributions. Inherently, this assumption does not apply to members of the Plans 3 since a withdrawal from their defined contribution account will not impact their employer-funded defined benefit.

This assumption was previously referred to as "Percent Vested". For information about the prior assumption, please see the *2007-2012 Demographic Experience Study*. The "Probability of Withdrawing Contributions" simply equals one minus our previous "Percent Vested" assumption. This is because there are only two options an eligible member can take when leaving employment, (1) withdraw their contributions or (2) select an annuity.

High-Level Takeaways

We continue to see members less likely to withdraw contributions after termination as years of service increase. For example, approximately 40 percent of members who terminated with five to nine years of service withdrew their contributions, compared to around 25 percent of members with 20-25 years of service.

We generally found that our actual experience was reasonably similar to our old assumptions. However, we chose to modify the structure of the assumption to improve credibility across service levels.

Data and Assumptions

Data

We record a termination in the valuation year it occurs. A withdrawal will also be counted in the year the member terminated, even if the withdrawal occurs years later. As noted in the next subsection on assumptions, we structured the data in this manner based upon how we model these benefits in our valuation software.

We began with 21 years of experience study records, from 1995-2015. No special data was added for this assumption, but some data was removed. We removed 2001 and 2007 data for all systems and plans due to unequal length valuation periods. While we recognize the Great Recession may have impacted member behavior, we chose to include that data as part of the analysis. As summarized above, our updated analysis is still in line with our old assumptions. We don't believe that the addition of post-recession experience was significantly different than what occurred during the Great Recession.

We also made the following exclusions for specific systems:

❖ We chose to remove SERS data in the year 2000 due to a much shorter-than-normal valuation cycle.

    o SERS opened September 1, 2000, and that valuation period was only four months long. We eliminated that year's data to ensure it did not overly influence the overall result.

❖ We removed 2007 from PERS due to the creation of PSERS for similar reasons as noted with the advent of SERS.

❖ Finally, 1998 was excluded from TRS when Plan 3 was created.

MISCELLANEOUS ASSUMPTIONS

Assumptions

We assume that members who are eligible to retire immediately upon leaving employment will not withdraw their contributions, instead choosing to collect a lifetime benefit. As such, the probability of withdrawing contributions assumption is focused on members who are not eligible for retirement when they terminate.

As we mentioned previously, when a member leaves employment (or rather, terminates) they can take a refund of their contributions or receive their earned retirement annuity at a later date. This decision can occur anytime between when they terminate and when they retire.

For purposes of modeling these benefits in our valuation software, we assume this choice is made immediately upon termination. The probability of withdrawing contributions assumption informs how many members we expect to take their contributions immediately. The remaining eligible members are assumed to defer their retirement annuity.

We do not apply this assumption to current terminated vested members. Instead, we assume that all current terminated vested members will elect to receive their earned retirement annuity at a later date. We may revisit this assumption as part of future experience studies.

General Methodology

To determine the actual rate at which members withdraw contributions, we divided the number of members who withdrew their contributions by the overall number of terminations. This gives us an observed, or actual, probability of withdrawing contributions. We performed this calculation for each Plan 2 by years of service. The exception to this is WSPRS, in which we assume the same rate for Plans 1 and 2. We then compare actual historical experience to our old assumptions. After taking into consideration our expectations for the future, we select our new assumption for the Probability of Withdrawing Contributions and again compare the fit with actual experience.

We only considered terminations and withdrawals through 2015, consistent with the data used as part of our analysis on **Termination Rates**; please see that section of this report for additional details. As noted above, terminated vested members may take a refund of their contributions after they leave service. Because we record withdrawals in the year the member terminated, the actual withdrawal counts for terminations through 2015 will increase over time. To address this issue, we analyzed the sensitivity of the probability of withdrawing contributions assumption with respect to its overall impact on the retirement system liabilities. That analysis suggested changes to the current assumption generally do not make a significant difference.

Law Changes

Since the last study, no law changes have impacted our analysis of this assumption.

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS

Analysis and Results

Analysis

Past Experience

The following tables show the Actual and Expected counts of members who withdrew their contributions after termination, along with the A/E Ratio. The Expected counts are based upon our old assumptions.

PERS 2 Members Withdrawing Their Contributions After Termination			
Service	Actual*	Expected	A/E
5-9	11,647	11,290.8	1.03
10-14	4,553	4,773.3	0.95
15-19	1,812	1,945.6	0.93
20-24	374	319.9	1.17
25+	66	58.4	1.13
Total	18,452	18,387.8	1.00

TRS 2 Members Withdrawing Their Contributions After Termination			
Service	Actual*	Expected	A/E
5-9	685	632.8	1.08
10-14	196	214.9	0.91
15-19	62	73.1	0.85
20-24	7	3.5	2.00
25+	1	0.6	1.74
Total	951	924.8	1.03

SERS 2 Members Withdrawing Their Contributions After Termination			
Service	Actual*	Expected	A/E
5-9	2,185	2,379.9	0.92
10-14	895	1,050.5	0.85
15-19	285	368.5	0.77
20-24	34	28.5	1.20
25+	4	3.5	1.16
Total	3,403	3,830.8	0.89

PSERS 2 Members Withdrawing Their Contributions After Termination			
Service	Actual*	Expected	A/E
5-9	195	191.6	1.02
10-14	56	61.9	0.91
15-19	24	28.7	0.84
20-24	8	5.0	1.60
25+	0	0.4	0.00
Total	283	287.5	0.98

LEOFF 2 Members Withdrawing Their Contributions After Termination			
Service	Actual*	Expected	A/E
5-9	654	682.6	0.96
10-14	390	401.3	0.97
15-19	178	190.0	0.94
20-24	33	48.4	0.68
25+	4	2.2	1.82
Total	1,259	1,324.5	0.95

WSPRS 1/2 Members Withdrawing Their Contributions After Termination			
Service	Actual*	Expected	A/E
5-9	41	42.5	0.96
10-14	18	17.3	1.04
15-19	9	9.9	0.91
20-24	1	0.4	2.50
25+	0	0.0	0.00
Total	69	70.2	0.98

*Based upon historical experience from 1995-2015; see the **Data** sub-section above for exclusions.*

MISCELLANEOUS ASSUMPTIONS *continued*

Methods and Format of Assumptions

We considered but did not adopt other alternate formats for the assumption. For reference, we considered:

- ❖ Separate rates by gender but believe that both genders' experience is reflected well in the data (a natural weighted average based on plan membership).

- ❖ Blended analysis for PERS 2, TRS 2, and SERS 2, and setting a single set of assumptions for the three plans; however, the actual experience of the plans suggests materially different behavior. We also considered how well PSERS 2 experience matched these plans.

- ❖ Deferred withdrawal of contributions, instead of assuming all withdrawals are done immediately after termination. Given a member's contributions earn 5.5 percent per year in interest and the discount rate is 7.5 percent, assuming only immediate withdrawals is slightly conservative. We do not believe this is material enough to create a more complex assumption for the timing of the withdrawal.

Results

All-Plan Summary

We generally found that our actual experience for the Plans 2 (and WSPRS 1) was reasonably similar to our old assumptions. However, we chose to make small modifications to the assumptions to improve credibility across service levels and simplify the overall structure. Specifically, we set this assumption in five-year service increments. Given the small remaining number of non-retirement eligible actives in the Plans 1, we determined this assumption is immaterial for the Plans 1 and decided to assume all future terminations will elect a deferred annuity. The following table shows A/E counts before and after the assumption changes.

Summary of A/E Ratios		
	Under Old Rates	**Under New Rates**
PERS 2	1.00	1.00
TRS 2	1.03	1.00
SERS 2	0.89	0.99
PSERS 2	0.98	0.98
LEOFF 2	0.95	0.97
WSPRS 1/2	0.98	0.99

As stated previously, we know that more terminated vested members will withdraw their contributions in the years to come. At that point, these A/E ratios will increase. Given the relatively small impact of testing the sensitivity of this assumption, we think targeting an A/E close to 1.00 is a reasonable approach.

By System Considerations

Here are a few comments for specific plans:

- ❖ PSERS 2 opened in 2007, and as a result experience data is fairly limited. The few observations available suggest similar behavior to PERS 2, so for this experience study we updated our probability of withdrawing contributions assumption to match PERS 2; we'll continue to monitor this assumption in future experience studies.

- ❖ LEOFF 2 exhibited higher rates of withdrawing contributions than other systems. Primarily, we believe this is due to the subsidized withdrawal benefit available to members with at least 10 years of service. According to RCW 41.26.540, members will receive 150 percent of their accumulated member contributions if they decide to forego their vested annuity. The other systems provide 100 percent of the member's accumulated contributions.

