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OREGON PUBLIC EMPLOYEES
RETIREMENT SYSTEM

2016 Experience Study

Prepared by:

Milliman, Inc.

Matt Larrabee, FSA, EA, MAAA
Principal and Consulting Actuary

Scott Preppernau, FSA, EA, MAAA
Principal and Consulting Actuary

111 SW Fifth Avenue, Suite 3700
Portland OR 97204-3654

Tel +1 503 227 0634
Fax +1 503 227 7956

milliman.com

July 26, 2017

Board of Trustees
Oregon Public Employees Retirement System

Re: 2016 Experience Study – Oregon Public Employees Retirement System

Dear Members of the Board:

The results of an actuarial valuation are based on the actuarial methods and assumptions used in the valuation. These methods and assumptions are used in developing employer contribution rates, disclosing employer liabilities pursuant to GASB requirements, and for analyzing the fiscal impact of proposed legislative amendments.

This experience study report has been prepared exclusively for the Oregon Public Employees Retirement System (PERS) and its governing PERS Board (Board). **The study recommends to the Board the actuarial methods and assumptions to be used in the December 31, 2016 and 2017 actuarial valuations of PERS.**

Except where otherwise noted, the analysis in this study was based on data for the experience period from January 1, 2013 to December 31, 2016 as provided by PERS. PERS is solely responsible for the validity, accuracy, and comprehensiveness of this information; the results of our analysis can be expected to differ and may need to be revised if the underlying data supplied is incomplete or inaccurate.

Milliman's work is prepared solely for the use and benefit of the Oregon Public Employees Retirement System.

Milliman does not intend to benefit or create a legal duty to any third party recipient of this report. No third party recipient of Milliman's work product should rely upon this report. Such recipients should engage qualified professionals for advice appropriate to their own specific needs.

The consultants who worked on this assignment are pension actuaries and, for the analysis of the RHIPA program, healthcare actuaries. Milliman's advice is not intended to be a substitute for qualified legal or accounting counsel.

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

On the basis of the foregoing, we hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices. We are members of the American Academy of Actuaries and meet the Qualification Standards to render the actuarial opinion contained herein. Assumptions related to the healthcare cost inflation rates for the RHIPA retiree healthcare program discussed in this report were determined by Milliman actuaries qualified in such matters.

Sincerely,

Matt Larrabee, FSA, EA, MAAA
Principal and Consulting Actuary

Scott Preppernau, FSA, EA, MAAA
Principal and Consulting Actuary

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1. Executive Summary

This experience study report has been prepared exclusively for the Oregon Public Employees Retirement System (PERS) and the PERS Board (Board) in order to analyze the system's experience from January 1, 2013 through December 31, 2016 and to recommend actuarial methods and assumptions to be used in the December 31, 2016 and 2017 actuarial valuations of PERS.

A brief summary of the recommended method and assumption changes contained in this report as well as items reviewed at the May 2017 and/or July 2017 Board meetings follows:

Economic Assumptions

- Lower the investment return assumption from the current assumption of 7.50% per year, based on an analysis of PERS's current target asset allocation using different sets of capital market outlook assumptions. The averages of the 50th percentiles for those outlooks across 10-year (four outlooks) and 20-year (two outlooks) time horizons fell in the range between 7.00% and 7.25%.
- Update the explicit assumptions regarding administrative expenses for Tier 1/Tier 2 and OPSRP.
- Update the assumed health cost trend (i.e., health cost inflation) rates for the RHIPA retiree healthcare program.

Demographic Assumptions

- Adjust mortality assumptions to use RP-2014 base tables and mortality improvement scale based on 60-year unisex average Social Security experience.
- Adjust retirement rates for certain member categories and service bands to more closely align with recent and expected future experience; reduce percentage of members assumed to elect a partial lump sum; increase percentage of members assumed to purchase credited service at retirement.
- Decrease the merit component of the salary increase assumption for two member categories based on observations of the last eight years of experience.
- Update pre-retirement termination of employment assumptions for three member categories.
- Lower assumed rates of ordinary (non-duty) disability to more closely match recent experience.
- Increase the Tier 1 unused vacation cash out assumption for most categories.
- Adjust the Tier 1/Tier 2 unused sick leave assumption for three member categories to more closely reflect recently observed experience.
- Decrease the healthy participation assumption for the RHIA retiree healthcare program.
- Decrease the RHIPA participation assumption for one service band.

Actuarial Methods

- No changes recommended for most actuarial methods, including actuarial cost method, amortization method, and rate collar.

Allocation Procedures

- When allocating accrued liability for Tier 1/Tier 2 active members who have earned service with multiple PERS employers, base 85% of the allocation on service with each employer (100% for police & fire members) and base the rest on the member account balance associated with each employer. The assumption for general service has increased 10% since the prior experience study. This movement illustrates the continued migration of projected future Tier 1/Tier 2 retirement benefits away from the Money Match calculation, which is based on account balances, toward the ongoing Full Formula approach, which is based on final average salary.

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2. Actuarial Methods and Allocation Procedures

Overview

Actuarial methods and allocation procedures are used as part of the valuation to determine actuarial accrued liabilities, to determine normal costs, to allocate costs to individual employers and to amortize unfunded liabilities. The following Board objectives were considered in developing the actuarial methods and allocation procedures:

- Transparency of shortfall and funded status calculations
- Predictable and stable employer contribution rates
- Protection of the plan's funded status to enhance benefit security for members
- Equity across generations of taxpayers funding the program
- Actuarial soundness - crafting policy that will fully fund the system if assumptions are met
- Compliance with GASB (Governmental Accounting Standards Board) requirements

The actuarial methods used for the December 31, 2015 actuarial valuation and the changes recommended for the December 31, 2016 and 2017 actuarial valuations are shown in the table below.

Method	December 31, 2015 Valuation	December 31, 2016 and 2017 Valuations
Cost method	Entry Age Normal (EAN)	No change
UAL Amortization method	UAL amortized as a level percent of combined Tier 1/Tier 2 and OPSRP payroll	No change
UAL Amortization period	- UAL bases – Closed amortization from the first rate setting valuation in which experience is recognized – Tier 1/Tier 2 – re-amortized over 20 years effective December 31, 2013 – OPSRP – 16 Years – RHIA/RHIPA – 10 years - Newly established side accounts – Aligned with the new Tier 1/Tier 2 base from the most recent rate-setting valuation - Newly established transition liabilities or surpluses – 18 years from the date joining the SLGRP (State & Local Government Rate Pool)	No change
Asset valuation method	Market value	No change
Exclusion of reserves from valuation assets	Contingency Reserve, Capital Preservation Reserve, and Tier 1 Rate Guarantee Reserve (RGR) excluded from valuation assets. RGR is not excluded from valuation assets when RGR is negative (i.e., when the RGR is a deficit reserve).	No change

Method	December 31, 2015 Valuation	December 31, 2016 and 2017 Valuations
Allocation of Benefits in Force (BIF) Reserve	The BIF is allocated to each rate pool in proportion to the retiree liability attributable to the rate pool.	No change
Rate collar	Change in base contribution rate limited (i.e., collared) to greater of 20% of current base rate or 3% of payroll. Size of collar doubles if funded percentage excluding side accounts falls below 60% or increases above 140%. If the funded percentage excluding side accounts is between 60% and 70% or between 130% and 140%, the size of the rate collar is increased on a graded scale. Exclude RHIA and RHIPA (retiree medical) rates from the rate collar calculation.	No change
Liability allocation for actives with several employers	▪ Allocate Actuarial Accrued Liability 25% (0% for police & fire) based on account balance with each employer and 75% (100% for police & fire) based on service with each employer	Change allocation to 15% (0% for police & fire) based on account balance and 85% (100% for police & fire) based on service with each employer.
	▪ Allocate Normal Cost to current employer	No change

The methods or procedures are described in greater detail on the following pages.

Actuarial Cost Method

The total cost of the program, over time, will be equal to the benefits paid less investment earnings and is not affected directly by the actuarial cost method. The actuarial cost method is simply a tool to allocate costs to past, current or future years and thus primarily affects the timing of cost recognition.

The December 31, 2015 valuation used the Entry Age Normal (EAN) method, which allocates costs as a level percentage of payroll across the full projected working career. EAN is the required method under the recently implemented GASB 67 and 68 financial reporting standards, though the Board could choose to use a different method for employer contribution rate calculations. Oregon PERS adopted EAN for all purposes with the December 31, 2012 valuation. Employing a consistent method for both financial reporting and contributions is more understandable to interested parties as only one set of liability and normal cost calculations will be made for each employer. The EAN approach is widely used in the actuarial and public plan sponsor community because it provides a realistic estimate of the long-term costs of a retirement program as a level percentage of payroll if all assumptions are met. The benefits of this method are unchanged from when the Board previously adopted it, and thus we recommend continuing to use the EAN cost method.

Amortization Method

Unfunded Actuarial Liability

The unfunded actuarial liability (UAL) is amortized as a level percentage of combined payroll (Tier 1/Tier 2 plus OPSRP) in order to maintain more level contribution rates as payroll for the closed group of Tier 1/Tier 2 members declines and payroll of OPSRP members increases. We recommend this methodology continue.

The UAL is currently amortized over the following closed periods as a level percent of projected payroll from the first rate-setting valuation in which the experience is recognized:

- Tier 1/Tier 2 – 20 years
- OPSRP – 16 years
- RHIA/RHIPA – 10 years

As part of a collection of method changes made with the 2012 Experience Study, the Board made a policy decision to re-amortize all existing Tier 1/Tier 2 shortfall (unfunded actuarial liability or UAL) at the December 31, 2013 rate-setting actuarial valuation. Gains and losses between subsequent rate-setting valuations will be amortized as a level percentage of payroll over a closed 20 year period from the valuation in which they are first recognized.

Side Accounts and Transition Liabilities/Surpluses

Prior to the 2010 Experience Study, side accounts and transition liabilities/surpluses were amortized over the period ending December 31, 2027. To better match the amortization periods for new side accounts and new transition liabilities with the amortization of the Tier 1/Tier 2 UAL and to avoid issues related to a shortening amortization period, as part of the 2010 Experience Study the PERS Board adopted the following amortization procedures which are not tied to a fixed date:

- Newly established side accounts are amortized over the same period as the new Tier 1/Tier 2 UAL base from the most recent rate-setting valuation. For example, a side account created in July 2017 would be amortized to December 31, 2035, aligned with the 20-year Tier 1/Tier 2 UAL base created in the most recent rate-setting valuation as of December 31, 2015 valuation.

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- New transition liabilities/surpluses are amortized over the 18 year period beginning when the employer joins the SLGRP. This amortization period aligns with the last Tier 1/Tier 2 amortization base established as an independent employer.

We recommend no change to the amortization method or periods of side accounts and new transition liabilities/surpluses.

Asset Valuation Method

Effective December 31, 2004, the Board adopted market value as the actuarial value of assets, replacing the four-year smoothing method previously used to determine the actuarial asset value, which is used for shortfall (UAL) calculations. Although asset smoothing is a common method for smoothing contribution rates in public sector plans, the smoothed asset value does not provide a transparent measure of the plan's funded status and UAL. Market value provides more transparency to members and other interested parties regarding the funded status of the plan. Instead of smoothing assets, a rate collar method (described below) is used to smooth contribution rates.

We recommend no change to the asset valuation method.

Excluded Reserves

Statute provides that the Board may establish Contingency and Capital Preservation reserve accounts to mitigate gains and losses of invested capital and other contingencies, including certain legal expenses or judgments. In addition, statute requires the establishment and maintenance of a Rate Guarantee or Deficit reserve to fund earnings crediting to Tier 1 member regular accounts when actual earnings are below the investment return assumption selected by the Board.

The Contingency and Capital Preservation reserves are excluded from the valuation assets used for employer rate-setting calculations. We recommend no change to the treatment of the Contingency and Capital Preservation reserves.

The Rate Guarantee Reserve (RGR) was positive as of December 31, 2015, but can become negative (in deficit status) if, over time, the required crediting on Tier 1 member accounts exceeds the investment earnings on those accounts. The RGR was negative from the December 31, 2008 valuation to the December 31, 2012 valuation. All else being equal, excluding a negative reserve increases the level of valuation assets used in employer rate-setting calculations. This occurs because subtracting a negative amount is mathematically equivalent to adding a positive amount of the same magnitude. If the negative reserve was larger in absolute value than the sum of the other reserves, this approach would lead to the actuarial value of assets used in shortfall (UAL) calculations being larger than the market value of assets.

As part of the 2010 Experience Study, the Board decided to only exclude the RGR from assets when it is in positive surplus position, and not to subtract a negative RGR (which would increase the actuarial value of assets) when it is in deficit status. We recommend this treatment of the RGR continue.

Rate Collar Method

Effective December 31, 2004, a rate collar method was adopted that limits biennium to biennium changes in contribution rates to be within a specified "collar". The existing rate collar method restricts the change in an employer's "base" Tier 1/Tier 2 contribution rate (i.e., the rate before contemplation of side account rate offsets or rate adjustments for any pre-pooled obligations) to the greater of 20 percent of the current rate or

3% of payroll. If the funded status excluding side accounts is less than 60% or greater than 140%, the size of the rate collar is doubled. If the funded percentage excluding side accounts is between 60% and 70% or between 130% and 140%, the size of the rate collar is increased on a graded scale.

The rate collar is applied for each employer (or rate pool) prior to any adjustments to the employer contribution rate for side accounts, transition liabilities, or pre-SLGRP pooled liabilities. The rate collar only applies to employer contribution rates for pension benefits. Rates attributable to RHIA and RHIPA (retiree medical) programs are not subject to the collar.

Liability Allocation for Actives with Several Employers

Over the course of a member's working career, a member may work for more than one employer covered under the Tier 1/Tier 2 program. Since employer contribution rates are developed on an individual employer basis, the member's liability should be allocated between such a member's various Tier 1/Tier 2 employers. If all of the member's employers participate in the same rate pool, the allocation has no effect on rates, but if the employers participate in different pools or are independent, the allocation can have an impact on the different employers' rates.

When a member retires, PERS allocates the cost of the retirement benefit between the employers the member worked for based on the formula that produces the member's retirement benefit. If the member's benefit is calculated under the Money Match approach, the cost is allocated in proportion to the member's account balance attributable to each employer. If the member's benefit is calculated under the percent of final average pay Full Formula approach, the cost is allocated in proportion to the service attributable to each employer.

In the period prior to the 2003 system reforms and shortly thereafter, the vast majority of retirement benefits were calculated under Money Match, so the member liability in valuations prior to December 31, 2006 had been allocated in proportion to the member's account balance attributable to each employer. With no new member contributions to Tier 1/Tier 2, however, this procedure meant no liability was allocated to employers for service after December 31, 2003 in the valuation. As Money Match benefits became less dominant and retirements with Full Formula benefits become more prevalent, a change in the procedure to allocate liability among employers was warranted.

Effective with the December 31, 2006 valuation, a change was made to allocate a member's actuarial accrued liability among employers based on a weighted average of the Money Match methodology, which utilizes account balance, and the Full Formula methodology, which utilizes service. The methodologies were weighted according to the percentage of the system-wide actuarial accrued liability for new retirements projected to be attributable to Money Match and Full Formula, respectively, as of the next rate-setting valuation. For the December 31, 2014 and December 31, 2015 valuations, the Money Match method was weighted 25 percent for general service members and 0 percent for police & fire members.

The table below shows a summary of the portion of the total actuarial liability for Tier 1/Tier 2 active members estimated to be attributable to Money Match benefits at the most recent published valuation date and how that proportion is projected to change in subsequent years.

December 31,	General Service	Police & Fire
2015	20%	2%
2016	18%	2%
2017	16%	1%
2018	14%	1%

Since the next rate-setting valuation is the December 31, 2017 valuation, we recommend the Money Match method be weighted 15 percent for general service members. This weighting will continue to be reviewed with each experience study and updated as necessary. For police & fire members we recommend the allocation continue to be based entirely on the Full Formula approach, an approach first adopted in the 2014 Experience Study, once the Money Match portion fell below 5%.

As in prior valuations, the member's normal cost will continue to be assigned to his or her current employer.

3. Economic Assumptions

Overview

Actuarial Standard of Practice (ASOP) No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations,* provides guidance on selecting economic assumptions used in measuring obligations under defined benefit pension plans. ASOP No. 27 suggests that economic assumptions be developed using the actuary's professional judgment, taking into consideration past experience and the actuary's expectations regarding the future. The process for selecting economic assumptions involves:

- Identifying components of each assumption and evaluating relevant data
- Considering factors specific to the measurement along with other general factors
- Selecting a reasonable assumption

Under ASOP No. 27, an assumption is considered reasonable if:

- It is appropriate for the purpose of the measurement,
- It reflects the actuary's professional judgment,
- It takes into account relevant historical and current economic data,
- It reflects the actuary's estimate of future experience, the actuary's observation of estimates inherent in market data, or a combination thereof, and
- It has no significant bias, except when provisions for adverse deviation are included and disclosed.

A summary of the economic assumptions used for the December 31, 2015 actuarial valuation and those recommended for the December 31, 2016 and 2017 actuarial valuations is shown below:

Assumption	December 31, 2015 Valuation	December 31, 2016 and 2017 Valuations
Inflation (other than healthcare)	2.50%	No Change
Real wage growth	1.00%	No Change
Payroll growth	3.50%	No Change
Regular investment return	7.50%	Decrease recommended; averages of reviewed 50th percentile estimates over 10 and 20 year time horizons fell in a range between 7.00% and 7.25%; Board will select the assumption at its July 28, 2017 meeting
Variable account investment return	Same as regular investment return	Same as regular investment return
Tier 1/Tier 2 administrative expenses	$33.0 million/year	$37.5 million/year
OPSRP administrative expenses	$5.5 million/year	$6.5 million/year
Healthcare cost inflation rates - 2017 rate - Ultimate inflation rate - Year reaching ultimate rate	 6.00% 4.40% 2094	 7.50% 4.20% 2093

The recommended assumptions shown above, in our opinion, were selected in a manner consistent with the requirements of ASOP No. 27. Each of the above assumptions is described in detail below and on the following pages.

Inflation

The assumed inflation rate is the basis for all of the other economic assumptions. It affects other assumptions including payroll growth, investment return, and healthcare inflation.

Historical CPI-U
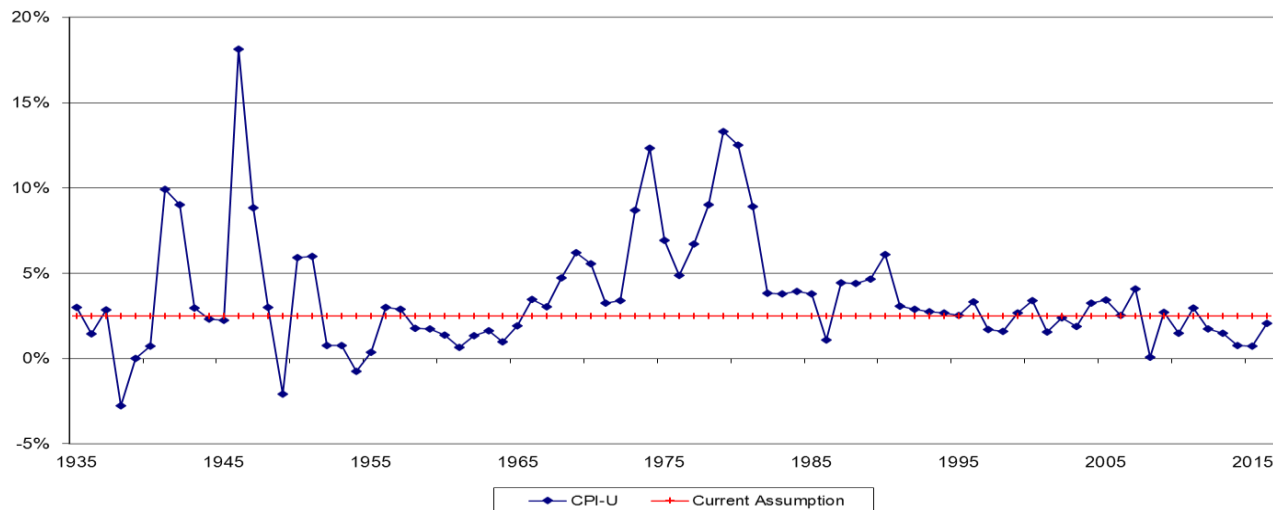
In selecting an appropriate inflation assumption, we consider both historical data and the breakeven inflation rates inherent in current long-term Treasury Inflation Protection Securities (TIPS). The chart above shows the annual inflation rate for the years ending December 31 from 1935 through 2016 as reported by the Bureau of Labor Statistics. The mean and median annual rates over this period are **3.64** percent and **2.93** percent respectively.

Historical inflation rates vary significantly from period to period and may not be an indication of future inflation rates. With the development of a TIPS market, we can calculate an estimated breakeven inflation rate by comparing yields on regular Treasury securities to the yields on TIPS. The table below shows yields as of December 31, 2016, for 10-year and 30-year Treasury bonds and TIPS.

