

Pennsylvania Public School Employees' Retirement System

Experience Review for the Period July 1, 2010 to June 30, 2015



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August 11, 2016

Board of Trustees
Pennsylvania Public School Employees' Retirement System
5 North 5th Street
Harrisburg, PA 17101

Ladies and Gentlemen:

This report presents the results of the actuarial review of the demographic and economic experience of the active members, annuitants, beneficiaries and survivors covered under the Pennsylvania Public School Employees' Retirement System (PSERS) for the five-year period July 1, 2010 to June 30, 2015.

This experience review was prepared in accordance with Section 8502(j) of the Retirement Code, which requires the actuary for PSERS to make an actuarial investigation into the mortality, service and compensation experience of the members and beneficiaries covered under the System at least once in each five-year period.

The attached report describes the actuarial process employed and identifies the significant results of the study.

Summary of Recommendations

After reviewing the recent experience of the System and considering its likely future experience, we recommended changes in a number of the actuarial assumptions used in the valuation of the System's liabilities. In particular, we have recommended and, at their June 10, 2016 meeting, the Board has adopted changes to the following actuarial assumptions:

- Rates of mortality among active members, annuitants, beneficiaries and survivors.
- Rates of withdrawal, disability and retirement from employment among active members.
- Rates of member elections for optional forms of benefit payment upon retirement.
- Rates of increase in annual salaries among active members.

In addition, the Board has adopted changes to the following economic assumptions:

- The rate of inflation.
- The interest rate.

We also recommended and the Board adopted changes to the option factors. The new option factors reflect the revised mortality assumptions and are to be effective for retirements after June 30, 2018.



A detailed analysis of the recommendations is included in the report. The financial impact of adopting the recommended assumptions is shown in the tables below.

**Financial Impact of Adopting Recommended Assumptions
As of the June 30, 2015 Valuation
(\$ Amounts in Thousands)**

Item	Unfunded Accrued Liability ¹	Employer Pension Contribution Rate ²
1. Current Assumptions	\$ 37,335,764	29.20%
2. Impact of Change in Assumptions	<u>2,632,046</u>	<u>0.67</u>
3. Revised Assumptions	\$ 39,967,810	29.87%

1. Actuarial value of assets basis.

2. Without regard to the Act 120 fiscal year 2017 pension rate collar. The health insurance rate is .83%. Note that the recommended assumptions will become effective with the June 30, 2016 actuarial valuation.

**Projected Financial Impact of Adopting Recommended Assumptions
As of the June 30, 2016 Valuation
(\$ Amounts in Thousands)**

Item	Unfunded Accrued Liability ³	Employer Pension Contribution Rate
1. Current Assumptions	\$ 41,034,295	32.26%
2. Impact of Change in Assumptions	<u>1,552,904</u>	<u>(0.01)</u>
3. Revised Assumptions	\$ 42,587,199	32.25%

3. Actuarial value of assets basis.

The potential impact of the recommended assumptions on the June 30, 2016 valuation was prepared using the same data, actuarial methods and assumptions that were used in the June 30, 2015 actuarial valuation and the following assumptions for the June 30, 2016 valuation:

- a. The recommended assumptions are first effective during the June 30, 2016 valuation.
- b. The active workforce size is assumed to remain constant over the projection period.
- c. Future new employees are assumed to be Class TE members.
- d. All prospective new employees are assumed to have similar characteristics (age/gender/salary) to those of new employees who entered the System in the period July 1, 2012 through June 30, 2015.
- e. Assumes a fiscal year 2016 investment return of -1.00%.

It should be noted that it is difficult to estimate the potential cost of the recommended assumptions. The projected fiscal year 2016 results may be different from actual results that will be determined during the June 30, 2016 valuation due to demographic and financial experience different than assumed. This will certainly be the case if the workforce and/or payroll continue to decrease. Accordingly, the information should not be used for any purpose other than providing the user with an estimate of future employer pension cost obligations based on the above parameters.

Further, the above only provides information with regards to future funding contributions of the System. It does not provide any information with regards to the impact any changes may have on financial disclosure and expense under GASB.

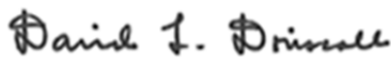
Buck performed the experience review based on data supplied by the Retirement System for the annual actuarial valuations. While we did not verify the data at their source, we did perform tests for internal consistency and reasonableness. The accuracy of the results of this review is dependent on the accuracy of the data.

The assumptions recommended in this report are proposed for use in valuing the benefit liabilities of the Pennsylvania Public School Employees' Retirement System. Use of this report for any other purpose or by anyone other than the Board or staff of the Pennsylvania Public School Employees' Retirement System may not be appropriate and may result in mistaken conclusions because of failure to understand applicable assumptions, methods, or inapplicability of the report for that purpose. Buck should be asked to review any statement to be made on the basis of the results contained in this report. Buck will accept no liability for any such statement made without prior review by Buck.

To the best of our knowledge, this experience investigation report is complete and accurate. Future actuarial measurements may differ significantly from current measurements due to plan experience differing from that anticipated by the economic and demographic assumptions, increases or decreases expected as part of the natural operation of the methodology used for these measurements, and changes in plan provisions or applicable law. An analysis of the potential range of future results is beyond the scope of this valuation.

This report was prepared under our supervision. David L. Driscoll is a Fellow of the Society of Actuaries and a Member of the American Academy of Actuaries. Edward Quinn and Salvador Nakar are Members of the American Academy of Actuaries. We meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein. This report has been prepared in accordance with all applicable Actuarial Standards of Practice, and we are available to answer questions concerning it.


Sincerely,



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Principal, Consulting Actuary



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Director, Retirement Actuary



Salvador Nakar, MAAA, EA
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Pennsylvania Public School Employees' Retirement System Experience Review for the Period July 1, 2010 to June 30, 2015

Section I - Introduction

Section 8502(j) of the Retirement Code provides that in every five-year period, the actuary of the System is to make an actuarial investigation and evaluation of the mortality, service and compensation experience of the members and beneficiaries covered under the System during the preceding five years. This report presents the results of the experience review of the System for the five-year period July 1, 2010 through June 30, 2015.

The objectives of the investigation are to:

- Determine appropriate rates to anticipate the following events among active members:
 - withdrawal from employment;
 - death in active service;
 - disability retirement;
 - early retirement; and
 - superannuation retirement
- Determine appropriate rates to anticipate member elections of optional forms of benefit payment upon retirement.
- Determine appropriate rates to anticipate mortality among annuitants, survivor annuitants, beneficiaries and disability annuitants.
- Determine appropriate economic assumptions to anticipate future trends in active members' salary increases and the investment return assumption in relation to the current underlying economic conditions.
- Make recommendations regarding the adoption of refinements to the actuarial basis of the System, which are deemed appropriate by the actuary for adoption by the Board.

Methodology

Data is supplied annually to the actuary by the System for use in preparing the actuarial valuation report. This data includes demographic characteristics of the current and past membership, including any changes in the members' status or relationship with the System. The data also includes a salary history for active members and System asset information. These demographic changes and economic history are the basis for the experience review.

Tabulations were compiled which show the distribution by age of the number of members who were **exposed** during the five-year period to the events of withdrawal from employment, retirement, death and disability. A member is considered exposed to an event if the member meets the age and service requirements for that event. The assumed rates of occurrence for each event currently used in the annual actuarial valuations were then applied to the number of members exposed to determine the number of members **expected** to separate from service for each category.

The **actual** numbers of members who separated from service due to withdrawal from employment, retirement, death or disability were then compared to the expected numbers. The results were then expressed as ratios of actual numbers to expected numbers. A ratio of actual to expected of 100% means the actual occurrence of the event was exactly as anticipated. A ratio above 100% means actual occurrence of the event was more than expected, while one below 100% means lower actual incidence of the event occurred than expected. In some instances, a high ratio is favorable for the financial experience of the System and in others, a high ratio is unfavorable. Data is generally grouped by age in five-year increments to provide statistically significant results.

The expected and actual salaries as of the end of each year were also compared to actual salaries as of the end of each previous year. The comparisons show an average annual total increase in both expected and actual salaries for the five-year period.

The System's fund performance was also examined by the System's investment advisor, Aon Hewitt. The interest rate assumption was then analyzed in relation to the current underlying economic conditions.

The results of the experience review are the basis for the actuary's recommendation of assumption changes. In recommending assumptions, the actuary must also take into account special plan benefits as well as past economic factors.

In addition to comparing actual to expected experience and adjusting the results for special plan benefits and economic conditions, the actuary must consider future expectations of experience due to future plan changes or changes in the economy. The anticipation of future experience is the primary goal in the selection and recommendation of actuarial assumptions.

To summarize, the actuary's recommendation of assumptions is based on the following:

- comparison of actual to expected experience,
- adjustment for special plan benefits and past economic conditions,
- adjustment for future plan changes and economic conditions,
- adherence to industry standards, such as the Actuarial Standards of Practice

Summary of Experience Review

The summaries included in Section VII show the comparisons and results of the experience investigation for:

- the actual and expected mortality among annuitants, disability annuitants and members in active service,
- the actual and expected cases of separation from active service,
- the actual rates of member elections for optional forms of benefit payment upon retirement,
- the average annual increases in salaries among active members, and
- the annual rates of return on assets.

Recommendations

Based on the results of our investigation, we recommend revisions to the rates of:

- mortality assumption among retirees, beneficiaries and members in active service,
- withdrawal,
- disability,
- early and superannuation retirement, and
- member elections for optional forms of benefit payment upon retirement.

The Board adopted a rate of inflation of 2.75% (reduced from 3.00%) and an investment return assumption of 7.25% (reduced from 7.50%). Accordingly, we also recommend that the salary increase assumption be changed in a way that results in a reduction in the average salary increase over a typical career to 5.00%.