MISCELLANEOUS ASSUMPTIONS *continued*

❖ WSPRS has less experience data than PSERS but is a much more mature system. As a result, we felt the historical experience was sufficient to select a unique assumption for WSPRS.

❖ We reviewed this assumption as it applies to PERS 1, TRS 1, and LEOFF 1 and determined it was reasonable to assume that no remaining active members (who are not retirement-eligible) would elect to withdraw their contributions. From a liability standpoint, there's no impact to TRS 1 and LEOFF 1, and the impact to PERS 1 is immaterial. Please see the **Termination Rates** section of this report for supporting headcount data.

New Probability of Withdrawing Contributions

The following tables show a summary of old, actual, and new probabilities of withdrawing contributions by years of service. Please note that the old assumption varied by each individual year of service, so the following tables represent an average over the service ranges. Please see our *2007-2012 Demographic Experience Study* report for additional detail.

PERS 2 Probability of Withdrawing Contributions			
Service	Old	Actual*	New
0-4**	1.00	1.00	1.00
5-9	0.45	0.46	0.45
10-14	0.39	0.38	0.40
15-19	0.34	0.32	0.30
20-24	0.23	0.28	0.30
25+	0.16	0.19	0.15

TRS 2 Probability of Withdrawing Contributions			
Service	Old	Actual*	New
0-4**	1.00	1.00	1.00
5-9	0.28	0.31	0.30
10-14	0.21	0.20	0.20
15-19	0.13	0.14	0.15
20-24	0.05	0.18	0.10
25+	0.04	0.25	0.05

SERS 2 Probability of Withdrawing Contributions			
Service	Old	Actual*	New
0-4**	1.00	1.00	1.00
5-9	0.33	0.30	0.30
10-14	0.29	0.25	0.25
15-19	0.23	0.18	0.20
20-24	0.17	0.23	0.20
25+	0.12	0.27	0.15

PSERS 2 Probability of Withdrawing Contributions			
Service	Old	Actual*	New
0-4**	1.00	1.00	1.00
5-9	0.45	0.47	0.45
10-14	0.39	0.36	0.40
15-19	0.34	0.31	0.30
20-24	0.19	0.50	0.30
25+	0.12	0.00	0.15

LEOFF 2 Probability of Withdrawing Contributions			
Service	Old	Actual*	New
0-4**	1.00	1.00	1.00
5-9	0.65	0.62	0.65
10-14	0.61	0.59	0.60
15-19	0.53	0.52	0.50
20-24	0.30	0.31	0.30
25+	0.08	0.30	0.15

WSPRS 1/2 Probability of Withdrawing Contributions			
Service	Old	Actual*	New
0-4**	1.00	1.00	1.00
5-9	0.53	0.53	0.50
10-14	0.51	0.56	0.50
15-19	0.47	0.51	0.50
20-24	0.11	1.00	0.25
25+	N/A	N/A	N/A

Note: WSPRS members are eligible to retire with 25 years of service.

Based upon historical experience from 1995-2015; see the **Data sub-section above for exclusions.*

**Terminated not vested members are not required to withdraw their contributions when they quit, but eventually they will. To simplify our valuation model, we assume this occurs at that time.

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS   *continued*

Salary Limits and Defaults

What are the Salary Limits and Defaults Assumptions and How Do We Use them?

Each year, we review the salaries reported in the valuation data for reasonableness and make a number of salary adjustments when we determine it is necessary. Below is a list of the adjustments we may make, which are studied as part of this assumption.

- ❖ **Maximum Salary Limit (for Active Members)** – If an active member's salary is higher than is reasonably expected, we reset the salary to a predetermined maximum compensation.

- ❖ **Minimum Salary Limit (for Active Members Who Earned a Full Year of Service Credit During the Valuation Period)** – If an active member met their respective plan's requirements to earn a full year of service credit during the valuation period, but their salary is lower than is reasonably expected, we reset the salary to a predetermined minimum compensation. Unreasonably low salaries could result from circumstances such as employers reporting incomplete salaries for certain members, and these salaries were not corrected before the valuation data was prepared.

- ❖ **Adjusted Salaries (for Active Members Who Earned Less than a Year of Service Credit During the Valuation Period)** – Our valuation model projects service and salaries based on full-time employment, so we must adjust the salaries of any active members with less than a full year of service credit earned during the valuation period.

- ❖ **Default Salaries (for Terminated Vested and TRS 1 Members with Temporary Disabilities)** – Terminated vested members and TRS Plan 1 members with temporary disabilities are inactive members who will eventually be entitled to a pension benefit. As such, we need to model the future payment of these benefits. However, salaries are not always provided for these members in the valuation data. We therefore develop and apply default salaries for those members with missing salary data.

- ❖ **Default Average Final Compensation (for WSPRS Members with Disabilities)** – The disability benefits for WSPRS members are paid from a fund outside the pension system. However, if a member with disabilities dies and their spouse receives a survivor benefit, that benefit is paid out of the pension fund. According to RCW 43.43.270, the Average Final Compensation (AFC) used in the calculation of this survivor benefit must be the same as the AFC for a currently active WSPRS member who holds the same rank that the member held at the time of their disablement. To value this future survivor benefit, our valuation model requires that we supply a salary for current members with disabilities.

High Level Takeaways

We study these assumptions by system. Overall, our current Salary Limits and Defaults assumptions are reasonable for all systems. However, we made several improvements to our methodologies behind these assumptions for the purposes of consistency and simplification. The Salary Limits and Defaults assumptions that resulted from these new methodologies closely modeled our current assumptions.

Data and Assumptions

We studied final 2017 valuation data and preliminary 2018 valuation data by system to develop these assumptions.

We assume that active members will become full-time employees in the future, even if they are not reported as full-time in any given valuation period.

Law Changes

During the 2016 Legislative Session, a law was passed which requires future WSPRS salaries remain competitive with other law enforcement agencies in the state (C 28 L 16). This law had an effective year of 2016.

continued

General Methodology, Analysis, and Results

Maximum Salary Limit (for Active Members)

For all systems, we currently limit salaries to the projected Internal Revenue Code 401(a)(17) maximum compensation level. This limit in the 2018 calendar year was $275,000, and it has historically risen by $5,000 each year. We continue to find this to be an appropriate and reasonable method and are not making any changes to this assumption.

Minimum Salary Limit (for Active Members Who Earned a Full Year of Service Credit during the Valuation Period)

❖ **PERS**

    o   We determine the minimum salary for PERS members based on the Washington State minimum wage. Each valuation year, we set the minimum PERS salary equal to the minimum hourly wage in effect on January 1 of the valuation year, multiplied by 2,080 hours (or 40 hours a week times 52 weeks a year). We round the resulting annual salary to the nearest thousand dollars. This process is consistent with our old method.

    o   For example, in 2017, the Washington State minimum wage was $11.00. Therefore, we set the 2017 PERS minimum salary as $23,000 ($11.00 per hour x 2,080 hours = $22,880 which rounds to $23,000).

❖ **TRS**

    o   We determine the minimum salary for TRS members in accordance with RCW 28A.400.200, which states that "beginning with the 2018-19 school year…salaries for full-time certificated instructional staff must not be less than forty thousand dollars" and that an annual inflationary adjustment is to be applied to this salary. We will then round the resulting salary to the nearest thousand dollars. This process is a change from our old method, which set the TRS minimum salary as the compensation provided to a teacher with a Bachelor of Arts degree and zero years of experience, rounded down to the nearest thousand dollars. This old method utilized the Washington State teachers' pay schedule, which will no longer be produced in the future.

❖ **SERS**

    o   We determine the minimum salary for SERS members based on the Washington State minimum wage. Each valuation year, we set the minimum SERS salary equal to the minimum hourly wage in effect on January 1 of the valuation year, multiplied by 1,440 hours (or 40 hours a week times 36 weeks a year). We round the resulting annual salary to the nearest thousand dollars. This is meant to reflect the fact that SERS members are employed by school districts and educational service districts, and the school year typically runs nine months or 36 weeks. This process is consistent with our old method.

    o   For example, in 2017, the Washington State minimum wage was $11.00. Therefore, we set the 2017 SERS minimum salary as $16,000 ($11.00 per hour x 1,440 hours = $15,840 which rounds to $16,000).

