



## **Pennsylvania Municipal Retirement System**

### **Experience Study Results and Recommendations**

**For the period covering  
January 1, 2014 –  
December 31, 2018**

**Produced by Cheiron**

**September 2020**

## TABLE OF CONTENTS

| <i>Section</i>        |   | <i>Page</i> |
|-----------------------|---|-------------|
|                       | Letter of Transmittal .....               | i           |
| Section I             | Board Summary .....                       | 1           |
| Section II            | Analysis of Demographic Assumptions ..... | 7           |
| Section III           | Analysis of Economic Assumptions .....    | 34          |
| <br><i>Appendices</i> |   |             |
| Appendix A            | Current Actuarial Assumptions .....       | 47          |
| Appendix B            | Proposed Actuarial Assumptions .....      | 51          |

**LETTER OF TRANSMITTAL**

September 2, 2020

Pennsylvania Municipal Retirement Board of the  
Pennsylvania Municipal Retirement System  
c/o Mr. Stephen W. Vaughn, Secretary  
1721 North Front Street  
Harrisburg, PA 17102-2315

Dear Board Members:

At your request, we have completed an experience study of the Pennsylvania Municipal Retirement System (PMRS). Our study compares assumed versus actual experience with respect to all demographic and economic assumptions used in the preparation of the Actuarial Valuations for the five-year period from January 1, 2014 through December 31, 2018.

The purpose of this report is to present the results of our study as well as adopted assumptions that will be employed for the January 1, 2021 Actuarial Valuation, as determined by the Board. This report is for the use of PMRS and its auditors, in accordance with applicable law and accounting requirements.

In preparing this report, we relied on information (some oral and some written) supplied by PMRS. This information includes, but is not limited to, the plan provisions and employee data. The employee data used in this report includes both data provided for actuarial valuations as well as supplemental data provided for the purposes of this study by PMRS. We performed an informal examination of the obvious characteristics of the data for reasonableness and consistency in accordance with Actuarial Standard of Practice No. 23.

This report and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and practices and our understanding of the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board as well as applicable laws and regulations. Furthermore, as credentialed actuaries, we meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained in this report. This report does not address any contractual or legal issues. We are not attorneys and our firm does not provide any legal services or advice.

Sincerely,  
Cheiron



Kenneth A. Kent, FSA, FCA, MAAA  
Principal Consulting Actuary



Karen Zangara, FSA, MAAA  
Principal Consulting Actuary

Cc: Bonnie Rightnour  
Anthony Bucci

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION I – BOARD SUMMARY**

At the request of the Retirement Board, Cheiron has performed a study of the experience of the Pennsylvania Municipal Retirement System (PMRS). This experience study examines PMRS's experience during the five-year period from January 1, 2014 through December 31, 2018, "The Study Period." Based on a review of this experience, past trends as well as future expectations, alternative assumptions are provided for several of the current actuarial assumptions based on the proposed assumptions presented to the Board for review. These alternative assumptions would be for use in future valuations of PMRS beginning January 1, 2021.

We studied PMRS's experience with respect to both "demographic" and "economic" assumptions. Demographic assumptions include the retirement rates, termination rates, disability rates, mortality rates, marital status and the male/female percentage of participants at PMRS. Economic assumptions include inflation, salary increase rate (salary scale) and discount rate. Salary increases can be considered either demographic (membership oriented) or economic (given the inflation component). For this report, we included salary experience with the economic portion of the study.

The experience review over this Study Period does not include experience from the 2020 COVID-19 pandemic crisis. The COVID-19 pandemic will likely have both a financial and demographic impact to the System. However, in the midst of this pandemic it is unknown the extent of this impact.

When the experience study results were reviewed with the Board, the possible impact of COVID-19 on the assumptions was discussed, as outlined below.

- Future termination rates – municipalities may be implementing layoffs and/or furloughs due to COVID-19. However, because the new termination assumptions will first go into effect January 1, 2021, the actuarial valuation data as of this date may already reflect many of these pandemic related lay-offs and/or furloughs. Due to the unknown behavior of participant terminations after January 1, 2021, the assumed termination rates for valuation purposes will not be adjusted as a result of the pandemic.
- Mortality rates – while mortality rates may be impacted as a result of the COVID-19 pandemic, there is no sufficient data to draw any conclusions as to the long-term ramifications of the changes. If the system experiences increased mortality rates during 2020, these rates may return to pre-pandemic levels for 2021. Because the new mortality assumptions will first go into effect with the January 1, 2021 actuarial valuation, data as of this date may already reflect the majority of the pandemic related deaths. For now, it is advised to not incorporate higher mortality rates into the assumptions as a result of the pandemic until there is sufficient credible data that indicates it has resulted in a long-term impact on mortality.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION I – BOARD SUMMARY**

- Salary Scale – unlike termination and mortality rates where the impact of the pandemic may already be reflected in the January 1, 2021 data, the impact on salary increases in the short-term may not be fully reflected in the data. Based on input from Board members and the current economic and unemployment environment in the United States, it is anticipated that salary increases in the short term after 2020 will be relatively low. Therefore, consideration of a two-year select period adjustment to the salary increases will be reflected as a result of the pandemic. During this select period (2021 and 2022), salary increases will reflect only the inflation component of the assumptions and will not reflect additional merit increases. Beginning in 2023, salary increases will include both an inflation component as well as a merit component. It is suggested that PMRS review this assumption again in 2022 for reasonability for the 2023 actuarial valuations.

Actuaries are required to follow the Actuarial Standards of Practice (ASOP) No. 27 and 35 when completing experience studies. ASOP No. 27 is the Selection of Economic Assumptions for Measuring Pension Obligations. ASOP No. 35 is Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations. In completing this experience study, these ASOPs were frequently referenced to ensure that these standards are being followed. For example, ASOP No. 35 outlines the types of demographic assumptions, the demographic assumption selection process, the relevant assumption universe available, and how to select specific assumptions that are reasonable. Unique features associated with each demographic assumption were considered, such as some plan design features and municipality size. For the selection of the economic assumptions, ASOP No. 27 was considered as applicable.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION I – BOARD SUMMARY**

Table I-1 summarizes the current and alternative assumptions adopted by the Board from this study.

| <b>Table I – 1<br/>Changes to Economic and Demographic Assumptions<br/>(All Municipal and Uniform Plans)</b> |   |   |
|--|---|---|
| <b>Demographic</b>   | <b>Current Assumption</b>   | <b>Alternative Assumption</b>   |
| Retirement Rates   | 1 <sup>st</sup> eligible rates for Municipal; rates vary by age for Muni/Uniform plans                      | Remove 1 <sup>st</sup> eligible rates for Municipal if <61; update rates to better fit experience. Accelerated DROP/in-service retirement rates |
| Termination Rates  | Municipal rates split for plans with <25 / 25+ actives  | Municipal rates continue split by plan size <25 / 25+, lower rates for less service   |
|  | Uniform rates split for plans with <25 / 25+ actives  | Uniform rates for all plans regardless of size; lower rates for <4 years; update other rates  |
| Disability Rates   | 40%/60% 1964 OASDI disability incidence table Muni/Uniform<br>Service disabilities 15%/40% for Muni/Uniform | 40% 2017 CalPERS Public Miscellaneous Group disability rate table blended 70%/30% male/female<br>Service disabilities 20%/70% for Muni/Uniform  |
| Mortality Rates - Healthy Actives  | RP-2000 Employee Healthy table; Scale AA mortality improvements to 2015, 0/5 year setback males/females     | PUB-2010 General Employee table; MP-2018 mortality improvements to 2023   |
| Mortality Rates - Healthy Retirees   | RP-2000 Retiree Healthy table; Scale AA mortality improvements to 2005 / 2010 males/females                 | RP-2006 Retiree Healthy table; MP-2018 mortality improvements to 2023   |
| Mortality Rates - Disabled   | RP-2000 Combined Healthy table set forward ten years  | RP-2006 Retiree Disabled table; MP-2018 mortality improvements to 2023  |
| <b>Miscellaneous Demographic</b>   |   |   |
| Marital Status   | 80 percent married<br>Wives 3 years younger than spouses  | 85%/65% married males/females<br>No change for spousal age difference   |
| Male/Female Percentage   | 70%/30% males/females   | No change   |
| <b>Economic</b>  |   |   |
| Inflation/Cost of Living Rate  | 2.8%  | 2.2%<br><i>May review again in fall of 2022</i>   |
| Salary Increase Rate   | Inflation plus merit/promotional  | Inflation plus merit/promotion  |
|  | For the first 3 years of employment, additional 2% pay increases expected                                   | Extend from first 3 years to first 6 years, additional increases grade down from 3% to 1%   |
|  | Age based merit/promotional salary scale  | No merit/promotional for 2021 and 2022<br>For 2023+, lower rates <27, increase >27  |
|  | Prior to retirement, an additional 6% increase in salary  | No change   |
| Discount Rate*   | 5.25%   | No change at this time – this assumption is reviewed annually by the Board  |

\* Also referred to as the Regular Interest Rate or Crediting Rate

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION I – BOARD SUMMARY**

**Methods for Experience Study Analysis**

This report is structured to:

1. Describe the current assumption basis
2. Review the key findings of the related experience over the study period
3. Discuss additional considerations
4. Present an alternative assumption basis, if appropriate.