Financial Impact

We have determined the financial impact on the System of adopting the recommended set of assumptions. The calculations are based on the results of the June 30, 2015 actuarial valuation and are shown in the table below.

Financial Impact of Adopting Recommended Assumptions As of the June 30, 2015 Valuation (\$ Amounts in Thousands)

Item	Unfunded Accrued Liability ¹	Employer Pension Contribution Rate ²
1. Current Assumptions	\$ 37,335,764	29.20%
2. Impact of Change:		
• Demographic Assumptions	1,101,702	0.53
• Economic Assumptions	<u>1,530,334</u>	<u>0.14</u>
3. Revised Assumptions (1) + (2)	\$ 39,967,810	29.87%

1. Actuarial value of assets basis.

2. Without regard to the Act 120 fiscal year 2017 pension rate collar. The health insurance rate is .83%. Note that the recommended assumptions will become effective with the June 30, 2016 actuarial valuation.

We have also estimated the potential financial impact on the June 30, 2016 actuarial valuation and the results are shown in the table below.

Projected Financial Impact of Adopting Recommended Assumptions As of the June 30, 2016 Valuation³ (\$ Amounts in Thousands)

Item	Unfunded Accrued Liability ⁴	Employer Pension Contribution Rate
1. Current Assumptions	\$ 41,034,295	32.26%
2. Impact of Change in Assumptions	<u>1,552,904</u>	<u>(0.01)</u>
3. Revised Assumptions (1) + (2)	\$ 42,587,199	32.25%

3. The caveats outlined in the certification letter continue to apply to this information.

4. Actuarial value of assets basis.

Section II – Discussion of Experience Review

Mortality Experience

Tables 1 through 3 included in Section VII summarize the mortality experience for annuitants, beneficiaries and survivor annuitants, disability annuitants, and members in active service. Separate summaries for males and females are presented for all of these categories. The tables also show the ratio of actual to expected experience under each current assumption. We have also presented the same information under the recommended change for each of the assumptions.

As noted in prior experience studies, we have seen continued and steady improvement in longevity over time. This trend is expected to continue into the future. In fact, Actuarial Standard of Practice No. 35 (ASOP No. 35) states that the actuary should “include an assumption as to expected mortality improvement after the measurement date.”

The current assumptions anticipate future improvements in mortality by assuming an annuitant is younger than his or her actual age (i.e., applying age set-backs to the base table). However, new studies from the Society of Actuaries (SOA) and other sources have indicated that longevity is increasing at a faster pace than had been previously expected. In view of this new evidence, and in view of the manner and extent by which the margin for future improvement was established in the current assumption, we recommend that the mortality assumption be updated and reflect an explicit rather than implicit provision for future improvements in longevity. In particular, we recommend the use of a generational approach to projecting future longevity improvements among active and inactive members.

The projection of mortality improvements on a generational basis results in a separate table of probabilities of death at each age for each year of birth. The rates of mortality decrease as the year of birth increases. For example, a participant born in 1960 will have a higher probability of dying at each age than a participant born in 1965. The mortality table for birth year 1965 will have five more years of mortality improvement than the table for birth year 1960.

To create this dynamic mortality table, we select a base mortality table that represents the current experience of the System. Each year after the measurement date, this base table will be projected with an additional year of improvement. The resulting generational mortality table will better reflect expected future mortality improvements.

The following table demonstrates the impact of the generational mortality improvement for female members. It compares the expected age at death for members of various ages before and after incorporating the recommended mortality projections. The base table is the current mortality assumption for female members retired on account of service retirement which is the RP-2000 Combined Healthy Female Mortality Table with ages set back 3 years. This table is then projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Age at Measurement Date	Expected Age at Death	
	Zero Future Mortality Improvement	Generational Mortality Improvement
50	86.5	88.6
55	86.8	88.5
60	87.1	88.6
65	87.7	88.8

Rates of Mortality Among Annuitants

Tables 1 and 2 included in Section VII summarize the mortality experience among service-based retirement annuitants, beneficiaries and survivor annuitants, and disability retirements during the five-year period ended June 30, 2015. The mortality experience is shown separately for males and females.

A summary of the results is shown in the table below:

Overall Ratios of Actual to Expected Mortality Experience
Service Retirements, Beneficiaries and Survivor Annuitants,
Disability Annuitants and Members in Active Service

Death After	Males	Females
Service Retirement, Beneficiary and Survivor annuitant	107%	109%
Disability Retirement	99%	104%
Members in Active Service	93%	95%

The experience study showed the following concerning service retirements, beneficiary and survivor annuitants, and disability annuitants:

- The actual incidence of death among male and female service retirement, beneficiaries and survivor annuitants was higher than expected.
- The mortality experience for male and female service retirements, beneficiaries and survivor annuitants meets the criteria of having “credible experience” (i.e., having, at least, 1,000 expected deaths over the examination period). This enables Buck to adjust the probabilities found in a standard table to reflect the experience of the System, where necessary.
- The actual incidence of death among disability annuitants was lower than expected for males and higher than expected for females.

As noted earlier, the current assumptions anticipate future improvements in mortality by applying age set-backs to the base table. However, the SOA and other sources have indicated that longevity is increasing at a faster pace than had been previously expected, and actuarial standards of practice make it advisable to have an explicit rather than implicit provision for future longevity improvements.

Longevity improvement among annuitants over the past several decades is well-documented. Recognizing this, along with the fact that experts hold widely differing expectations for the degree to which mortality rates will continue to improve, a number of different mortality improvement projection scales have been developed and used over the years. These improvement projection scales include Scale AA, Scale BB, Scale MP-2014 and Scale MP-2015.

In October 2014, the SOA issued reports on the recent mortality experience of participants in uninsured private retirement plans, including a new set of mortality tables (RP-2014) and a new companion mortality improvement scale (MP-2014). These new mortality tables are generally intended to supersede the RP-2000 mortality tables and their associated mortality improvement projection scale, Scale AA, and are based on mortality data gathered by the SOA from 2004 through 2008. In October 2015, the SOA released an updated projection scale, MP-2015.

The RP-2014 mortality tables were developed based on data between 2004 and 2008, with a central year of 2006. Mortality rates were developed from this data and then projected using MP-2014 from 2006 to the year 2014.

The MP-2014 and MP-2015 projection scales were published as a two-dimensional table (with rates of improvement varying by age and calendar year). The MP-2014 projection scale reflects additional data above that which had been used in constructing Scale BB. The MP-2015 projection scale reflects two years of additional data that had become available from the Social Security Administration. Given that U.S. Social Security experience is based on a broad population, mortality improvement for specific retirement plan and employee populations may potentially be better modeled by alternative projection models.

There are many who believe that the SOA's MP-2015 scale is unduly conservative and reflects unrealistic future mortality improvement rates. Emerging experience since the data was collected by the SOA seems to support this contention. Therefore, Buck has published an alternative mortality improvement scale, the Buck Modified MP-2015. The Buck Modified 2015 projection scale is based on the same data and algorithm as the MP-2015 Projection Scale but trends to an ultimate improvement rate of 0.75% at most ages, achieving the ultimate rate over a fifteen year period following the end of the historic data used to construct MP-2015. The change was made to bring the ultimate rate of improvement more in line with recent data published by the Social Security Administration (SSA), including the SSA's Intermediate Alternative for mortality improvement from the 2015 Trustee's Report. The SSA data/assumptions indicate a lower level of improvement than was forecasted by the MP-2015 projection scale.

Recommendations:

- Update the male annuitant mortality table to the RP-2014 male mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale and projected to the valuation date with the Buck Modified 2015 projection scale.
- Update the female annuitant mortality table to the RP-2014 female mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale, projected to 2013 with the Buck Modified 2015 projection scale and adjusted by approximately 93% for credibility. This base mortality table will then be projected on a generational basis using the Buck Modified 2015 projection scale to the valuation date.
- Update the male and female disabled annuitant mortality tables to the RP-2014 disabled mortality tables adjusted backward to 2006 with the MP-2014 mortality improvement scale and projected to the valuation date with the Buck Modified 2015 projection scale.
- These base mortality tables will then be projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Rates of Mortality Among Active Members

Table 3 shows the actual incidence of deaths in active service was less than expected for both males and females. For males, the ratio of actual to expected experience was 93%. Among females, the ratio was 95%.

The current assumptions anticipate future improvements in mortality by applying age set-backs to the base table. As with the mortality assumptions currently used for annuitants, we now view it inappropriate to claim that the current assumption provides a margin for improvements in longevity as was contemplated when adopted back in 2010.

Therefore, we recommend the following updates to the active member mortality rates to reflect recent experience and anticipate future improvements in mortality.

- Male annuitants: RP-2014 male employee mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale, projected to 2013 with the Buck Modified 2015 projection scale and adjusted by approximately 81% for credibility.

- Female annuitants: RP-2014 female employee mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale, projected to 2013 with the Buck Modified 2015 projection scale and adjusted by approximately 78% for credibility.
- These base mortality tables will then be projected on a generational basis using the Buck Modified 2015 projection scale to the valuation date and further projected using the Buck Modified 2015 projection scale.

The recommended mortality assumptions among annuitants and active members are appropriate for purposes of the valuation. The recommended assumptions are reasonably related to the experience of the System and are reasonable long-term expectations. The recommended assumptions are in compliance with the requirements of ASOP No. 35.

Section III – Discussion of Experience Review Demographic Assumptions for Active Members

Tables 4 through 7 in Section VII summarize the actual and expected separations from active service due to withdrawal from employment, disability, early retirement and superannuation retirement during the five-year period ended June 30, 2015.