❖ **PSERS, LEOFF, and WSPRS**

    o   We determine the minimum salaries for these three public safety systems based on the Washington State average annual wage. We set the minimum salaries for LEOFF and WSPRS equal to 75 percent of the Washington State average annual wage, rounded to the nearest thousand dollars. Since PSERS salaries have historically been less than LEOFF and WSPRS salaries, we set the minimum salaries for PSERS equal to 50 percent of the Washington State average annual wage, rounded to the nearest thousand dollars. This process is a change from our old method and provides simplicity since the minimum now adjusts automatically. Our old method set minimum salaries based on the first percentile of all active member salaries in the most recent actuarial valuation and retained this minimum salary until the next experience study. Below is a comparison of the minimum salaries under both methods as of the 2017 valuation.

	PSERS	LEOFF	WSPRS
Old Method	$36,000	$51,000	$52,000
New Method	$31,000	$46,000	$46,000

- o For example, in 2017, the Washington State average annual wage was $61,893. Therefore, we set the 2017 LEOFF and WSPRS minimum salaries as $46,000 ($61,893 x 75% = $46,420 which rounds to $46,000). We set the 2017 PSERS minimum salary as $31,000 ($61,893 x 50% = $30,947 which rounds to $31,000).

Adjusted Salaries (for Active Members Who Earned Less than a Year of Service Credit during the Valuation Period)

For all systems, we adjust the salaries of active members who earned less than a year of service credit during the valuation period, so that their salaries are reflective of a full-time employee. We do this because our valuation model projects service and salaries based on full-time employment. We divide this group into two categories: those members with less than two months of service during the valuation period, and those members with at least two months of service but less than one full year of service during the valuation period. We set a two-month threshold to avoid annualizing a salary that may have incomplete or missing data due to the short time period for employer reporting.

- ❖ **Members with Less Than Two Months of Service During the Valuation Period**

  - o We adjust the salaries for members with less than two months of service during the valuation year according to their system's average new entrant profile salary,[1] rounded to the nearest thousand dollars. Below are the adjusted salaries by system for 2017. For the Plans 2/3, the adjusted salaries were derived by taking the weighted average new entrant profile salary by plan, based on the assumed new entrant plan split. This process is a change from our old method, made for purposes of simplicity and consistency with assumptions used in other models. Under our old method, we set a default salary based on an average active member's salary and used assumed salary growth to adjust the salary to the defaulted member's service level. We observed minor changes to default salaries when simplifying our method.

	PERS	TRS	SERS	PSERS	LEOFF	WSPRS
Old Method	$45,000	$59,000	$29,000	$46,000	$65,000	$60,000
New Method	$45,000	$60,000	$23,000	$46,000	$68,000	$60,000

- ❖ **Members with at Least Two Months of Service but Less Than One Year of Service During the Valuation Period**

  - o We adjust the salaries for members with at least two months of service but less than one year of service during the valuation period to estimate their projected full-time annual salaries. We do this by dividing their actual reported compensation by the amount of service credit they received during the valuation period. For example, if a member earned $45,000 and received 0.75 years of service during the year, we would annualize their salary to $60,000. This process is consistent with our old method for all systems except SERS. The prior SERS method created different salary adjustments based on when a member was hired. If a member was hired before November 15, we divided salary by earned service. While if hired after this date, we relied on the greater of the default salary for service less than two months and the member's actual reported salary. In general, the new method for SERS produces adjusted salaries greater than the prior method.

[1]*In order to project the membership makeup of the retirement systems, our office makes assumptions on the demographics of future entrants to the system. To do this, we develop new entrant demographic profiles and determine average salaries for these members. These salaries are set during our* Risk Assessment Assumptions Study *and increased with assumed general salary growth between studies.*

o   We make one additional salary adjustment for new hires of TRS and SERS. New hires of these systems usually start their employment at the beginning of the school year in September. This means that during our July to June valuation period, these members typically only work 10 out of the 12 months (or 83.3 percent) of the year. We also found that DRS reports these members' salaries based on 10 months being the full-time equivalent in these particular cases. For this reason, when we adjust the salaries for new entrants to TRS and SERS who have at least two months of service but less than one year of service, we only project their salary based on 10 months of employment. If a new entrant is reported as having worked more than 10 months during the valuation period, we make no adjustment to the salary.

Default Salaries (for Terminated Vested and TRS 1 Members with Temporary Disabilities)

❖   For terminated vested members who are reported without a salary, we first determine if the member was reported with a salary in the prior year's data. If so, we copy the salary over to the current year's data. If a salary is not found in the prior year's data, then we assign a default salary. We base the default salary on the average salary of an active member in the same system from the prior year's valuation, increased by one year of assumed general salary growth, and rounded to the nearest thousand dollars. Below are the default salaries by system for 2017. This process is generally consistent with our old method, except that our old method made an additional adjustment based on the member's years of service.

	PERS	TRS	SERS	PSERS	LEOFF	WSPRS
Default Salaries	$64,000	$75,000	$33,000	$62,000	$108,000	$89,000

❖   For TRS 1 members with temporary disabilities who are reported without a salary, we set their salary equal to the default salary developed above for TRS terminated vested members. This process is consistent with our old method.

❖   It is worth noting that we do not apply these default salaries often. For example, in 2017 we applied the salary default to less than 0.5 percent of all terminated vested records across all retirement systems. We have not applied the salary default for a TRS 1 temporary disability member to anyone in the last five years.

Default Average Final Compensation (for WSPRS Members with Disabilities)

❖   We set the AFC for the WSPRS disability survivor benefit at $95,000, as of the 2017 valuation. This AFC will increase by the general salary growth assumption, rounded to the nearest thousand dollars, for each year after the 2017 base year. We determined this base AFC by taking a weighted average of active member's AFCs, by plan, as of the 2017 valuation. We placed a 75 percent weight on active Plan 1 members' AFC, and a 25 percent weight on active Plan 2 members' AFC. We placed a greater weight on Plan 1 because all current WSPRS members with disabilities are from Plan 1. However, Plan 1 is closed to new entrants and we expect future WSPRS members with disabilities will increasingly be from Plan 2. This process is a change from our old method, where we set this AFC equal to the average AFC of active Plan 1 members only. For our new method, we want to start trending away from Plan 1 data, since the Plan 1 population is aging and maturing in service rank, which can inflate the estimated salary for this assumption. The default AFC would be $101,000 if based solely on WSPRS 1. We believe that over time the Plan 2 AFC will become a better approximation for this assumption.

THREE: APPENDICES

Survivor Remarriage Benefit

What are the Survivor Remarriage Benefit Assumptions and How Do We Use them?

When a member of LEOFF 2 or WSPRS dies from duty-related causes, their survivors receive a retirement benefit from the retirement system and a pension benefit from Labor & Industries (L&I). When, and if, a survivor of a duty-related death remarries, DRS assumes payment of the L&I pension benefit and the cost is borne by the corresponding retirement plan trust fund. This benefit was passed into law during the 2015 Legislative Session; see the **Law Changes** section for details.

We use three assumptions to estimate the liability associated with the Survivor Remarriage Benefit for LEOFF 2 and WSPRS. The assumptions include the probability a survivor remarries, the number of years until remarriage, and the annual COLA of the benefit. The COLA for this benefit is the annual increase in Washington State of the "average annual wage" as defined in [RCW 50.04.355](RCW 50.04.355).

High Level Takeaways

We lowered the probability a survivor remarries and changed the time period until remarriage to be consistent across active and inactive members. Under the old assumptions structure, we assumed different time periods for active members and inactive members. We retained the assumed growth of the COLA applied to this benefit.

Note that we developed the initial assumptions for the fiscal note, using national remarriage data and our professional judgement, in order to determine the potential impact of the establishing bill. We used experience after the bill became law to set the new assumptions for this benefit.

Data and Assumptions

We used survivor data between 2015 and 2018 to study these assumptions. No special data was added.

We assumed all survivors of duty-related death have a probability of remarriage regardless of age or gender. We make the same assumption for both active members and inactive members. We also assumed LEOFF 2 and WSPRS survivors will remarry and utilize this benefit at the same rate. Therefore, we combined LEOFF 2 and WSPRS data to study this assumption.

General Methodology

Probability a Survivor Remarries

We calculated the percent of survivors that remarried by dividing the number of remarried survivors by the total number of survivors in the study period.

Number of Years Until Remarriage

To determine the number of years until survivors remarry, we averaged the amount of time until remarriage across all survivors. For survivors that remarried before this benefit became law, we used the amount of time between the member's death and the remarriage. For survivors that remarried after this benefit became law, we used the amount of time between either the member's date of death or the effective date of the law, and the remarriage.