As of 12/31/2016	10-Year	30-Year
Treasury Yield	2.45%	3.06%
TIPS Yield	0.50%	0.99%
Breakeven Inflation	**1.95%**	**2.07%**

We also considered three other inflation measures in our analysis: Social Security's intermediate inflation projection average of **2.62** percent over the period 2017-2027 (with an ultimate rate of 2.60 percent), Medicare Trustees' intermediated assumption of **2.40** percent inflation for ten years and **2.60** percent thereafter, and the Congressional Budget Office's projection of CPI of an average of **2.38** percent inflation over the period 2017-2027. These measures were taken from, respectively, the 2016 OASDI Trustees Report, the 2016 Annual Report of the Boards of Trustees of the Federal Hospital Insurance and Federal

Supplementary Medical Insurance Trust Funds, and *The Budget and Economic Outlook: 2017 to 2027* published by the CBO in January 2017.

Based on the information shown above, we consider the current assumption of 2.50 percent to continue to be appropriate. We recommend no change to the assumption at this time.

Real Wage Growth

The expected salary growth assumption is the sum of three factors:

▪ Inflation,
▪ Real wage growth, and
▪ Merit and longevity wage growth.

Real wage growth represents the increase in wages above inflation for an entire population due to improvements in productivity and competitive pressures. Merit and longevity wage growth, in contrast, represent the increases in wages for an individual due to factors such as performance, promotion, or seniority.

The chart below shows the real growth in national average wages over the past fifty years based on data compiled by the Social Security Administration.

Historical Real Growth in National Average Wages
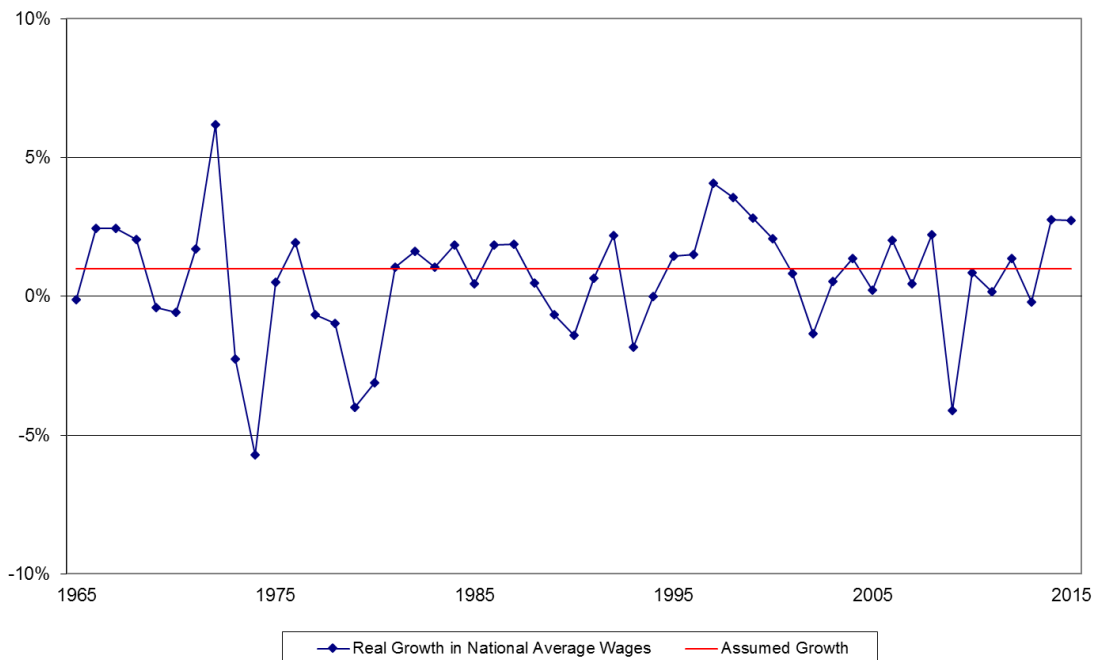
While the change in any one year has been volatile, the change over longer periods of time is more stable as shown in the table below. However, the significant outlier result of a 4.1 percent productivity decrease in 2009 (measuring change in national average wages from 2008 to 2009) has a strong downward impact on the trailing averages shown in the table below. For example, the 10 year trailing average ending on December 31, 2008, is 1.11 percent.

Length of Period Ending December 31, 2015	Average Real Growth in National Average Wages
10 years	0.80%
20 years	1.18%
30 years	0.93%
40 years	0.67%
50 years	0.66%

We also considered the Social Security Administration's current long-term intermediate wage growth assumption of 1.20 percent in our analysis.

Based on the combination of historical data and forecasted future experience, we consider the current assumption of 1.00 percent to continue to be appropriate. We recommend no change to the assumption at this time.

Payroll Growth

Real wage growth combined with inflation represents the expected growth in total payroll for a stable population. Changes in payroll due to an increase or decline in the covered population are not captured by this assumption. The payroll growth assumption is used to develop the annual amount necessary to amortize the unfunded actuarial liability as a level percentage of expected payroll.

Since we are recommending no changes to the inflation assumption or real wage growth assumption, the payroll growth assumption will remain at 3.50 percent.

Investment Return

The assumed rate of investment return is used to calculate the present value as of the valuation date of future projected benefit payments from the retirement plan, to project interest credits applied to member accounts until retirement, to convert member accounts to a monthly retirement allowance under the Money Match formula, and to convert the retirement allowance to optional joint & survivor benefits. As such, it is one of the most important assumptions used in valuing the plan's liabilities and developing contribution rates. The assumption is intended to reflect the long-term expected future return on the portfolio of assets that fund the benefits.

To provide some perspective on this assumption, the chart below shows the assumptions used by the 127 largest US public sector systems in a regularly updated survey published by the National Association of State Retirement Administrators (NASRA). As can be seen from the chart (updated in NASRA's February 2017 Issue Brief), the Oregon PERS assumption of 7.50% used in the prior valuation is currently the median assumption for large US public sector systems. The clear majority of systems have investment return assumptions below 8%. The average (mean) of the return assumptions in the chart is 7.52%. Given the consensus view among investment professionals regarding low long-term expected returns for fixed income investments (relative to historical averages), we believe that this downward trend in the survey will continue in the future as systems periodically revisit their investment return assumptions.

**NASRA Public Fund Survey
Assumed Investment Return**
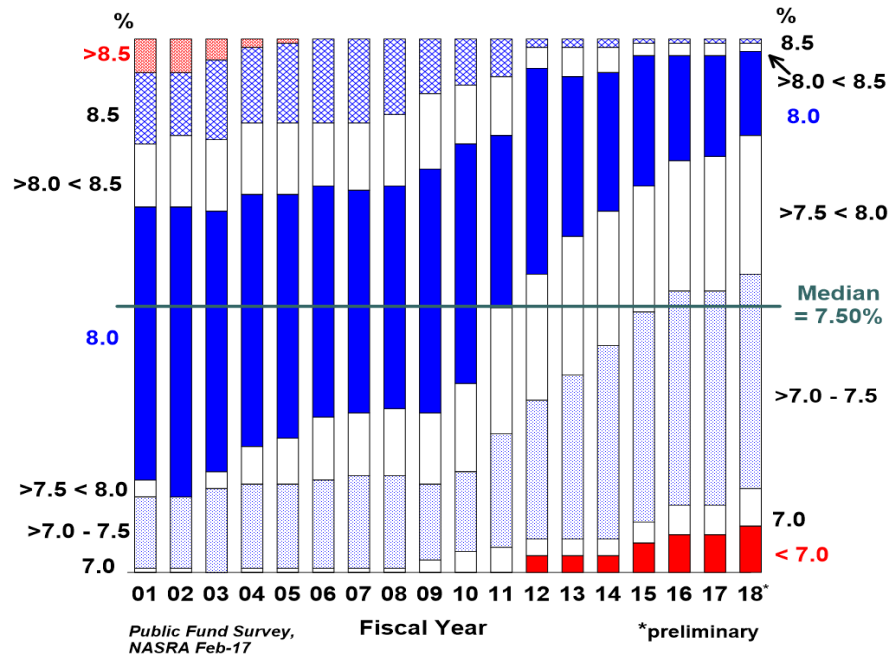
Regular Accounts

Based on the Oregon Investment Council's (OIC) Statement of Investment Objectives and Policy Framework for the Oregon Public Employees Retirement Fund revised as of June 7, 2017, we understand the target asset allocation adopted by the OIC is as follows:
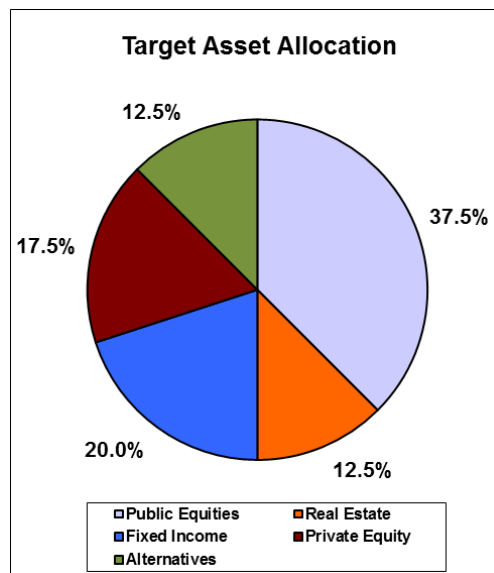
To develop an analytical basis for the Board's selection of the investment return assumption, we use long-term assumptions developed by Milliman's capital market assumptions team for each of the asset classes in which the plan is invested based on the OIC's long-term target asset allocation. Since the OIC uses broader asset classes than those for which Milliman's investment actuaries develop long-term return assumptions, we

used OIC's description of each asset class to map it to the classes shown below. For example, the OIC's allocation to "alternatives" was distributed among hedge funds, real estate, and commodities based on the detail available. Each asset class assumption is based on a consistent set of underlying assumptions, including the inflation assumption. These assumptions are not based on historical returns, but instead are based on a forward-looking capital market economic model. Based on the target allocation and investment return assumptions for each of the asset classes, our model's 50th percentile output is developed as follows:

Asset Class	Target Allocation	Annual Arithmetic Mean	20-Year Annualized Geometric Mean	Annual Standard Deviation
Core Fixed Income	8.00%	3.59%	3.49%	4.55%
Short-Term Bonds	8.00%	3.42%	3.38%	2.70%
Bank/Leveraged Loans	3.00%	5.34%	5.09%	7.50%
High Yield Bonds	1.00%	6.90%	6.45%	10.00%
Large/Mid Cap US Equities	15.75%	7.45%	6.30%	16.25%
Small Cap US Equities	1.31%	8.49%	6.69%	20.55%
Micro Cap US Equities	1.31%	9.01%	6.80%	22.90%
Developed Foreign Equities	13.13%	8.21%	6.71%	18.70%
Emerging Market Equities	4.13%	10.53%	7.45%	27.35%
Non-US Small Cap Equities	1.88%	8.67%	7.01%	19.75%
Private Equity	17.50%	11.45%	7.82%	30.00%
Real Estate (Property)	10.00%	6.15%	5.51%	12.00%
Real Estate (REITS)	2.50%	8.26%	6.37%	21.00%
Hedge Fund of Funds – Diversified	2.50%	4.36%	4.09%	7.80%
Hedge Fund – Event-driven	0.63%	6.21%	5.86 %	8.90%
Timber	1.88%	6.37%	5.62%	13.00%
Farmland	1.88%	6.90%	6.15%	13.00%
Infrastructure	3.75%	7.54%	6.60%	14.65%
Commodities	1.88%	5.43%	3.84%	18.95%
Portfolio – Net of Investment Expenses	**100.00%**	**7.48 %**	**6.74%***	**12.97%**

The model's 20-year annualized geometric median is 6.70%.

Based on capital market expectations developed by Milliman.

We compared the expected return to the range of returns developed using a mean-variance model and the capital market assumptions of Milliman, along with both Callan and Pension Consulting Alliance (PCA), the OIC's investment consultants. In addition, we modeled the returns projected for the OIC's asset allocation using the 10-year capital market assumptions from the 2016 Survey of Capital Market Assumptions published by Horizon Actuarial Services, LLC. Returns shown below are net of passive investment expenses. In our modeling, we assumed that expenses incurred for active management are offset by additional returns gained from active management.

The table below compares the median of expected annualized returns calculated on a geometric basis for the Regular Account based on Milliman's, Callan's, and PCA's capital market assumptions, and based on the average assumptions from the Horizon survey. Both 10-year and 20-year timeframes are shown for Milliman and PCA.

	Callan	PCA	Milliman	Horizon	Milliman	PCA
Median annualized geometric return	7.05%	7.40%	6.33%	7.24%	6.70%	7.60%
Assumed inflation	2.25%	2.25%	2.30%	2.16%	2.50%	2.25%
Timeframe modeled	10 years	10 years	10 years	10 years	20 years	20 years

It is common practice among public pension systems for the investment return assumption to be a multiple of a quarter-point (i.e., 0.25%). The lack of additional precision in selected assumptions can reasonably be attributed to the inability to have precise knowledge in advance regarding future investment returns. For both the 10-year timeframe and the 20-year timeframes, the average of the median 50th percentile estimates fell in the quarter-point range between 7.00% and 7.25%. The median 50th percentile estimate of Callan, which is the Oregon Investment Council's (OIC) lead investment consultant, also falls in that quarter-point range. Those model outputs are based on the forward-looking return expectations of the investment professionals considered, and before any potential active management adjustments. Actual investment returns are not determined by the assumed rate of return. Selecting an assumed return materially above the 50th percentile implies a materially greater than 50% chance of actual long-term future experience falling short of the selected assumption.

Based on the capital market outlooks modeled, we believe the investment return assumption should be reduced from the current 7.50% assumption and note that assumptions in the quarter-point range between 7.00% and 7.25% are clearly reasonable based on the reviewed capital market outlooks.

Variable Account

The variable account is invested entirely in Public Equities. As a result, the annual expected arithmetic return is significantly higher than for the regular account, but so is the standard deviation. The result is a long-term compounded geometric annual return similar to the regular account, based on Milliman's capital market assumptions. Prior to the December 31, 2012 valuation, the compound geometric variable account return was assumed to be higher than the regular account return. Beginning with that valuation, the variable account return assumption was set equal to the regular account return assumption, as the relationship between the various asset classes no longer warranted such a distinction. We recommend continuing to set the variable account return assumption equal to the regular account return assumption.

Administrative Expenses

In accordance with GASB Statements No. 67 and No. 68, the long-term investment return assumption is considered to be gross of administrative expenses. In order to account for expected administrative expenses, we develop explicit assumptions for both Tier 1/Tier 2 and OPSRP based on recent and expected future experience. The assumed expenses for each program are added to the normal cost in the calculation of contribution rates in order to fund expenses each year as they occur.

The Tier 1/Tier 2 assumed administrative expenses in the December 31, 2015 valuation were $33.0 million per year and the OPSRP assumed administrative expenses were $5.5 million. A summary of recent actual administrative expenses for both Tier 1/Tier 2 and OPSRP is shown below.

Year	Tier 1/Tier 2		OPSRP	
	Dollar Amount ($ millions)	Percentage of Beginning of Year Assets	Dollar Amount ($ millions)	Percentage of Beginning of Year Assets
2012	$26.4	0.06%	$5.3	0.63%
2013	$29.6	0.06%	$4.5	0.38%
2014	$30.1	0.06%	$5.0	0.30%
2015	$31.5	0.06%	$5.7	0.28%
2016	$35.8	0.07%	$5.9	0.25%

Based on PERS financial reporting information reviewed as part of this study, we recommend setting the assumed actual administrative expenses for 2016 and 2017 at $37.5 million for Tier 1/Tier 2 and $6.5 million for OPSRP. These amounts reflect recent historical experience with an expectation of inflation-related growth for the next two years.

Healthcare Cost Trend Rates

Healthcare cost trend rates are used to estimate increases in the employer cost of the RHIPA subsidy. Based on analysis performed by Milliman's healthcare actuaries, we recommend the following change to the healthcare cost trend assumption. These rates include consideration of the excise tax scheduled to be introduced in 2020 by the Affordable Care Act.

Note that the following chart shows sample rates. A full chart can be found in the appendices.

Year	December 31, 2014 and 2015 Valuations	December 31, 2016 and 2017 Valuations
2015	7.0%	N/A
2016	6.3%	N/A
2017	6.0%	7.5%
2018	5.4%	6.5%
2019	5.3%	5.9%
2020	5.4%	5.4%
2021	5.4%	5.3%
2022	5.4%	5.3%
2023	5.4%	5.3%
2024	5.4%	5.2%
2025	5.5%	5.2%
2030	6.4%	6.2%
2035	6.3%	6.1%
2040	5.9%	6.0%
2045	5.7%	5.6%
2050	5.5%	5.4%
2060	5.4%	5.2%
2070	4.6%	4.6%
2080	4.5%	4.3%
2090	4.5%	4.3%
2094+	4.4%	4.2%

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4. Demographic Assumptions

Overview

Actuarial Standard of Practice (ASOP) No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations,* provides guidance on selecting demographic assumptions used in measuring obligations under defined benefit pension plans. The general process for recommending demographic assumptions as defined in ASOP No. 35 is as follows:

- Identify the types of assumptions;
- Consider the relevant assumption universe;
- Consider the assumption format;
- Select the specific assumptions; and
- Evaluate the reasonableness of the selected assumption.

The purpose of the demographic experience study is to compare actual experience against expected experience based on the assumptions used in the most recent actuarial valuation. The observation period used in this study is January 1, 2013 through December 31, 2016, and the current assumptions are those adopted by the Board for the December 31, 2015 actuarial valuation. If the actual experience differs significantly from the overall expected experience, or if the pattern of actual decrements by age, sex, or duration does not follow the expected pattern, new assumptions are considered.

Confidence intervals have been used to measure observed experience against current assumptions to determine the reasonableness of the assumption. The floating bars represent the 50 percent and 90 percent confidence intervals around the observed experience. The 90 percent confidence interval represents the range around the observed rate that could be expected to contain the true rate during the period of study with 90 percent probability. The size of the confidence interval depends on the number of observations and the likelihood of occurrence. If an assumption is outside the 90 percent confidence interval and there is no other information to explain the observed experience, a change in assumption should be considered. A sample graph with confidence intervals is shown below:

Overview (continued)
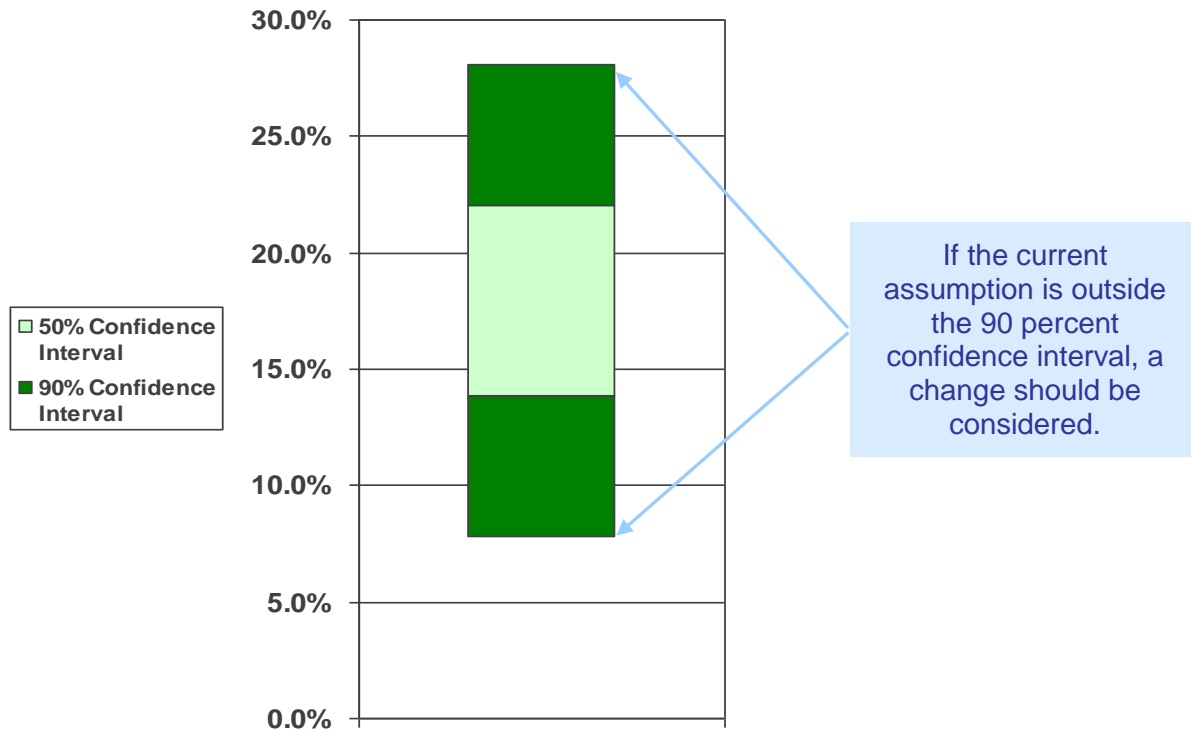
The demographic assumptions used for the December 31, 2015 actuarial valuation and the recommended assumptions for the December 31, 2016 and December 31, 2017 actuarial valuations are shown in detail in the following sections.