The following discuss the results of the experience study with respect to the demographic factors, along with our recommendations for modifying the assumptions.

Act 2010-120 Memberships

Act 2010-120 (Act 120) created the new Class T-E and an optional new Class T-F membership groups. Any employee who became a member of the Retirement System after June 30, 2011, is a Class T-E member. A Class T-E member would be eligible for an annuity based upon an annual benefit accrual rate of 2% and would have a corresponding employee contribution requirement equal to 7.5% of compensation. Any employee who became a member of the Retirement System after June 30, 2011 has the option of electing Class T-F membership within 45 days of becoming a member. A Class T-F member is eligible for an annuity based upon an annual benefit accrual rate of 2.5% and a corresponding employee contribution requirement equal to 10.3% of compensation. Act 120 also:

- Increased the superannuation requirements for Class T-E and Class T-F members to i) age 65 with a minimum of three years of service credit, or ii) any combination of age and service that totals 92 with at least 35 years of credited service.
- Increased the vesting eligibility requirement for Class T-E and Class T-F members to ten years of service credit.
- Made Class T-E and Class T-F members ineligible to elect to receive a lump sum payment of member contributions.
- Made Class T-E and Class T-F members subject to “shared-risk” contributions if investment returns do not meet certain thresholds.

Since the June 30, 2012 actuarial valuation, the actuarial valuation applied the same demographic assumptions used for legacy Classes T-C and T-D members to Classes T-E and T-F members. One difficulty in the estimation of liabilities for the new Act 120 membership classes is that we would expect a change in retirement patterns to result since the benefit entitlements were reduced. In general, decreasing benefits may lead to postponed retirements among affected members, who may need to remain in service longer than would have previously been necessary to earn sufficient benefits to meet their financial needs in retirement. However, the nature and extent of such postponements will not be identified until the new Act 120 members retire under the new benefit design and credible data is accumulated for analysis.

In the June 30, 2015, actuarial valuation, there were 41,189 Class T-E members with average service of 1.3 years and 7,280 Class T-F members with average service of 1.7 years. We believe that there is insufficient Class T-E and Class T-F data accumulated to develop demographic assumptions solely for Class T-E and Class T-F active members. For purposes of this study, the experience for Class T-E and Class T-F members for withdrawal prior to 5 years of Service and Superannuation (age 65 with 3 years of service) have been combined with the experience of Class T-C and Class T-D members. The Class T-E and Class T-F experience will be reviewed when the next scheduled study is prepared as of June 30, 2020 and changes, if warranted, will be recommended at that time.

The following table summarizes the ratios of actual to expected cases of separation from active service based on current assumptions.

Summary Comparison of Actual to Expected Cases Males and Females

Event	Ratio of Actual To Expected Experience	
	Males	Females
Withdrawal from Employment		
• With Less than Five Years of Service	136%	114%
• Withdrawals with at least Five but less than Ten Years of Service	133%	109%
• With at least Ten Years of Service	125%	118%
Disability Retirement	87%	93%
Early Retirement	131%	133%
Superannuation Retirement	111%	114%

Rates of Withdrawal from Employment

We examined the actual experience of terminations separately for members with less than five years of service, members with at least five but less than ten years of service, and members with at least ten years of service. The results of the study still show differences among the withdrawal rates for all three categories. For this reason, we recommend the continued use of separate rates of withdrawal.

Table 4(a) shows that during the five-year period, the actual rate of termination among males with less than five years of service was 136% of what was expected. Among females, the ratio was 114%. Therefore, we recommend the following adjustments to the withdrawal rates to reflect the experience.

- Male members: We recommend increasing the rates since the total incidence of actual withdrawals was more than expected.
- Female members: We recommend increasing the rates since the total incidence of actual withdrawals was more than expected.

Table 4(b) shows that during the five-year period, the actual rates of termination of members with at least five but less than ten years of service were higher than expected. Among males, the ratio of actual to expected experience was 133%. Among females, the ratio was 109% but the ratio of actual to expected experience among the females varied by age. Therefore, we recommend the following adjustments to the withdrawal rates to reflect the experience.

- Male members: We recommend increasing the rates since the total incidence of actual non-vested withdrawals was higher than expected.
- Female members: Actual withdrawals were less than expected for all ages up to age 30 and we recommend decreasing the rates at these ages. Actual withdrawals in the age 35 group were close to expected. However, we still recommend a minor increase to the rates to smooth the progression of the rates into the higher ages. Actual withdrawals above age 35 were higher than expected and we recommend increasing the rates at these ages.

Table 4(c) shows that during the five-year period, the actual rates of termination of members with at least ten years of service were greater than expected. Among males, the ratio of actual to expected experience was 125%. Among females, the ratio was 118%. However, the ratio of actual to expected experience

varied by age for both genders. Therefore, we recommend the following adjustments to the withdrawal rates to reflect the experience.

- Male members: Actual total withdrawals were higher than expected. The difference occurs at all ages, except at age 35 where the actual number of terminations is close to that expected. We recommend an increase to the rates at all ages, except at age 35 where we recommend no adjustment to the rate.
- Female members: Actual total withdrawals were higher than expected. The difference occurs at all ages older than age 35. Actual experience for ages below age 35 is within an acceptable range while the experience at age 35 is lower than expected. We recommend an increase to the rates at all ages after age 35, no change to the rates before age 35 and a decrease to the rate at age 35.

Disability Retirement

Table 5 shows the summary of experience for disability retirements among members who have at least five years of service. The five-year study shows that actual incidence of disability retirements among males and females was lower than what was expected. For males, the ratio of actual to expected experience was 87%. For females, the ratio was 93%. However, the ratio of actual to expected experience varied by age for both genders. Therefore, we recommend the following adjustments to the active disability rates to reflect the experience.

- Male members: Actual total incidence of disability was lower than expected. The difference occurs at ages below age 50 and at age 65. We recommend a decrease to the assumed rates at these ages. The actual incidence of disability for all other ages was higher than expected and we recommend an increase to the rates at these ages.
- Female members: Actual total incidence of disability was lower than expected. The difference occurs at all ages, except for ages 50 and 70. We recommend a decrease to the assumed rates at these ages. The actual incidence of disability for ages 50 and 70 was higher than expected and we recommend an increase to the rates at these ages.

Early Retirement

Table 6 shows a comparison of the actual incidence of early retirement to that expected. For males, the actual numbers of early retirement were 31% greater than expected. For females, the actual numbers of early retirement were 33% greater than expected. Therefore, we recommend the following adjustments to the active early retirement rates to reflect the experience.

- Male members: Actual total retirements were higher than expected at all ages. We recommend an increase to the assumed rates at all ages.
- Female members: Actual total retirements were higher than expected at all ages. We recommend an increase to the assumed rates at all ages.

Superannuation Retirement

Table 7 shows the summary of experience for superannuation retirement. For males, the ratio of actual to expected experience was 111%. For females, the ratio was 114%. Therefore, we recommend the following adjustments to the assumed active superannuation rates to reflect the experience.

- Male members: Actual total retirements were higher than expected. The difference occurs at all ages except at ages before age 53, where the actual number of retirements was less than expected. We recommend an increase to the rates at all ages except at ages before age 53, where we recommend a decrease in the rates.

- Female members: Actual total retirements were higher than expected. The difference occurs at all ages except at ages before age 53, where the actual number of retirements was less than expected. We recommend an increase to the rates at all ages except at ages before age 53, where we recommend a decrease in the rates.

Optional Forms of Benefit Payment at Retirement: Annuity Payments

Under Section 8345(a) of the PSERS Retirement Code, any member who retires on a Withdrawal, Early or Superannuation Annuity may apply for and elect to receive either a Maximum Single Life Annuity (MSLA), or a reduced annuity that is actuarially equivalent to the MSLA in accordance with the following options:

- Option 1. A life annuity to the member with a guaranteed total payment equal to the present value of the MSLA on the effective date of retirement with the provision that if, at the member's death, the member has received less than such present value, the unpaid balance shall be payable to the beneficiary.
- Option 2. A joint and 100% survivor annuity payable during the lifetime of the member with the full amount of such annuity payable thereafter to the member's survivor annuitant, if living at the time of the member's death.
- Option 3. A joint and 50% survivor annuity payable during the lifetime of the member with one-half of such annuity payable thereafter to the member's survivor annuitant, if living at the time of the member's death.
- Option 4. Some other benefit, which shall be certified by the actuary to be actuarially equivalent to the MSLA (subject to certain restrictions).

Currently it is assumed that 100% of all eligible retirees will elect the MSLA form of payment upon retirement. However, the data examined in the experience study showed the following distribution of retiring members' elections of the available optional forms of payment:

- 51.5% elected MSLA
- 20.8% elected Option 1
- 18.8% elected Option 2
- 7.8% elected Option 3
- 1.1% elected Option 4

The System's optional forms of payment factors are based on the statutory interest crediting rate, per Section 8102 of the PSERS Retirement Code, of 4% per annum. The System's annual valuations are currently based on an assumed 7.50% annual rate of investment return. The current assumption thus projects benefit payments that are greater than what the actual member elections of payment options in the recent past produce.

Therefore, we recommend that the System's annual actuarial valuation recognize the incidence of retiring member elections of annuity payments other than an MSLA and update the assumption of anticipated active member elections of optional forms of payment at retirement as follows:

- 50% will elect MSLA
- 20% will elect Option 1
- 20% will elect Option 2 (assuming males are 3 years older than females)

- 10% will elect Option 3 (assuming males are 3 years older than females)
- 0% will elect Option 4

Adoption of the recommendation will result in more accurate projection of benefits payable from the System.