Benefit COLA Assumption

We continued to rely on the assumed General Salary Growth assumption, as determined in our *2019 Report on Financial Condition and Economic Experience Study*, as the annual assumed growth in the cost of living.

Law Changes

❖ **SHB 1194** (2015) – Establishing Law.

MISCELLANEOUS ASSUMPTIONS *continued*

Analysis and Results

Analysis

Past Experience

Experience shows fewer survivors remarried than under our initial assumed probability, but those remarriages occurred near our assumed number of years until remarriage.

Survivors and Remarriages		
Survivors	**Remarried**	**Rate**
81	18	22.2%

Number of Years Until Remarriage		
Date of Death Before or After Effective Date		
	Before	**After**
Count	10	8
Years	4.5	2.0

Methods and Format of Assumptions

To set the percent remarriage assumption, we observed the simple average percent that remarried and used our professional judgement regarding our future expectations, taking into account the data studied when we prepared analysis for the establishing bill.

We considered retaining the current format of using different assumptions for active and inactive members. We ultimately chose to change the format because we believe that the anticipated demand amongst current survivors has dissipated since the passing of this bill.

We changed the method used to estimate the current survivor liability. We limited the number of years over which we apply our assumptions to a four-year window. The window begins at the time of the member's death or the effective date of the law, whichever was more recent. This window represents our assumed number of years until remarriage. Effectively, we assign each survivor a number that begins at four and will decrement each year in the future until reaching zero.

MISCELLANEOUS ASSUMPTIONS

Results

We found that of the 81 survivors of duty related deaths, 18 remarried – approximately 22 percent. We also found that, on average, survivors waited 3.3 years to remarry following the member's death.

The following table shows the old and new assumptions used for the survivor remarriage benefit.

Remarriage Assumptions for Duty-Related Death Survivors in LEOFF 2 and WSPRS		
Percent of Survivors Assumed to Remarry		
	Old	New
	40%	30%
Assumed Number of Years Until Remarriage		
	Old	New
Current Survivors	2	4
Future Survivors	4	4
Benefit COLA Assumption*	3.50%	3.50%

Survivors of duty-related deaths may qualify for a death benefit paid by Labor and Industries (L&I). Upon remarriage the death benefit is paid from the respective system's pension trust fund.

Note: We assume all duty-related death survivors could qualify for the remarriage benefit.

*The benefit COLA changes with the state average wage.

Survivor Annuity Assumptions

What are the Survivor Annuity Assumptions and How Do We Use them?

A Survivor Annuity assumption is used to estimate the rate at which survivors receive an annuity benefit when an active or terminated vested member dies. In Plans 1 and Plans 2, eligible survivors have the option to select an annuity or take a refund of the member's contributions and interest. In Plans 3, since members do not contribute to the defined benefit portion, we expect all eligible survivors will receive the annuity benefit.

We also set a Survivor Annuity assumption to model the portion of LEOFF and WSPRS Plans 1 active or terminated vested members we expect will receive a subsidized Joint and Survivor (J&S) benefit in the future.

These assumptions are set by the age of the member at death, the type of benefits a survivor is eligible to receive, and retirement plan.

These assumptions were previously referred to as "Survivors Selecting Annuities". For information about the prior assumptions, please see the *2007-2012 Demographic Experience Study*.

High-Level Takeaways

Overall, we expect the rates at which eligible survivors receive an annuity benefit to continue to differ by plan and age.

Since survivors of Plan 3 members don't have the option to take a refund of contributions and interest for the defined benefit component of the plan, our assumption approximates the portion of the population that has an eligible survivor. Similarly, all the Plans 1 members are close to normal retirement age and typically have accrued a larger benefit, so we assumed an annuity will be paid for members with a survivor. On the other hand, Plans 2 survivors are less likely to elect an annuity at earlier ages because it is actuarially reduced. Using experience data, population data, and our expectations for the future, we selected general assumptions by plan and age as shown in the following table for non-duty related deaths.

Survivor Annuity Assumption			
Age	Plans 1*	Plans 2	Plans 3
20-24	N/A	0.00	0.35
25-29	N/A	0.00	0.35
30-34	N/A	0.00	0.35
35-39	N/A	0.00	0.65
40-44	N/A	0.10	0.65
45-49	N/A	0.20	0.65
50-54	N/A	0.30	0.65
55-59	0.60	0.40	0.65
60-64	0.60	0.50	0.65
65+	0.60	0.60	0.65

*WSPRS and LEOFF Plan 1 uses Plans 3 rates.

Data

We began with 23 years of experience study records, from 1995-2017. No special data was added for this assumption, but some data was removed. We removed 2001 and 2007 data for all systems due to odd-length valuation periods. While we recognize the Great Recession may have impacted member behavior, we chose to include that data as part of the analysis. We did not observe any significant variance of the Great Recession observations to the years immediately before and after, as illustrated in the following table for all PERS plans combined.

PERS Annuity Selection Rate			
Year	Male	Female	All
1995	44%	25%	36%
1996	41%	28%	35%
1997	54%	27%	42%
1998	53%	34%	46%
1999	42%	39%	41%
2000	39%	25%	32%
2001			
2002	38%	33%	36%
2003	58%	28%	46%
2004	47%	33%	41%
2005	56%	27%	44%
2006	47%	32%	41%
2007			
2008	47%	32%	41%
2009	53%	41%	49%
2010	62%	26%	48%
2011	56%	33%	46%
2012	62%	33%	50%
2013	54%	40%	49%
2014	57%	34%	47%
2015	55%	37%	48%
2016	55%	42%	49%
2017	53%	29%	42%
Total	**52%**	**33%**	**44%**

Since a member generally must be married for a survivor to receive an annuity benefit, we also gathered data on marriage statistics from the United States Census Bureau. Below is a chart of the percentage of married individuals by age in Washington State as of 2017.

Washington State Percent Married		
Age	Male	Female
15-19	0.01	0.14
20-34	0.30	0.38
35-44	0.63	0.67
45-54	0.65	0.64
55-64	0.65	0.63
65+	0.71	0.47
Total	**0.51**	**0.50**

We do not have sufficient data to set rates for PSERS and WSPRS. Instead, we relied on experience from our larger systems and Washington State marriage data.

General Methodology

We calculated the actual survivor annuity rate by dividing the number of survivors that selected an annuity benefit (observations) by the total number of members who met the service requirements for an annuity option when they died (exposures).

To determine our new assumed rates for active members, we examined the actual rate of survivors receiving annuities over five-year age bands, made comparisons to the Washington State marriage rates, considered historical trend experience, and applied professional judgment with respect to our expectations for the future.

We based our new assumptions more heavily on the Washington State marriage data for the following plans and benefits:

- ❖ All death benefits in Plans 3;
- ❖ Duty-related death benefits in all plans;
- ❖ WSPRS 1 death benefits (since survivors also receive unreduced benefits for non-duty deaths);
- ❖ LEOFF 1 (since member contributions have ceased); and
- ❖ Subsidized J&S benefits.

For the active and terminated vested member death benefits in Plans 1 and 2, where survivors have the additional option of selecting a return of contributions, we set our new assumed rates based primarily on historical experience while taking into consideration the age-based marriage data.

For current inactive members, or members that have already terminated from active service, we reviewed the current inactive population that met the service criteria for an annuity death benefit and selected a single rate.

Law Changes

Since the last study, no law changes have impacted our analysis of this assumption.

Analysis and Results

Analysis

Overall, we see the rates at which survivors receive annuities differ more by age and plan than by gender and system.

Differing plan designs impact the rate at which survivors are eligible to receive annuity benefits. In order to qualify for an annuity benefit, the member must have met certain service requirements and the survivor must be a qualified beneficiary such as spouse or minor child. Survivors of Plans 1 and 2 members have the additional option of selecting a return of contributions in lieu of an annuity benefit. In general, we observed higher rates of annuity benefits paid to qualified members of Plans 3 than Plans 1/2.

Our experience indicated that survivors of older members are more likely to select an annuity benefit. This relationship correlates to the likelihood of being married at each age and the average accrued retirement benefit by the member at each age. For Plans 3, we expect the rates of annuity benefits paid to vested members' survivors to generally mirror the proportion of the population that is married. A minor child may also be eligible for an annuity death benefit in the absence of a spouse. We assumed the likelihood of a minor child receiving a benefit is small, and we did not increase our assumptions beyond the Washington State marriage data.