Demographic assumptions help us to predict when benefits will be paid in the future. The timing of benefits is dependent on several factors – how long the participant will work, what types of benefits they will be eligible to receive, at what age they will elect to receive benefits and how long they will receive benefits. Participant statuses considered are:

- Active (accruing benefits)
- Inactive not in receipt (deferring benefits)
- Disabled in receipt
- Retired / Inactive in receipt (receiving benefits, ceasing benefits)
- Deceased / Beneficiary in receipt
- Deceased no further benefits due

Changes in status are defined as the movement from one status to another. To determine the actual plan experience over the Study Period, we determine the status of each participant on each census date. Then we determine the rate of change from each status to each other status to all other statuses between census dates. The types of status movement are called decrements. The number of participants eligible for each decrement is called exposures. The demographic assumptions define a probability for each decrement. This probability applied to the exposures is used to determine the expected number of decrement occurrence. The actual number of occurrences is compared to the expected number of occurrences to determine how well the assumption predicted the overall participant behavior.

For each of the decrement-related demographic assumptions noted in Table I-1, we provide graphs outlining the results of the experience study analysis and charts outlining the actual vs. expected number of participants for the occurrence.

*Graph Analysis*

The graphs within this report provide the results of the experience study for each demographic assumption under review. Along the left axis is the rate of the decrement occurring while the participant's age or service (depending upon the assumption) is provided along the horizontal axis. For all graphs presented, the data details are provided in Section II of the report.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION I – BOARD SUMMARY**

There are three items provided in each graph for the demographic assumptions:

1. Actual rate of the occurrence (such as retirement) (illustrated by the black points),
2. Expected rate of the occurrence (such as retire) based on the *current* assumptions (illustrated by red line) and,
3. Expected rate of the occurrence based on the *proposed* assumptions which were presented to the Board (illustrated by teal line)

In addition to reviewing the ratios of actual versus expected, the credibility of the data at each study period is also reviewed. Credibility refers to the question: “Do we have enough data to make a judgement that the experience supports a change in trend to warrant an assumption change?”

In any statistical analysis of trends, one must consider whether the experience is sufficient to believe a true change is occurring over what was expected in the past. For example, if a coin is flipped twice and both times comes up heads, one will not necessarily conclude that both sides are heads. However, if the coin is flipped 10 times and all flips result in heads, one would have more confidence in believing that both sides of the coin show heads. The more incidences that occur at a data point, such as a specific age, the greater the confidence that the experience is real and will continue to occur at the observed rate. Thus, we put more credence on high confidence intervals.

The credibility of the data in the graphs is illustrated by *90% confidence intervals* (gold bars). The 90% confidence range indicates that there is a 90% probability that the true results fall within this interval (the area of the gold bars). Less experience data will result in larger confidence intervals, which is an indication that the data may be insufficient to provide much information regarding where the true value lies. The converse is true as well, the smaller the confidence interval, the more credible the data. Typically we want to consider assumption changes around the data points with the narrowest bars because the data is sufficient to support the expectation that these results represent reasonable expectations of future participant behavior.

*Analysis of Experience and Proposed Demographic Assumptions*

For some of the demographic assumptions, we determined an actual to expected occurrence ratio (A/E ratio) at each age (sometimes further segregated by gender or by plan type). For example, for Uniform plans there are 95 participants who actually retired during the study period while there were 114 participants expected to retire. Therefore the ratio of actual to expected retirees is 83% (95 divided by 114).

When the A/E ratio is greater than one, the rates for the assumption may be too low; when less than one, the rates for the assumption may be too high. When there is a trend of rates that are materially too high or low and the data is credible, the proposed assumption is intended to bring the ratios closer to one, which means the number of people we expect for an occurrence under the adopted assumptions is closer to the actual number of people who had the occurrence.



**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION I – BOARD SUMMARY**

Another statistical measurement that is sometimes used in the review of some assumptions is the R-squared factor. This value describes how well the assumption matches the data by measuring the proportion of the variance of the assumption versus the experience. A value closer to 100% indicates a better match to the data.

While these two statistical values can be useful tools for evaluating the appropriateness of current or proposed assumptions, they do not tell the whole story. For example:

- The A/E ratio may be skewed by outlier age groups. Therefore, in addition to reviewing the overall A/E ratio for an assumption, it is important to review each data point's A/E ratio to see if this has occurred.
- While an A/E ratio closer to one may demonstrate an assumption as more “accurate”, sometimes additional considerations are warranted.
- It is important to also review prior studies to understand how the experience of the current Study Period compares to experience from prior time periods. This may identify a continuing trend that would support heavier reliance on the current Study Period experience or in contrast, it may identify situations where the current Study Period experience is not consistent with prior studies and may suggest an outlier time period being reviewed.
- The A/E ratio and R-squared factor provide quantitative measures for the Study Period only. Additional factors including input from the Board may impact expectations going forward.

A discussion of the factors used to develop the proposed assumptions is included in each section as relevant.

*Analysis of Economic Assumption Review*

The review of the economic assumptions is based upon the following, which is reviewed in more detail in Section III of the report:

- Historical experience (i.e. the markets),
- Historical experience of the plan,
- Outlook for the future, and
- Assumptions used by other public sector plans.

All of the alternative assumptions were proposed and adopted by the Retirement Board on July 16, 2020 to be implemented effective January 1, 2021, based on Cheiron's analysis of the experience.

The balance of this report supports the rationale for the proposed assumptions which were ultimately adopted. In Section II, we present detailed analysis and exhibits supporting the various demographic assumption changes. In Section III we present similar information with respect to the economic assumptions.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

In this section, we present the key findings of our experience review of the demographic assumptions used by PMRS, including proposed assumptions that the Board considered and adopted. The demographic assumptions included in this review are:

1. Retirement
2. Termination from Active Employment (Other than Death, Disability, or Retirement)
3. Disability
4. Mortality (Active, Inactive Healthy, and Inactive Disabled)
5. Marriage Percentage and Spouse's Age
6. Male/Female Percentage

**1. Retirement**

Participants meeting the eligibility requirements for normal retirement benefits are “exposed” to the retirement assumption.

Although some PMRS municipalities offer early retirement benefits, all early retirement benefits are actuarially equivalent to the normal retirement benefits. When early retirement benefits are not subsidized, all benefits paid earlier than the normal retirement age are actuarially equivalent to the benefits paid at the normal retirement date. This means there is no gain or loss associated with the value of the benefit paid to a participant electing early retirement.

According to ASOP No. 35, for retirement rates “employer-specific or job-related factors” should be considered. The job related factors as it pertains to the Municipal Plans compared to the Uniform Plans are different, such that Uniform Plan active participants may have more physically demanding work environments as police officers or firefighters. A direct consequence of this is that retirement plan provisions for Uniform Plans tend to permit these active participants to retire earlier than Municipal Plans. Therefore, these assumptions were reviewed separately for Municipal and Uniform Plans.

**A. Current Assumptions**

*Municipal and Uniform Plans (Police and Fire Plans)*

Assumptions are based on ages once normal retirement eligibility requirements are met. Rates are increased for the first year the participant becomes eligible for normal retirement.