Optional Forms of Benefit Payment at Retirement: Option 4 – Withdrawal of Accumulated Deductions at Retirement

In accordance with the provisions of Section 8345 of the PSERS Retirement Code, a Class T-C or Class T-D member may elect an Option 4 Lump Sum. Under this option, the member receives a lump sum that is less than or equal to the member's accumulated deductions at retirement and the balance of the present value of the MSLA is paid as a single life annuity to the member or under an optional form of annuity payment.

The current valuation assumption assumes 100% of all eligible retirements will elect to withdraw all accumulated deductions under an Option 4 form of payment. However, PSERS' in-house data show:

- 87% of recent retirements elect to receive a partial or full withdrawal of the member's accumulated deductions.
- Approximately 80% of recent retirements elect to withdraw 100% of the accumulated deductions.

The annual valuation data provided to Buck does not contain information on withdrawal of accumulated deductions upon retirement. However, the data provided for retired members include information on the balances of members' accumulated deductions. As of the June 30, 2015, 77% of retired member records report no remaining balance for the accumulated deductions.

As mentioned, the System's optional forms of payment factors are based on the statutory interest crediting rate of 4% per annum, while the System's annual valuation currently uses a 7.50% annual assumed rate of investment return. The current assumption then anticipates refunds of accumulated deductions and annuity payments that are greater than what the actual Class T-C and Class T-D member retirement data produces.

Therefore, we recommend reducing the assumed rate of Option 4 Lump Sum payments from 100% to 80% of all eligible retirements. Acceptance of this recommendation should result in more accurate projections of future benefit payments by the System.

Section IV – Discussion of Experience Review

Economic Factors

Tables 8 and 9 in Section VII summarize the actual results for the key economic factors affecting the operation of the System during the five-year period ended June 30, 2015. Table 8 shows a summary of annual investment rates of returns and average annual increases in the CPI-U. Table 9 shows a comparison of actual and expected salaries of active full-time members.

Rates of Investment Return

The rate of investment return assumption used for the System’s annual actuarial valuation is chosen by the Board of the System based on recommendations from its investment advisor and actuary.

The current interest rate assumption is 7.50% per year, which includes an inflation component of 3.00% per year. The average annual increase in the CPI-U and rates of investment return during the five-year period ended June 30, 2015 are shown below. The actual returns on the market value of assets fluctuated during the five-year study period. The average return on the market value of assets exceeded the expected annual return of 7.50%.

Fiscal Year	CPI-U	Return on Market Value of Assets ¹
2010/2011	3.6%	20.40%
2011/2012	1.7	3.40
2012/2013	1.8	8.00
2013/2014	2.1	14.90
2014/2015	<u>0.1</u>	<u>3.00</u>
Average	1.8%	9.74%

1. Provided by PSERS’ investment consultant (Aon Hewitt for fiscal years 2013/2014 and 2014/2015 and Wilshire Associates for prior years).

The table above shows the annual increase in the CPI-U during the five-year period ending June 30, 2015. The average increase in the CPI-U was 1.8%.

Also shown are the historic investment rates of return, measured on a market value basis. The return on the market value of assets was volatile during the five years that ended June 30, 2015. The return on the market value exceeded the 7.50% assumed return rate during fiscal years 2011, 2013 and 2014 but underperformed during the other fiscal years. The arithmetic average rate of return on investments based on the market value of assets during the five-year examination period was equal to 9.74%. Based on information provided by PSERS staff, the arithmetic average rate of return on investments based on the market value of assets during the last 25-year and 30-year examination periods was equal to 8.45% and 8.98%, respectively.

The 7.50% interest rate assumption is made up of two components – the rate of inflation and the real rate of return. The rate of inflation assumption (based on the CPI-U) is currently 3.00% and the real rate of return assumption is 4.50%.

The historical returns on the funds should not be used as the sole basis for selecting the interest rate for calculating costs in future years. The reason for this is that the interest rate is an assumption that is used to fund benefits payable many years into the future, in some instances for as long as 80 years. Thus, while a review of past experience is useful and indicates that the actual rate of investment return over the past five years was in excess of the assumed rate of 7.50%, we do not believe that these investment returns signal a major change in the long-term earnings prospects of the System. However, we do believe that the 3.00% inflation assumption is high based on historical increases in the CPI-U.

There is increased scrutiny of both public fund assumptions and aggressive risk-taking. In addition, public systems' investment advisors believe that long-term expected return for many asset classes are declining. This has caused many public systems to adopt more conservative long-term investment expectations. Current surveys of public funds show a trend towards lower investment return assumptions as a prudent measure against added volatility and risk.

The System's investment advisor, Aon Hewitt, believes the System would have to accept increased volatility and risk-bearing in order to achieve the current assumed 7.50% annual return. In their study, they report that under the current 30-year Capital Market Assumptions, the current PSERS asset allocation's expected annual return is 7.12%. However, this expected return does not include any "alpha" (measure of the additional return on an investment due to active management) expectations for the liquid asset classes. Given PSERS' historical track record in these areas, Aon Hewitt believes that a 15 to 25 basis point additional alpha expectation is a reasonable assumption.

In view of these observations it was recommended and the Board adopted an inflation assumption of 2.75% (reduced from the current 3.00%) and an interest rate assumption of 7.25% (reduced from the current 7.50%). This means that the real return assumption will be maintained at the current 4.50%. The following table shows the current and revised components of the interest rate assumption:

Components of Interest Rate Assumption

Item	Current Assumptions	Revised Assumptions
Inflation	3.00%	2.75%
Real Return	<u>4.50</u>	<u>4.50</u>
Total	7.50%	7.25%

We believe that the revised economic assumptions are appropriate for purposes of the valuation. These assumptions are reasonably related to the experience of the System and are reasonable long-term expectations.

Rates of Salary Increase

The growth in average annual salary is presented in Table 9 of Section VII. The assumed salary increase assumption is an effective average of 5.50%. Table 9 shows that the actual average annual salary increase over the examination period for all age groups is 3.8%. However, based on historical information provided for the annual valuations, the average annual salary increase during the last 10-year and 15-year examination periods were equal to 4.5% and 4.7%, respectively.

The salary increase assumption should be selected with an eye towards past experience but with considerable emphasis placed on judgment concerning future expectations. The salary increase assumption should be consistent with the interest rate assumption as both assumptions are based on a long-term inflation assumption. The revised long-term inflation assumption is 2.75%.

We recommend that the current 5.50% salary increase assumption be reduced by 0.50% to 5.00%. The reduction reflects the 0.25% decrease in the long-term inflation assumption (from 3.00% to 2.75%) and a 0.25% decrease in the real wage growth and career scale (from 2.50% to 2.25%).

It is generally accepted in actuarial practice that a reasonable spread between the investment return assumption and the salary increase assumption falls in the range of 2% to 3%. We believe the recommended use of a salary scale averaging 5.00% along with a gross investment return assumption of 7.25% reflects consistency in the economic basis of the two assumptions.

Section V – Discussion of Experience Review Option Factors

Members may elect to receive their retirement annuity for their lifetime only (i.e., MSLA) or under various optional forms of payment that would provide a death benefit. Under the Option 4 lump sum option, the member receives a refund of the accumulated deductions together with an annuity that has been reduced by the amount of monthly annuity that could have been provided by the accumulated deductions.

When a member elects to receive an annuity under an optional form of payment that provides a death benefit, the MSLA is reduced to reflect the cost of providing the death benefit. When a member elects to retire early by commencing the annuity before superannuation age, the annuity is reduced to reflect the longer time period of retirement.

Option factors are used to:

- 1) Reduce the MSLA to pay for the cost of providing the death benefit,
- 2) Determine the monthly annuity that could be provided by a member's accumulated deductions, and
- 3) Convert the benefit payable at superannuation age to the benefit paid at withdrawal or early retirement.

The option factors are based on two assumptions – mortality and statutory interest.

The PSERS Code requires the option factors to be based on 4% statutory interest. The current mortality basis is the RP-2000 Healthy Annuitant Mortality Tables with both the male and female tables set back three years assuming the population consists of 25% males and 75% females. We recommend that the mortality table be updated to a blend of the recommended annuitant base mortality tables projected to 2020 with the Buck 2015 improvement scale assuming the population consists of 25% males and 75% females.

Updating the mortality table used in the option factors produces:

- Minimal effect on members who withdraw from the plan electing to receive benefits prior to superannuation;
- No significant effect on members who elect to receive an annuity under one of the optional forms of payment;
- A relatively cost neutral impact on the System;

In accordance with discussions with PSERS staff, it is also recommended that the updated option factors take effect for retirements after June 30, 2018, for the sake of operational transitioning.

Section VI – Financial Impact of Recommended Assumptions

Based on the results of the experience review, we recommend revisions to the rates of:

- Mortality among annuitants
- Mortality among active members
- Disability
- Withdrawal
- Early retirement
- Superannuation retirement
- Optional Forms of Benefit Payment at Retirement: Annuity forms of payment and withdrawal of accumulated deductions
- Annual salary increases

The Board adopted an inflation assumption 2.75% per year (reduced from the current 3.00%) and an interest rate assumption of 7.25% per year (reduced from the current 7.50%).

Financial Impact of Recommended Assumption Changes

- a. The table below shows the impact on the fiscal year 2017 employer contribution rate for each recommended assumption change assuming the recommended assumptions were in effect for the June 30, 2015 actuarial valuation:

Increase (Decrease) in Employer Contribution Rate

Assumption	Normal Rate	Total Contribution Rate ¹
Demographic Changes		
Post-retirement mortality	.21%	.80%
Death in-service	(.01)	(.02)
Disability retirement	(.01)	(.01)
Withdrawal prior to Retirement	(.16)	(.11)
Retirement (Early, Superannuation and Late)	.18	.51
Optional forms of benefit payment	<u>(.26)</u>	<u>(.64)</u>
Total Demographic Changes	.05%	.53%
Economic Changes		
Interest Rate	.84%	1.64%
Annual Salary Increases	<u>(1.03)</u>	<u>(1.50)</u>
Total Economic Change	(.19)%	.14%
Total Change	(.14)%	.67%

1. Without regard to the fiscal year 2017 Act 120 pension collar.

- b. We have also estimated the potential financial impact on the June 30, 2016 actuarial valuation and the results are shown in the table below.