A summary of the changes recommended to the Board are as follows:

- Adjust mortality assumptions to use RP-2014 base tables and mortality improvement scale based on 60-year unisex average Social Security experience.
- Adjust retirement rates for certain member categories and service bands to more closely align with recent and expected future experience; reduce percentage of members assumed to elect a partial lump sum; increase percentage of members assumed to purchase credited service at retirement.
- Decrease the merit component of the salary increase assumption for two member categories based on observations of the last eight years of experience.
- Update pre-retirement termination of employment assumptions for three member categories.
- Lower assumed rates of ordinary (non-duty) disability to more closely match recent experience.
- Increase the Tier 1 unused vacation cash out assumption for most categories.
- Adjust the Tier 1/Tier 2 unused sick leave assumption for three member categories to more closely reflect recently observed experience.
- Decrease the healthy participation assumption for the RHIA retiree healthcare program.
- Decrease the RHIPA participation assumption for one service band.

The recommended assumptions, in our opinion, were selected in a manner consistent with the requirements of ASOP No. 35.

Mortality

Mortality rates are used to project the length of time benefits will be paid to current and future retirees and beneficiaries. The selection of a mortality assumption affects plan liabilities because the estimated value of retiree benefits depends on how long the benefit payments are expected to continue. There are clear differences in the mortality rates among healthy retired members, disabled retired members, and non-retired members. As a result, each of these groups is reviewed independently.

A summary of the current assumed mortality rates and recommended changes is shown below:

Assumption	December 31, 2015 Valuation	Recommended December 31, 2016 and 2017 Valuations
Healthy Annuitant Mortality	**RP-2000 Generational with Scale BB, Combined Active/Healthy Annuitant, Sex Distinct**	**RP-2014 Healthy Annuitant, Sex Distinct, Generational Projection with Unisex Social Security Data Scale**
▪ School District male	No collar, set back 24 months	White collar, set back 12 months
▪ Other General Service male (and male beneficiary)	Blended 25% blue collar/75% white collar, set back 12 months	Blended 50% blue collar/50% white collar, set back 12 months
▪ Police & Fire male	Blended 25% blue collar/75% white collar, set back 12 months	Blended 50% blue collar/50% white collar, set back 12 months
▪ School District female	No collar, set back 24 months	White collar, set back 12 months
▪ Other female (and female beneficiary)	Blended 25% blue collar/75% white collar, no set back	Blended 50% blue collar/50% white collar, no set back
Disabled Retiree Mortality	**RP-2000 Generational with Scale BB, Disabled, No Collar, Sex distinct**	**RP-2014 Disabled Retiree, Sex Distinct, Generational Projection with Unisex Social Security Data Scale**
▪ Male	70% of Disabled table, but not less than corresponding healthy annuitant rates	No collar adjustment, no set back
▪ Female	95% of Disabled table, but not less than corresponding healthy annuitant rates	No collar adjustment, no set back
Non-Annuitant Mortality	**Fixed Percentage of Healthy Annuitant Mortality**	**RP-2014 Employee, Sex Distinct, Generational Projection with Unisex Social Security Data Scale**
▪ School District male	60%	Same collar and set back as Healthy Annuitant assumption
▪ Other General Service male	75%	Same collar and set back as Healthy Annuitant assumption
▪ Police & Fire male	75%	Same collar and set back as Healthy Annuitant assumption
▪ School District female	55%	Same collar and set back as Healthy Annuitant assumption
▪ Other female	60%	Same collar and set back as Healthy Annuitant assumption

Mortality (*continued*)

Mortality Improvement Scale

Mortality rates are expected to continue to decrease in the future, and the resulting increased longevity should be anticipated in the actuarial valuation. For Oregon PERS, this is done through the use of a generational mortality assumption, which incorporates a base table and a projection scale. The base table defines the mortality rates assumed at each age in a single specific calendar year, while the projection scale defines how quickly the mortality rates at each individual age are assumed to improve in future calendar years.

The current assumed mortality improvement scale, Scale BB, was prepared by the Society of Actuaries (SOA) based on Social Security data through 2007. Since Scale BB was published, several additional years of Social Security data have become available and the SOA has released three "two-dimensional" mortality improvement scales in a period of three years (MP-2014, MP-2015, MP-2016). We understand that the SOA intends to release two-dimensional scales on an annual basis, and does not intend to develop or release any further "one-dimensional" scales.

There are a number of reasonable approaches to reflecting future mortality improvement in the valuation. One possibility is to adopt the latest two-dimensional scale released by the SOA. However, for reasons outlined below, we recommend adopting a mortality improvement scale based on 60-year unisex average mortality improvement rates by age, calculated using Social Security data (currently available through 2013). We believe this meets the *"best actuarial information on mortality at the time"* standard mandated by ORS 238.607. A full listing of the recommended projection scale rates is included in the appendix.

Two-dimensional projection scales are developed and applied using a technically complex method which assumes that, for any given birth year, age, and gender combination, mortality will improve by different amounts in different future years. This can be helpful when modeling historical "cohort effects," which occur when mortality improves more quickly for one generation of a population than for others. However, it's unclear whether future cohort effects are predictable based on historical data. Attempting to do so may be an example of "overfitting" an assumption to the data.

The risk of overfitting is that any unusual characteristic of recent data is effectively assumed to persist into the future, resulting in a less accurate and more volatile assumption. For example, the first two-dimensional scale released by the SOA was based on data through 2009, and mortality improvement had been relatively high in the last few years of the data set. Extrapolating those mortality improvement rates into the future resulted in an unusually optimistic picture of future longevity. As more data became available, it became clear that mortality improvement had actually slowed since 2009, so the SOA's most recent two-dimensional scale is markedly less optimistic than its first two-dimensional scale, even though the two scales were only published two years apart. Future SOA scales may continue to fluctuate from year to year as new data is added.

Rather than introducing this unpredictability, volatility, and complexity into a long-term assumption about how longevity will change in the future, we propose using a 60-year average of mortality improvement rates. The average improvement rate for ages 60 through 90 in aggregate has been remarkably stable for 60-year periods ending between 1985 and 2013, consistently falling between 0.9% and 1.1%.

In addition, we recommend using a unisex mortality improvement scale. Over the long-term, we have no reason to believe that mortality improvement will consistently favor one gender over the other. Over the past century, mortality improvement rates have been greater for females in some decades and males in others. But as of 2013, the 60-year average mortality improvement rates for males and females are similar in general and almost identical between ages 40 and 80. On this basis, we believe a unisex mortality improvement scale is appropriate as a long-term assumption.

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Mortality (*continued*)

Healthy Annuitant Mortality

Mortality assumptions for healthy retired members are separated into five groups based on employment category and gender (school district males, school district females, police & fire males, other general service males, all other females). Experience for female police & fire members was not sufficient for them to be rated on their own, so they were combined with non-school district general service females. Beneficiaries were also combined with non-school district general service members of the same gender.

To assist in review of the current mortality assumptions' reasonability, we calculated the ratio of actual deaths to expected deaths (A/E ratio) during the experience study period for each of the five groups described above. In the prior study, mortality assumptions were targeted to achieve an A/E ratio slightly above 100 percent (from 102 to 104 percent) on a headcount-weighted basis. In the current study, A/E ratios for most groups increased slightly compared to the prior study, with a somewhat larger increase for police & fire males.

	Headcount-Weighted		Current Assumption	
	Exposures	Actual Deaths	Expected Deaths	A/E Ratio
School District male	64,033	1,857	1,785	104%
Other General Service male (and male beneficiary)	108,686	3,262	3,126	104%
Police & Fire male	25,675	513	458	112%
School District Female	140,706	3,223	3,043	106%
Other female (and female beneficiary)	148,458	4,035	3,899	103%

We also analyzed A/E ratios on a benefits-weighted basis. This approach is recommended when setting mortality assumptions for pension plans because it takes into account the fact that members with larger benefits have a greater impact on total liabilities than those with smaller benefits, all else being equal. Consistent with the SOA's analysis of the US population as a whole, we found that PERS members with larger monthly pension benefits experienced lower mortality rates on average over the past four years than those with smaller benefits. As a result, A/E ratios on a benefits-weighted basis were lower than those on a headcount-weighted basis.

	Benefits-Weighted ($1,000s of monthly benefits)		Current Assumption		Recommended Assumption	
	Exposures	Actual Deaths	Expected Deaths	A/E Ratio	Expected Deaths	A/E Ratio
School District male	198,496	3,883	4,517	86%	3,757	103%
Other General Service male (and male beneficiary)	316,127	7,112	7,754	92%	7,265	98%
Police & Fire male	96,622	1,450	1,434	101%	1,404	103%
School District Female	293,768	4,200	4,633	91%	4,233	99%
Other female (and female beneficiary)	283,322	5,081	5,430	94%	5,211	98%

Mortality (*continued*)

The prior study, which used a headcount-weighted approach, targeted A/E ratios slightly above 100 percent to account for the expectation that a benefits-weighted approach would result in moderately lower weighted mortality rates. Based on the last four years of data, the difference between headcount-weighted and benefits-weighted experience has been somewhat larger than anticipated in the prior study. As a result, we recommend moving to a benefits-weighted approach for the current study.

Healthy Retiree Mortality
Aggregate Confidence Intervals and Rates
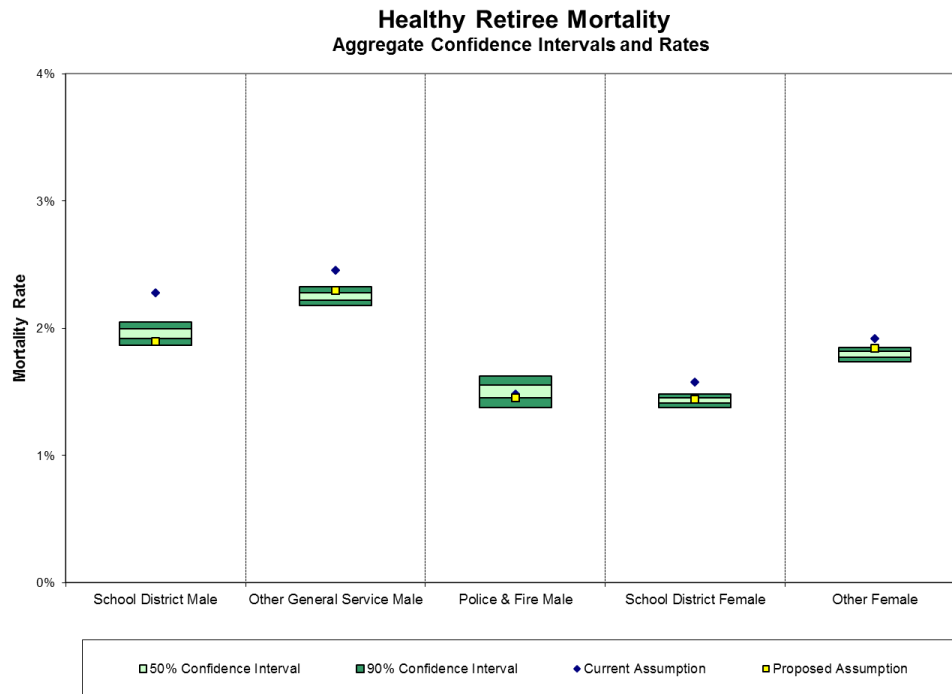
We also recommend moving from the RP-2000 mortality tables to the more-recent RP-2014 mortality tables as the underlying base tables for generational mortality assumptions in the current study. Since both sets of tables have a number of adjustments that can be applied to match the mortality rates of Oregon PERS, we believe either set of mortality tables would be an acceptable starting for this assumption, provided appropriate adjustments are applied. At times we use a "set back" to adjust the mortality rates. A "set back" of 12 months, for example, treats all members as if they were 12 months younger than they really are when applying the mortality table, which results in lower assumed mortality rates for members. In addition to a "set back," we have also applied a "collar" adjustment as defined in the RP-2014 table. Essentially, a "white collar" adjustment further reduces the rates of mortality while a "blue collar" adjustment increases the rates of mortality. Please note that "white collar" and "blue collar" are used in this context only to describe the adjustments made to the RP-2014 generational mortality table as applied to better create a table that closely matches PERS-specific mortality experience. Use of those tables is not intended to classify the nature of the employment of any members as either "blue collar" or "white collar", per se.

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Mortality (*continued*)

A summary of the current and recommended healthy retiree mortality assumptions is shown below:

	December 31, 2015 Valuation	**Recommended December 31, 2016 and 2017 Valuations**
Basic Table	RP-2000 Generational with Scale BB, Combined Active/Healthy Annuitant, Sex Distinct	RP-2014 Healthy Annuitant, Sex Distinct, Generational Projection with Unisex Social Security Data Scale
School District male	No collar, set back 24 months	White collar, set back 12 months
Other General Service male (and male beneficiary)	Blended 25% blue collar/75% white collar, set back 12 months	Blended 50% blue collar/50% white collar, set back 12 months
Police & Fire male	Blended 25% blue collar/75% white collar, set back 12 months	Blended 50% blue collar/50% white collar, set back 12 months
School District female	No collar, set back 24 months	White collar, set back 12 months
Other female (and female beneficiary)	Blended 25% blue collar/75% white collar, no set back	Blended 50% blue collar/50% white collar, no set back

Disabled Retiree Mortality

Disabled members are expected to experience higher mortality rates at a given age than healthy retired members. As a result, disabled member mortality experience is analyzed separately from that of healthy annuitants and beneficiaries. We recommend using the RP-2014 Disabled Retiree mortality tables and the 60-year average unisex Social Security projection scale as the starting point for setting disabled mortality assumptions in the current study. This will maintain a consistent basis for disabled and healthy retiree assumptions, as has been the case in prior studies.

In prior studies, we have recommended applying adjustments to the underlying disabled mortality tables published by the SOA in order to more-closely match assumptions to Oregon PERS experience. For this study, we compared recent experience to the RP-2014 Disabled Retiree mortality tables on both a headcount-weighted and a benefits-weighted approach to see whether similar adjustments would be advisable.

	Headcount-Weighted		**Current Assumption**		**Recommended Assumption**	
	Exposures	**Actual Deaths**	**Expected Deaths**	**A/E Ratio**	**Expected Deaths**	**A/E Ratio**
Disabled male	7,978	330	283	117%	325	102%
Disabled female	9,420	284	270	105%	273	104%

	Benefits-Weighted ($1,000s of monthly benefits)		**Current Assumption**		**Recommended Assumption**	
	Exposures	**Actual Deaths**	**Expected Deaths**	**A/E Ratio**	**Expected Deaths**	**A/E Ratio**
Disabled male	18,430	621	603	103%	680	91%
Disabled female	15,954	411	405	101%	403	102%

Mortality (*continued*)

For disabled males on a benefits-weighted basis, the A/E ratio differed moderately from the target of 100 percent. However, given the limited number of disabled retiree deaths in the experience period, a degree of volatility is to be expected. Using either a headcount-weighted or a benefits-weighted approach, the RP-2014 Disabled Retiree mortality tables fell within a 90 percent confidence interval around observed experience. On that basis, we do not recommend applying adjustments to these tables in order to more-closely match Oregon PERS experience.

Disabled Retired Mortality
Aggregate Confidence Intervals and Rates

A summary of current and recommended disabled retiree mortality assumptions is shown below:

	December 31, 2015 Valuation	Recommended December 31, 2016 and 2017 Valuations
Basic Table	**RP-2000 Generational with Scale BB, Disabled, No Collar, Sex Distinct**	**RP-2014 Disabled Retiree, Sex Distinct, Generational Projection with Unisex Social Security Data Scale**
Male	70% of Disabled table, but not less than corresponding healthy annuitant rates	No collar adjustment, no set back
Female	95% of Disabled table, but not less than corresponding healthy annuitant rates	No collar adjustment, no set back

Mortality (*continued*)

Non-Annuitant Mortality

The non-annuitant mortality assumption applies to active members and dormant members (those members who have terminated employment but are vested and entitled to a future benefit). As with the other mortality assumptions, we recommend using the RP-2014 mortality tables and the 60-year average unisex Social Security projection scale as the starting point for setting mortality assumptions for this group. This will maintain a consistent basis for mortality assumptions, as has been the case in prior studies.

For a given age and gender, an employed person is on average less likely to die in a given year than a retired person of the same age and gender. In prior studies we have recommended reflecting this difference by setting assumed non-annuitant mortality rates equal to a fixed percentage of assumed healthy annuitant mortality rates. This approach was possible in part because prior studies used the RP-2000 Combined mortality tables, which were developed by the SOA on a combined annuitant and non-annuitant basis. The RP-2014 mortality tables do not include combined tables, so for the current study we recommend using separate RP-2014 Healthy Annuitant and RP-2014 Employee mortality tables for healthy annuitants and non-annuitants, respectively. Each Healthy Annuitant table published by the SOA has a corresponding Employee table, which reflects differences in the rates at which these two populations die.

For each population subgroup, we recommend using the RP-2014 Employee table (including adjustments) that corresponds to the Healthy Annuitant table selected for that subgroup. For example, mortality for non-annuitant School District males will be assumed to follow the RP-2014 Employee table with white collar adjustment, set back 12 months, and will be projected generationally using the Social Security Unisex Scale.

The relative values of corresponding RP-2014 Employee and Healthy Annuitant mortality tables were developed by the SOA based on a much larger population than that of Oregon PERS. As a result, we believe it is preferable to reflect that relationship when developing non-annuitant versions of the recommended healthy annuitant mortality tables for Oregon PERS. The analysis below compares recent experience in aggregate for the non-annuitant population under this approach. This comparison was done on a headcount-weighted basis only, since the final level of retirement benefits cannot be predicted with certainty for current active members.

	Headcount-Weighted		Current Assumption		Recommended Assumption	
	Exposures	Actual Deaths	Expected Deaths	A/E Ratio	Expected Deaths	A/E Ratio
Total Non-Annuitant Experience	802,062	1,110	1,090	102%	1,115	99%

In aggregate, using the RP-2014 Employee mortality tables corresponding to the relevant recommended Healthy Annuitant mortality tables for each subgroup produces an A/E ratio very close to 100 percent, reinforcing the reasonableness of this approach.

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Mortality (*continued*)

A summary of the current and recommended non-annuitant mortality assumptions is shown below:

	December 31, 2015 Valuation	Recommended December 31, 2016 and 2017 Valuations
Basic Assumption	Fixed Percentage of Healthy Annuitant Mortality	**RP-2014 Employee, Sex Distinct, Generational Projection with Unisex Social Security Data Scale**
School District male	60%	White collar, set back 12 months
Other General Service male	75%	Blended 50% blue collar/50% white collar, set back 12 months
Police & Fire male	75%	Blended 50% blue collar/50% white collar, set back 12 months
School District female	55%	White collar, set back 12 months
Other female	60%	Blended 50% blue collar/50% white collar, no set back

Retirement Assumptions

The retirement assumptions used in the actuarial valuation include the following assumptions:

- Retirement from active status
- Probability a member will elect a lump sum option at retirement
- Percentage of members who elect to purchase credited service at retirement.
- Probability a member will remain an Oregon resident during retirement.

Retirement from Active Status

Members are eligible to retire as early as age 55 (50 for police & fire members), or earlier if the member has 30 years of service. In our analysis, we have found significant differences in the retirement patterns based on length of service, employment category (general service or police & fire), and eligibility for unreduced benefits.

A summary of the early, normal, and unreduced retirement dates under the plan are as follows:

Employment Category	Tier	Normal Retirement Age	Early Retirement Age	Unreduced Retirement
General Service	1	58	55	30 years of service
General Service	2	60	55	30 years of service
General Service	OPSRP	65	55	Age 58 with 30 years
Police & Fire	1 and 2	55	50	30 years of service, or age 50 with 25 years of service
Police & Fire	OPSRP	60	50	Age 53 with 25 years
State Judiciary	N/A	65	60	60 if Plan B; N/A if Plan A

Structure for Retirement Rates

The structure of the PERS retirement rate assumption separates rates by job classification and by service level. General service rates differ across three service bands: less than 15 years, 15 to 29 years, and 30 or more years of service. Each service band has different assumptions for school districts versus all other general service members. Police & fire rates employ the following three service bands: less than 13 years, 13 to 24 years, and 25 or more years of service.

The service band structure anticipates that member retirement decisions will contemplate the amount of the retirement benefit and the affordability of retirement.

School District and General Service Retirement Rates

Members with Less Than 15 Years of Service

Retirement decisions by members with less than 15 years of service are likely to be heavily influenced by the availability of resources other than PERS benefits, including Social Security, prior employment, spousal benefits, and savings.

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Retirement Assumptions (*continued*)

The following charts show the current assumed rates of retirement, the confidence interval around observed experience, and the recommended retirement rate assumption for school district and general service members retiring with less than 15 years of service.