*DROP (Deferred Retirement Option Plans) or In-Service Distribution Plans*

In the past, very few PMRS plans offered DROP or in-service distribution payment options. These options allow participants to start receiving their pension benefits (either into a DROP account or directly) and continue to work up to 3 years until full retirement. Due to limited data, the retirement assumptions were not adjusted for plans that offered these retirement options.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**B. Experience and Alternative**

The following section provides the graphs summarizing the plan experience compared to the current assumptions and the proposed assumptions. As stated above:

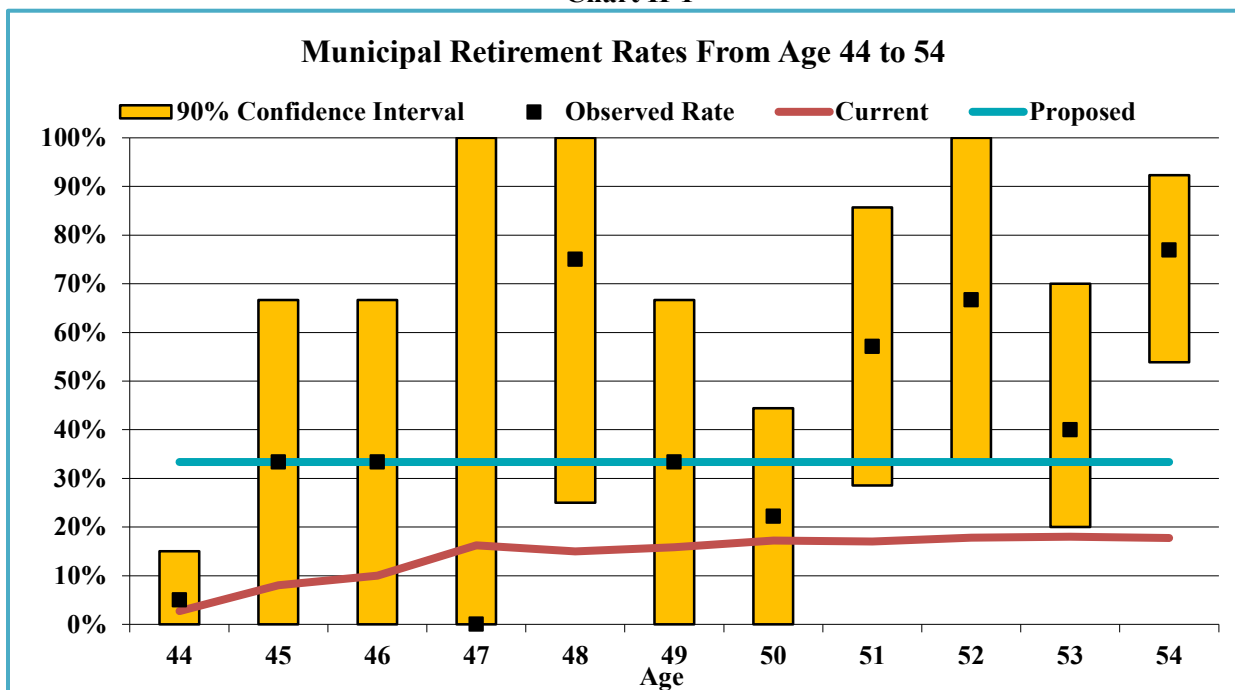
- (i) “Actual Rates:” actual rate of the status change (black dots)
- (ii) “Expected Rates:” expected rate of the status change based on the current assumptions (red lines)
- (iii) “Proposed Rate:” expected rate of the status change based on the proposed assumptions (teal lines)

If the analysis indicates that the actual rates of status change are consistent with the expected rates, then only the “Proposed Rates” (teal lines) will be visible on the graph.

**Municipal Plans**

The tall gold bars in the retirement rates chart for Municipal Plans ages 44 -54 indicate that there is limited credible data. As will be detailed later, this data was not separated by the first year of eligibility due to the proposed assumption to not include the increased retirement rates for these ages. Separating this group would further decrease the credibility. However, the experience (black dots) show that the actual rates are significantly greater than the current assumption at most ages represented. **The proposed assumption increases the retirement rates for ages 44 – 54.**

**Chart II-1**

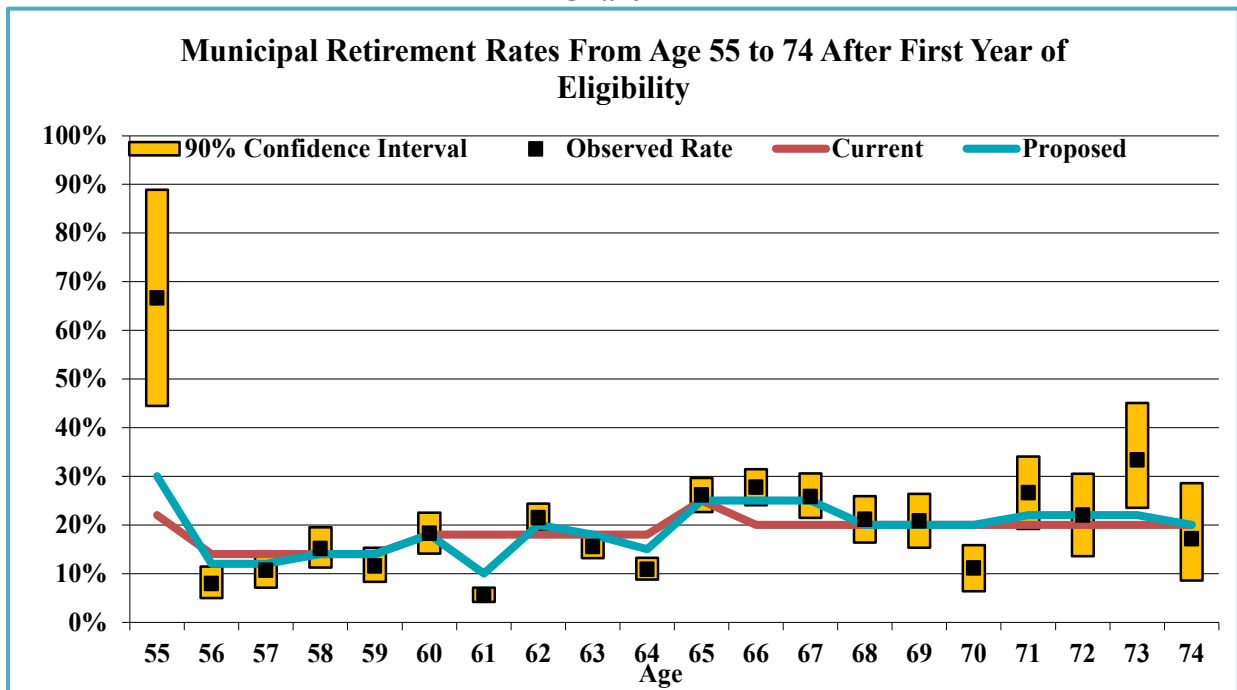


**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

For Municipal Plans ages 55 - 74, the first step in reviewing this assumption is to review the retirement rates for participants *after* their first year of retirement eligibility. For this group, actual retirements are slightly less than expected at age 61 and slightly greater than expected for ages greater than 66. **The proposed assumption decreases the retirement assumptions for ages 61 and increases this assumption slightly for 66+ after first year of retirement eligibility.**

**Chart II-2**



The next step in reviewing this assumption for this group is to review the additional retirement rates for participants during their first year of retirement eligibility. Looking at retirement rates when participants were first eligible for normal retirement, we did not see increased rates for ages prior to 61 and over age 71 and we found increased rates at age 63. A summary of the current and proposed additional rates by age is as follows:

| Table II-1                   |                                    |                                     |
|------------------------------|------------------------------------|-------------------------------------|
| Age First Eligible to Retire | Current Additional Retirement Rate | Proposed Additional Retirement Rate |
| <60                          | 5%                                 | 0%                                  |
| 60                           | 10%                                | 0%                                  |
| 61                           | 10%                                | 10%                                 |
| 62                           | 10%                                | 10%                                 |
| 63                           | 5%                                 | 10%                                 |
| 64 – 70                      | 5%                                 | 5%                                  |
| 71+                          | 5%                                 | 0%                                  |