Assumption	Normal Rate ¹	Total Contribution Rate ¹
1. Current Assumptions	8.14%	32.26%
2. Impact of Change in Assumptions	<u>(0.25)</u>	<u>(0.01)</u>
3. Revised Assumptions (1) + (2)	7.89%	32.25%

1. The caveats outlined in the certification letter continue to apply to this information.

A summary of the current assumptions is as follows:

Current Assumptions

Interest Rate: 7.50% per annum, compounded annually. The components are 3.00% for inflation and 4.50% for the real rate of return. Actuarial equivalent benefits are determined based on a statutorily specified interest rate of 4% per year (since 1960).

Separation from Service: Illustrative rates of assumed separation from service are shown in the following table.

Age	Annual Rate of:						
	Withdrawal			Death	Disability	Early Retirement ¹	Superannuation Retirement
	Less Than Five Years of Service	Five Years but Less Than 10 Years of Service	10 or More Years of Service				
MALES							
25	12.50%	5.50%	2.00%	.037%	.024%		
30	10.50	3.20	2.00	.038	.024		
35	11.00	3.00	1.50	.056	.100		
40	13.00	3.50	1.25	.090	.180		
45	13.00	3.50	1.25	.121	.180		25.00%
50	13.00	3.50	1.70	.173	.280		25.00
55	11.00	3.50	3.00	.245	.430	15.00%	30.00
60	10.50	3.50	4.50	.363	.580	12.00	28.00
65				.592	.100		20.00
69				.810	.100		18.00
FEMALES							
25	13.00%	8.50%	5.00%	.018%	.030%		
30	13.00	6.50	4.00	.019	.040		
35	13.00	5.50	3.00	.022	.060		
40	10.90	4.50	1.50	.035	.100		
45	10.90	4.00	1.50	.055	.150		30.00%
50	10.90	3.75	1.75	.085	.200		30.00
55	10.90	3.75	3.00	.133	.380	15.00%	30.00
60	10.90	4.50	5.50	.197	.380	15.00	30.00
65				.301	.130		25.00
69				.428	.130		20.00

1. Early Retirement – Age 55 with 25 years of service, but not eligible for Superannuation retirement.

Death after Retirement: The RP-2000 Combined Healthy Annuitant Tables (Male and Female) with age set back 3 years for both genders for healthy annuitants and for dependent beneficiaries. The RP-2000 Combined Disabled Tables (Male and Female) with age set back 7 years for males and set back 3 years for females for disabled annuitants. (A unisex table based on the RP-2000 Combined Healthy Annuitant Tables (Male and Female) with age set back 3 years for both genders assuming a population comprised of 25% males and 75% females is used to determine actuarial equivalent benefits.)

Salary Increase: Effective average of 5.50% per annum, compounded annually. The components are 3.00% for inflation, 1% for real wage growth and 1.50% for merit or seniority increases. Representative values are as follows:

Age	Annual Rate of Salary Increase
20	10.75%
30	8.25
40	6.25
50	4.25
55	3.75
60	3.75
65	3.75
70	3.75

A summary of the recommended assumptions is as follows. A complete set of the recommended assumptions is presented in Section VIII.

Recommended Assumptions

Interest Rate: 7.25% per annum, compounded annually. The components are 2.75% for inflation and 4.50% for the real rate of return. Actuarial equivalent benefits are determined based on a statutorily specified interest rate of 4% per year (since 1960).

Separation from Service: Illustrative rates of assumed separation from service are shown in the following table.

Age	Annual Rate of:						
	Vested Withdrawal ¹			Death ¹	Disability	Early Retirement ²	Superannuation Retirement
	Less Than Five Years of Service	Five Years but Less Than 10 Years of Service	10 or More Years of Service				
MALES							
25	14.85%	5.70%	2.57%	.041%	.020%		
30	12.74	3.37	2.57	.039	.020		
35	13.39	3.21	1.50	.044	.058		
40	14.49	3.97	1.34	.050	.116		
45	14.42	4.53	1.37	.084	.160		19.16%
50	14.31	4.45	1.92	.138	.284		19.16
55	12.17	4.43	3.38	.233	.442	18.57%	26.59
60	12.43	5.58	5.57	.379	.582	14.42	30.87
65				.700	.087		21.39
69				1.067	.135		19.34
FEMALES							
25	13.41%	7.47%	5.02%	.013%	.018%		
30	13.81	6.05	4.02	.017	.023		
35	14.22	5.53	2.85	.024	.055		
40	11.79	4.87	1.60	.032	.096		
45	11.54	4.51	1.65	.051	.135		15.00%
50	11.66	4.43	2.06	.088	.229		15.00
55	11.75	4.38	3.11	.133	.368	18.59%	10.02
60	12.25	5.97	6.40	.196	.360	17.05	35.77
65				.327	.082		22.23
69				.443	.118		22.79

1. These base mortality tables will then be projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.
2. Early Retirement – Age 55 with 25 years of service, but not eligible for Superannuation retirement.

Death after Retirement:

Male annuitants: RP-2014 male mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale and projected to the valuation date with the Buck Modified 2015 projection scale.

Female annuitants: RP-2014 female mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale, projected to 2013 with the Buck Modified 2015 projection scale and adjusted for credibility. This base mortality table will then be projected on a generational basis using the Buck Modified 2015 projection scale to the valuation date.

Disabled annuitants: RP-2014 male and female disabled mortality tables adjusted backward to 2006 with the MP-2014 mortality improvement scale and projected to the valuation date with the Buck Modified 2015 projection scale.

These base mortality tables will then be projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Salary Increase: Effective average of 5.00% per annum, compounded annually. The components are 2.75% for inflation and 2.25% for real wage growth and for merit or seniority increases. Representative values are as follows:

Age	Annual Rate of Salary Increase
20	10.10%
30	7.81
40	5.75
50	3.81
55	3.31
60	3.25
65	3.25
70	3.25

Section VII

Comparison of Actual and Expected Experience During Five-Year Period from July 1, 2010 through June 30, 2015

Table 1

Summary of Mortality Experience Among Annuitants

Superannuation, Early, Withdrawal, Beneficiaries and Survivor Annuitants

Males

2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 35	5	1	1	1,671	769%	658%
35	3	2	2	3,599	144	160
40	13	4	3	4,926	290	413
45	15	7	6	5,828	210	256
50	35	12	24	6,958	286	147
55	78	35	75	12,464	225	104
60	240	216	348	43,173	111	69
65	670	735	931	82,227	91	72
70	985	1,053	1,150	66,193	94	86
75	1,223	1,220	1,270	44,599	100	96
80	1,681	1,611	1,648	34,425	104	102
85	2,008	1,747	1,804	22,064	115	111
90	1,392	1,210	1,277	9,264	115	109
Over 93	678	556	585	2,554	122	116
Total	9,026	8,408	9,124	339,945	107%	99%

Recommendation: RP-2014 male mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale and projected to the 2015 valuation date with the Buck Modified 2015 projection scale. This base mortality table will then be projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Table 1 (continued)

Summary of Mortality Experience Among Annuitants

Superannuation, Early, Withdrawal, Beneficiaries and Survivor Annuitants

Females
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 35	3	1	1	6,168	208%	226%
35	11	5	4	15,129	205	272
40	18	10	7	17,335	186	276
45	26	15	11	17,425	174	248
50	59	28	43	21,105	208	137
55	154	82	137	38,942	189	112
60	385	377	538	102,232	102	72
65	818	1,014	1,199	151,131	81	68
70	1,092	1,333	1,401	110,493	82	78
75	1,405	1,674	1,681	81,070	84	84
80	2,287	2,289	2,335	66,761	100	98
85	3,289	2,991	3,239	53,327	110	102
90	3,619	2,871	3,197	30,429	126	113
Over 93	3,271	2,363	2,696	14,550	138	121
Total	16,437	15,053	16,489	726,097	109%	100%

Recommendation: RP-2014 female mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale, projected to 2013 with the Buck Modified 2015 projection scale and adjusted for credibility. This base mortality table will then be projected on a generational basis using the Buck Modified 2015 projection scale to the 2015 valuation date. This base mortality table will then be further projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Table 2

Summary of Mortality Experience Among Annuitants

Disability

Males

2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 35	0	0	0	18	0%	0%
35	0	1	0	32	0	0
40	2	3	1	119	74	146
45	8	8	6	364	97	129
50	16	18	17	796	89	95
55	46	47	42	1,755	98	110
60	69	87	71	2,635	79	98
65	84	89	73	2,280	94	115
70	69	56	51	1,220	122	136
75	47	42	43	749	111	110
80	24	29	32	398	83	74
85	28	23	28	239	122	99
90	11	8	11	64	137	97
Over 953	7	2	4	15	283	185
Total	411	414	380	10,684	99%	108%

Recommendation: RP-2014 male disabled mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale and projected to the valuation date with the Buck Modified 2015 projection scale. This base mortality table will then be further projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Table 2 (continued)