School District
Members with less than 15 Years of Service

General Service
Members with less than 15 Years of Service
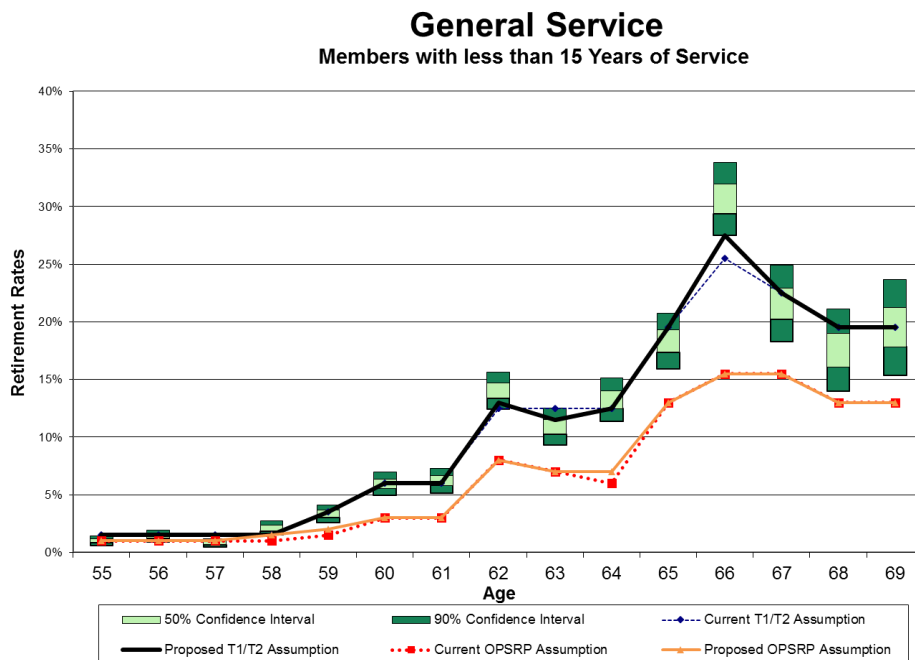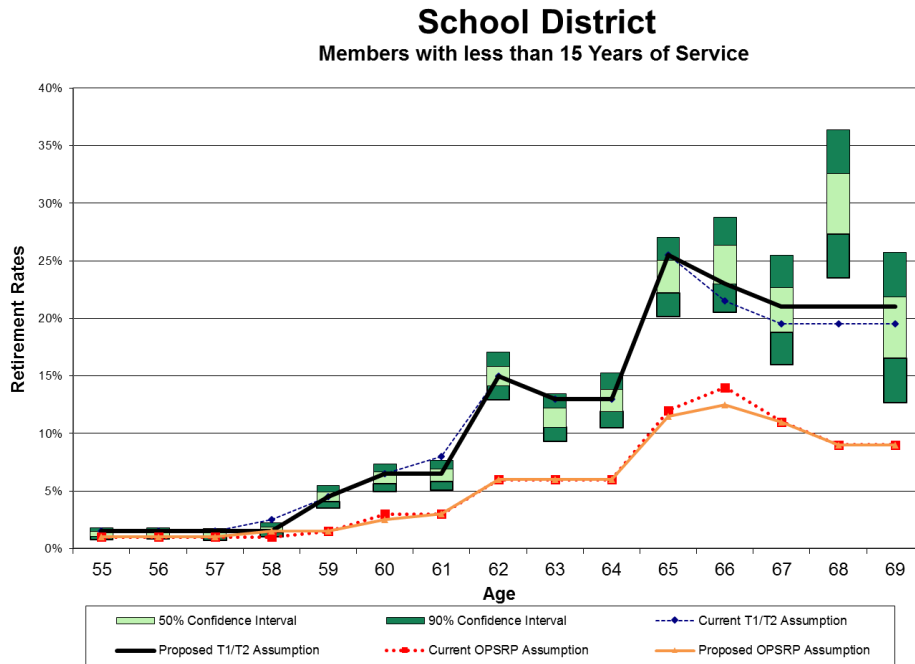
Retirement Assumptions (*continued*)

Members with 15 to 30 Years of Service

Retirement decisions by members with 15 to 29 years of service are likely to be influenced by the structure of PERS benefits as well as the availability of other resources, including Social Security, prior employment, spousal benefits, and savings.

The following charts show the current assumed rates of retirement, the confidence interval around observed experience, and the recommended retirement rate assumption for school district and general service members retiring with more than 15 years of service and less than 30 years of service.

School District
Members with 15 - 29 Years of Service

General Service
Members with 15 - 29 Years of Service
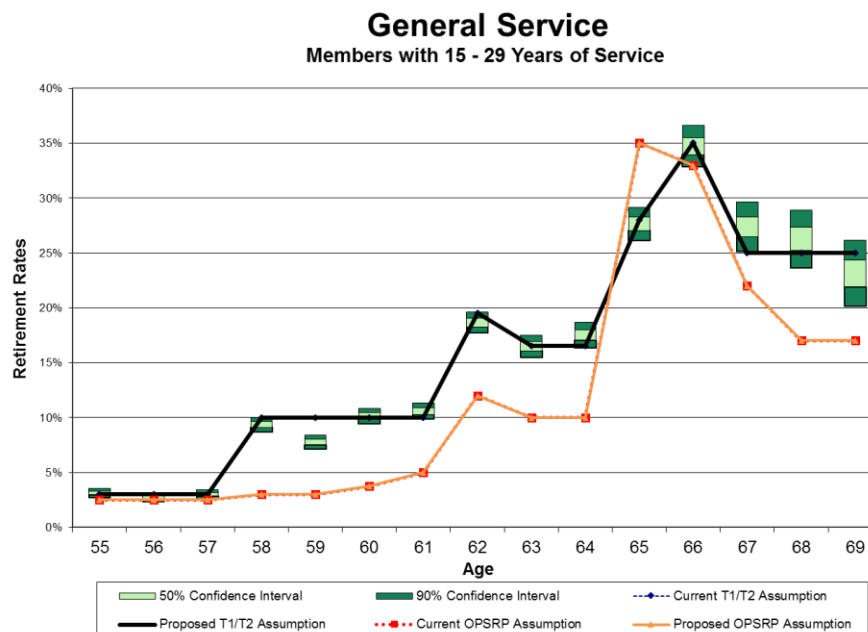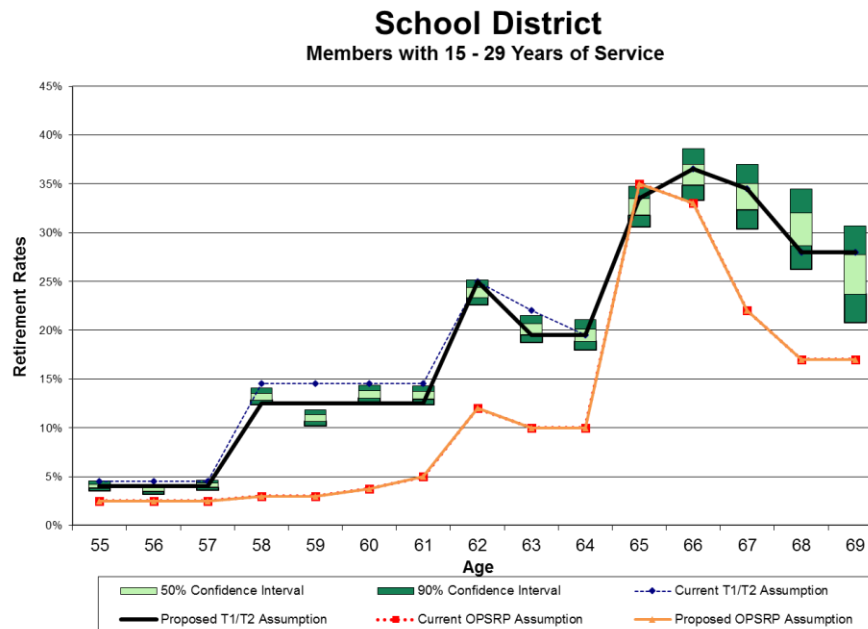
Retirement Assumptions (*continued*)

Members with 30 or More Years of Service

Members with 30 or more years of service are eligible for unreduced PERS benefits at any age (age 58 for OPSRP). As a result, retirement rates at all ages are relatively high, with a spike when Social Security benefits become available.

The following charts show the current assumed rates of retirement, the confidence interval around observed experience and the recommended retirement rate assumption for school district and other general service members retiring with more than 30 years of service.

School District
Members with 30+Years of Service

General Service
Members with 30+Years of Service
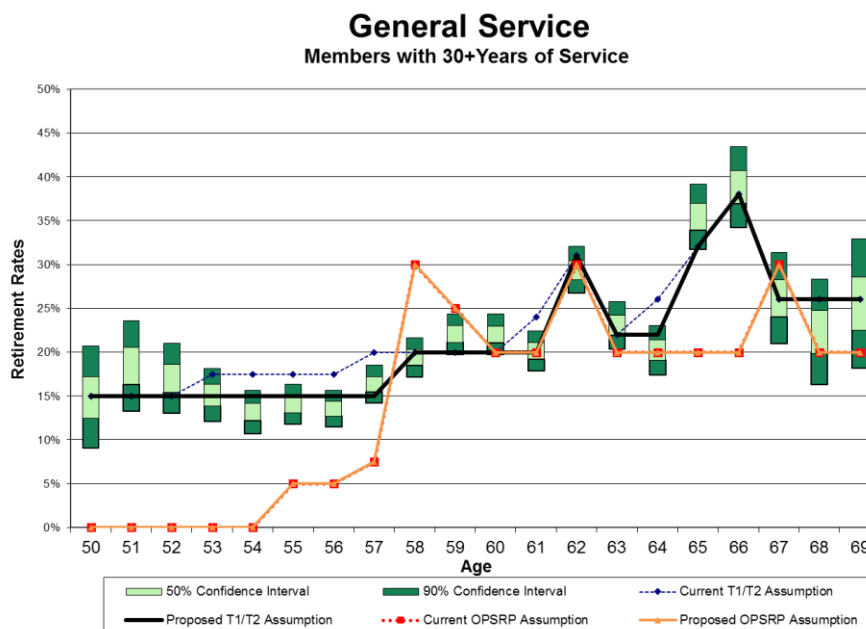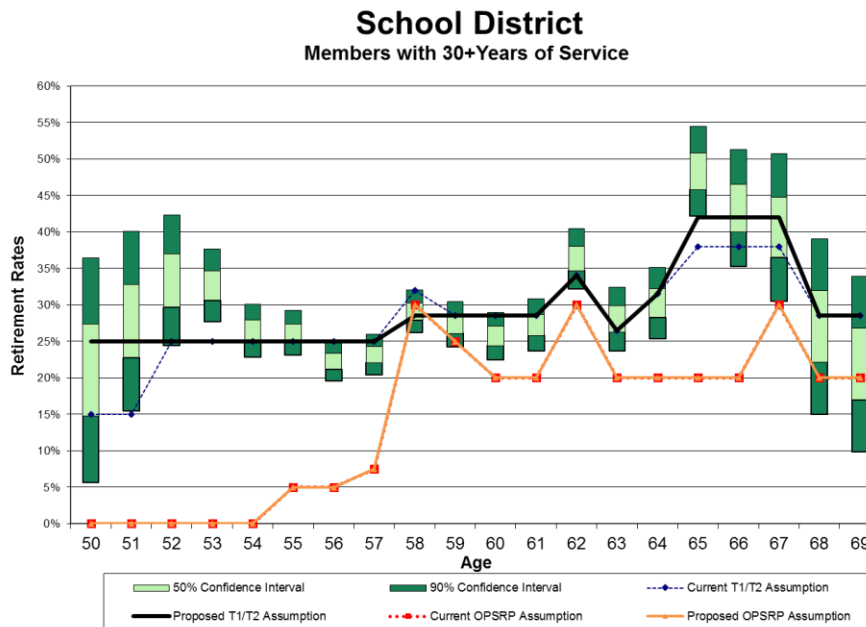
Retirement Assumptions (*continued*)

Police & Fire

Members with Less Than 13 Years of Service

The retirement assumption for police & fire members differs for members retiring with less than 13 years of service, those retiring with between 13 and 24 years of service, and those retiring with more than 25 years of service. Retirement decisions by members with less than 13 years of service are likely to be heavily influenced by the availability of resources other than PERS benefits, including Social Security, prior employment, spousal benefits, and savings.

The following graph shows the current assumed rates of retirement, the confidence interval around observed experience and the recommended retirement rate assumption for police & fire members retiring with less than 13 years of service.

Police & Fire
Members with less than 13 Years of Service
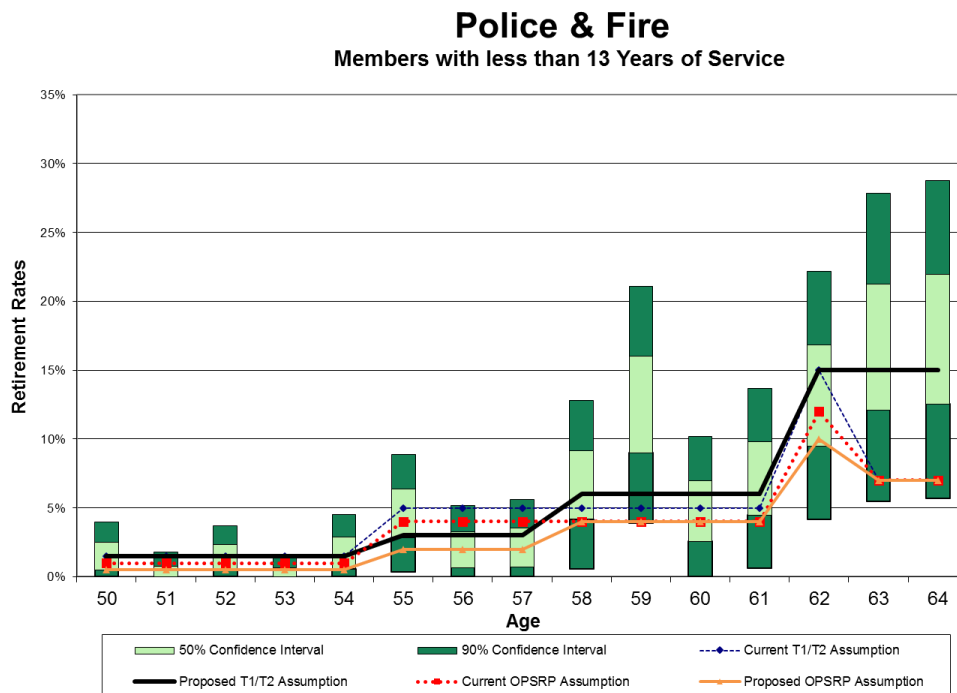
Retirement Assumptions (*continued*)

Members with 13 to 24 Years of Service

Retirement rates for members with 13 to 24 years of service are likely to be influenced by the structure of PERS benefits as well as the availability of other resources, including Social Security, prior employment, spousal benefits, and savings.

The following chart shows the current assumed rates of retirement, the confidence interval around observed experience, and the recommended retirement rate assumption for police & fire members retiring with between 13 and 24 years of service.

Police & Fire
Members with 13 - 24 Years of Service
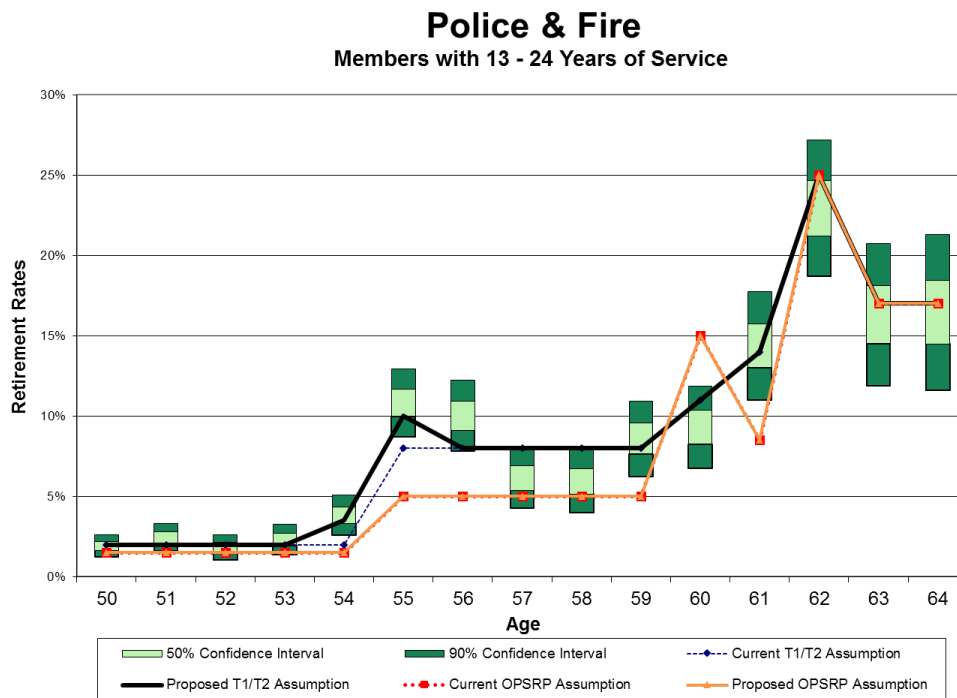
Retirement Assumptions (*continued*)

Members with 25 or More Years of Service

Police & fire members with 25 or more years of service can retire immediately at age 50 (53 for OPSRP) with unreduced retirement benefits. As a result, retirement rates at all ages are relatively high, with a spike at first eligibility for unreduced benefits, and another increase when Social Security benefits become available.

The following chart shows the current assumed rates of retirement, the confidence interval around observed experience, and the recommended retirement rate assumption for police & fire members retiring with more than 25 years of service.

Police & Fire
Members with 25+Years of Service
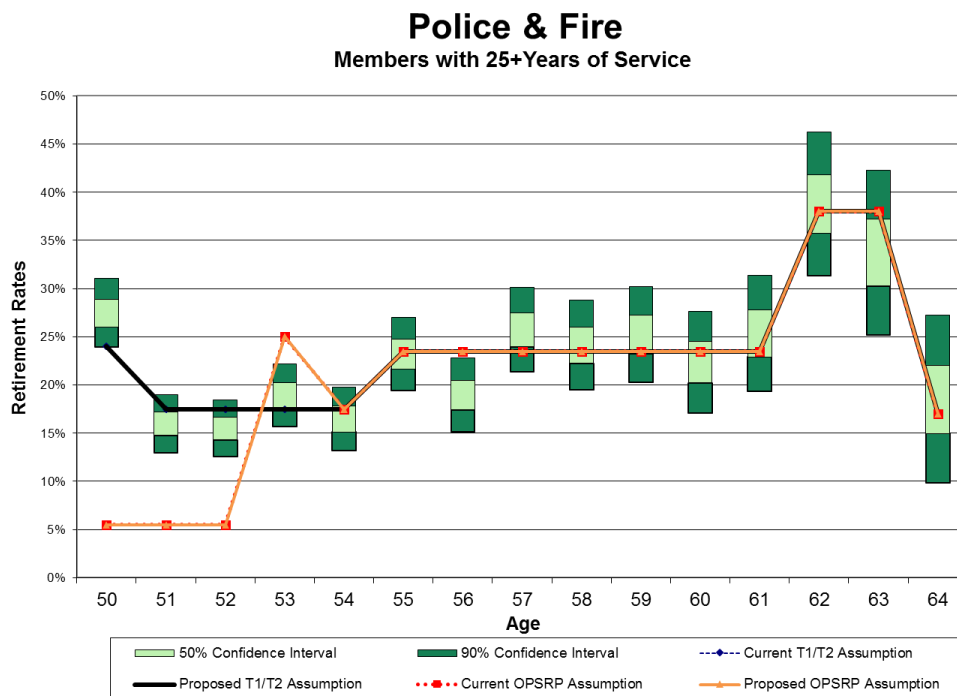
Retirement Assumptions (*continued*)

Judges

The vast majority of members of the State Judiciary elect to receive PERS benefits under Plan B. These benefits are available on an unreduced basis immediately upon retirement eligibility at age 60. As a result, there is relatively little variation in retirement rates by age for these members.

The following chart shows the current assumed rates of retirement, the confidence interval around observed experience, and the recommended retirement rate assumption for members of the State Judiciary.