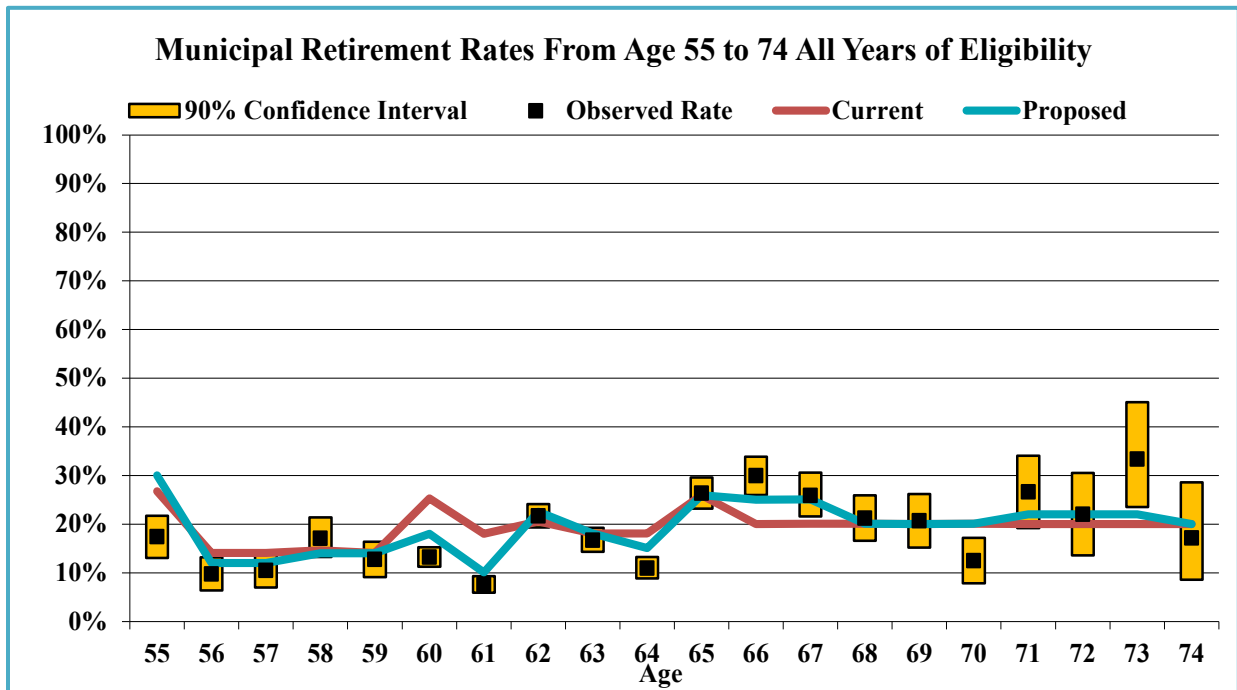
**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

Because this additional rate increases the regular retirement assumption when participants are first retirement eligible, to analyze how well this proposed assumption fits as a whole, the next step is to review the combined retirement assumptions for all years of eligibility.

As you can see, actual retirements are slightly less than expected at ages 60 and 61 and slightly greater than expected for ages greater than 66, except age 70. This decrease in the retirement assumption at age 60 is achieved by decreasing the retirement assumption for participants that are initially eligible for retirement at age 60. Therefore, the suggested assumptions outlined above achieve the goal of having the retirement assumption for all years that participants are eligible to retire to match closer with the experience.

**Chart II-3**



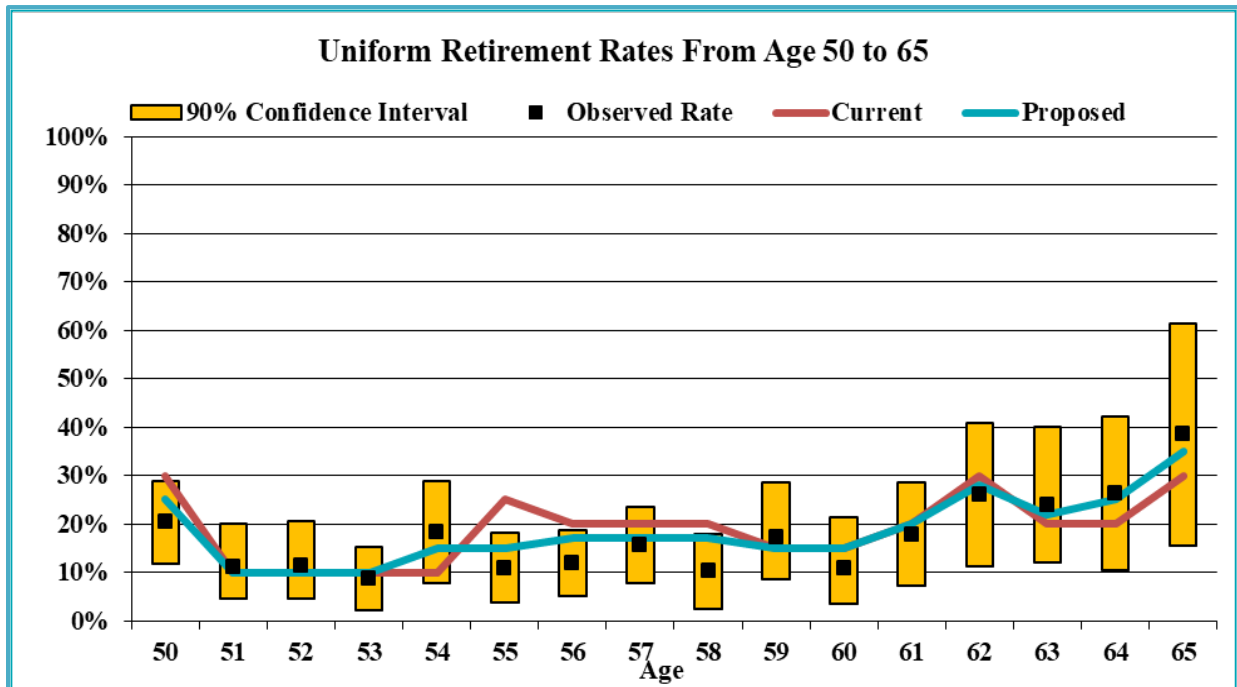
**Uniform Plans**

For the Uniform Plans, this graph shows that the actual retirement rate experience is less than expected compared to the current assumption for ages 55 - 58. This is a continuation of the trend observed in the prior study. Actual retirement rates were analyzed at each age compared to the expected retirement rates at each age. Based on this analysis, **the proposed rates are lower for ages 55 - 58. Also the proposed rates extend the table out from 100% at age 66 (not shown) to age 67, as there are employees past age 66.**

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**Chart II-4**



*DROP (Deferred Retirement Option Plans) or In-Service Distribution Plans*

There has been an increase in the number of PMRS plans offering DROP or in-service distribution options in recent years. Because this change is relatively new, the data from PMRS on how these options are impacting the retirement rates for these plans is extremely sparse.

Cheiron’s experience with other plans that offer DROP options has been that participants tend to retire earlier when a DROP is offered. Furthermore, participants in uniform plans tend to retire roughly half of the DROP period earlier and participants in municipal plans have a lower utilization DROP rate. If this pattern is inferred to PMRS plans, this would mean that Uniform Plans that offer a 3-year DROP option would be expected to retire by entering the DROP roughly 1.5 years earlier than the average retirement age. Similarly, participants in Municipal Plans would be expected to retire by entering the DROP slightly less than one year earlier than the average retirement age.

ASOP No. 35 states that the consideration is made with respect to “the plan design, where specific incentives may influence when participants retire” and that the actuary shall apply “professional judgement” when setting retirement assumptions. Therefore, the proposed assumption increases retirement rates for plans offering DROP options or in-service distributions as follows:

- 15% increase in the retirement rates for Municipal Plans
- 30% increase in the retirement rates for Uniform Plans

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

These changes decrease the expected retirement age for Municipal Plans from 59.4 to 58.7 (about 0.7 years) and for Uniform Plans from 55.0 to 53.8 (about 1.2 years). This assumption will be reviewed against actual PMRS experience in the next experience study when additional data for DROP and in-service retirees will be available.

C. Results

The tables on the following pages compare three items: the number of people eligible to retire, the number of people expected to retire based on the current assumptions, and the number of people expected to retire based on the proposed assumptions. This data was used to determine the graphs provided above.

The proposed assumptions overall bring the A/E ratios closer to one, which is seen in the far right green column compared to the far right red column. The total A/E ratio is provided at the bottom of each column. This means the number of people expected to retire under the proposed assumptions is closer to the actual number of people who actually retired.