Duty-related death benefits also impact the rate at which annuities are selected. The annuity provided under a duty-related death is more generous than the non-duty-related death annuity for most plans. Systems such as LEOFF may see higher rates of annuity selpection due to the higher proportion of duty-related deaths. For more information on duty-related death benefits, please see the section on the **Duty-Related Death Assumption.**

MISCELLANEOUS ASSUMPTIONS   *continued*

Lastly, we observed the survivor of a male member to be generally more likely to receive an annuity benefit than the survivor of a female member. However, we expect this difference between male and female rates to erode over time.

Past Experience

We compared the number of active member deaths meeting survivor annuity service requirements (exposures)to our expected number of survivor annuity recipients based on our old assumptions. To determine the expected number of survivors receiving annuities, we multiplied the old assumption by the number of exposures over the study period.

We considered the A/E ratio on an annual basis and as a whole over the entire study period. This helped us identify trends in the data where our old assumptions were over or underestimating the rates at which survivors received an annuity benefit. Generally, we found our old assumptions were close to actual experience in Plans 1 and 2 but underestimated the proportion of annuity recipients in Plans 3.

The following tables show the Actual and Expected number of members who received an annuity based on our old assumptions, along with the A/E Ratio.

PERS Survivor Annuities (1995-2017)				
Plan 1				
Age	**Exposure**	**Actual**	**Expected**	**A/E**
<40	0	0	0	N/A
40-44	20	4	5	0.73
45-49	69	29	31	0.95
50-54	174	100	89	1.13
55-59	225	155	122	1.27
60-64	236	129	139	0.93
65+	122	62	78	0.80
Total	**846**	**479**	**464**	**1.03**

PERS Survivor Annuities (1995-2017)								
Plan 2					**Plan 3**			
Age	**Exposure**	**Actual**	**Expected**	**A/E**	**Exposure**	**Actual**	**Expected**	**A/E**
<40	55	3	0	N/A	10	6	2	3.57
40-44	136	9	8	1.16	19	10	5	1.88
45-49	248	28	39	0.72	34	19	11	1.73
50-54	464	151	123	1.23	58	25	23	1.09
55-59	607	275	216	1.27	80	42	36	1.17
60-64	599	318	292	1.09	61	38	35	1.09
65+	366	161	215	0.75	26	16	16	0.99
Total	**2475**	**945**	**892**	**1.06**	**288**	**156**	**128**	**1.22**

MISCELLANEOUS ASSUMPTIONS *continued*

TRS Survivor Annuities (1995-2017)				
Plan 1				
Age	**Exposure**	**Actual**	**Expected**	**A/E**
<40	1	0	0	N/A
40-44	7	5	3	1.64
45-49	40	25	18	1.42
50-54	85	49	46	1.06
55-59	84	54	48	1.12
60-64	70	37	43	0.85
65+	32	17	21	0.82
Total	**319**	**187**	**179**	**1.04**

TRS Survivor Annuities (1995-2017)								
Plan 2					**Plan 3**			
Age	**Exposure**	**Actual**	**Expected**	**A/E**	**Exposure**	**Actual**	**Expected**	**A/E**
<40	5	0	0	N/A	27	14	8	1.75
40-44	10	0	0	N/A	46	20	18	1.14
45-49	26	2	1	2.68	69	32	29	1.09
50-54	23	5	5	0.97	116	69	54	1.29
55-59	49	23	19	1.22	140	95	69	1.38
60-64	52	25	28	0.90	97	59	52	1.14
65+	20	10	13	0.76	32	19	18	1.04
Total	**185**	**65**	**66**	**0.99**	**527**	**308**	**248**	**1.24**

SERS Survivor Annuities (1995-2017)								
Plan 2					**Plan 3**			
Age	**Exposure**	**Actual**	**Expected**	**A/E**	**Exposure**	**Actual**	**Expected**	**A/E**
<40	3	0	0	N/A	3	2	1	3.28
40-44	16	0	1	0.00	10	5	3	1.95
45-49	25	6	6	1.08	46	19	16	1.20
50-54	63	17	19	0.91	94	42	36	1.16
55-59	109	48	40	1.20	116	61	47	1.29
60-64	115	58	48	1.20	105	54	49	1.10
65+	103	49	50	0.97	73	38	38	1.00
Total	**434**	**178**	**163**	**1.09**	**447**	**221**	**189**	**1.17**

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS

LEOFF Survivor Annuities (1995-2017)								
	Plan 1				Plan 2			
Age	Exposure	Actual	Expected	A/E	Exposure	Actual	Expected	A/E
<40	0	0	0	N/A	22	12	7	1.61
40-44	2	2	1	1.57	40	11	19	0.58
45-49	10	7	6	1.10	40	26	22	1.18
50-54	18	16	11	1.40	50	37	30	1.22
55-59	4	3	3	1.18	25	18	17	1.09
60-64	5	5	3	1.54	17	15	12	1.26
65+	1	1	1	1.49	3	1	2	0.44
Total	**40**	**34**	**26**	**1.33**	**197**	**120**	**109**	**1.10**

Methods and Format of Assumptions

Given the limited amount of data available to study this assumption and its relatively minor impact to the overall pension liabilities, we made some simplifications to the format of this assumption and how we apply it to the relevant benefits in our valuation software.

Previously, this assumption was set by age, plan, system, and gender. We simplified this format to age-based rates that differ by plan and benefit type only. For PERS, TRS and LEOFF Plans 1, we selected a single rate given the size of the remaining populations and the small variance across member ages.

We considered but did not adopt other alternate formats for the assumption. For reference, we considered:

❖ **Separate rates by gender in PERS, TRS, and SERS.**
   We concluded the added complexity did not improve accuracy or materially impact plan liabilities. Furthermore, due to observed trends, we expect the rates of survivors receiving annuities between males and females to converge over time.

❖ **Separate rates by system.**
   Similar to gender-specific rates, we found that the added complexity did not add significant value to our expectations for the future.

❖ **Combined, blended rates by plan**
   We found that the plan design and actual experience of the plans suggests materially different behavior.

As part of this study, we identified potential areas of improvement in our valuation software. Specifically concerning how we model survivor annuity benefits paid to current active members we project to die after terminating employment. We identified areas for consolidating multiple complex benefit calculations into a few streamlined calculations. This simplification will not result in a material impact to plan liabilities and will reduce the complexity of our valuation model. These improvements may be considered and disclosed as part of a future actuarial valuation report.

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS

Results

All-Plan Summary

Generally, we found similar rates of annuity recipients at various ages across Plans 2 and Plans 3. The exception was LEOFF 2, which has a higher proportion of duty-related deaths that provide more generous annuity benefits.

Observed Survivor Annuity Rates (1995-2017)							
	Plans 2				Plans 3		
Age	PERS	TRS	SERS	LEOFF	PERS	TRS	SERS
<40	5%	0%	0%	55%	60%	52%	67%
40-44	7%	0%	0%	28%	53%	43%	50%
45-49	11%	8%	24%	65%	56%	46%	41%
50-54	33%	22%	27%	74%	43%	59%	45%
55-59	45%	47%	44%	72%	53%	68%	53%
60-64	53%	48%	50%	88%	62%	61%	51%
65+	44%	50%	48%	33%	62%	59%	52%
Total	38%	35%	41%	61%	54%	58%	49%

For Plans 3 and subsidized J&S benefits, which do not have a return of contributions option, we found our experience generally matches the rate of Washington State marriages because a member must have a qualified beneficiary to receive an annuity death benefit. As such, we set our new assumption for Plans 3, subsidized J&S benefits, and all duty-related death benefits, based on our expectations for the proportion of married members by age.

For Plans 2, we set new rates based largely on average historical experience across the various systems while taking into consideration the age-based portion of the population we expect to be married.

MISCELLANEOUS ASSUMPTIONS

New Survivor Annuity Assumption

The following tables show a summary of old and new probabilities of survivors receiving annuities by age, gender, system, and plan that we use for modeling active member benefits. For WSPRS 1 and duty-related deaths in all Plans 2, we will apply the Plans 3 survivor annuity assumptions because these benefits are not subject to early retirement reduction factors. Likewise, we will apply the Plans 3 survivor annuity assumptions to LEOFF Plan 1 because member contributions have not been collected for several years so we expect a return of contributions benefit to be much smaller than an annuity benefit.