Judge Members
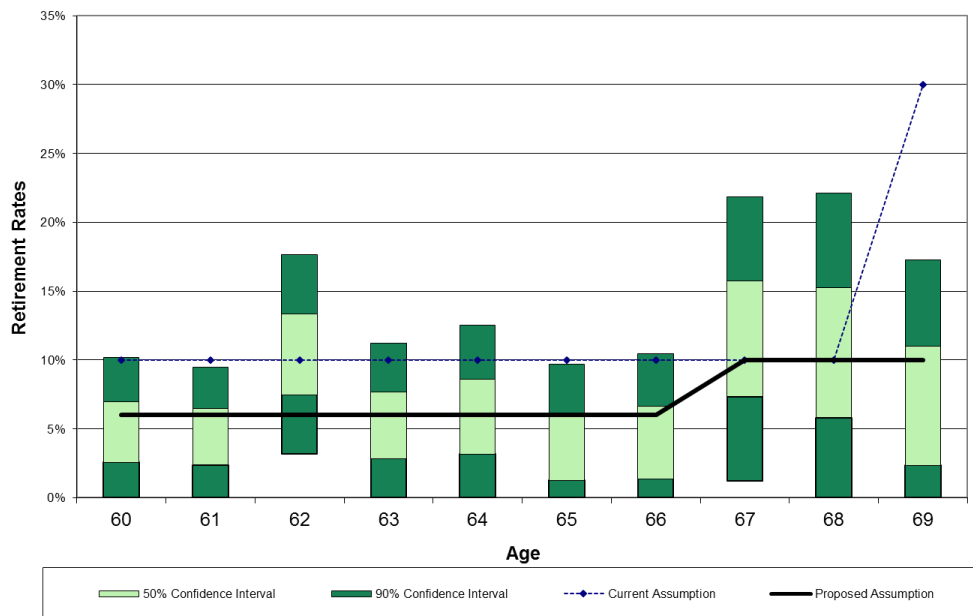
Retirement Assumptions (*continued*)

Summary of Recommended Retirement Rates

The following table summarizes our recommended Tier 1/Tier 2 retirement rates:

	Tier 1/Tier 2 Recommended December 31, 2016 and 2017 Valuations									
	Police & Fire			General Service			School Districts			Judges
Age	< 13 yrs	13-24 yrs	25+ yrs	<15 yrs	15-29 yrs	30+ yrs	<15 yrs	15-29 yrs	30+ yrs	
Less than 50						15.00%			25.00%	
50	1.50%	2.00%	24.00%			15.00%			25.00%	
51	1.50%	2.00%	17.50%			15.00%			25.00%	
52	1.50%	2.00%	17.50%			15.00%			25.00%	
53	1.50%	2.00%	17.50%			15.00%			25.00%	
54	1.50%	3.50%	17.50%			15.00%			25.00%	
55	3.00%	10.00%	23.50%	1.50%	3.00%	15.00%	1.50%	4.00%	25.00%	
56	3.00%	8.00%	23.50%	1.50%	3.00%	15.00%	1.50%	4.00%	25.00%	
57	3.00%	8.00%	23.50%	1.50%	3.00%	15.00%	1.50%	4.00%	25.00%	
58	6.00%	8.00%	23.50%	1.50%	10.00%	20.00%	1.50%	12.50%	28.50%	
59	6.00%	8.00%	23.50%	3.50%	10.00%	20.00%	4.50%	12.50%	28.50%	
60	6.00%	11.00%	23.50%	6.00%	10.00%	20.00%	6.50%	12.50%	28.50%	6.00%
61	6.00%	14.00%	23.50%	6.00%	10.00%	20.00%	6.50%	12.50%	28.50%	6.00%
62	15.00%	25.00%	38.00%	13.00%	19.50%	31.00%	15.00%	25.00%	34.00%	6.00%
63	15.00%	17.00%	38.00%	11.50%	16.50%	22.00%	13.00%	19.50%	26.50%	6.00%
64	15.00%	17.00%	17.00%	12.50%	16.50%	22.00%	13.00%	19.50%	31.50%	6.00%
65	100.00%	100.00%	100.00%	19.50%	28.00%	32.00%	25.50%	33.50%	42.00%	6.00%
66				27.50%	35.00%	38.00%	23.00%	36.50%	42.00%	6.00%
67				22.50%	25.00%	26.00%	21.00%	34.50%	42.00%	10.00%
68				19.50%	25.00%	26.00%	21.00%	28.00%	28.50%	10.00%
69				19.50%	25.00%	26.00%	21.00%	28.00%	28.50%	10.00%
70				100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

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Retirement Assumptions (*continued*)

The following table summarizes our recommended OPSRP retirement rates:

OPSRP Recommended December 31, 2016 and 2017 Valuations									
	Police & Fire			General Service			School Districts		
Age	< 13 yrs	13-24 yrs	25+ yrs	<15 yrs	15-29 yrs	30+ yrs	<15 yrs	15-29 yrs	30+ yrs
50	0.50%	1.50%	5.50%						
51	0.50%	1.50%	5.50%						
52	0.50%	1.50%	5.50%						
53	0.50%	1.50%	25.00%						
54	0.50%	1.50%	17.50%						
55	2.00%	5.00%	23.50%	1.00%	2.50%	5.00%	1.00%	2.50%	5.00%
56	2.00%	5.00%	23.50%	1.00%	2.50%	5.00%	1.00%	2.50%	5.00%
57	2.00%	5.00%	23.50%	1.00%	2.50%	7.50%	1.00%	2.50%	7.50%
58	4.00%	5.00%	23.50%	1.50%	3.00%	30.00%	1.50%	3.00%	30.00%
59	4.00%	5.00%	23.50%	2.00%	3.00%	25.00%	1.50%	3.00%	25.00%
60	4.00%	15.00%	23.50%	3.00%	3.75%	20.00%	2.50%	3.75%	20.00%
61	4.00%	8.50%	23.50%	3.00%	5.00%	20.00%	3.00%	5.00%	20.00%
62	10.00%	25.00%	38.00%	8.00%	12.00%	30.00%	6.00%	12.00%	30.00%
63	7.00%	17.00%	38.00%	7.00%	10.00%	20.00%	6.00%	10.00%	20.00%
64	7.00%	17.00%	17.00%	7.00%	10.00%	20.00%	6.00%	10.00%	20.00%
65	100.00%	100.00%	100.00%	13.00%	35.00%	20.00%	11.50%	35.00%	20.00%
66				15.50%	33.00%	20.00%	12.50%	33.00%	20.00%
67				15.50%	22.00%	30.00%	11.00%	22.00%	30.00%
68				13.00%	17.00%	20.00%	9.00%	17.00%	20.00%
69				13.00%	17.00%	20.00%	9.00%	17.00%	20.00%
70				100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

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Retirement Assumptions (*continued*)

Lump Sum Option at Retirement

At retirement, a member has the option of electing a total lump sum distribution equal to two times the member's account balance, a partial lump sum distribution equal to the member's account balance with a reduced monthly allowance, or a monthly allowance with no lump sum distribution. The percentage of active members electing a lump sum distribution at retirement has declined slightly from the prior experience study. The results of our analysis are as follows:

Election at Retirement	Number of Retired Members	Percentage of Retirements	December 31, 2015 Valuation Assumption	Recommended December 31, 2016 and 2017 Valuations
Partial Lump Sum	759	3.6%	4.5%	3.5%
Total Lump Sum				
• 2013	217	3.3%	N/A	N/A
• 2014	129	2.6%	N/A	N/A
• 2015	110	2.0%	3.0%	N/A
• 2016	98	2.4%	2.5%	N/A
• 2017	TBD	TBD	2.0%	No change
• 2018	TBD	TBD	1.5%	No change

When a member elects a total or partial lump sum under Money Match or a partial lump sum under Full Formula, he or she gives up the value of future COLAs (cost of living allowances) on the lump sum amount. A total lump sum election under Full Formula may cause the member to give up significantly more. Because there are no new contributions to member accounts and the system is projected to become dominated by Full Formula over time, we expect the total lump sum rate to decline over time.

Based on the data shown above, we recommend lowering the partial lump sum assumption of 4.5 percent to 3.5 percent. We recommend no change to the total lump sum assumption of 2.0 percent in 2017 decreasing by 0.5 percent per year until reaching 0.0 percent.

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Retirement Assumptions (*continued*)

Purchase of Credited Service

A member has the option of purchasing service at retirement to enhance his or her retirement benefits. Service may be purchased under one or more of the following categories:

- Purchase of forfeited service
- Credit for waiting time
- Credit for educational service
- Credit for military service
- Credit for seasonal positions
- Credit for police officers and firefighters
- Purchase of retirement credit for disability time

Most purchases are full cost purchases, meaning the member pays both the member and employer cost to obtain the service. Since the member pays the full cost of the service purchased, the purchase produces no impact or only a small impact on projected Tier 1/Tier 2 employer costs. The most common, and predictable, non-full cost service purchase made by members is purchasing credit for the six-month waiting period. Thus, for valuation purposes, we have included an adjustment to account for those members who are expected to make the waiting period service purchase.

For Money Match retirements, the purchase of credited service is generally cost-neutral to the system, because the member is depositing both the member and employer contributions. Therefore, in reviewing actual experience, we examined non-Money Match retirements. The following table shows the number of members who retired in the experience period and elected to purchase credit for the six-month waiting period:

	Count	Number Electing to Purchase Waiting Time Service	Percentage of Retirements	December 31, 2015 Valuation Assumption	Recommended December 31, 2016 and 2017 Valuations
Non-Money Match Retirements	12,112	7,938	66%	60%	65%

We recommend increasing the assumption of non-Money Match retirements purchasing credited service for the six month waiting period from 60 percent to 65 percent.

Retirement Assumptions (*continued*)

Oregon Residency Status

Members who are eligible for a tax remedy benefit adjustment under Senate Bill 656 or House Bill 3349 may only receive the adjustment as long as they remain residents of Oregon for tax purposes following retirement. Since a member's residency status may change multiple times during retirement, the residency status of a newly retired member may not be representative of that member's probability of remaining resident later in retirement. As such, we analyzed the entire current population of retired members and beneficiaries who are eligible for a tax remedy and compared to the number who are currently receiving a tax remedy. The results of that analysis are as follows:

Number Eligible for Tax Remedy	Number Receiving Tax Remedy	Percentage Receiving Tax Remedy	December 31, 2015 Valuation Assumption	Recommended December 31, 2016 and 2017 Valuations
114,810	97,686	85%	85%	85%

Disability Incidence Assumptions

The Plan provides duty and non-duty disability benefits to members. Members are eligible to receive duty disability benefits if they become disabled as a direct result of a job-related injury or illness, regardless of length of service. Members are eligible for non-duty disability benefits (also referred to as ordinary disability) if they become disabled after ten years of service (six years if a judge), but prior to normal retirement eligibility.

Duty disability incidence rates are developed separately for police & fire and general service members. Ordinary (non-duty) disability rates are developed for the system as a whole.

Duty Disability

Due to the limited amount of experience data available at some ages, this assumption employs a standard table adjusted to fit within the aggregate confidence interval.

The current assumed aggregate rate for the general service assumption is above actual observed experience, but within the 90 percent confidence interval. As such, we recommend maintaining the current assumption and continuing to monitor experience in the next study.

Duty Disability Rates - General Service
Aggregate Confidence Intervals and Rates
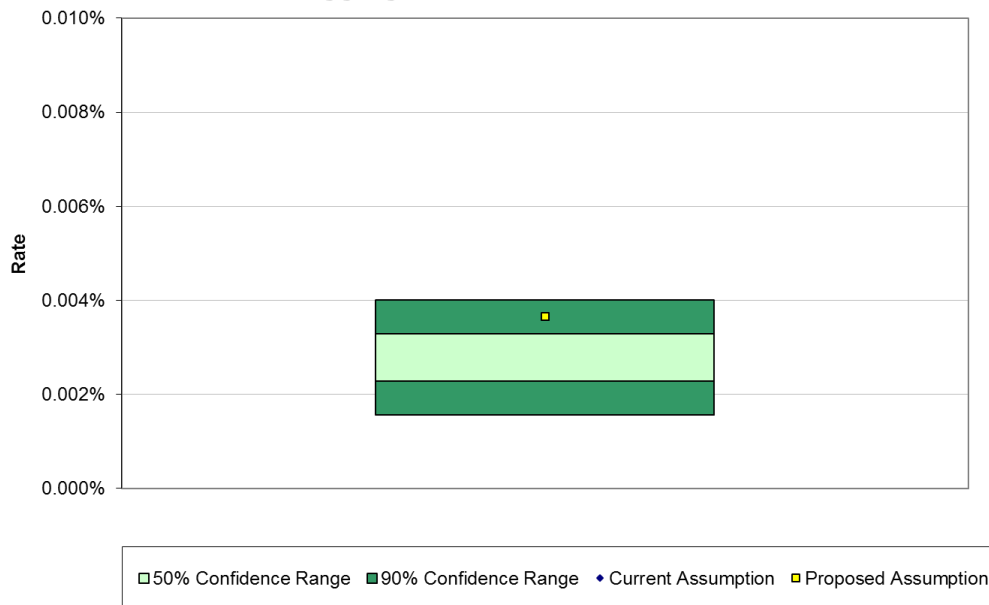
The current assumed aggregate rate for police & fire members is above actual observed experience, but within the 90 percent confidence interval. As such, we recommend maintaining the current assumption and continuing to monitor experience in the next study.

Disability Incidence Assumptions (*continued*)

Duty Disability Rates - Police & Fire
Aggregate Confidence Intervals and Rates
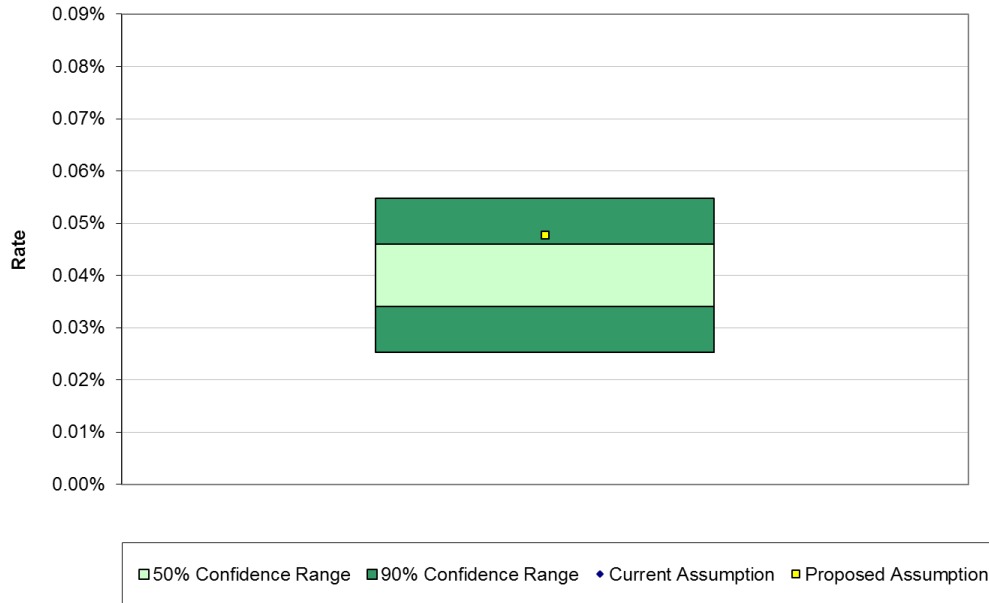
Ordinary (Non-Duty) Disability

As with duty disability, the experience data for ordinary disability was very limited at specific ages. Therefore, this assumption also uses a standard table adjusted to fit within the aggregate confidence interval. Based on the disability rates experienced in the observation period, we recommend lowering the ordinary disability incidence assumption at this time.

The data underlying the ordinary disability study showed a pattern wherein a member's record would only be recognized as a disability retirement (rather than a service retirement or other separation from service) after a lag period that could span over a year. Because such lagged experience is not yet available for 2016, the final year of our study, we included in our analysis an assumption as to additional disabilities occurring in 2016 that will not be apparent until the subsequent reporting period. This assumption was based on an average of such records observed in the first three years of the study.

Disability Incidence Assumptions (*continued*)

Ordinary Disability
Aggregate Confidence Intervals and Rates
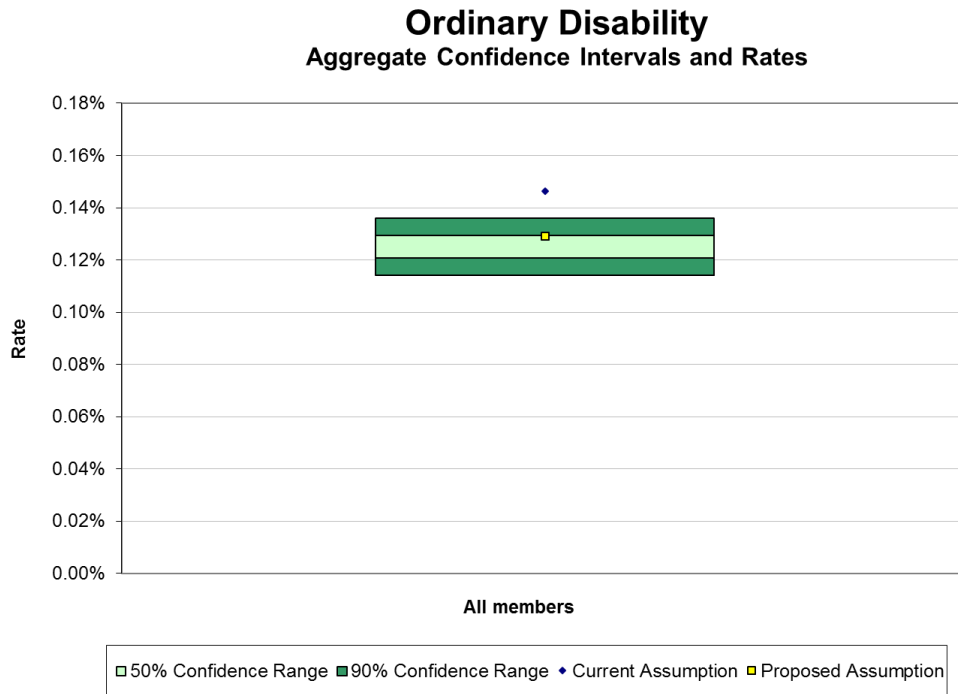
The following table summarizes our recommended disability incidence rate assumptions:

	Percentage of the 1985 Disability Class 1 Rates (sample rates shown for ages 20–55)	
	December 31, 2015 Valuation	**Recommended December 31, 2016 and 2017 Valuations**
Duty Disability		
• Police & Fire	20% (0.0060%–0.1690%)	No change
• General Service	0.9% (0.0003%–0.0076%)	No change
Ordinary Disability	50% with 0.18% cap (0.0150%–0.1800%)	35% with 0.18% cap (0.0105%–0.1800%)

Termination Assumptions

Not all active members are expected to continue working for covered employers until retirement. Termination rates represent the probabilities that a member will leave covered employment for causes other than retirement, disability or death at any given point during their working career.

Termination rates have been developed as service-based assumptions. The service-based assumptions reflect the experience of Tier 1, Tier 2, and OPSRP members, with each group affecting the period of the table relating to the relevant service amount.

Assumptions are developed for the following groups:

- School District males
- School District females
- Other General Service males
- Other General Service females
- Police & Fire (single table for both males and females)

Termination Rates

The following charts show the confidence interval around observed experience and the recommended rates of termination by year of service. These charts are based on the observed experience of members in the relevant group during the study period. We recommend changes to the assumptions for school district males, school district females, and non-school district general service males. For the other two groups, we recommend maintaining the current assumption and evaluating again with the next study.

Full listings of recommended termination assumptions are included in the appendix.