One aspect of these results that will be prevalent throughout the study is that at the younger and older ages, the number of exposures to retirement can be relatively small. For example, at age 55 the Municipal Plans only had 9 participants that reached that age, there are 2 participants expected to retire from this group but 6 participants actually retired. As a result, we cannot always have great confidence that the experience reflects a new retirement pattern. This uncertainty is reflected in the confidence intervals shown on the graphs above where the taller golden bars indicate lower confidence in the actual experience.

Another statistic provided below is the R-squared factor. This factor measures how well the assumptions match the actual data. The closer that the R-squared factor is to 100%, then the better the assumptions fit the actual data. Except for the Municipal Plan ages 44 – 54 proposed retirement assumptions, the R-squared factor is closer to 100%, implying the proposed assumptions are a better fit to the actual experience of the plan. For the Municipal Plan ages 44 – 54 retirement assumption, the lack of credible data means that the R-squared factor has less impact on setting the proposed assumptions.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**Table II-2**

| <b>Municipal Retirement Rates From Age 44 to 54</b> |                  |                    |                |                 |                         |                |                 |                   |                 |
|---|------------------|--------------------|----------------|-----------------|-------------------------|----------------|-----------------|-------------------|-----------------|
| <b>Age</b>  | <b>Exposures</b> | <b>Retirements</b> |                |                 | <b>Retirement Rates</b> |                |                 | <b>A/E Ratios</b> |                 |
|   |                  | <b>Actual</b>      | <b>Current</b> | <b>Proposed</b> | <b>Actual</b>           | <b>Current</b> | <b>Proposed</b> | <b>Current</b>    | <b>Proposed</b> |
| 44  | 20               | 1                  | 1              | 7               | 5.0%                    | 2.8%           | 33.3%           | 182%              | 15%             |
| 45  | 6                | 2                  | 0              | 2               | 33.3%                   | 8.0%           | 33.3%           | 417%              | 100%            |
| 46  | 3                | 1                  | 0              | 1               | 33.3%                   | 10.0%          | 33.3%           | 333%              | 100%            |
| 47  | 4                | 0                  | 1              | 1               | 0.0%                    | 16.3%          | 33.3%           | 0%                | 0%              |
| 48  | 4                | 3                  | 1              | 1               | 75.0%                   | 15.0%          | 33.3%           | 500%              | 225%            |
| 49  | 6                | 2                  | 1              | 2               | 33.3%                   | 15.8%          | 33.3%           | 211%              | 100%            |
| 50  | 9                | 2                  | 2              | 3               | 22.2%                   | 17.2%          | 33.3%           | 129%              | 67%             |
| 51  | 7                | 4                  | 1              | 2               | 57.1%                   | 17.0%          | 33.3%           | 336%              | 171%            |
| 52  | 6                | 4                  | 1              | 2               | 66.7%                   | 17.8%          | 33.3%           | 374%              | 200%            |
| 53  | 10               | 4                  | 2              | 3               | 40.0%                   | 18.0%          | 33.3%           | 222%              | 120%            |
| 54  | 13               | 10                 | 2              | 4               | 76.9%                   | 17.8%          | 33.3%           | 433%              | 231%            |
| <b>Total</b>  | <b>88</b>        | <b>33</b>          | <b>11</b>      | <b>29</b>       | <b>37.5%</b>            | <b>13.0%</b>   | <b>33.3%</b>    | <b>288%</b>       | <b>113%</b>     |
| <b>R-squared</b>                                    |                  |                    | <b>69%</b>     | <b>13%</b>      |                         |                |                 |                   |                 |

**Table II-3**

| <b>Municipal Retirement Rates From Age 55 to 74 After First Year of Eligibility</b> |                  |                    |                |                 |                         |                |                 |                   |                 |
|---|------------------|--------------------|----------------|-----------------|-------------------------|----------------|-----------------|-------------------|-----------------|
| <b>Age</b>  | <b>Exposures</b> | <b>Retirements</b> |                |                 | <b>Retirement Rates</b> |                |                 | <b>A/E Ratios</b> |                 |
|   |                  | <b>Actual</b>      | <b>Current</b> | <b>Proposed</b> | <b>Actual</b>           | <b>Current</b> | <b>Proposed</b> | <b>Current</b>    | <b>Proposed</b> |
| 55  | 9                | 6                  | 2              | 3               | 66.7%                   | 22.0%          | 30.0%           | 303%              | 222%            |
| 56  | 201              | 16                 | 28             | 24              | 8.0%                    | 14.0%          | 12.0%           | 57%               | 66%             |
| 57  | 197              | 21                 | 28             | 24              | 10.7%                   | 14.0%          | 12.0%           | 76%               | 89%             |
| 58  | 205              | 31                 | 29             | 29              | 15.1%                   | 14.0%          | 14.0%           | 108%              | 108%            |
| 59  | 216              | 25                 | 30             | 30              | 11.6%                   | 14.0%          | 14.0%           | 83%               | 83%             |
| 60  | 213              | 39                 | 38             | 38              | 18.3%                   | 18.0%          | 18.0%           | 102%              | 102%            |
| 61  | 676              | 38                 | 122            | 68              | 5.6%                    | 18.0%          | 10.0%           | 31%               | 56%             |
| 62  | 595              | 128                | 107            | 119             | 21.5%                   | 18.0%          | 20.0%           | 120%              | 108%            |
| 63  | 623              | 97                 | 112            | 112             | 15.6%                   | 18.0%          | 18.0%           | 86%               | 86%             |
| 64  | 514              | 56                 | 93             | 77              | 10.9%                   | 18.0%          | 15.0%           | 61%               | 73%             |
| 65  | 428              | 112                | 107            | 107             | 26.2%                   | 25.0%          | 25.0%           | 105%              | 105%            |
| 66  | 378              | 105                | 76             | 95              | 27.8%                   | 20.0%          | 25.0%           | 139%              | 111%            |
| 67  | 252              | 65                 | 50             | 63              | 25.8%                   | 20.0%          | 25.0%           | 129%              | 103%            |
| 68  | 189              | 40                 | 38             | 38              | 21.2%                   | 20.0%          | 20.0%           | 106%              | 106%            |
| 69  | 144              | 30                 | 29             | 29              | 20.8%                   | 20.0%          | 20.0%           | 104%              | 104%            |
| 70  | 126              | 14                 | 25             | 25              | 11.1%                   | 20.0%          | 20.0%           | 56%               | 56%             |
| 71  | 94               | 25                 | 19             | 21              | 26.6%                   | 20.0%          | 22.0%           | 133%              | 121%            |
| 72  | 59               | 13                 | 12             | 13              | 22.0%                   | 20.0%          | 22.0%           | 110%              | 100%            |
| 73  | 51               | 17                 | 10             | 11              | 33.3%                   | 20.0%          | 22.0%           | 167%              | 152%            |
| 74  | 35               | 6                  | 7              | 7               | 17.1%                   | 20.0%          | 20.0%           | 86%               | 86%             |
| <b>Total</b>  | <b>5,205</b>     | <b>884</b>         | <b>961</b>     | <b>932</b>      | <b>17.0%</b>            | <b>18.5%</b>   | <b>17.9%</b>    | <b>92%</b>        | <b>95%</b>      |
| <b>R-squared</b>  |                  |                    | <b>67%</b>     | <b>93%</b>      |                         |                |                 |                   |                 |