Summary of Mortality Experience Among Annuitants

Disability

Females
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 35	1	0	0	16	833%	0%
35	1	1	1	147	91	159
40	5	3	2	370	181	228
45	11	6	7	767	193	155
50	22	17	22	1,850	129	98
55	59	51	55	3,686	116	107
60	86	111	105	5,906	78	82
65	92	115	104	4,827	80	88
70	89	92	87	2,943	97	103
75	72	75	76	1,746	97	95
80	92	75	83	1,275	122	111
85	67	60	71	741	111	94
90	60	34	42	304	177	141
Over 93	28	21	28	131	132	102
Total	685	660	683	24,709	104%	100%

Recommendation: RP-2014 female disabled mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale and projected to the valuation date with the Buck Modified 2015 projection scale. This base mortality table will then be further projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Table 3

Summary of Experience for Death in Active Service

Males
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
20	0	1	1	3,199	0%	0%
25	11	10	10	26,821	112	111
30	15	17	16	42,851	90	96
35	21	26	19	46,177	80	111
40	17	43	26	48,142	39	66
45	53	56	35	45,963	94	151
50	67	79	64	45,352	85	105
55	111	119	112	48,590	93	99
60	157	136	140	37,807	115	113
65	73	92	108	16,029	80	68
Over 68	69	61	86	7,160	113	80
Total	594	641	616	368,091	93%	96%

Recommendation: RP-2014 male employee mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale, projected to 2013 with the Buck Modified 2015 projection scale and adjusted by, approximately, 81% for credibility. This base mortality table will then be further projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Table 3 (continued)

Summary of Experience for Death in Active Service

Females
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
20	0	0	0	2,684	0%	0%
25	8	13	10	70,170	62	78
30	20	21	18	107,520	95	111
35	23	23	24	101,410	101	97
40	28	41	40	114,803	69	71
45	79	73	67	130,393	109	118
50	110	122	124	140,899	91	89
55	200	199	199	149,807	100	100
60	222	217	216	112,240	102	103
65	85	104	107	36,047	82	80
Over 68	45	48	55	10,279	94	82
Total	820	860	860	976,252	95%	95%

Recommendation: RP-2014 female employee mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale, projected to 2013 with the Buck Modified 2015 projection scale and adjusted by, approximately, 78% for credibility. This base mortality table will then be further projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Table 4(a)

Summary of Experience for Termination from Employment Before Retirement

Withdrawals with Less than Five Years of Service

Males

2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
20	1,011	445	728	3,178	227%	139%
25	4,244	3,084	3,664	24,672	138	116
30	2,739	1,921	2,331	18,296	143	118
35	1,617	1,128	1,373	10,254	143	118
40	1,373	1,118	1,246	8,597	123	110
45	1,410	1,156	1,283	8,896	122	110
50	1,460	1,215	1,338	9,348	120	109
55	1,225	1,010	1,117	8,671	121	110
60	871	637	754	6,216	137	116
Total	15,950	11,714	13,834	98,128	136%	115%

Recommendation: Increase the rates since the total incidence of actual withdrawals with less than five years of service is more than expected.

Table 4(a) (continued)

Summary of Experience for Termination from Employment Before Retirement

Withdrawals with Less than Five Years of Service

Females
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
20	849	378	614	2,683	225%	138%
25	8,954	8,427	8,693	64,821	106	103
30	5,956	5,300	5,631	40,773	112	106
35	3,720	3,133	3,427	24,174	119	109
40	3,903	3,352	3,626	29,858	116	108
45	4,223	3,779	4,001	34,672	112	106
50	3,527	3,095	3,311	28,393	114	107
55	2,431	2,104	2,268	19,299	116	107
60	1,383	1,109	1,246	10,171	125	111
Total	34,946	30,677	32,817	254,844	114%	106%

Recommendation: Increase the rates since the total incidence of actual withdrawals with less than five years of service is more than expected.

Table 4(b)

Summary of Experience for Termination from Employment Before Retirement

Withdrawals with at Least Five but Less Than Ten Years of Service

Males
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 28	128	119	123	2,164	108%	104%
30	816	736	775	22,996	111	105
35	545	479	513	15,975	114	106
40	398	314	356	8,971	127	112
45	366	231	299	6,593	158	122
50	360	234	297	6,672	154	121
55	370	242	306	6,909	153	121
60	391	179	285	5,107	218	137
Total	3,374	2,534	2,954	75,387	133%	114%

Recommendation: Actual withdrawals were higher than expected for all ages and we recommend increasing the rates.

Table 4(b) (continued)

Summary of Experience for Termination from Employment Before Retirement

Withdrawals with at Least Five but Less Than Ten Years of Service

Females
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 28	344	455	400	5,348	76%	86%
30	3,560	4,136	3,849	63,628	86	92
35	2,023	2,000	2,011	36,362	101	101
40	1,352	1,162	1,257	25,812	116	108
45	1,597	1,273	1,435	31,813	125	111
50	1,812	1,328	1,569	35,414	136	115
55	1,319	988	1,153	26,333	134	114
60	942	570	757	12,672	165	124
Total	12,949	11,912	12,431	237,382	109%	104%

Recommendation: Actual withdrawals were less than expected for all ages up to age 30 and we recommend decreasing the rates at these ages. Actual withdrawals after age 30 were higher than expected and we recommend increasing the rates.

Table 4(c)

Summary of Experience for Termination from Employment Before Retirement

Withdrawals with at Least Ten Years of Service

Males

2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 33	49	31	40	1,565	158%	123%
35	293	299	299	19,948	98	98
40	435	382	410	30,574	114	106
45	456	381	417	30,474	120	109
50	629	498	563	29,317	126	112
55	680	543	612	22,939	125	111
60	896	608	752	11,609	147	119
Total	3,438	2,742	3,093	146,426	125%	111%

Recommendation: Actual total withdrawals were higher than expected for all ages, except age 35, and we recommend increasing the rate at these ages. Actual experience at age 35 is within an acceptable range and no change is recommended.

Table 4(c)

Summary of Experience for Termination from Employment Before Retirement

Withdrawals with at Least Ten Years of Service

Females
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 33	126	125	125	3,121	101%	101%
35	1,101	1,226	1,165	40,874	90	95
40	1,009	887	946	59,133	114	107
45	1,151	959	1,054	63,908	120	109
50	1,820	1,349	1,588	77,077	135	115
55	2,607	2,424	2,515	83,370	108	104
60	3,834	2,889	3,361	49,612	133	114
Total	11,648	9,859	10,754	377,095	118%	108%

Recommendation: Actual total withdrawals were higher than expected, for all ages after age 35. We recommend an increase to the rates from age 40. Actual experience under age 33 is within an acceptable range and no change is recommended. Actual withdrawals at age 35 were lower than expected and we recommend decreasing the rate.

Table 5

Summary of Experience for Disability Retirement with at Least Five Years of Service

Males
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 33	6	10	8	27,639	60%	75%
35	6	37	21	36,472	16	29
40	20	68	44	40,050	29	46
45	56	72	64	37,668	78	88
50	108	105	107	36,718	103	101
55	185	175	180	40,719	106	103
60	151	150	151	31,345	101	100
65	14	19	17	12,409	74	82
70	10	5	10	7,389	200	100
Total	556	641	602	270,409	87%	92%

Recommendation: Decrease rates since the incidence of actual disability retirements is less than expected.

Table 5 (continued)

Summary of Experience for Disability Retirement with at Least Five Years of Service

Females
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 33	5	29	17	73,985	17%	29%
35	39	47	43	78,574	83	91
40	81	88	84	87,550	92	96
45	119	150	135	99,997	79	88
50	301	234	267	117,012	129	113
55	428	456	442	133,859	94	97
60	310	347	329	102,706	89	94
65	11	42	26	31,990	26	42
70	13	11	13	11,303	118	100
Total	1,307	1,404	1,356	736,976	93%	96%

Recommendation: Decrease rates, except for age 50, since the incidence of actual disability retirements is less than expected. Actual experience at age 50 is higher than expected, increase rates at age 50.

Table 6

Summary of Experience for Early Retirement

Age 55 with at Least 25 Years of Service, but Ineligible for Superannuation

Males
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
55	751	509	630	3,393	148%	119%
56	570	466	518	3,004	122	110
57	458	383	420	2,469	120	109
58	382	311	346	2,004	123	110
59	436	309	373	1,719	141	117
60	127	90	109	754	141	117
61	224	174	199	695	129	113
Total	2,948	2,242	2,595	14,038	131%	114%

Recommendation: Actual retirements were higher than expected for all ages and we recommend increasing the rates.

Table 6 (continued)

Summary of Experience for Early Retirement

Age 55 with at Least 25 Years of Service, but Ineligible for Superannuation

Females
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
55	1,505	1,018	1,262	6,788	148%	119%
56	1,170	1,000	1,085	6,451	117	108
57	1,086	907	996	5,849	120	109
58	1,022	822	922	5,306	124	111
59	1,263	835	1,049	4,912	151	120
60	529	416	472	2,770	127	112
61	907	648	778	2,593	140	117
Total	7,482	5,646	6,564	34,669	133%	114%

Recommendation: Actual retirements were higher than expected for all ages and we recommend increasing the rates.

Table 7

Summary of Experience for Superannuation

Age 62, Age 60 with 30 Years, or 35 Years

Males

2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 53	2	4	3	15	50%	67%
55	397	352	375	1,205	113	106
60	2,989	2,825	2,907	9,703	106	103
65	3,387	2,974	3,180	15,289	114	107
68	334	291	312	1,615	115	107
69	<u>288</u>	<u>250</u>	<u>269</u>	<u>1,391</u>	<u>115</u>	<u>107</u>
Subtotal under 70	7,397	6,696	7,046	29,218	110	105
70+	812	681	732	3,784	119	111
Total All Ages	8,209	7,377	7,778	33,002	111%	106%

Recommendation: Actual retirements after age 53 were higher than expected and we recommend an increase to the rates for these ages. Actual retirements prior to age 55 were less than expected and we recommend a decrease to these rates.