School Districts

School District Male
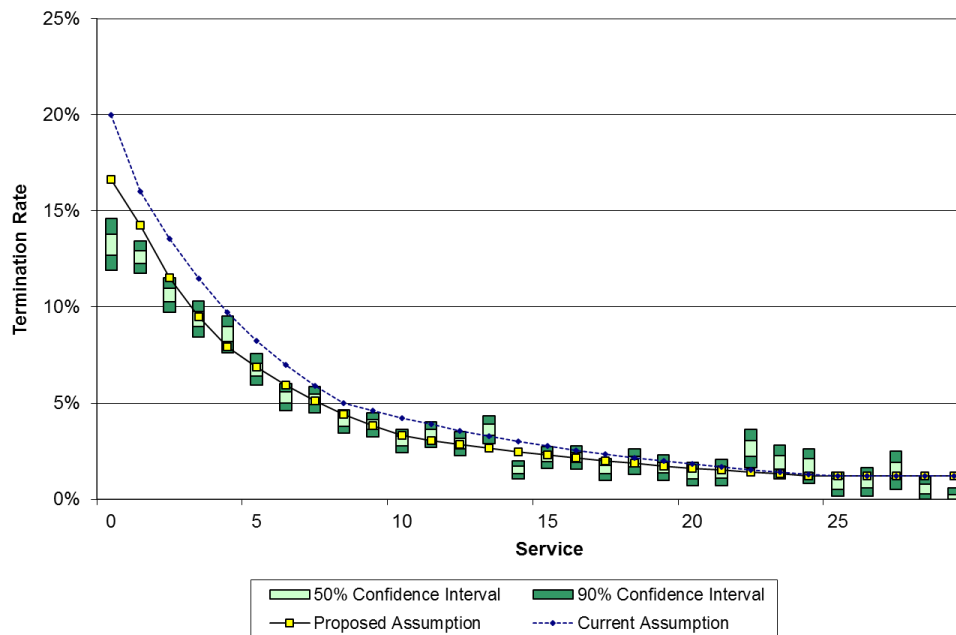
Termination Assumptions (*continued*)

School District Female
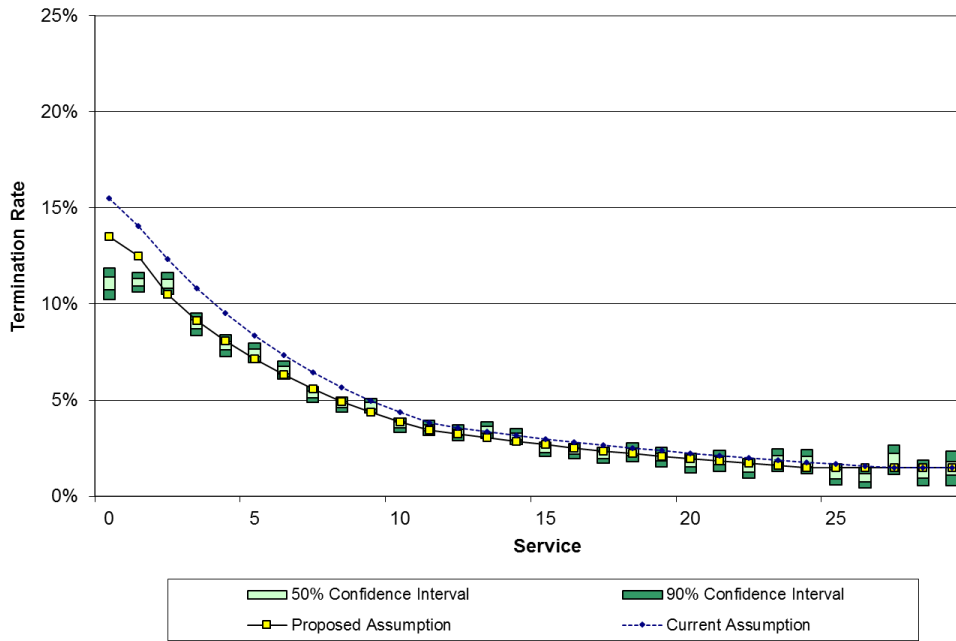
General Service

Other General Service Male
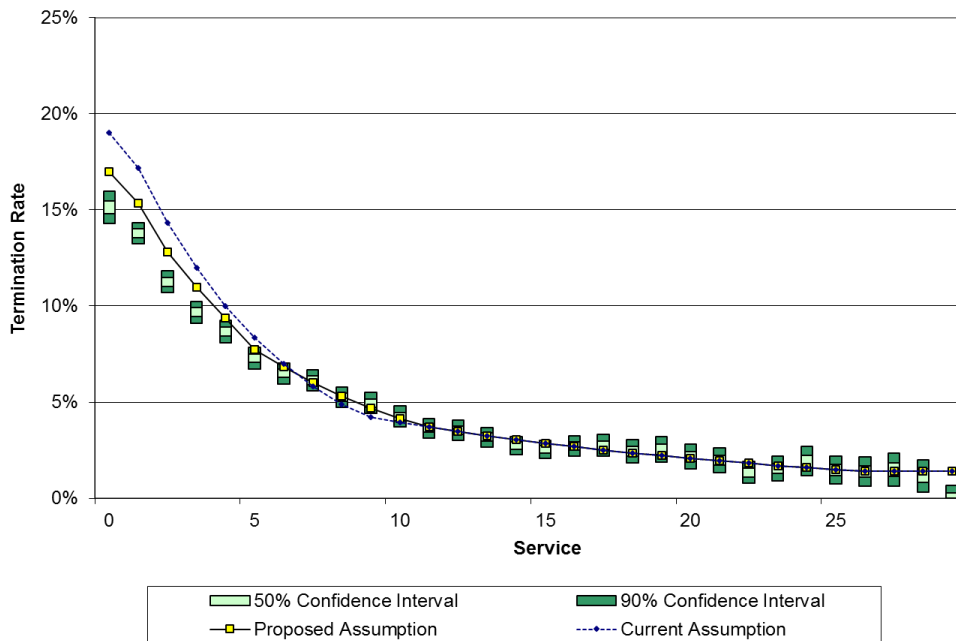
Termination Assumptions (*continued*)

Other General Service Female
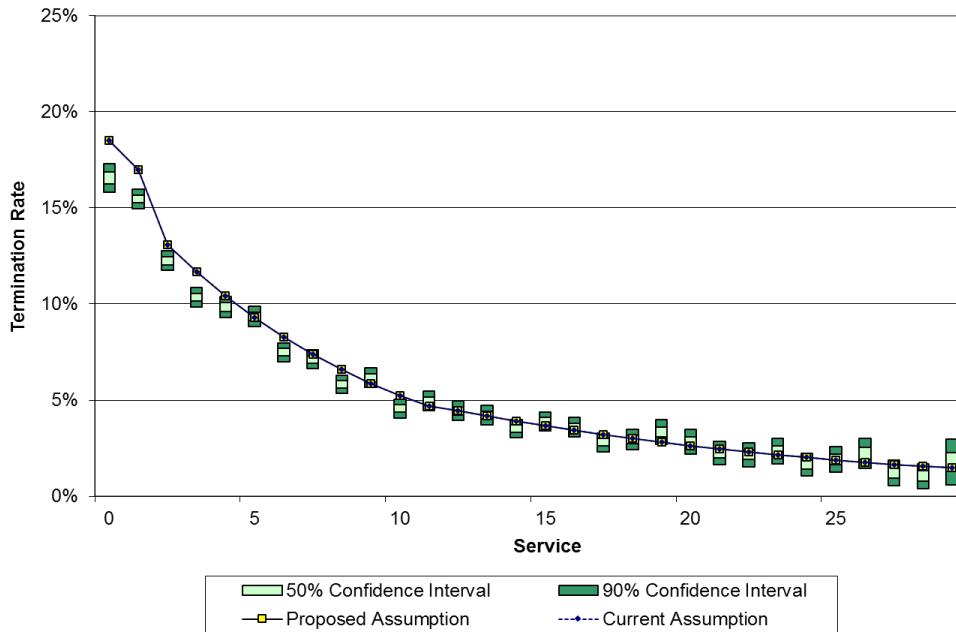
Police & Fire

All police & fire members were rated together, with no variation by group or gender.

Police & Fire
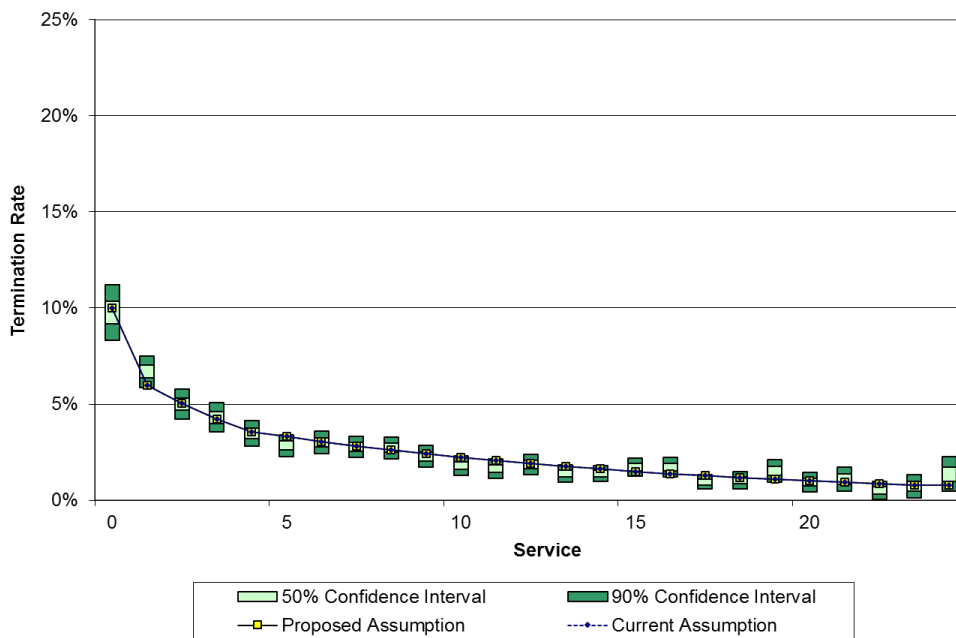
Salary Increase Assumptions

The salary increase assumptions analyzed with demographic experience were:

- Merit scale increases
- Unused sick leave adjustments
- Unused vacation cash out adjustments

Merit Scale

The merit scale assumption is used in conjunction with the inflation and real wage growth assumptions to project individual member salaries to retirement. In developing this assumption, our analysis first focused on the gross pay increases experienced by members during the study period. The assumed merit (or longevity) component was then determined by backing out assumed inflation and real wage growth.

In order to capture experience across a broader range of budget, collective bargaining, and economic cycles, the analysis covered observed salary experience from 2008 through 2016.

Assumptions are developed for the following groups:

- School Districts
- Other General Service
- Police & Fire

The following charts show the current assumed rates of gross salary increases, the eight-year average of pay increases based on observed experience, and the recommended rates of gross salary increases. We recommend maintaining the current salary increase assumption for school districts, and reducing the assumptions for the other two groups. Where we have proposed new assumptions, the proposed rates strike a balance between the previous assumptions and the experience observed in the study period.

School Districts
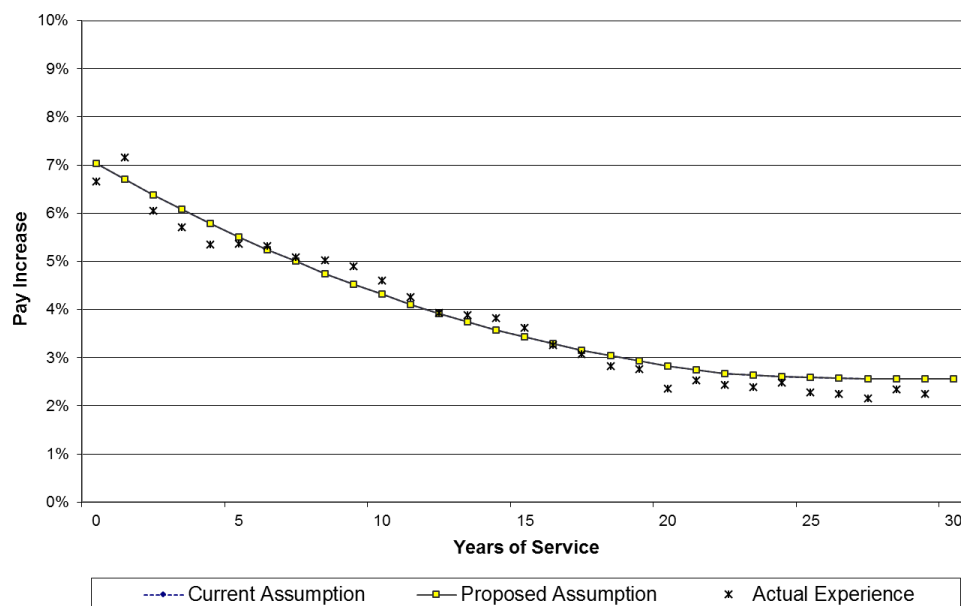
Salary Increase Assumptions (*continued*)

Other General Service
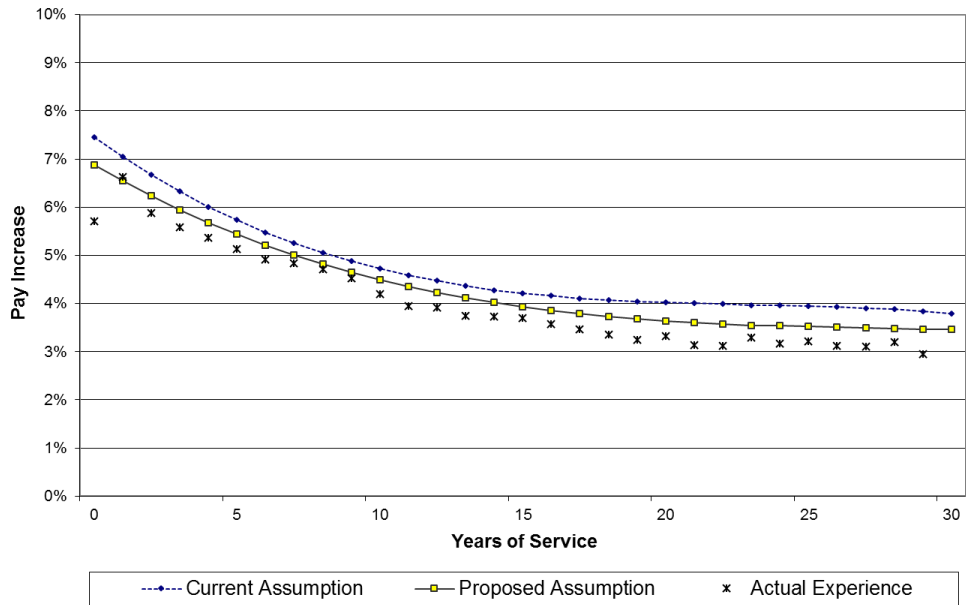
Police & Fire
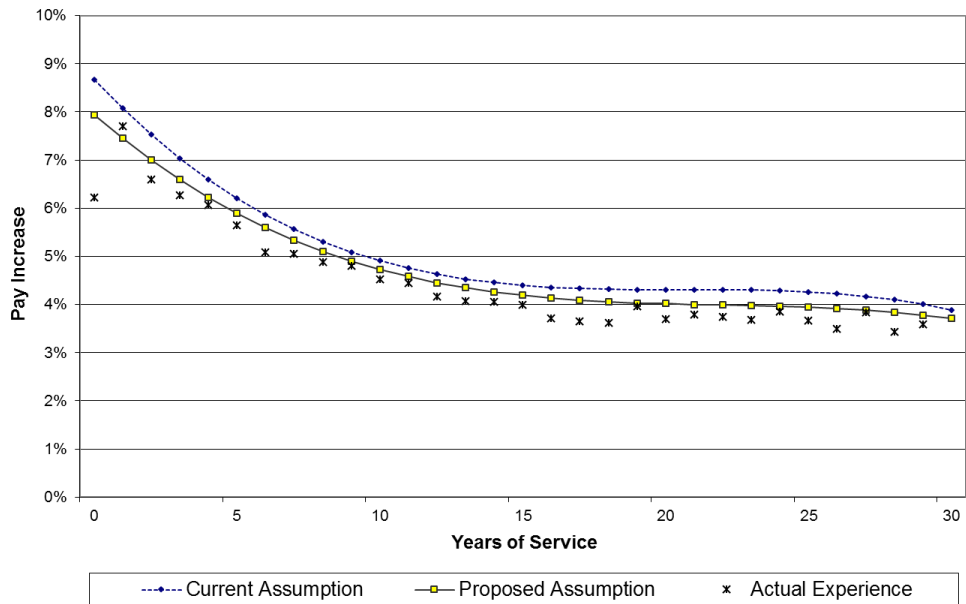
Salary Increase Assumptions (*continued*)

Unused Sick Leave Adjustment

Employers may elect to participate in the Unused Sick Leave Program. This program allows Tier 1/Tier 2 members to convert the value of one-half of their accumulated sick leave into additional retirement benefits. The assumption represents the percentage increase in a member's final average pay due to the inclusion of the value of 50 percent of the member's accumulated sick leave, and is only applied to employers who participate in the program.

For active members, there are currently eight sets of rates developed by employer group, employment category (general service or police & fire), and gender. In addition, a single rate is developed for eligible dormant members. The chart below shows the current assumption, the four-year average of the observed experience, and the recommended assumption for each of the groups studied. If the current assumption is not visible on the chart, it is the same as the proposed assumption.

Unused Sick Leave Adjustment
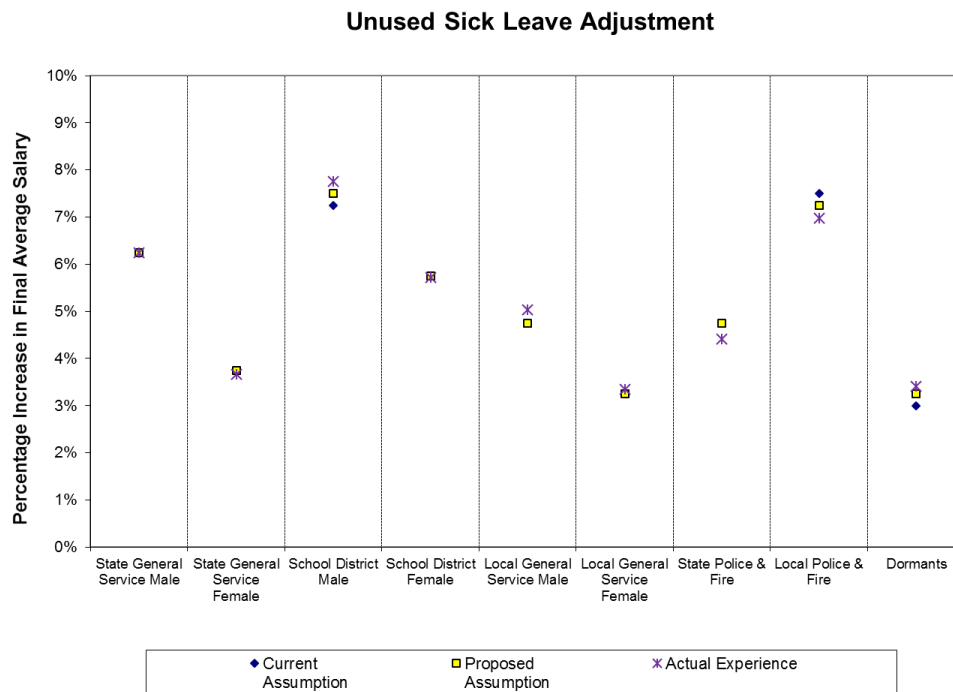
Due to the volatility in experience from one study to the next, for the groups where we recommended changes the recommended change is between the prior assumption and the actual observed experience. How closely the recommended assumption is set to the recently observed experience is influenced by the sample size of the particular group.

Salary Increase Assumptions (*continued*)

Unused Vacation Cash Out Adjustment

Tier 1 members are eligible to include the value of any lump sum payment of unused vacation pay in the calculation of their final average salary. The assumption shown below represents the percentage increase in a member's final average salary expected to result from this provision.

Unused Vacation Cash Out Adjustment
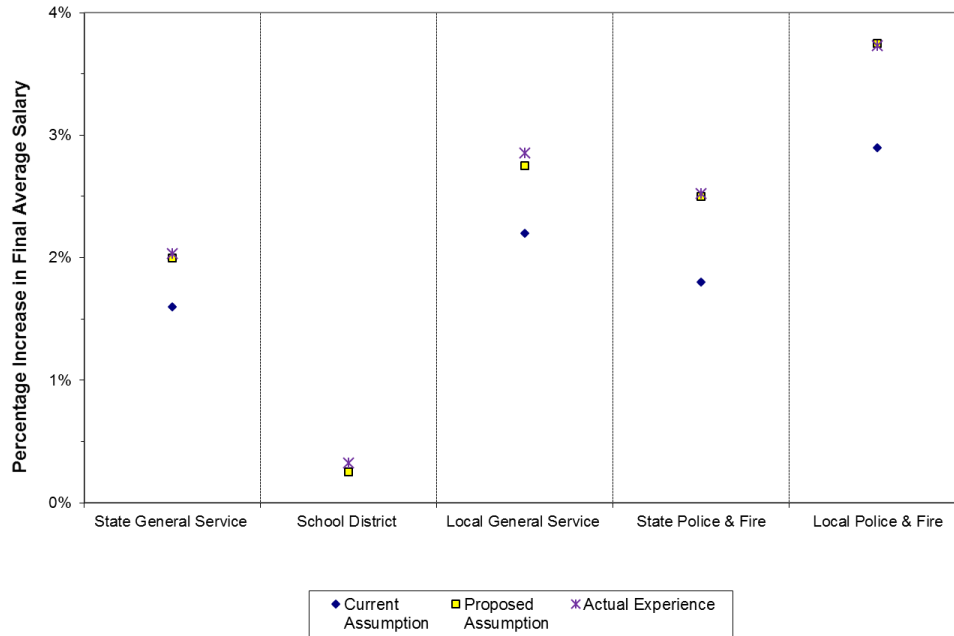
Retiree Healthcare Assumptions

There are two retiree healthcare programs offered to eligible members, the Retiree Health Insurance Premium Account (RHIPA) and the Retiree Health Insurance Account (RHIA).

RHIPA

RHIPA is a program for eligible retirees from State of Oregon employment that provides a subsidized pre-Medicare insurance plan. In the previous valuation, the participation rate assumption for future eligible retirees varied based on service at the time of retirement, as the level of employer-paid benefits in the RHIPA program varies by service level. We recommend continuing this structure for the assumption.