**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**Table II-4**

| Municipal Retirement Rates From Age 55 to 74 All Years of Eligibility |              |              |              |              |                  |              |              |            |            |
|---|--------------|--------------|--------------|--------------|------------------|--------------|--------------|------------|------------|
| Age   | Exposures    | Retirements  |              |              | Retirement Rates |              |              | A/E Ratios |            |
|   |              | Actual       | Current      | Proposed     | Actual           | Current      | Proposed     | Current    | Proposed   |
| 55  | 207          | 36           | 55           | 62           | 17.4%            | 26.8%        | 30.0%        | 65%        | 58%        |
| 56  | 205          | 20           | 29           | 25           | 9.8%             | 14.1%        | 12.0%        | 69%        | 81%        |
| 57  | 201          | 21           | 28           | 24           | 10.4%            | 14.1%        | 12.0%        | 74%        | 87%        |
| 58  | 234          | 40           | 34           | 33           | 17.1%            | 14.6%        | 14.0%        | 117%       | 122%       |
| 59  | 220          | 28           | 31           | 31           | 12.7%            | 14.1%        | 14.0%        | 90%        | 91%        |
| 60  | 781          | 103          | 197          | 141          | 13.2%            | 25.3%        | 18.0%        | 52%        | 73%        |
| 61  | 679          | 51           | 123          | 68           | 7.5%             | 18.0%        | 10.0%        | 42%        | 75%        |
| 62  | 797          | 173          | 164          | 180          | 21.7%            | 20.5%        | 22.5%        | 106%       | 96%        |
| 63  | 629          | 105          | 114          | 114          | 16.7%            | 18.0%        | 18.1%        | 92%        | 92%        |
| 64  | 522          | 57           | 94           | 79           | 10.9%            | 18.1%        | 15.1%        | 60%        | 72%        |
| 65  | 531          | 140          | 138          | 138          | 26.4%            | 26.0%        | 26.0%        | 102%       | 102%       |
| 66  | 381          | 114          | 76           | 95           | 29.9%            | 20.0%        | 25.0%        | 149%       | 119%       |
| 67  | 255          | 66           | 51           | 64           | 25.9%            | 20.1%        | 25.1%        | 129%       | 103%       |
| 68  | 193          | 41           | 39           | 39           | 21.2%            | 20.1%        | 20.1%        | 106%       | 106%       |
| 69  | 145          | 30           | 29           | 29           | 20.7%            | 20.0%        | 20.0%        | 103%       | 103%       |
| 70  | 128          | 16           | 26           | 26           | 12.5%            | 20.1%        | 20.1%        | 62%        | 62%        |
| 71  | 94           | 25           | 19           | 21           | 26.6%            | 20.0%        | 22.0%        | 133%       | 121%       |
| 72  | 59           | 13           | 12           | 13           | 22.0%            | 20.0%        | 22.0%        | 110%       | 100%       |
| 73  | 51           | 17           | 10           | 11           | 33.3%            | 20.0%        | 22.0%        | 167%       | 152%       |
| 74  | 35           | 6            | 7            | 7            | 17.1%            | 20.0%        | 20.0%        | 86%        | 86%        |
| <b>Total</b>  | <b>6,347</b> | <b>1,102</b> | <b>1,276</b> | <b>1,198</b> | <b>17.4%</b>     | <b>20.1%</b> | <b>18.9%</b> | <b>86%</b> | <b>92%</b> |
| <b>R-squared</b>  |              |              | <b>72%</b>   | <b>93%</b>   |                  |              |              |            |            |

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**Table II-5**

| <b>Uniform Retirement Rates From Age 50 to 65</b> |                  |                    |                |                 |                         |                |                 |                   |                 |
|---|------------------|--------------------|----------------|-----------------|-------------------------|----------------|-----------------|-------------------|-----------------|
| <b>Age</b>  | <b>Exposures</b> | <b>Retirements</b> |                |                 | <b>Retirement Rates</b> |                |                 | <b>A/E Ratios</b> |                 |
|   |                  | <b>Actual</b>      | <b>Current</b> | <b>Proposed</b> | <b>Actual</b>           | <b>Current</b> | <b>Proposed</b> | <b>Current</b>    | <b>Proposed</b> |
| 50  | 59               | 12                 | 18             | 15              | 20.3%                   | 30.0%          | 25.0%           | 68%               | 81%             |
| 51  | 45               | 5                  | 5              | 5               | 11.1%                   | 10.0%          | 10.0%           | 111%              | 111%            |
| 52  | 44               | 5                  | 4              | 4               | 11.4%                   | 10.0%          | 10.0%           | 114%              | 114%            |
| 53  | 46               | 4                  | 5              | 5               | 8.7%                    | 10.0%          | 10.0%           | 87%               | 87%             |
| 54  | 38               | 7                  | 4              | 6               | 18.4%                   | 10.0%          | 15.0%           | 184%              | 123%            |
| 55  | 55               | 6                  | 14             | 8               | 10.9%                   | 25.0%          | 15.0%           | 44%               | 73%             |
| 56  | 59               | 7                  | 12             | 10              | 11.9%                   | 20.0%          | 17.0%           | 59%               | 70%             |
| 57  | 51               | 8                  | 10             | 9               | 15.7%                   | 20.0%          | 17.0%           | 78%               | 92%             |
| 58  | 39               | 4                  | 8              | 7               | 10.3%                   | 20.0%          | 17.0%           | 51%               | 60%             |
| 59  | 35               | 6                  | 5              | 5               | 17.1%                   | 15.0%          | 15.0%           | 114%              | 114%            |
| 60  | 28               | 3                  | 4              | 4               | 10.7%                   | 15.0%          | 15.0%           | 71%               | 71%             |
| 61  | 28               | 5                  | 6              | 6               | 17.9%                   | 20.0%          | 20.0%           | 89%               | 89%             |
| 62  | 27               | 7                  | 8              | 8               | 25.9%                   | 30.0%          | 28.0%           | 86%               | 93%             |
| 63  | 25               | 6                  | 5              | 6               | 24.0%                   | 20.0%          | 22.0%           | 120%              | 109%            |
| 64  | 19               | 5                  | 4              | 5               | 26.3%                   | 20.0%          | 25.0%           | 132%              | 105%            |
| 65  | 13               | 5                  | 4              | 5               | 38.5%                   | 30.0%          | 35.0%           | 128%              | 110%            |
| <b>Total</b>                                      | <b>611</b>       | <b>95</b>          | <b>114</b>     | <b>105</b>      | <b>15.5%</b>            | <b>18.7%</b>   | <b>17.2%</b>    | <b>83%</b>        | <b>91%</b>      |
| <b>R-squared</b>                                  |                  |                    | <b>57%</b>     | <b>77%</b>      |                         |                |                 |                   |                 |

**2. Termination from Active Employment**

According to ASOP No. 35, actuaries may consider “the size of the covered population.” For the termination rates, the size of the covered population for the Municipal and Uniform Plans was considered.

**A. Current Assumptions**

**All Employees**

Current termination rates for all employees are service based assumptions. Different rates apply for Plans with less than 25 active participants and with 25 or more active participants. Municipal and Uniform Plans have distinct rates resulting in four tables of rates. In all cases, termination rates decrease as service increases. See the graphs and tables on the following pages for more details.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**B. Experience and Alternative**

**All Employees**

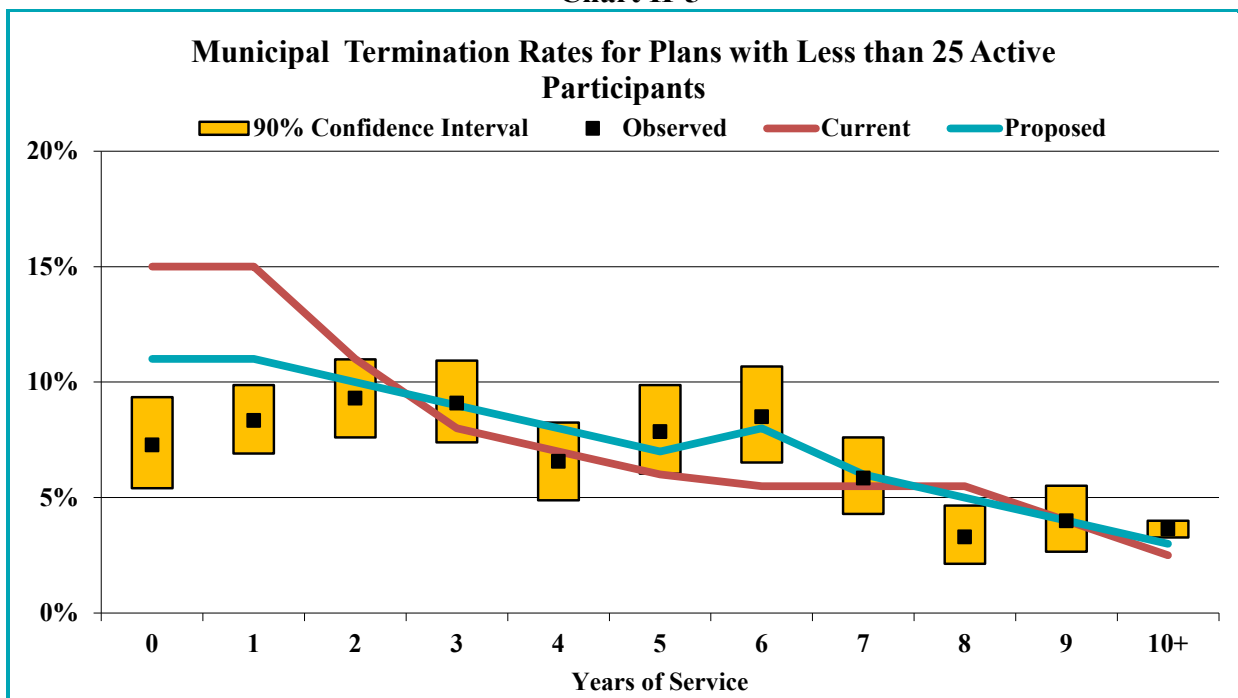
Similar to the prior studies, there was more credible data for the Municipal Plans than the Uniform Plans. We evaluated the termination rates based on plan size for the Municipal Plans to determine if the 25+ breakpoint was still appropriate. The data supports a continuation of this breakpoint for this group. The data from the Uniform Plans does not support a separation of the assumption based on plan size which limits the credible data available for plans with less than 25 active participants. Therefore, for Uniform Plans, we propose removing the plan size distinction and using one service based table of rates for all plans.