PERS Plan 1			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-39	0.00	0.00	N/A
40-44	0.39	0.14	N/A
45-49	0.52	0.32	N/A
50-54	0.58	0.40	N/A
55-59	0.62	0.46	0.60
60-64	0.68	0.54	0.60
65+	0.70	0.57	0.60

PERS & PSERS Plan 2			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.00
25-29	0.00	0.00	0.00
30-34	0.00	0.00	0.00
35-39	0.00	0.00	0.00
40-44	0.07	0.02	0.10
45-49	0.20	0.09	0.20
50-54	0.32	0.16	0.30
55-59	0.44	0.23	0.40
60-64	0.60	0.34	0.50
65+	0.72	0.41	0.60

PERS Plan 3			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.35
25-29	0.00	0.15	0.35
30-34	0.09	0.17	0.35
35-39	0.19	0.18	0.65
40-44	0.29	0.20	0.65
45-49	0.39	0.22	0.65
50-54	0.49	0.24	0.65
55-59	0.59	0.26	0.65
60-64	0.73	0.31	0.65
65+	0.79	0.32	0.65

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS

TRS Plan 1			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	N/A
25-29	0.00	0.00	N/A
30-34	0.00	0.00	N/A
35-39	0.00	0.00	N/A
40-44	0.43	0.21	N/A
45-49	0.55	0.37	N/A
50-54	0.61	0.45	N/A
55-59	0.65	0.50	0.60
60-64	0.72	0.57	0.60
65+	0.73	0.59	0.60

TRS Plan 2			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.00
25-29	0.00	0.00	0.00
30-34	0.00	0.00	0.00
35-39	0.00	0.00	0.00
40-44	0.00	0.00	0.10
45-49	0.07	0.01	0.20
50-54	0.26	0.16	0.30
55-59	0.45	0.31	0.40
60-64	0.67	0.50	0.50
65+	0.79	0.59	0.60

TRS Plan 3			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.35
25-29	0.00	0.08	0.35
30-34	0.18	0.25	0.35
35-39	0.29	0.34	0.65
40-44	0.36	0.39	0.65
45-49	0.41	0.43	0.65
50-54	0.45	0.47	0.65
55-59	0.49	0.49	0.65
60-64	0.55	0.55	0.65
65+	0.58	0.57	0.65

SERS Plan 2			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.00
25-29	0.00	0.00	0.00
30-34	0.00	0.00	0.00
35-39	0.00	0.00	0.00
40-44	0.03	0.05	0.10
45-49	0.24	0.20	0.20
50-54	0.34	0.28	0.30
55-59	0.41	0.33	0.40
60-64	0.49	0.40	0.50
65+	0.54	0.43	0.60

SERS Plan 3			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.35
25-29	0.00	0.00	0.35
30-34	0.00	0.00	0.35
35-39	0.00	0.29	0.65
40-44	0.11	0.33	0.65
45-49	0.32	0.35	0.65
50-54	0.43	0.36	0.65
55-59	0.50	0.37	0.65
60-64	0.58	0.41	0.65
65+	0.62	0.42	0.65

MISCELLANEOUS ASSUMPTIONS

continued

LEOFF Plan 1		
	Old Rates	New Rates
Age	Male & Female	Male & Female
20-39	0.00	N/A
40-44	0.64	N/A
45-49	0.64	N/A
50-54	0.64	N/A
55-59	0.64	0.65
60-64	0.67	0.65
65+	0.67	0.65

LEOFF Plan 2		
	Old Rates	New Rates
Age	Male & Female	Male & Female
20-24	0.00	0.00
25-29	0.00	0.00
30-34	0.12	0.00
35-39	0.35	0.00
40-44	0.47	0.10
45-49	0.55	0.20
50-54	0.61	0.30
55-59	0.66	0.60
60-64	0.73	0.60
65+	0.75	0.60

WSPRS Plan 1		
	Old Rates	New Rates
Age	Male & Female	Male & Female
20-24	0.00	0.35
25-29	0.00	0.35
30-34	0.00	0.35
35-39	0.00	0.65
40-44	0.64	0.65
45-49	0.64	0.65
50-54	0.64	0.65
55-59	0.64	0.65
60-64	0.67	0.65
65+	0.67	0.65

WSPRS Plan 2		
	Old Rates	New Rates
Age	Male & Female	Male & Female
20-24	0.00	0.00
25-29	0.00	0.00
30-34	0.12	0.00
35-39	0.35	0.00
40-44	0.47	0.10
45-49	0.55	0.20
50-54	0.61	0.30
55-59	0.66	0.60
60-64	0.73	0.60
65+	0.75	0.60

All Systems – Duty Death	
	New Rates
Age	Male & Female
20-24	0.35
25-29	0.35
30-34	0.35
35-39	0.65
40-44	0.65
45-49	0.65
50-54	0.65
55-59	0.65
60-64	0.65
65+	0.65

To model inactive terminated vested member death benefits, we select a single survivor receiving annuity rate of:

❖ 50 percent for all Plans 2;

❖ 65 percent for all Plans 3;

❖ 60 percent for PERS and TRS Plans 1; and

❖ 65 percent for LEOFF and WSPRS Plans 1.

In addition to inactive member benefits, we use the above rate to model the portion of members' survivors who will receive a subsidized J&S benefit in the future in LEOFF and WSPRS Plans 1 (65 percent).

TRS Salary Bonus

What is the TRS Salary Bonus Assumption and How Do We Use it?

The Teachers' Retirement System (TRS) Salary Bonus assumption reflects the expectation of higher future salaries due to an increasing proportion of teachers obtaining a National Board (NB) certification through the National Board for Professional Teaching Standards (NBPTS). NB certified teachers receive an annual bonus (base bonus) that is included in pensionable compensation. We model the expected impact of those bonuses on average salary by adding an additional temporary rate to our General Salary Growth (GSG) assumption for TRS. When the proportion of TRS members receiving these bonuses reaches our long-term expected percent, this assumption will no longer be necessary. Please see the **Service-Based Salary Increase** section for more information about salary growth.

NB certified teachers who work at any one of the specified "challenging schools" receive an additional annual bonus (CS bonus) that is also included in pensionable compensation.

High-Level Takeaways

Based on our analysis and information from the Office of Superintendent of Public Instruction (OSPI), we continue to expect the proportion of TRS members receiving the base and CS bonus will increase over the next few years. However, we anticipate fewer bonus recipients in the future than our old assumptions for three main reasons:

1. OSPI historical and projected data falls short of our old expectations for the number of bonuses awarded.

2. There have been recent changes to the NB certification process that may impact the number of teachers who obtain and maintain their credentials.

3. There may be less incentive for teachers to earn a NB certification given the recent compensation adjustments through collective bargaining.

We expect the proportion of teachers receiving this bonus will reach our long-term expected percent by the next demographic experience study in six years. Once this percentage is reached, all of the general pay increases due to increased participation in NB certification will be reflected in our data. As a result, we will review updated data from OSPI but may not produce a section in the next report if we deem the assumption is no longer needed.

Data and Assumptions

We received data from OSPI on historical and projected headcounts from 2005-2023 of NB certified bonus recipients and how many of those teachers worked in a CS. We compared these counts to our historical valuation data on the total active TRS population from 2005-2018.

Below is a graph of the base and CS bonuses allocated from 2005 to 2018.

TRS Bonus Recipients by Year

Base Bonus Recipients — CS Bonus Recipients
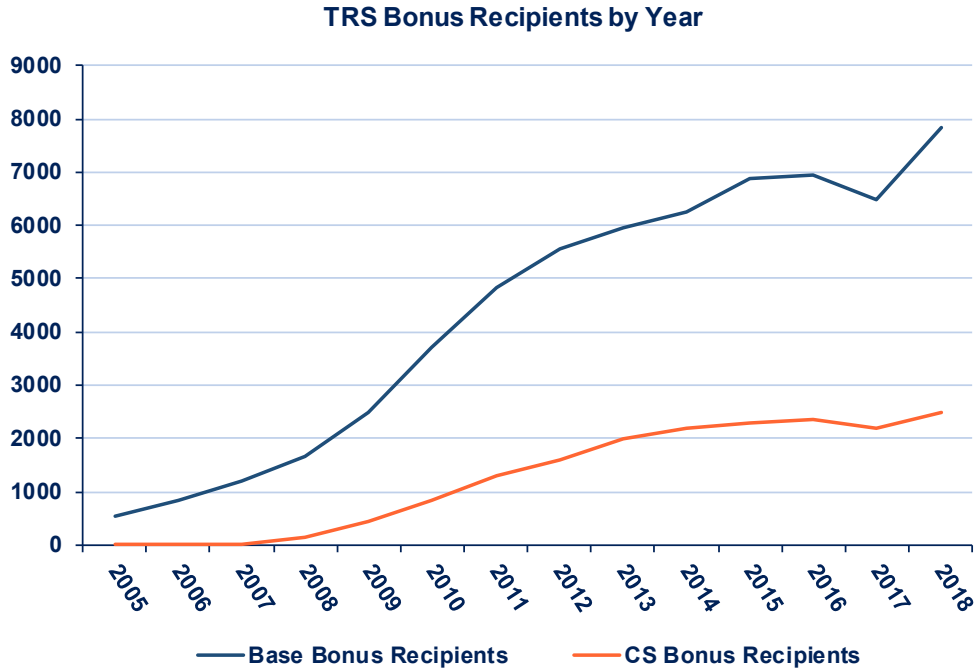
As directed by RCW 28A.405.415, the base bonus was $5,000 in the 2007-2008 school year. In recent years, the base bonus has increased annually for inflation. For the 2018-2019 school year, the base bonus was $5,397 and the CS bonus was a flat $5,000 with no inflation adjustment. Newly certified teachers receive 60 percent of the annual bonuses in the first year.