Table 7 (continued)

Summary of Experience for Superannuation

Age 62, Age 60 with 30 Years, or 35 Years

Females
2010 – 2015

Average Age	Number of Separations			Exposed	Ratio of Actual to Expected Experience	
	Actual	Expected			Current	Proposed
		Current	Proposed			
Under 53	0	5	2	15	0%	0%
55	533	531	532	1,717	100	100
60	7,647	7,322	7,483	24,204	104	102
65	9,030	7,381	8,204	35,264	122	110
68	680	532	606	2,659	128	112
69	<u>486</u>	<u>413</u>	<u>449</u>	<u>2,063</u>	<u>118</u>	<u>108</u>
Subtotal under 70	18,376	16,184	17,276	65,922	114%	106%
70+	1,186	1,040	1,133	5,201	114	105
Total All Ages	19,562	17,224	18,409	71,123	114%	106%

Recommendation: Actual retirements after age 53 were higher than expected and we recommend an increase to the rates for these ages. There were no actual retirements prior to age 55 and we recommend a decrease to these rates.

Table 8

Summary of Inflation and Investment Returns

Fiscal Year	Average Annual Increase in CPI-U	Return on Market Value of Assets ¹
2010/2011	3.6%	20.40%
2011/2012	1.7	3.40
2012/2013	1.8	8.00
2013/2014	2.1	14.90
2014/2015	0.1	3.00
Average	1.8%	9.74%

1. Provided by PSERS' investment consultant (Aon Hewitt for fiscal years 2013/2014 and 2014/2015 and Wilshire Associates for prior years).

Also note the following investment performance information from PSERS' October 6, 2015 press release:

- a. Investment performance of the fund over the 25 year period ending June 30, 2015 is 8.45%.
- b. Investment performance of the fund over the 30 year period ending June 30, 2015 is 8.98%.

Table 9

Salary Increase Rates of Active Members

Males and Females

Average Age	Five-Year Actual Increase: 2010 - 2015						Ten-Year Actual Increase	Fifteen-Year Actual Increase	Expected Increase	Proposed Increase
	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	Total				
20	15.0%	13.1%	15.8%	18.0%	16.7%	15.6%	16.6%	16.3%	10.60%	10.10%
25	8.9	6.6	7.7	8.5	9.3	8.1	8.9	9.1	9.69	9.19
30	6.3	4.4	4.8	4.9	5.3	5.2	6.2	6.4	8.31	7.81
35	5.7	3.9	4.3	4.4	4.5	4.5	5.5	5.7	7.25	6.75
40	5.3	3.5	3.8	4.0	4.1	4.2	4.9	5.2	6.25	5.75
45	4.5	3.0	3.1	3.4	3.3	3.4	4.2	4.5	5.25	4.75
50	4.0	2.6	2.7	2.8	2.9	3.0	3.7	3.9	4.31	3.81
55	3.6	2.2	2.4	2.4	2.7	2.7	3.2	3.4	3.81	3.31
60	3.4	2.1	2.2	2.2	2.4	2.5	3.0	3.2	3.75	3.25
65	3.4	2.1	1.8	2.0	2.3	2.3	2.8	3.0	3.75	3.25
Over 70	3.4	2.1	1.8	1.7	2.2	2.3	3.1	3.1	3.75	3.25
Total	4.9%	3.2%	3.5%	3.6%	3.7%	3.8%	4.5%	4.7%	5.50%	5.00%

Section VIII

Recommended Demographic and Active Salary Increase Assumptions

Active Service Termination Assumptions

Age	Withdrawal with less than Five Years of Service		Withdrawal with at least Five but less than Ten Years of Service		Withdrawal with at least Ten Years of Service	
	Male	Female	Male	Female	Male	Female
19	0.2290	0.2287	0.0622	0.1054	0.0000	0.0000
20	0.2290	0.2287	0.0622	0.1054	0.0000	0.0000
21	0.2290	0.2287	0.0622	0.1054	0.0000	0.0000
22	0.2290	0.2287	0.0622	0.1054	0.0000	0.0000
23	0.1485	0.1341	0.0570	0.0747	0.0257	0.0502
24	0.1485	0.1341	0.0570	0.0747	0.0257	0.0502
25	0.1485	0.1341	0.0570	0.0747	0.0257	0.0502
26	0.1485	0.1341	0.0570	0.0747	0.0257	0.0502
27	0.1485	0.1341	0.0570	0.0747	0.0257	0.0502
28	0.1274	0.1381	0.0337	0.0605	0.0257	0.0402
29	0.1274	0.1381	0.0337	0.0605	0.0257	0.0402
30	0.1274	0.1381	0.0337	0.0605	0.0257	0.0402
31	0.1274	0.1381	0.0337	0.0605	0.0257	0.0402
32	0.1274	0.1381	0.0337	0.0605	0.0257	0.0402
33	0.1339	0.1422	0.0321	0.0553	0.0150	0.0285
34	0.1339	0.1422	0.0321	0.0553	0.0150	0.0285
35	0.1339	0.1422	0.0321	0.0553	0.0150	0.0285
36	0.1339	0.1422	0.0321	0.0553	0.0150	0.0285
37	0.1339	0.1400	0.0321	0.0553	0.0150	0.0285
38	0.1449	0.1320	0.0397	0.0487	0.0134	0.0160
39	0.1449	0.1244	0.0397	0.0487	0.0134	0.0160
40	0.1449	0.1179	0.0397	0.0487	0.0134	0.0160
41	0.1449	0.1179	0.0397	0.0487	0.0134	0.0160
42	0.1449	0.1179	0.0397	0.0487	0.0134	0.0160
43	0.1442	0.1154	0.0453	0.0451	0.0137	0.0165
44	0.1442	0.1154	0.0453	0.0451	0.0137	0.0165
45	0.1442	0.1154	0.0453	0.0451	0.0137	0.0165
46	0.1442	0.1154	0.0453	0.0451	0.0137	0.0165
47	0.1442	0.1154	0.0453	0.0451	0.0137	0.0165
48	0.1431	0.1166	0.0445	0.0443	0.0192	0.0206
49	0.1431	0.1166	0.0445	0.0443	0.0192	0.0206
50	0.1431	0.1166	0.0445	0.0443	0.0192	0.0206
51	0.1431	0.1166	0.0445	0.0443	0.0192	0.0206
52	0.1431	0.1166	0.0445	0.0443	0.0192	0.0206
53	0.1438	0.1175	0.0443	0.0438	0.0192	0.0208
54	0.1438	0.1175	0.0443	0.0438	0.0225	0.0311
55	0.1217	0.1175	0.0443	0.0438	0.0338	0.0311
56	0.1217	0.1175	0.0443	0.0438	0.0338	0.0337
57	0.1107	0.1175	0.0443	0.0438	0.0338	0.0363
58	0.1184	0.1225	0.0558	0.0597	0.0371	0.0465
59	0.1184	0.1225	0.0558	0.0597	0.0557	0.0582
60	0.1243	0.1225	0.0558	0.0597	0.0557	0.0640
61	0.1243	0.1225	0.0558	0.0597	0.1237	0.1164

Active Service Termination Assumptions (continued)