In general, actual terminations were lower than expected based on the current rates for shorter service participants for all groups. For the Municipal plans with less than 25 active participants, the actual terminations were slightly higher than expected based on the current rates for participants with 3 – 6 years of service. For the Uniform Plans, the actual terminations were slightly higher than expected based on the current rates for participants with 3 – 4 years of service.

**Municipal Plans**

For Municipal Plans with less than 25 active participants, **the proposed rates are lower than the current rates for participants with less than 3 years of service and higher than the current rates for participants with 3 – 6 years of service.**

**Chart II-5**

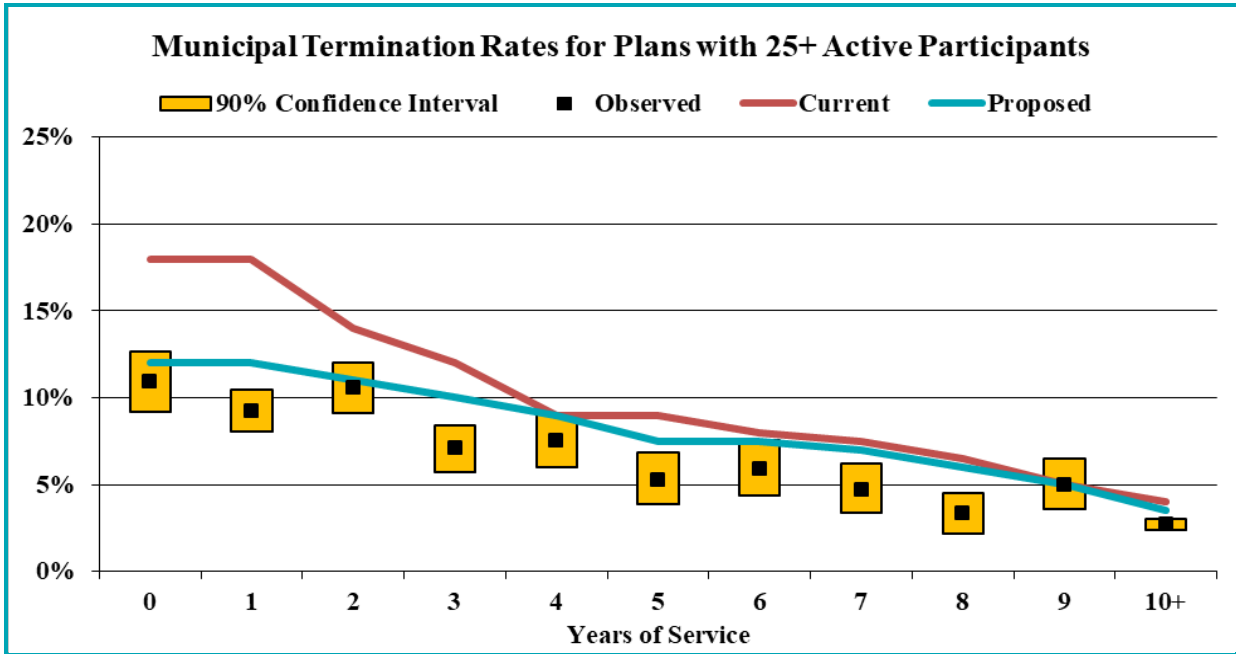


**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

For Municipal Plans with 25 or more active participants, the **proposed termination rates are lower than the current rates for all service levels.**

**Chart II-6**



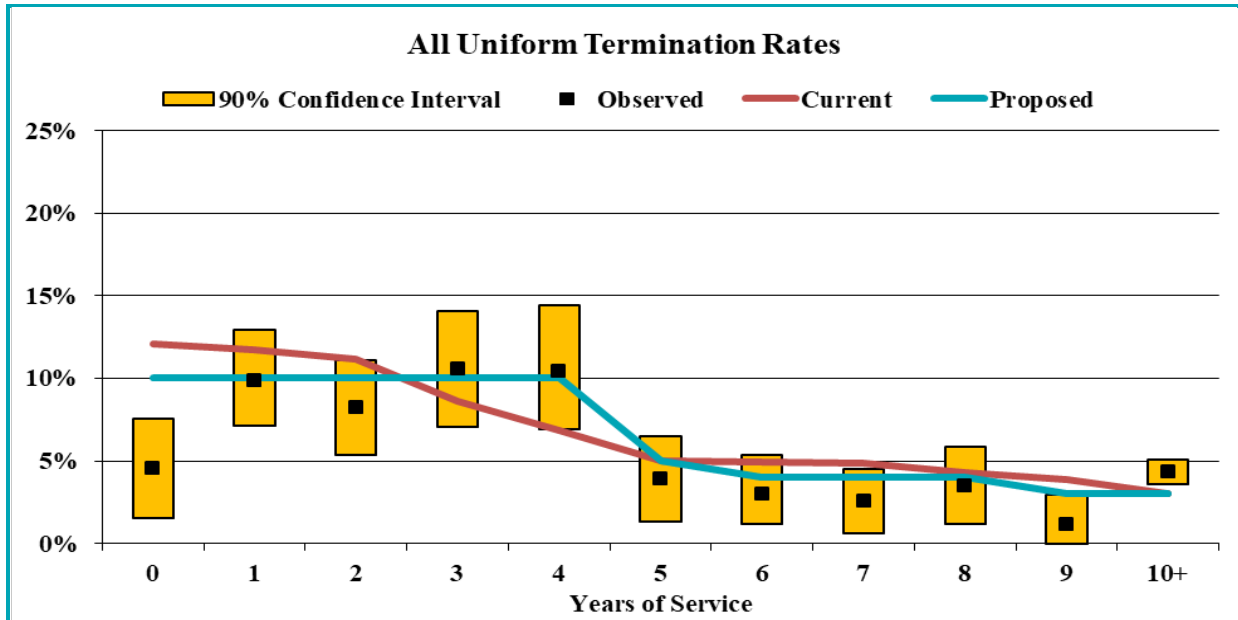
**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

Uniform Plans

**The proposed Uniform Plan termination rates are lower than the current rates for participants with less than three years of service and higher than the current rates for those with 3 – 4 years of service.**

**Chart II-7**



**C. Results**

The following tables compare three items: the number of people eligible for the termination decrement, the number of people expected to terminate based on the current assumptions, and the number of people expected to terminate based on the proposed assumptions. This data was used to determine the graphs provided above.