We assume the long-term proportion of all teachers obtaining a NB certification is 15 percent and the portion of NB certified teachers working in CS is 40 percent (or rather, 6 percent of all teachers). For purposes of setting our TRS Salary Bonus assumption, we assume these long-term rates will be reached by the year 2025. Combining those percentages with our TRS active head counts, we projected the number of base and CS bonus recipients until the ultimate rates are expected to be reached, as illustrated below.

MISCELLANEOUS ASSUMPTIONS *continued*

Projected TRS Bonus Recipients by Year

Legend: —— Percent Certified —— Percent Certified in CS
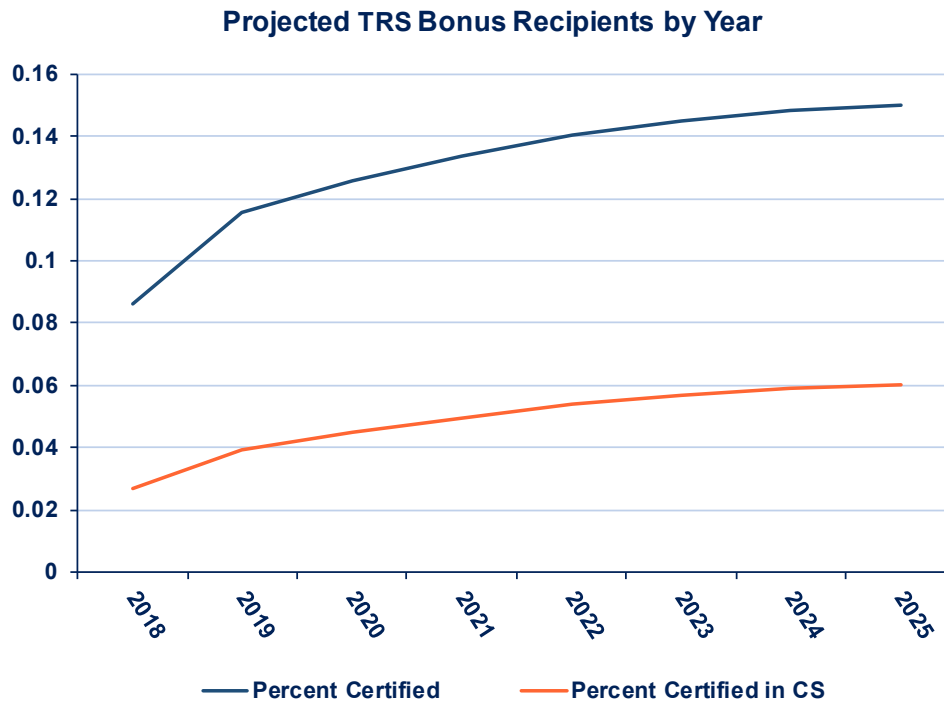
General Methodology

Our approach to this analysis is intended to capture the expected growth in system salaries over and above our GSG and Service-Based Salary Assumptions due to new NBPTS bonuses not already in current salaries. We start by reviewing total plan average projected salaries over roughly the next 15 years based upon the current portion of the TRS population receiving the NB base bonus and CS bonus. Then we estimate how that average salary will increase when reflecting our ultimate assumption for the percentage of teachers who receive these bonuses and by when (as outlined in the **Analysis** sub-section below).

By comparing these projected average salaries with and without the additional bonuses, we are able to estimate the expected short-term increase to our GSG assumption for TRS. The structure of this assumption will be in the form of a select-and-ultimate table by year that trends to zero percent when we're expected to reach the ultimate NBPTS certified portion of teachers.

Based on the assumptions we made regarding the percentage of teachers who receive these bonuses, this **General Methodology** write-up illustrates how we translate those assumptions into a format we can apply in our valuation model.

Law Changes

Since the last study, no law changes have impacted our analysis of this assumption.

MISCELLANEOUS ASSUMPTIONS *continued*

Analysis and Results

Analysis

To help set the assumptions for the proportion of TRS members receiving base and CS bonuses, we examined the historical and projected data provided by OSPI.

As illustrated in the **Data** section above, there was recently a dip in the total NB bonuses awarded. Beginning in 2014, NBPTS began a three-year endeavor to revise their assessment process and consequently placed temporary restrictions on new certifications. Due to this revision, we see an influx of new certifications in 2015 accompanied by a drop in 2016 and 2017, and a similar increase in 2018. While we studied and considered this recent experience, due to the volatility we primarily focused our analysis on expectations for the future.

To inform our decision, we examined five years of projected NB bonus data provided by OSPI and compared it to our internal TRS population projections. Below is a summary of the data.

	OSPI Projected Bonus Allocation			
Year	**Base Number of Bonus Recipients**	**% of TRS Population**	**CS Bonus Recipients**	**% of Recipients in a CS**
2019	8,696	11.6%	2,771	31.9%
2020	8,512	11.2%	2,987	35.1%
2021	8,693	11.3%	3,164	36.4%
2022	8,812	11.3%	3,309	37.6%
2023	9,002	11.4%	3,428	38.1%

We compared this data with our prior projections using our old assumptions. Previously we assumed 20 percent of teachers would ultimately receive a base bonus and 40 percent of those teachers would receive a CS bonus. Based on the data above and OSPI feedback, we believe our old assumptions are overestimating the future number of total teachers receiving a bonus. As such, we lowered our ultimate assumption of total TRS bonus recipients from 20 percent to 15 percent. We found our old assumption of 40 percent of bonus recipients working in CS continues to be reasonable.

Results

All-Plan Summary

Overall, we expect GSG to continue to increase in future years due to the NB bonuses. However, we expect these increases to be smaller than our old assumptions.

Given the current demographics and the size of the remaining TRS 1 active population (approximately 500 members at the end of Fiscal Year 2018), we found this assumption is no longer material for Plan 1. In addition, we don't expect any new TRS 1 members will go through the certification process. Therefore, we decided to remove the additional GSG increases for NB bonuses in TRS 1.

The following new rates will be added to the GSG assumption of 3.5 percent.

	Assumed GSG Increase			
Year	**Old Plan 1**	**Old Plan 2/3**	**New Plan 1**	**New Plan 2/3**
2019	0.10%	0.10%	0.00%	0.09%
2020	0.09%	0.09%	0.00%	0.08%
2021	0.08%	0.08%	0.00%	0.06%
2022	0.08%	0.07%	0.00%	0.05%
2023	0.07%	0.07%	0.00%	0.04%
2024	0.06%	0.06%	0.00%	0.02%
2025	0.05%	0.05%	0.00%	0.01%
2026	0.04%	0.04%	0.00%	0.00%
2027	0.03%	0.03%	0.00%	0.00%
2028	0.02%	0.02%	0.00%	0.00%
2029	0.02%	0.02%	0.00%	0.00%
2030+	0.00%	0.00%	0.00%	0.00%

MISCELLANEOUS ASSUMPTIONS

Assumptions Removed from Future Studies

The assumptions contained in this section will be removed from future studies based on our analysis.

Age and Service Limits

What are the Age and Service Limits Assumptions and How Do We Use them?

The Age and Service Limits apply lower and upper bounds to reported ages and service levels to help us ensure our data is reasonable. We substitute ages or service levels for our valuation data records when a member's age or service level falls outside our minimum or maximum limits, or is unreasonable given the plan's closure date.

For example, if the valuation data showed a 30-year-old PERS 1 member, the data would be considered invalid, since PERS 1 closed to new members more than 30 years ago. We would adjust this member's age to reflect the current age of a member who joined PERS 1 at the earliest possible age, on the last day PERS 1 was open to new entrants (September 30, 1977).