Age	Early Retirement		Superannuation Retirement		Disability Retirement		Death in Active Service ¹	
	Male	Female	Male	Female	Male	Female	Male	Female
19	0.0000	0.0000	0.0000	0.0000	0.000196	0.000176	0.000355	0.000161
20	0.0000	0.0000	0.0000	0.0000	0.000196	0.000176	0.000391	0.000161
21	0.0000	0.0000	0.0000	0.0000	0.000196	0.000176	0.000432	0.000162
22	0.0000	0.0000	0.0000	0.0000	0.000196	0.000176	0.000470	0.000162
23	0.0000	0.0000	0.0000	0.0000	0.000196	0.000176	0.000394	0.000125
24	0.0000	0.0000	0.0000	0.0000	0.000196	0.000176	0.000395	0.000172
25	0.0000	0.0000	0.0000	0.0000	0.000196	0.000176	0.000406	0.000129
26	0.0000	0.0000	0.0000	0.0000	0.000196	0.000176	0.000368	0.000155
27	0.0000	0.0000	0.0000	0.0000	0.000196	0.000176	0.000316	0.000143
28	0.0000	0.0000	0.0000	0.0000	0.000196	0.000234	0.000306	0.000139
29	0.0000	0.0000	0.0000	0.0000	0.000196	0.000234	0.000348	0.000143
30	0.0000	0.0000	0.0000	0.0000	0.000196	0.000234	0.000393	0.000165
31	0.0000	0.0000	0.0000	0.0000	0.000318	0.000234	0.000356	0.000185
32	0.0000	0.0000	0.0000	0.0000	0.000441	0.000234	0.000421	0.000208
33	0.0000	0.0000	0.0000	0.0000	0.000407	0.000548	0.000363	0.000214
34	0.0000	0.0000	0.0000	0.0000	0.000494	0.000548	0.000413	0.000222
35	0.0000	0.0000	0.0000	0.0000	0.000582	0.000548	0.000442	0.000244
36	0.0000	0.0000	0.0000	0.0000	0.000675	0.000548	0.000399	0.000224
37	0.0000	0.0000	0.0000	0.0000	0.000768	0.000548	0.000437	0.000262
38	0.0000	0.0000	0.0000	0.0000	0.000956	0.000963	0.000487	0.000300
39	0.0000	0.0000	0.0000	0.0000	0.001059	0.000963	0.000481	0.000296
40	0.0000	0.0000	0.0000	0.0000	0.001163	0.000963	0.000502	0.000320
41	0.0000	0.0000	0.0000	0.0000	0.001163	0.000963	0.000554	0.000382
42	0.0000	0.0000	0.0000	0.0000	0.001163	0.000963	0.000639	0.000406
43	0.0000	0.0000	0.0000	0.0000	0.001598	0.001345	0.000605	0.000409
44	0.0000	0.0000	0.0000	0.0000	0.001598	0.001345	0.000715	0.000445
45	0.0000	0.0000	0.1916	0.1500	0.001598	0.001345	0.000838	0.000506
46	0.0000	0.0000	0.1916	0.1500	0.001776	0.001345	0.000776	0.000539
47	0.0000	0.0000	0.1916	0.1500	0.001954	0.001345	0.000912	0.000662
48	0.0000	0.0000	0.1916	0.1500	0.002430	0.002286	0.001132	0.000725
49	0.0000	0.0000	0.1916	0.1500	0.002633	0.002286	0.001267	0.000793
50	0.0000	0.0000	0.1916	0.1500	0.002835	0.002286	0.001376	0.000881
51	0.0000	0.0000	0.1916	0.1500	0.003139	0.002286	0.001490	0.000939
52	0.0000	0.0000	0.1916	0.1500	0.003443	0.002286	0.001734	0.001037
53	0.0000	0.0000	0.1916	0.1500	0.003805	0.002521	0.001769	0.001109
54	0.0000	0.0000	0.2659	0.1002	0.004114	0.002909	0.002067	0.001206
55	0.1857	0.1859	0.2659	0.1002	0.004423	0.003684	0.002334	0.001331
56	0.1724	0.1682	0.3191	0.3005	0.004731	0.003684	0.002490	0.001423
57	0.1703	0.1703	0.3191	0.3005	0.005040	0.003684	0.002870	0.001588
58	0.1728	0.1738	0.3191	0.3505	0.005218	0.003595	0.002965	0.001691
59	0.2168	0.2136	0.3087	0.3577	0.005519	0.003595	0.003414	0.001792
60	0.1442	0.1705	0.3087	0.3577	0.005820	0.003595	0.003788	0.001959
61	0.2861	0.2999	0.2881	0.3066	0.003613	0.002743	0.004059	0.002137
62	0.0000	0.0000	0.5145	0.6132	0.003111	0.001797	0.004678	0.002280
63	0.0000	0.0000	0.2573	0.2555	0.001736	0.000822	0.005517	0.002539
64	0.0000	0.0000	0.2139	0.2223	0.001736	0.000822	0.006190	0.002790
65	0.0000	0.0000	0.2139	0.2223	0.000868	0.000822	0.007003	0.003270
66	0.0000	0.0000	0.2139	0.2779	0.000868	0.000822	0.007516	0.003415
67	0.0000	0.0000	0.1925	0.2223	0.000868	0.000822	0.009177	0.003680
68	0.0000	0.0000	0.1925	0.2223	0.001350	0.001149	0.009611	0.004473
69	0.0000	0.0000	0.1934	0.2279	0.001350	0.001149	0.010674	0.004431
70	0.0000	0.0000	0.1935	0.2178	0.001350	0.001149	0.011193	0.005011
71	0.0000	0.0000	0.1935	0.2178	0.001350	0.001149	0.013648	0.005982
72	0.0000	0.0000	0.1935	0.2178	0.001350	0.001149	0.014447	0.006756
73	0.0000	0.0000	0.1935	0.2178	0.001350	0.001149	0.017039	0.007602
74	0.0000	0.0000	1.0000	1.0000	0.000000	0.000000	0.000000	0.000000

1. Males: RP-2014 male employee mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale, projected to 2013 with the Buck Modified 2015 projection scale and adjusted by, approximately, 81% for credibility. Females: RP-2014 female employee mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale, projected to 2013 with the Buck Modified 2015 projection scale and adjusted by, approximately, 78% for credibility. These base mortality tables will then be projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Post-Retirement Mortality Assumptions

Age	Healthy ¹		Disability ²	
	Male	Female	Male	Female
50	0.004193	0.002556	0.021038	0.011940
51	0.004527	0.002741	0.021703	0.012501
52	0.004870	0.002869	0.022358	0.013063
53	0.005188	0.003025	0.022853	0.013634
54	0.005506	0.003181	0.023308	0.014203
55	0.005833	0.003439	0.023768	0.014768
56	0.006173	0.003640	0.024244	0.015334
57	0.006534	0.003958	0.024770	0.015894
58	0.006920	0.004299	0.025348	0.016453
59	0.007338	0.004654	0.025984	0.017029
60	0.007799	0.005071	0.026700	0.017615
61	0.008312	0.005503	0.027507	0.018257
62	0.008892	0.006020	0.028433	0.018957
63	0.009554	0.006570	0.029505	0.019748
64	0.010309	0.007223	0.030731	0.020663
65	0.011169	0.007892	0.032135	0.021715
66	0.012143	0.008650	0.033712	0.022923
67	0.013242	0.009540	0.035466	0.024315
68	0.014484	0.010465	0.037430	0.025899
69	0.015882	0.011529	0.039601	0.027681
70	0.017451	0.012706	0.041986	0.029672
71	0.019195	0.013983	0.044581	0.031899
72	0.021156	0.015469	0.047446	0.034358
73	0.023337	0.016991	0.050557	0.037083
74	0.025766	0.018808	0.053940	0.040088
75	0.028482	0.020776	0.057639	0.043392
76	0.031517	0.022922	0.061669	0.047004
77	0.034924	0.025278	0.066087	0.050992
78	0.038741	0.028080	0.070909	0.055337
79	0.043032	0.031167	0.076192	0.060074
80	0.047877	0.034654	0.082021	0.065216
81	0.053323	0.038706	0.088413	0.070823
82	0.059472	0.043189	0.095470	0.076856

1. Males: RP-2014 male mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale and projected to the valuation date with the Buck Modified 2015 projection scale.

Females: RP-2014 female mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale, projected to 2013 with the Buck Modified 2015 projection scale and adjusted for credibility. This base mortality table will then be projected on a generational basis using the Buck Modified 2015 projection scale to the valuation date.

2. RP-2014 male and female disabled mortality tables adjusted backward to 2006 with the MP-2014 mortality improvement scale and projected to the valuation date with the Buck Modified 2015 projection scale.

These base mortality tables will then be projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Post-Retirement Mortality Assumptions (continued)

Age	Healthy ¹		Disability ²	
	Male	Female	Male	Female
83	0.066387	0.048593	0.103233	0.083399
84	0.074196	0.054352	0.111831	0.090454
85	0.082932	0.061115	0.121249	0.098012
86	0.092706	0.068410	0.131589	0.106125
87	0.103659	0.076642	0.142982	0.114756
88	0.115809	0.085860	0.155381	0.123866
89	0.129321	0.096109	0.168932	0.133466
90	0.144272	0.107632	0.183652	0.143701
91	0.160124	0.119724	0.198369	0.154906
92	0.176437	0.132818	0.212982	0.167064
93	0.192931	0.146463	0.227416	0.179964
94	0.209555	0.160560	0.241727	0.193512
95	0.226206	0.175231	0.255817	0.207661
96	0.244336	0.191814	0.271271	0.223077
97	0.262934	0.207561	0.286868	0.239119
98	0.282203	0.224075	0.302795	0.255817
99	0.302026	0.242783	0.318956	0.272983
100	0.322136	0.261237	0.335194	0.290601
101	0.342415	0.280540	0.351643	0.308603
102	0.362436	0.299145	0.368272	0.326959
103	0.382219	0.317332	0.385279	0.345576
104	0.401426	0.336126	0.402489	0.364318
105	0.419865	0.355401	0.419865	0.383227
106	0.437668	0.375944	0.437668	0.402288
107	0.454347	0.388598	0.454347	0.420461
108	0.470128	0.399982	0.470128	0.437955
109	0.484925	0.432671	0.484925	0.454369
110	0.498558	0.469753	0.498558	0.469753
111	0.503419	0.455181	0.503419	0.484106
112	0.502510	0.497455	0.502510	0.497455
113	0.501755	0.503014	0.501755	0.503014
114	0.500902	0.501403	0.500902	0.501403
115	0.500000	0.500000	0.500000	0.500000

1. Males: RP-2014 male mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale and projected to the valuation date with the Buck Modified 2015 projection scale.

Females: RP-2014 female mortality table adjusted backward to 2006 with the MP-2014 mortality improvement scale, projected to 2013 with the Buck Modified 2015 projection scale and adjusted for credibility. This base mortality table will then be projected on a generational basis using the Buck Modified 2015 projection scale to the valuation date.

2. RP-2014 male and female disabled mortality tables adjusted backward to 2006 with the MP-2014 mortality improvement scale and projected to the valuation date with the Buck Modified 2015 projection scale.

These base mortality tables will then be projected on a generational basis using the Buck Modified 2015 projection scale from the valuation date.

Active Salary Increase Assumptions

Age	Salary Scale	Age	Salary Scale
19	10.25	47	4.35
20	10.25	48	4.15
21	10.05	49	3.95
22	9.85	50	3.75
23	9.65	51	3.65
24	9.45	52	3.55
25	9.25	53	3.45
26	8.95	54	3.35
27	8.65	55	3.25
28	8.35	56	3.25
29	8.05	57	3.25
30	7.75	58	3.25
31	7.55	59	3.25
32	7.35	60	3.25
33	7.15	61	3.25
34	6.95	62	3.25
35	6.75	63	3.25
36	6.55	64	3.25
37	6.35	65	3.25
38	6.15	66	3.25
39	5.95	67	3.25
40	5.75	68	3.25
41	5.55	69	3.25
42	5.35	70	3.25
43	5.15	71	3.25
44	4.95	72	3.25
45	4.75	73	3.25
46	4.55		