The current assumptions matched observed experience well overall. We recommend decreasing the assumed participation level at one age range, as shown below. The level of participation in RHIPA may be affected, at least in part, by economic conditions, cost of coverage, competition from alternative programs available to retirees, and the impact of healthcare reform legislation becoming effective. Since changes in these factors could change participation rates in RHIPA quickly and because the program's funded status is very low, we recommend that PERS closely monitor participation on a regular basis.
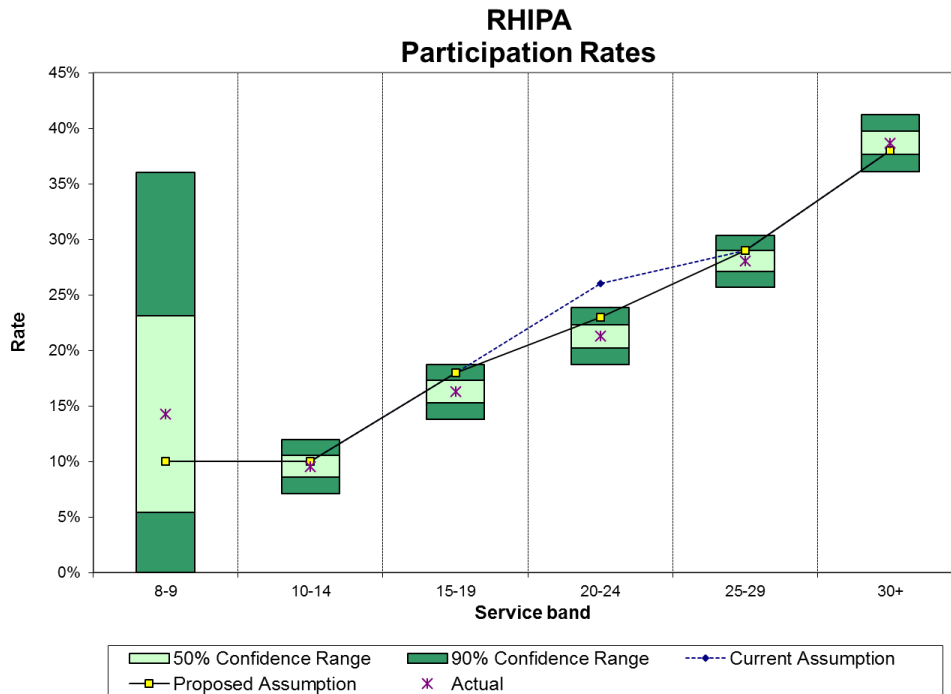
Retiree Healthcare Assumptions (*continued*)

RHIA

RHIA is a subsidized Medicare supplemental insurance program offered to all eligible retirees. Participation rates during the period of study decreased to approximately 35 percent for healthy retirees compared to the current assumption of 38 percent. For disabled retirees, the participation followed the current assumption of 20 percent fairly closely. As shown in the table below, we recommend decreasing the healthy assumption to 35 percent and maintaining the disabled assumption of 20 percent.

The data underlying this study showed a pattern wherein members would sometimes not appear until one or two years following retirement (or reaching age 65 if already retired). This may be due to a combination of participant behavior and administrative delay. Because such lagged experience is not yet available for the final two years of our study, we included in our analysis an assumption as to the number of additional enrollments not yet reported for members who retired (or reached age 65 if already retired) during 2015 or 2016. This assumption was based on the number of such records observed in the first two years of the study

RHIA
Participation Rates

This work product was prepared solely for Oregon Public Employees Retirement System for the purposes stated herein, and may not be appropriate to use for other purposes. Milliman does not intend to benefit and assumes no duty or liability to other parties who receive this work. Milliman recommends that third parties be aided by their own actuary or other qualified professional when reviewing the Milliman work product.

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5. Appendix

Data

Except where noted, the analysis in this study was based on data for the experience period from January 1, 2013 to December 31, 2016 as provided by the Oregon Public Employees Retirement System (PERS). PERS is solely responsible for the validity, accuracy and comprehensiveness of this information; the results of our analysis can be expected to differ and may need to be revised if the underlying data supplied is incomplete or inaccurate.

The member data was summarized according to the actual and potential member decrements for each year in the study. Actual and potential decrements were grouped according to age or service depending on the demographic assumption.

Assumption Tables

A complete listing of all the assumptions, methods and procedures presented to the Board for review on July 28, 2017 that are to be used in the December 31, 2016 and December 31, 2017 actuarial valuations are summarized on the following pages.

Methods and Procedures

Actuarial cost method: Entry Age Normal

UAL amortization method: Level percent of combined Tier 1, Tier 2, and OPSRP payroll

UAL amortization period:

- Closed amortization from the first rate setting valuation in which the experience is recognized
  - Tier 1/Tier 2 – 20 years
  - OPSRP – 16 years
  - RHIA/RHIPA – 10 years
- New side accounts are aligned with the new Tier 1/Tier 2 base from the most recent rate-setting valuation.
- New transition liabilities are amortized over the 18-year period beginning when the employer joins the SLGRP.

Asset valuation method: Market value

Excluded reserves: Contingency Reserve, Capital Preservation Reserve. Rate Guarantee Reserve is excluded only when it is positive.

Contribution Rate Stabilization Method: Contribution rates for a rate pool (e.g. Tier 1/Tier 2 SLGRP, Tier 1/Tier 2 School Districts, OPSRP) are confined to a collar based on the prior contribution rate (prior to application of side accounts, pre-SLGRP liabilities, and 6 percent Independent Employer minimum). The new contribution rate will generally not increase or decrease from the prior contribution rate by more than the greater of 3 percentage points or 20 percent of the prior contribution rate. If the funded percentage excluding side accounts drops below 60% or increases above 140%, the size of the collar doubles. If the funded percentage excluding side accounts is between 60% and 70% or between 130% and 140%, the size of the rate collar is increased on a graded scale.

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Liability Allocation for Actives with Several Employers: Allocate Actuarial Accrued Liability 15% (0% for police & fire) based on account balance with each employer and 85% (100% for police & fire) based on service with each employer.

Allocate Normal Cost to current employer.

Allocation of Benefits-In-Force (BIF) Reserve: The BIF is allocated to each rate pool in proportion to the retiree liability attributable to the rate pool.

Recommended Economic Assumptions

Inflation	2.50%
Real wage growth	1.00%
Payroll growth	3.50%
Investment Return	Decrease recommended; averages of reviewed 50th percentile estimates over 10 and 20 year time horizons fell in a range between 7.00% and 7.25%; Board will select the assumption at its July 28, 2017 meeting
Interest Crediting	
▪ Regular account	Equal to investment return assumption
▪ Variable account	Equal to investment return assumption
Health cost trend rates ▪ 2017 trend rate ▪ Ultimate trend rate ▪ Year reaching ultimate trend	 7.50% 4.20% 2093

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Demographic Assumptions

Mortality

	Healthy Annuitant Mortality - Sample Values										Beneficiary Mortality - Sample Values			
Age	School District Male		Other General Service Male		Police & Fire Male		School District Female		Other Female		Male		Female	
	RP2014 Annuitant White collar, Generational w/Social Security Data Scale, 1 year setback		RP2014 Annuitant 50%White/50% Blue collar blend, Generational w/Social Security Data Scale, 1 year setback		RP2014 Annuitant 50%White/50% Blue collar blend, Generational w/Social Security Data Scale, 1 year setback		RP2014 Annuitant White collar, Generational w/Social Security Data Scale, 1 year setback		RP2014 Annuitant 50%White/50% Blue collar blend, Generational w/Social Security Data Scale, 0 year setback		RP2014 Annuitant 50%White/50% Blue collar blend, Generational w/Social Security Data Scale, 1 year setback		RP2014 Annuitant 50%White/50% Blue collar blend, Generational w/Social Security Data Scale, 0 year setback	
Year of Birth	1950	1960	1950	1960	1950	1960	1950	1960	1950	1960	1950	1960	1950	1960
50	0.001254	0.001114	0.001785	0.001586	0.001785	0.001586	0.000998	0.000886	0.002896	0.002569	0.001785	0.001586	0.002896	0.002569
51	0.003229	0.002865	0.003989	0.003539	0.003989	0.003539	0.002426	0.002152	0.003056	0.002708	0.003989	0.003539	0.003056	0.002708
52	0.003446	0.003054	0.004257	0.003773	0.004257	0.003773	0.002519	0.002232	0.003222	0.002853	0.004257	0.003773	0.003222	0.002853
53	0.003661	0.003241	0.004537	0.004017	0.004537	0.004017	0.002620	0.002320	0.003388	0.003003	0.004537	0.004017	0.003388	0.003003
54	0.003869	0.003429	0.004840	0.004290	0.004840	0.004290	0.002729	0.002419	0.003563	0.003161	0.004840	0.004290	0.003563	0.003161
55	0.004077	0.003617	0.005142	0.004562	0.005142	0.004562	0.002850	0.002529	0.003748	0.003332	0.005142	0.004562	0.003748	0.003332
56	0.004294	0.003817	0.005443	0.004839	0.005443	0.004839	0.002984	0.002653	0.003954	0.003515	0.005443	0.004839	0.003954	0.003515
57	0.004475	0.003978	0.005731	0.005095	0.005731	0.005095	0.003143	0.002794	0.004183	0.003718	0.005731	0.005095	0.004183	0.003718
58	0.004675	0.004156	0.006033	0.005363	0.006033	0.005363	0.003323	0.002954	0.004442	0.003941	0.006033	0.005363	0.004442	0.003941
59	0.004901	0.004348	0.006359	0.005642	0.006359	0.005642	0.003532	0.003134	0.004732	0.004190	0.006359	0.005642	0.004732	0.004190
60	0.005150	0.004559	0.006713	0.005944	0.006713	0.005944	0.003770	0.003338	0.005059	0.004466	0.006713	0.005944	0.005059	0.004466
61	0.005424	0.004788	0.007102	0.006269	0.007102	0.006269	0.004039	0.003566	0.005491	0.004842	0.007102	0.006269	0.005491	0.004842
62	0.005724	0.005048	0.007529	0.006639	0.007529	0.006639	0.004478	0.003949	0.005951	0.005242	0.007529	0.006639	0.005951	0.005242
63	0.006060	0.005339	0.008008	0.007054	0.008008	0.007054	0.004929	0.004342	0.006443	0.005670	0.008008	0.007054	0.006443	0.005670
64	0.006442	0.005669	0.008548	0.007522	0.008548	0.007522	0.005394	0.004747	0.006970	0.006140	0.008548	0.007522	0.006970	0.006140
65	0.006881	0.006062	0.009158	0.008067	0.009158	0.008067	0.005877	0.005177	0.007542	0.006650	0.009158	0.008067	0.007542	0.006650
66	0.007392	0.006518	0.009847	0.008683	0.009847	0.008683	0.006386	0.005631	0.008166	0.007201	0.009847	0.008683	0.008166	0.007201
67	0.007983	0.007039	0.010620	0.009364	0.010620	0.009364	0.006930	0.006111	0.008854	0.007816	0.010620	0.009364	0.008854	0.007816
68	0.008670	0.007653	0.011487	0.010140	0.011487	0.010140	0.007522	0.006640	0.009611	0.008484	0.011487	0.010140	0.009611	0.008484
69	0.009457	0.008348	0.012450	0.010989	0.012450	0.010989	0.008168	0.007210	0.010455	0.009238	0.012450	0.010989	0.010455	0.009238
70	0.010360	0.009154	0.013527	0.011953	0.013527	0.011953	0.008887	0.007852	0.011389	0.010074	0.013527	0.011953	0.011389	0.010074
71	0.011381	0.010066	0.014724	0.013023	0.014724	0.013023	0.009685	0.008566	0.012427	0.011002	0.014724	0.013023	0.012427	0.011002
72	0.012522	0.011087	0.016048	0.014209	0.016048	0.014209	0.010572	0.009360	0.013576	0.012032	0.016048	0.014209	0.013576	0.012032
73	0.013792	0.012224	0.017515	0.015523	0.017515	0.015523	0.011559	0.010245	0.014849	0.013173	0.017515	0.015523	0.014849	0.013173
74	0.015197	0.013483	0.019135	0.016976	0.019135	0.016976	0.012660	0.011232	0.016255	0.014436	0.019135	0.016976	0.016255	0.014436
75	0.016752	0.014877	0.020929	0.018586	0.020929	0.018586	0.013888	0.012333	0.017832	0.015868	0.020929	0.018586	0.017832	0.015868
76	0.018499	0.016462	0.022945	0.020418	0.022945	0.020418	0.015281	0.013598	0.019609	0.017503	0.022945	0.020418	0.019609	0.017503
77	0.020478	0.018278	0.025223	0.022514	0.025223	0.022514	0.016869	0.015057	0.021567	0.019289	0.025223	0.022514	0.021567	0.019289
78	0.022675	0.020280	0.027737	0.024807	0.027737	0.024807	0.018637	0.016668	0.023688	0.021186	0.027737	0.024807	0.023688	0.021186
79	0.025080	0.022431	0.030459	0.027242	0.030459	0.027242	0.020566	0.018394	0.026049	0.023298	0.030459	0.027242	0.026049	0.023298
80	0.027791	0.024856	0.033492	0.029955	0.033492	0.029955	0.022731	0.020330	0.028730	0.025722	0.033492	0.029955	0.028730	0.025722
81	0.030912	0.027675	0.036941	0.033073	0.036941	0.033073	0.025205	0.022565	0.031845	0.028597	0.036941	0.033073	0.031845	0.028597
82	0.034590	0.031062	0.040956	0.036779	0.040956	0.036779	0.028098	0.025232	0.035495	0.032036	0.040956	0.036779	0.035495	0.032036
83	0.038955	0.035159	0.045668	0.041218	0.045668	0.041218	0.031510	0.028403	0.039806	0.036182	0.045668	0.041218	0.039806	0.036182
84	0.044168	0.040147	0.051233	0.046569	0.051233	0.046569	0.035563	0.032326	0.044840	0.041088	0.051233	0.046569	0.044840	0.041088
85	0.050315	0.046105	0.057728	0.052898	0.057728	0.052898	0.040333	0.036959	0.050635	0.046774	0.057728	0.052898	0.050635	0.046774
86	0.057445	0.053065	0.065187	0.060216	0.065187	0.060216	0.045869	0.042371	0.057308	0.053367	0.065187	0.060216	0.057308	0.053367
87	0.065697	0.061179	0.073748	0.068676	0.073748	0.068676	0.052298	0.048701	0.064841	0.060808	0.073748	0.068676	0.064841	0.060808
88	0.075049	0.070382	0.083370	0.078185	0.083370	0.078185	0.059620	0.055913	0.073307	0.069165	0.083370	0.078185	0.073307	0.069165
89	0.085582	0.080746	0.094130	0.088811	0.094130	0.088811	0.067919	0.064081	0.082779	0.078495	0.094130	0.088811	0.082779	0.078495
90	0.097378	0.092338	0.106107	0.100615	0.106107	0.100615	0.077274	0.073274	0.093323	0.088850	0.106107	0.100615	0.093323	0.088850
91	0.110516	0.105219	0.119371	0.113649	0.119371	0.113649	0.087761	0.083554	0.104990	0.100360	0.119371	0.113649	0.104990	0.100360
92	0.124901	0.119393	0.133755	0.127856	0.133755	0.127856	0.099460	0.095074	0.118055	0.113417	0.133755	0.127856	0.118055	0.113417
93	0.140778	0.135247	0.149481	0.143609	0.149481	0.143609	0.112668	0.108174	0.131897	0.127225	0.149481	0.143609	0.131897	0.127225
94	0.157313	0.151740	0.165636	0.159768	0.165636	0.159768	0.126793	0.122302	0.147262	0.142760	0.165636	0.159768	0.147262	0.142760
95	0.175409	0.170046	0.183151	0.177552	0.183151	0.177552	0.142600	0.138240	0.162870	0.158366	0.183151	0.177552	0.162870	0.158366
96	0.193509	0.188158	0.200380	0.194840	0.200380	0.194840	0.158826	0.154435	0.179525	0.175087	0.200380	0.194840	0.179525	0.175087
97	0.212663	0.207406	0.218410	0.213011	0.218410	0.213011	0.176296	0.171938	0.196617	0.192142	0.218410	0.213011	0.196617	0.192142
98	0.232197	0.226911	0.236535	0.231150	0.236535	0.231150	0.194403	0.189978	0.214329	0.209660	0.236535	0.231150	0.214329	0.209660
99	0.251925	0.246437	0.254563	0.249018	0.254563	0.249018	0.212935	0.208296	0.232307	0.227247	0.254563	0.249018	0.232307	0.227247
100	0.271449	0.265536	0.272166	0.266237	0.272166	0.266237	0.231612	0.226566	0.251116	0.245892	0.272166	0.266237	0.251116	0.245892
101	0.290491	0.284448	0.290491	0.284448	0.290491	0.284448	0.250589	0.245376	0.270261	0.264904	0.290491	0.284448	0.270261	0.264904
102	0.309871	0.303729	0.309871	0.303729	0.309871	0.303729	0.269720	0.264374	0.288629	0.282908	0.309871	0.303729	0.288629	0.282908
103	0.327966	0.321465	0.327966	0.321465	0.327966	0.321465	0.288052	0.282343	0.308174	0.302368	0.327966	0.321465	0.308174	0.302368
104	0.347090	0.340551	0.347090	0.340551	0.347090	0.340551	0.307588	0.301794	0.327741	0.321890	0.347090	0.340551	0.327741	0.321890
105	0.365929	0.359395	0.365929	0.359395	0.365929	0.359395	0.327152	0.321310	0.347189	0.341331	0.365929	0.359395	0.347189	0.341331
106	0.384359	0.377875	0.384359	0.377875	0.384359	0.377875	0.346598	0.340751	0.366373	0.360553	0.384359	0.377875	0.366373	0.360553
107	0.402272	0.395881	0.402272	0.395881	0.402272	0.395881	0.365786	0.359976	0.383512	0.377420	0.402272	0.395881	0.383512	0.377420
108	0.417733	0.411098	0.417733	0.411098	0.417733	0.411098	0.382898	0.376816	0.401685	0.395700	0.417733	0.411098	0.401685	0.395700
109	0.434245	0.427775	0.434245	0.427775	0.434245	0.427775	0.401083	0.395107	0.419261	0.413428	0.434245	0.427775	0.419261	0.413428
110	0.450030	0.443769	0.450030	0.443769	0.450030	0.443769	0.418764	0.412849	0.436165	0.430528	0.450030	0.443769	0.436165	0.430528
111	0.465055	0.459045	0.465055	0.459045	0.465055	0.459045	0.435598	0.429968	0.452343	0.446944	0.465055	0.459045	0.452343	0.446944
112	0.471997	0.466364	0.471997	0.466364	0.471997	0.466364	0.451800	0.446407	0.465519	0.459963	0.471997	0.466364	0.465519	0.459963
113	0.471431	0.465804	0.471431	0.465804	0.471431	0.465804	0.464960	0.459411	0.473749	0.468564	0.471431	0.465804	0.473749	0.468564
114	0.473228	0.468048	0.473228	0.468048	0.473228	0.468048	0.473228	0.468048	0.475603	0.470868	0.473228	0.468048	0.475603	0.470868
115	0.475127	0.470397	0.475127	0.470397	0.475127	0.470397	0.475127	0.470397	0.477559	0.473278	0.475127	0.470397	0.477559	0.473278
116	0.477129	0.472852	0.477129	0.472852	0.477129	0.472852	0.477129	0.472852	0.477129	0.472852	0.477129	0.472852	0.477129	0.472852
117	0.476700	0.472427	0.476700	0.472427	0.476700	0.472427	0.476700	0.472427	0.476700	0.472427	0.476700	0.472427	0.476700	0.472427
118	0.476271	0.472001	0.476271	0.472001	0.476271	0.472001	0.476271	0.472001	0.476271	0.472001	0.476271	0.472001	0.476271	0.472001
119	0.475842	0.471577	0.475842	0.471577	0.475842	0.471577	0.475842	0.471577	0.475842	0.471577	0.475842	0.471577	0.475842	0.471577
120	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