High Level Takeaways

Our current Age and Service Limits are as follows.

	Non-Annuitant Age	Annuitant Age	Years of Service
Minimum Limit	16	20	0
Maximum Limit	80	110	N/A

We reassessed the reasonableness of these assumptions using 2018 valuation data, reported to us by DRS. We found that very few members had ages outside our current limits. We also found that less than 50 members had over 50 years of service, and all of them were Plan 1 members. These service levels were reasonable, and thus we did not feel it necessary to impose a maximum limit on years of service.

Given this information, we find our current Age and Service Limits to be reasonable and are not making any changes to this assumption. We do not plan to revisit this assumption in the future unless plan or legislation changes merit it.

THREE: APPENDICES

Deferred Annuity

What is the Deferred Annuity Assumption and How Do We Use Them?

This assumption was used to estimate the portion of retirement eligible members that terminate employment without immediately commencing their retirement benefit. Terminated members of the PERS, TRS, and SERS Plan 3 and LEOFF Plan 2 systems with at least 20 years of service receive a benefit increase of 3 percent annually for each year the member defers retirement.

We previously modeled this behavior as a probability applied to retirements at ages 55 to 64 of members eligible for the deferred benefit increase. We updated our methodology with this study to include this assumption as part of setting the termination rates instead of retirement. Therefore, this assumption is now part of our termination rates and will no longer be studied separately as part of the demographic experience study. Please see the **Termination Rates** section for more information.

MISCELLANEOUS ASSUMPTIONS *continued*

Early Retirement Factor (ERF) Selection

What is the ERF Selection Assumption and How Do We Use it?

Members of PERS, TRS, and SERS Plans 2/3 who were hired before May 1, 2013, meet specific eligibility requirements, and retire early have the choice of retiring under the 2000 Early Retirement Factors (ERFs) or the 2008 ERFs.

❖ The 2000 ERFs reduce a member's pension by 3 percent for each year that they retire prior to age 65, but they allow the member to return to work in an eligible position prior to age 65 and still receive their full pension, subject to certain restrictions.

❖ The 2008 ERFs reduce a member's pension by a specified percentage for each year that they retire prior to age 62. This pension reduction is less than the reduction under the 2000 ERFs. However, the 2008 ERFs generally prohibit a member from receiving their full pension if they return to work before age 65.

The ERF Selection assumption assigns the probability that a member who retires before age 65 from PERS, TRS, or SERS Plans 2/3 will elect the 2000 ERFs rather than the 2008 ERFs. This assumption allows us to more accurately project the pension benefits of members who retire early from these plans.

High Level Takeaways

We currently assume that no members will elect the 2000 ERFs, since these ERFs reduce a member's pension benefit by a greater amount than the 2008 ERFs. However, we recognize that some members have selected the 2000 ERFs in the past.

To this end, we studied ERF selection data from DRS for Fiscal Years 2009 through 2016. We observed that the percentage of retirees who selected the 2008 ERFs in PERS, TRS, and SERS Plans 2/3 was 98 percent, 95 percent, and 94 percent, respectively.

We also looked at the impacts of [E2SHB 1139](#) which passed during the 2019 Legislative Session. This bill allows TRS and SERS Plans 2/3 members who retire under the 2008 ERFs to work in certain positions up to 867 hours per year while under age 65 without a suspension of benefits. These conditions now mirror the conditions from the 2000 ERFs. Therefore, we believe this bill will result in all TRS and SERS members selecting the 2008 ERFs over the 2000 ERFs in the future.

Given this information, we find our current ERF Selection assumption to be reasonable, and we are not making any change to this assumption. We do not plan to revisit this assumption in the future unless plan or legislation changes merit it.

THREE: APPENDICES

MISCELLANEOUS ASSUMPTIONS

WSPRS Disabled Life Expectancy

What is the WSPRS Disabled Life Expectancy Assumption and How Do We Use them?

When a WSPRS member disables in the line of duty, Washington State Patrol provides a disability benefit not paid from the retirement fund while the member remains alive. When the disabled WSPRS member dies, the member's spouse may receive a survivor benefit paid from the retirement fund. The survivor benefit is based on the salary of current active members with the same rank as the disabled member at the time of disablement.

Previously, we used the WSPRS Disabled Life Expectancy assumption to estimate the number of years after disablement we expected the member to live. This assumption helped approximate the salary of an active member with the same rank as the disabled member at the disabled member's death.

Based on this experience study, we removed the WSPRS Disabled Life Expectancy assumption from our valuation model for future valuations. Instead, we updated our valuation method such that a spousal benefit relies on the **Disabled Mortality Rates** assumption. This method does not require an explicit assumption that estimates the average number of years a member may live after disablement. Therefore, we will no longer separately study this assumption as part of the demographic experience study.

FOUR
GLOSSARY

FOUR: GLOSSARY

Active Member

A person currently employed in an eligible position with a public employer. Active members accrue membership service in a public retirement system and generally make contributions toward their retirement benefits.

Actuarial Assumptions

Factors actuaries use to estimate the cost of funding a defined benefit pension plan. Examples include: the rate of return on plan investments; mortality rates; and the rates at which plan participants are expected to leave the system because of retirement, disability, termination, etc.

Prescribed Assumption

A specific assumption mandated or selected from a specific range that is deemed to be acceptable by law, regulation, or other binding authority.

Assumption Format

The form in which a particular assumption will be used or expressed. The format can be as simple as a single point estimate, where one number is applied, regardless of a member's age or gender. An assumption can also be developed by age, gender, credited service, plan or other group, or any combination of those categories.

Actuarial Gain or Loss

Experience of the plan, from one year to the next, which differs from that assumed, results in an actuarial gain or loss. For example, an actuarial gain would occur if assets earned 10 percent for a given year since the assumed interest rate in the valuation is 8 percent.

Actuarial Reduction

A reduction in a benefit received at an early date so that the expected total cost to the retirement system is equivalent to the cost if the benefit did not begin until later.

Annuitant

A person receiving periodic payments from a retirement system. This term includes service and disability retirees, and their survivors.

Annuity

A series of periodic payments, usually for life, payable monthly or at other specified intervals.

Deferred Annuity

An annuity for which payments do not commence until a designated time in the future.

Joint and Survivor Annuity

A provision that enables a plan participant to take annuity payments with continuing payments of all or part of the benefits after his or her death going to a designated beneficiary. The survivor annuity will automatically be provided to a married participant if he or she does not choose against it. The annual pension benefits of the participant electing to have such a survivor annuity are generally reduced to provide for the survivor.

Life Annuity

A monthly benefit payable as long as the annuitant is alive. There are no residual payments to survivors.

Beneficiary

The person designated to receive benefits under an employee benefit plan in the event of the death of the person covered by the plan.

FOUR: GLOSSARY

Data Outliers

Observations that lie well outside the normal range experienced by others. An example of an outlier could be a recorded service retirement at age 110, when most other members retire by age 80.

Death Benefit

A benefit payable to a survivor or estate by reason of a member's death. The benefit can be in the form of a lump sum, an annuity, or a refund of the member's contributions.

Life Expectancy

The average number of future years a person of a given age might be expected to live.

Portability

The ability of an employee who changes jobs and joins a different retirement system to become a dual member, maintaining membership in both systems. Dual members may combine service for benefit eligibility. They may also use their highest salary from either system for benefit calculation.

Ratio of Actual-to-Expected (A/E)

A helpful statistic in determining how closely existing assumptions match actual experience. Ratios near 1.0 indicate a very close match. Ratios below 1.0 demonstrate that current assumptions are higher than actual rates. Ratios above 1.0 show that current assumptions are lower than actual rates.

Retirement

Disability Retirement

A termination of employment that provides, as a result of an accident or sickness, the payment of a retirement allowance before a participant is eligible for normal retirement.

Service Retirement

Retirement dependent upon attainment of a specified age and/or completion of a given length of service. In some cases, the term has the same meaning as "normal retirement".

Early Retirement

A termination of employment that provides the payment of a retirement allowance before a participant is eligible for normal retirement. The retirement allowance payable in the event of early retirement is often lower than the normal retirement allowance.

Vesting

The right of an employee to the benefits he or she has accrued, or some portion of them, even if employment under the plan is terminated. An employee who has met the vesting requirements of a pension plan is said to have a vested right. Voluntary and mandatory employee contributions are always fully vested.

Withdrawal

The termination of employment prior to becoming eligible for any benefits. The term sometimes refers to subsequent termination of membership in a system by withdrawal of the employee's accumulated contributions from the system.

Dexter, OSA's Office Mascot