Demographic Assumptions *(continued)*

Disabled Retired Mortality			Non-Annuitant Mortality										
Age	Male	Female	Age	School District Male		Other General Service Male		Police & Fire Male		School District Female		Other Female	
	RP2014 Disabled Retiree, Generational w/Social Security Data Scale, 0 year setback			RP2014 Employee White collar, Generational w/Social Security Data Scale, 1 year setback		RP2014 Employee 50%White/50% Blue collar blend, Generational w/Social Security Data Scale, 1 year setback		RP2014 Employee 50%White/50% Blue collar blend, Generational w/Social Security Data Scale, 1 year setback		RP2014 Employee White collar, Generational w/Social Security Data Scale, 1 year setback		RP2014 Employee 50%White/50% Blue collar blend, Generational w/Social Security Data Scale, 0 year setback	
Year of Birth	1950	1950	Year of Birth	1950	1960	1950	1960	1950	1960	1950	1960	1950	1960
45	0.021350	0.011338	30	0.000404	0.000375	0.000575	0.000533	0.000575	0.000533	0.000225	0.000208	0.000277	0.000257
46	0.021927	0.011908	31	0.000408	0.000378	0.000580	0.000538	0.000580	0.000538	0.000237	0.000219	0.000295	0.000272
47	0.022471	0.012456	32	0.000419	0.000387	0.000595	0.000550	0.000595	0.000550	0.000251	0.000232	0.000311	0.000287
48	0.023059	0.013022	33	0.000431	0.000397	0.000612	0.000565	0.000612	0.000565	0.000265	0.000244	0.000330	0.000303
49	0.023607	0.013564	34	0.000444	0.000408	0.000632	0.000581	0.000632	0.000581	0.000281	0.000258	0.000349	0.000320
50	0.024116	0.014080	35	0.000460	0.000421	0.000655	0.000600	0.000655	0.000600	0.000297	0.000272	0.000366	0.000334
51	0.024587	0.014566	36	0.000474	0.000433	0.000674	0.000615	0.000674	0.000615	0.000311	0.000284	0.000385	0.000350
52	0.025022	0.015021	37	0.000487	0.000442	0.000692	0.000629	0.000692	0.000629	0.000327	0.000298	0.000411	0.000371
53	0.025364	0.015410	38	0.000501	0.000453	0.000714	0.000646	0.000714	0.000646	0.000348	0.000315	0.000439	0.000395
54	0.025689	0.015771	39	0.000522	0.000469	0.000743	0.000668	0.000743	0.000668	0.000373	0.000336	0.000476	0.000425
55	0.025980	0.016097	40	0.000546	0.000488	0.000778	0.000695	0.000778	0.000695	0.000404	0.000361	0.000517	0.000459
56	0.026318	0.016435	41	0.000578	0.000513	0.000824	0.000732	0.000824	0.000732	0.000439	0.000390	0.000565	0.000500
57	0.026666	0.016765	42	0.000617	0.000546	0.000878	0.000776	0.000878	0.000776	0.000478	0.000423	0.000617	0.000545
58	0.027066	0.017117	43	0.000660	0.000583	0.000940	0.000829	0.000940	0.000829	0.000522	0.000461	0.000674	0.000596
59	0.027491	0.017479	44	0.000712	0.000629	0.001013	0.000895	0.001013	0.000895	0.000571	0.000505	0.000739	0.000654
60	0.027966	0.017869	45	0.000774	0.000685	0.001101	0.000975	0.001101	0.000975	0.000626	0.000555	0.000809	0.000719
61	0.028468	0.018280	46	0.000844	0.000750	0.001202	0.001068	0.001202	0.001068	0.000686	0.000609	0.000890	0.000791
62	0.029039	0.018742	47	0.000931	0.000827	0.001325	0.001178	0.001325	0.001178	0.000755	0.000671	0.000978	0.000870
63	0.029691	0.019273	48	0.001027	0.000914	0.001461	0.001300	0.001461	0.001300	0.000830	0.000739	0.001074	0.000955
64	0.030433	0.019884	49	0.001136	0.001010	0.001617	0.001437	0.001617	0.001437	0.000912	0.000810	0.001176	0.001044
65	0.031289	0.020599	50	0.001254	0.001114	0.001785	0.001586	0.001785	0.001586	0.000998	0.000886	0.001281	0.001136
66	0.032259	0.021430	51	0.001381	0.001225	0.001965	0.001744	0.001965	0.001744	0.001087	0.000964	0.001388	0.001230
67	0.033361	0.022396	52	0.001517	0.001344	0.002158	0.001913	0.002158	0.001913	0.001177	0.001043	0.001496	0.001325
68	0.034583	0.023499	53	0.001661	0.001471	0.002363	0.002092	0.002363	0.002092	0.001269	0.001124	0.001605	0.001422
69	0.035958	0.024767	54	0.001811	0.001605	0.002577	0.002284	0.002577	0.002284	0.001361	0.001206	0.001714	0.001521
70	0.037481	0.026200	55	0.001974	0.001751	0.002808	0.002491	0.002808	0.002491	0.001455	0.001290	0.001828	0.001625
71	0.039163	0.027807	56	0.002148	0.001910	0.003057	0.002717	0.003057	0.002717	0.001551	0.001379	0.001949	0.001733
72	0.041011	0.029591	57	0.002344	0.002084	0.003336	0.002965	0.003336	0.002965	0.001654	0.001470	0.002076	0.001846
73	0.043039	0.031558	58	0.002564	0.002279	0.003648	0.003243	0.003648	0.003243	0.001762	0.001566	0.002214	0.001965
74	0.045261	0.033713	59	0.002813	0.002496	0.004003	0.003551	0.004003	0.003551	0.001878	0.001666	0.002361	0.002091
75	0.047748	0.036101	60	0.003095	0.002740	0.004403	0.003899	0.004403	0.003899	0.002003	0.001774	0.002523	0.002227
76	0.050548	0.038751	61	0.003413	0.003013	0.004856	0.004287	0.004856	0.004287	0.002139	0.001888	0.002696	0.002377
77	0.053578	0.041584	62	0.003769	0.003323	0.005361	0.004728	0.005361	0.004728	0.002286	0.002016	0.002887	0.002543
78	0.056762	0.044528	63	0.004166	0.003670	0.005928	0.005222	0.005928	0.005222	0.002448	0.002156	0.003098	0.002727
79	0.060253	0.047681	64	0.004612	0.004059	0.006562	0.005775	0.006562	0.005775	0.002627	0.002312	0.003330	0.002933
80	0.064189	0.051136	65	0.005108	0.004500	0.007267	0.006402	0.007267	0.006402	0.002823	0.002487	0.003587	0.003163
81	0.068763	0.055031	66	0.005661	0.004992	0.008053	0.007101	0.008053	0.007101	0.003042	0.002682	0.003943	0.003477
82	0.074115	0.059456	67	0.006267	0.005526	0.008808	0.007767	0.008808	0.007767	0.003356	0.002959	0.004335	0.003826
83	0.080415	0.064526	68	0.006941	0.006127	0.009640	0.008509	0.009640	0.008509	0.003704	0.003270	0.004764	0.004205
84	0.087690	0.070239	69	0.007684	0.006783	0.010546	0.009309	0.010546	0.009309	0.004088	0.003608	0.005240	0.004630
85	0.095919	0.076547	70	0.008513	0.007522	0.011547	0.010203	0.011547	0.010203	0.004514	0.003989	0.005764	0.005099
86	0.105223	0.083520	71	0.009433	0.008343	0.012645	0.011185	0.012645	0.011185	0.004986	0.004410	0.006342	0.005615
87	0.115474	0.091025	72	0.010454	0.009255	0.013853	0.012265	0.013853	0.012265	0.005508	0.004876	0.006979	0.006186
88	0.126713	0.099067	73	0.011587	0.010269	0.015179	0.013453	0.015179	0.013453	0.006086	0.005393	0.007683	0.006816
89	0.138969	0.107645	74	0.012846	0.011397	0.016637	0.014760	0.016637	0.014760	0.006726	0.005967	0.008459	0.007512
90	0.152263	0.116748	75	0.014245	0.012651	0.018241	0.016199	0.018241	0.016199	0.007435	0.006603	0.009326	0.008299
91	0.165971	0.126977	76	0.015819	0.014077	0.020029	0.017823	0.020029	0.017823	0.008230	0.007324	0.010298	0.009192
92	0.180646	0.138712	77	0.017597	0.015706	0.022032	0.019666	0.022032	0.019666	0.009126	0.008146	0.011364	0.010164
93	0.195382	0.151218	78	0.019559	0.017493	0.024219	0.021661	0.024219	0.021661	0.010112	0.009044	0.012510	0.011189
94	0.211315	0.165334	79	0.021682	0.019392	0.026554	0.023750	0.026554	0.023750	0.011174	0.009994	0.013772	0.012317
95	0.226592	0.179573	80	0.024036	0.021498	0.029117	0.026041	0.029117	0.026041	0.012348	0.011044	0.015186	0.013596
96	0.242395	0.194803											
97	0.257914	0.210319											
98	0.272952	0.225879											
99	0.287298	0.241221											
100	0.302904	0.257913											
101	0.318860	0.275142											
102	0.333914	0.291757											
103	0.350534	0.309839											
104	0.367560	0.328330											
105	0.385014	0.347189											
106	0.402916	0.366373											
107	0.418403	0.383512											
108	0.434897	0.401685											
109	0.450661	0.419261											
110	0.465661	0.436165											
111	0.472564	0.452343											
112	0.471997	0.465519											
113	0.473749	0.473749											
114	0.475603	0.475603											
115	0.477559	0.477559											
116	0.477129	0.477129											
117	0.476700	0.476700											
118	0.476271	0.476271											
119	0.475842	0.475842											
120	1.000000	1.000000											

Demographic Assumptions *(continued)*

Mortality Improvement Scale

	Unisex Social Security Data Mortality Projection Scale				
	Based on 60-year average of experience through 2013				
Age	**Improvement Rate**	**Age**	**Improvement Rate**	**Age**	**Improvement Rate**
15	1.76%	50	1.19%	85	0.79%
16	1.68%	51	1.20%	86	0.71%
17	1.57%	52	1.21%	87	0.64%
18	1.43%	53	1.20%	88	0.58%
19	1.28%	54	1.19%	89	0.53%
20	1.15%	55	1.17%	90	0.49%
21	1.04%	56	1.17%	91	0.45%
22	0.96%	57	1.17%	92	0.40%
23	0.90%	58	1.19%	93	0.36%
24	0.86%	59	1.21%	94	0.31%
25	0.82%	60	1.24%	95	0.28%
26	0.78%	61	1.25%	96	0.25%
27	0.75%	62	1.26%	97	0.23%
28	0.74%	63	1.27%	98	0.22%
29	0.75%	64	1.26%	99	0.22%
30	0.76%	65	1.25%	100	0.21%
31	0.79%	66	1.25%	101	0.20%
32	0.81%	67	1.24%	102	0.20%
33	0.84%	68	1.24%	103	0.19%
34	0.88%	69	1.23%	104	0.18%
35	0.91%	70	1.22%	105	0.17%
36	0.95%	71	1.21%	106	0.16%
37	1.00%	72	1.20%	107	0.16%
38	1.06%	73	1.19%	108	0.15%
39	1.12%	74	1.18%	109	0.14%
40	1.18%	75	1.16%	110	0.13%
41	1.22%	76	1.13%	111	0.12%
42	1.24%	77	1.11%	112	0.12%
43	1.23%	78	1.11%	113	0.11%
44	1.21%	79	1.11%	114	0.10%
45	1.18%	80	1.10%	115	0.09%
46	1.17%	81	1.07%	116	0.09%
47	1.16%	82	1.02%	117	0.09%
48	1.17%	83	0.95%	118	0.09%
49	1.18%	84	0.87%	119	0.09%

Demographic Assumptions *(continued)*

Retirement Assumptions

Retirement from Active Status (Tier 1/Tier 2)

	Police & Fire			General Service / School Districts						Judges
				General Service			School Districts			
Age	<13 Years	13 - 24	25+ Years	< 15 years	15-29 Years	30+ Years	< 15 years	15-29 Years	30+ Years	
< 50						15.0%			25.0%	
50	1.5%	2.0%	24.0%			15.0%			25.0%	
51	1.5%	2.0%	17.5%			15.0%			25.0%	
52	1.5%	2.0%	17.5%			15.0%			25.0%	
53	1.5%	2.0%	17.5%			15.0%			25.0%	
54	1.5%	3.5%	17.5%			15.0%			25.0%	
55	3.0%	10.0%	23.5%	1.5%	3.0%	15.0%	1.5%	4.0%	25.0%	
56	3.0%	8.0%	23.5%	1.5%	3.0%	15.0%	1.5%	4.0%	25.0%	
57	3.0%	8.0%	23.5%	1.5%	3.0%	15.0%	1.5%	4.0%	25.0%	
58	6.0%	8.0%	23.5%	1.5%	10.0%	20.0%	1.5%	12.5%	28.5%	
59	6.0%	8.0%	23.5%	3.5%	10.0%	20.0%	4.5%	12.5%	28.5%	
60	6.0%	11.0%	23.5%	6.0%	10.0%	20.0%	6.5%	12.5%	28.5%	6.0%
61	6.0%	14.0%	23.5%	6.0%	10.0%	20.0%	6.5%	12.5%	28.5%	6.0%
62	15.0%	25.0%	38.0%	13.0%	19.5%	31.0%	15.0%	25.0%	34.0%	6.0%
63	15.0%	17.0%	38.0%	11.5%	16.5%	22.0%	13.0%	19.5%	26.5%	6.0%
64	15.0%	17.0%	17.0%	12.5%	16.5%	22.0%	13.0%	19.5%	31.5%	6.0%
65	100.0%	100.0%	100.0%	19.5%	28.0%	32.0%	25.5%	33.5%	42.0%	6.0%
66				27.5%	35.0%	38.0%	23.0%	36.5%	42.0%	6.0%
67				22.5%	25.0%	26.0%	21.0%	34.5%	42.0%	10.0%
68				19.5%	25.0%	26.0%	21.0%	28.0%	28.5%	10.0%
69				19.5%	25.0%	26.0%	21.0%	28.0%	28.5%	10.0%
70				100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Retirement from Active Status (OPSRP)

	Police & Fire			General Service / School Districts					
				General Service			School Districts		
Age	<13 Years	13 - 24	25+ Years	< 15 years	15-29 Years	30+ Years	< 15 years	15-29 Years	30+ Years
50	0.5%	1.5%	5.5%						
51	0.5%	1.5%	5.5%						
52	0.5%	1.5%	5.5%						
53	0.5%	1.5%	25.0%						
54	0.5%	1.5%	17.5%						
55	2.0%	5.0%	23.5%	1.0%	2.5%	5.0%	1.0%	2.5%	5.0%
56	2.0%	5.0%	23.5%	1.0%	2.5%	5.0%	1.0%	2.5%	5.0%
57	2.0%	5.0%	23.5%	1.0%	2.5%	7.5%	1.0%	2.5%	7.5%
58	4.0%	5.0%	23.5%	1.5%	3.0%	30.0%	1.5%	3.0%	30.0%
59	4.0%	5.0%	23.5%	2.0%	3.0%	25.0%	1.5%	3.0%	25.0%
60	4.0%	15.0%	23.5%	3.0%	3.8%	20.0%	2.5%	3.8%	20.0%
61	4.0%	8.5%	23.5%	3.0%	5.0%	20.0%	3.0%	5.0%	20.0%
62	10.0%	25.0%	38.0%	8.0%	12.0%	30.0%	6.0%	12.0%	30.0%
63	7.0%	17.0%	38.0%	7.0%	10.0%	20.0%	6.0%	10.0%	20.0%
64	7.0%	17.0%	17.0%	7.0%	10.0%	20.0%	6.0%	10.0%	20.0%
65	100.0%	100.0%	100.0%	13.0%	35.0%	20.0%	11.5%	35.0%	20.0%
66				15.5%	33.0%	20.0%	12.5%	33.0%	20.0%
67				15.5%	22.0%	30.0%	11.0%	22.0%	30.0%
68				13.0%	17.0%	20.0%	9.0%	17.0%	20.0%
69				13.0%	17.0%	20.0%	9.0%	17.0%	20.0%
70				100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Demographic Assumptions *(continued)*

Lump Sum Option at Retirement

Partial Lump Sum	3.5% for all years
Total Lump Sum	2.0% for 2017, declining by 0.5% per year until reaching 0.0%

Purchase of Credited Service at Retirement

Money Match Retirements	0%
Non-Money Match Retirements	65%

Oregon Residency Status

For purposes of determining eligibility for SB 656/HB 3349 benefit adjustments, 85% of retirees are assumed to remain Oregon residents after retirement.

Disability Assumptions

	Duty Disability		Ordinary
Age	Police & Fire	General Service	Ordinary Disability
20	0.006%	0.000%	0.011%
25	0.009%	0.000%	0.015%
30	0.013%	0.001%	0.022%
35	0.020%	0.001%	0.034%
40	0.032%	0.001%	0.055%
45	0.052%	0.002%	0.091%
50	0.090%	0.004%	0.157%
55	0.169%	0.008%	0.180%
60	0.241%	0.011%	0.180%

Demographic Assumptions *(continued)*

Termination Assumptions

Duration	School District Male	School District Female	General Service Male	General Service Female	Police & Fire
0	16.63%	13.50%	17.00%	18.50%	10.00%
1	14.25%	12.50%	15.33%	17.00%	5.97%
2	11.50%	10.50%	12.80%	13.09%	5.02%
3	9.50%	9.13%	10.96%	11.67%	4.22%
4	7.93%	8.07%	9.39%	10.41%	3.54%
5	6.86%	7.13%	7.74%	9.29%	3.31%
6	5.93%	6.31%	6.83%	8.28%	3.06%
7	5.12%	5.58%	6.03%	7.38%	2.83%
8	4.43%	4.93%	5.32%	6.59%	2.61%
9	3.82%	4.36%	4.70%	5.87%	2.41%
10	3.31%	3.85%	4.15%	5.24%	2.23%
11	3.04%	3.45%	3.71%	4.67%	2.06%
12	2.84%	3.24%	3.48%	4.46%	1.90%
13	2.65%	3.04%	3.26%	4.18%	1.76%
14	2.47%	2.85%	3.06%	3.91%	1.63%
15	2.30%	2.68%	2.86%	3.66%	1.50%
16	2.15%	2.51%	2.68%	3.43%	1.39%
17	2.00%	2.36%	2.51%	3.21%	1.28%
18	1.87%	2.21%	2.36%	3.00%	1.19%
19	1.74%	2.08%	2.21%	2.81%	1.10%
20	1.62%	1.95%	2.07%	2.63%	1.01%
21	1.52%	1.83%	1.94%	2.46%	0.94%
22	1.41%	1.72%	1.82%	2.31%	0.87%
23	1.32%	1.61%	1.70%	2.16%	0.80%
24	1.23%	1.50%	1.59%	2.02%	0.80%
25	1.20%	1.50%	1.49%	1.89%	0.80%
26	1.20%	1.50%	1.40%	1.77%	0.80%
27	1.20%	1.50%	1.40%	1.66%	0.80%
28	1.20%	1.50%	1.40%	1.55%	0.80%
29	1.20%	1.50%	1.40%	1.50%	0.80%
30 +	1.20%	1.50%	1.40%	1.50%	0.80%

Milliman

Demographic Assumptions *(continued)*

Merit Salary Increase Assumptions

Duration	School District	Other General Service	Police & Fire
0	3.53%	3.38%	4.44%
1	3.20%	3.05%	3.95%
2	2.88%	2.74%	3.50%
3	2.58%	2.45%	3.09%
4	2.29%	2.18%	2.72%
5	2.01%	1.94%	2.39%
6	1.74%	1.71%	2.10%
7	1.50%	1.51%	1.83%
8	1.25%	1.32%	1.60%
9	1.03%	1.15%	1.40%
10	0.82%	0.99%	1.23%
11	0.61%	0.85%	1.08%
12	0.42%	0.73%	0.95%
13	0.25%	0.62%	0.85%
14	0.08%	0.52%	0.76%
15	-0.07%	0.43%	0.69%
16	-0.21%	0.36%	0.64%
17	-0.34%	0.29%	0.59%
18	-0.46%	0.23%	0.56%
19	-0.57%	0.18%	0.53%
20	-0.67%	0.14%	0.52%
21	-0.75%	0.11%	0.50%
22	-0.83%	0.08%	0.49%
23	-0.86%	0.05%	0.48%
24	-0.89%	0.04%	0.46%
25	-0.91%	0.02%	0.44%
26	-0.93%	0.01%	0.42%
27	-0.94%	-0.01%	0.38%
28	-0.94%	-0.02%	0.34%
29	-0.94%	-0.03%	0.28%
30 +	-0.94%	-0.04%	0.21%

Milliman

Demographic Assumptions *(continued)*

Unused Sick Leave Adjustment

Actives	
• State General Service Male	6.25%
• State General Service Female	3.75%
• School District Male	7.50%
• School District Female	5.75%
• Local General Service Male	4.75%
• Local General Service Female	3.25%
• State Police & Fire	4.75%
• Local Police & Fire	7.25%
Dormants	3.25%

Unused Vacation Cash Out Adjustment

Tier 1	
• State General Service	2.00%
• School District	0.25%
• Local General Service	2.75%
• State Police & Fire	2.50%
• Local Police & Fire	3.75%
Tier 2	0.00%

Retiree Healthcare Assumptions

Retiree Healthcare Participation

RHIPA	
• 8 – 9 years of service	10.0%
• 10 – 14 years of service	10.0%
• 15 – 19 years of service	18.0%
• 20 – 24 years of service	23.0%
• 25 – 29 years of service	29.0%
• 30+ years of service	38.0%
RHIA	
• Healthy Retired	35.0%
• Disabled Retired	20.0%

Milliman

Healthcare Cost Trend Rates

Year	Rate
2017	7.50%
2018	6.50%
2019	5.90%
2020	5.40%
2021-2023	5.30%
2024	5.20%
2025	5.20%
2026	5.30%
2027	5.30%
2028	5.40%
2029-2032	6.20%
2033-2039	6.10%
2040	6.00%
2041	5.80%
2042	5.70%
2043	5.70%
2044	5.60%
2045	5.60%
2046-2048	5.50%
2049-2052	5.40%
2053-2058	5.30%
2059-2063	5.20%
2064	5.10%
2065	5.00%
2066	4.90%
2067	4.80%
2068	4.80%
2069	4.70%
2070	4.60%
2071	4.50%
2072	4.40%
2073	4.40%
2074-2090	4.30%
2091	4.20%
2092	4.30%
2093+	4.20%