For the proposed assumptions, the R-squared factors are closer to one and the overall A/E ratios are either closer to one or remain relatively close to one. The proposed assumptions smooth the changes in the termination rates between data points, which may cause the overall A/E ratio to be further from one, but brings more of the individual A/E ratios closer to the value of one. This implies the proposed assumptions reflect the experience of the plan better than the old assumptions.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**Table II-6**

| <b>Municipal Termination Rates for Plans with Less than 25 Active Participants</b> |                  |                     |                |                 |                          |                |                 |                   |                 |
|--|------------------|---------------------|----------------|-----------------|--------------------------|----------------|-----------------|-------------------|-----------------|
| <b>Service</b>   | <b>Exposures</b> | <b>Terminations</b> |                |                 | <b>Termination Rates</b> |                |                 | <b>A/E Ratios</b> |                 |
|  |                  | <b>Actual</b>       | <b>Current</b> | <b>Proposed</b> | <b>Actual</b>            | <b>Current</b> | <b>Proposed</b> | <b>Current</b>    | <b>Proposed</b> |
| 0  | 481              | 35                  | 72             | 53              | 7.28%                    | 15.00%         | 11.00%          | 49%               | 66%             |
| 1  | 912              | 76                  | 137            | 100             | 8.33%                    | 15.00%         | 11.00%          | 56%               | 76%             |
| 2  | 828              | 77                  | 91             | 83              | 9.30%                    | 11.00%         | 10.00%          | 85%               | 93%             |
| 3  | 704              | 64                  | 56             | 63              | 9.09%                    | 8.00%          | 9.00%           | 114%              | 101%            |
| 4  | 594              | 39                  | 42             | 48              | 6.57%                    | 7.00%          | 8.00%           | 94%               | 82%             |
| 5  | 547              | 43                  | 33             | 38              | 7.86%                    | 6.00%          | 7.00%           | 131%              | 112%            |
| 6  | 506              | 43                  | 28             | 40              | 8.50%                    | 5.50%          | 8.00%           | 155%              | 106%            |
| 7  | 513              | 30                  | 28             | 31              | 5.85%                    | 5.50%          | 6.00%           | 106%              | 97%             |
| 8  | 516              | 17                  | 28             | 26              | 3.29%                    | 5.50%          | 5.00%           | 60%               | 66%             |
| 9  | 526              | 21                  | 21             | 21              | 3.99%                    | 4.00%          | 4.00%           | 100%              | 100%            |
| 10+  | 7,143            | 260                 | 179            | 214             | 3.64%                    | 2.50%          | 3.00%           | 146%              | 121%            |
| <b>Total</b>   | <b>13,270</b>    | <b>705</b>          | <b>715</b>     | <b>718</b>      | <b>5.31%</b>             | <b>5.39%</b>   | <b>5.41%</b>    | <b>99%</b>        | <b>98%</b>      |
| <b>R-squared</b>   |                  |                     | <b>74.3%</b>   | <b>96.0%</b>    |                          |                |                 |                   |                 |

**Table II-7**

| <b>Municipal Termination Rates for Plans with 25+ Active Participants</b> |                  |                     |                |                 |                          |                |                 |                   |                 |
|---|------------------|---------------------|----------------|-----------------|--------------------------|----------------|-----------------|-------------------|-----------------|
| <b>Service</b>  | <b>Exposures</b> | <b>Terminations</b> |                |                 | <b>Termination Rates</b> |                |                 | <b>A/E Ratios</b> |                 |
|   |                  | <b>Actual</b>       | <b>Current</b> | <b>Proposed</b> | <b>Actual</b>            | <b>Current</b> | <b>Proposed</b> | <b>Current</b>    | <b>Proposed</b> |
| 0   | 879              | 96                  | 158            | 105             | 10.92%                   | 18.00%         | 12.00%          | 61%               | 91%             |
| 1   | 1,535            | 142                 | 276            | 184             | 9.25%                    | 18.00%         | 12.00%          | 51%               | 77%             |
| 2   | 1,233            | 130                 | 173            | 136             | 10.54%                   | 14.00%         | 11.00%          | 75%               | 96%             |
| 3   | 949              | 67                  | 114            | 95              | 7.06%                    | 12.00%         | 10.00%          | 59%               | 71%             |
| 4   | 813              | 61                  | 73             | 73              | 7.50%                    | 9.00%          | 9.00%           | 83%               | 83%             |
| 5   | 645              | 34                  | 58             | 48              | 5.27%                    | 9.00%          | 7.50%           | 59%               | 70%             |
| 6   | 597              | 35                  | 48             | 45              | 5.86%                    | 8.00%          | 7.50%           | 73%               | 78%             |
| 7   | 599              | 28                  | 45             | 42              | 4.67%                    | 7.50%          | 7.00%           | 62%               | 67%             |
| 8   | 600              | 20                  | 39             | 36              | 3.33%                    | 6.50%          | 6.00%           | 51%               | 56%             |
| 9   | 584              | 29                  | 29             | 29              | 4.97%                    | 5.00%          | 5.00%           | 99%               | 99%             |
| 10+   | 7,976            | 216                 | 319            | 279             | 2.71%                    | 4.00%          | 3.50%           | 68%               | 77%             |
| <b>Total</b>  | <b>16,410</b>    | <b>858</b>          | <b>1,332</b>   | <b>1,073</b>    | <b>5.23%</b>             | <b>8.12%</b>   | <b>6.54%</b>    | <b>64%</b>        | <b>80%</b>      |
| <b>R-squared</b>  |                  |                     | <b>94.7%</b>   | <b>97.6%</b>    |                          |                |                 |                   |                 |

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**Table II-8**

| <b>All Uniform Termination Rates</b> |                  |                     |                |                 |                          |                |                 |                   |                 |
|--------------------------------------|------------------|---------------------|----------------|-----------------|--------------------------|----------------|-----------------|-------------------|-----------------|
| <b>Service</b>                       | <b>Exposures</b> | <b>Terminations</b> |                |                 | <b>Termination Rates</b> |                |                 | <b>A/E Ratios</b> |                 |
|                                      |                  | <b>Actual</b>       | <b>Current</b> | <b>Proposed</b> | <b>Actual</b>            | <b>Current</b> | <b>Proposed</b> | <b>Current</b>    | <b>Proposed</b> |
| 0                                    | 132              | 6                   | 16             | 13              | 4.55%                    | 12.11%         | 10.00%          | 38%               | 45%             |
| 1                                    | 294              | 29                  | 34             | 29              | 9.86%                    | 11.73%         | 10.00%          | 84%               | 99%             |
| 2                                    | 244              | 20                  | 27             | 24              | 8.20%                    | 11.20%         | 10.00%          | 73%               | 82%             |
| 3                                    | 199              | 21                  | 17             | 20              | 10.55%                   | 8.64%          | 10.00%          | 122%              | 106%            |
| 4                                    | 173              | 18                  | 12             | 17              | 10.40%                   | 6.86%          | 10.00%          | 152%              | 104%            |
| 5                                    | 154              | 6                   | 8              | 8               | 3.90%                    | 5.00%          | 5.00%           | 78%               | 78%             |
| 6                                    | 167              | 5                   | 8              | 7               | 2.99%                    | 4.94%          | 4.00%           | 61%               | 75%             |
| 7                                    | 155              | 4                   | 8              | 6               | 2.58%                    | 4.88%          | 4.00%           | 53%               | 65%             |
| 8                                    | 171              | 6                   | 7              | 7               | 3.51%                    | 4.32%          | 4.00%           | 81%               | 88%             |
| 9                                    | 170              | 2                   | 7              | 5               | 1.18%                    | 3.88%          | 3.00%           | 30%               | 39%             |
| 10+                                  | 2,035            | 88                  | 61             | 61              | 4.32%                    | 3.00%          | 3.00%           | 144%              | 144%            |
| <b>Total</b>                         | <b>3,894</b>     | <b>205</b>          | <b>205</b>     | <b>198</b>      | <b>5.26%</b>             | <b>5.28%</b>   | <b>5.08%</b>    | <b>100%</b>       | <b>104%</b>     |
| <b>R-squared</b>                     |                  |                     | <b>90.9%</b>   | <b>96.4%</b>    |                          |                |                 |                   |                 |

**3. Disability**

**A. Current Assumptions**

The disability assumption provides the assumed rates of disability as well as the percentage of disabilities that are service-related.

**Municipal Plans**

Current assumptions for municipal employees are based on age. The rates are 40% of the 1964 OASDI (Social Security) Experience for males. 15% of disablements are assumed to be service related.

**Uniform Plans**

Current assumptions for uniformed employees are based on age. The rates are 60% of the 1964 OASDI (Social Security) Experience for males. 50% of disablements are assumed to be service related.

Workers Compensation for service-related disability benefits payable to municipal employees is assumed to be 25% of final average salary.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

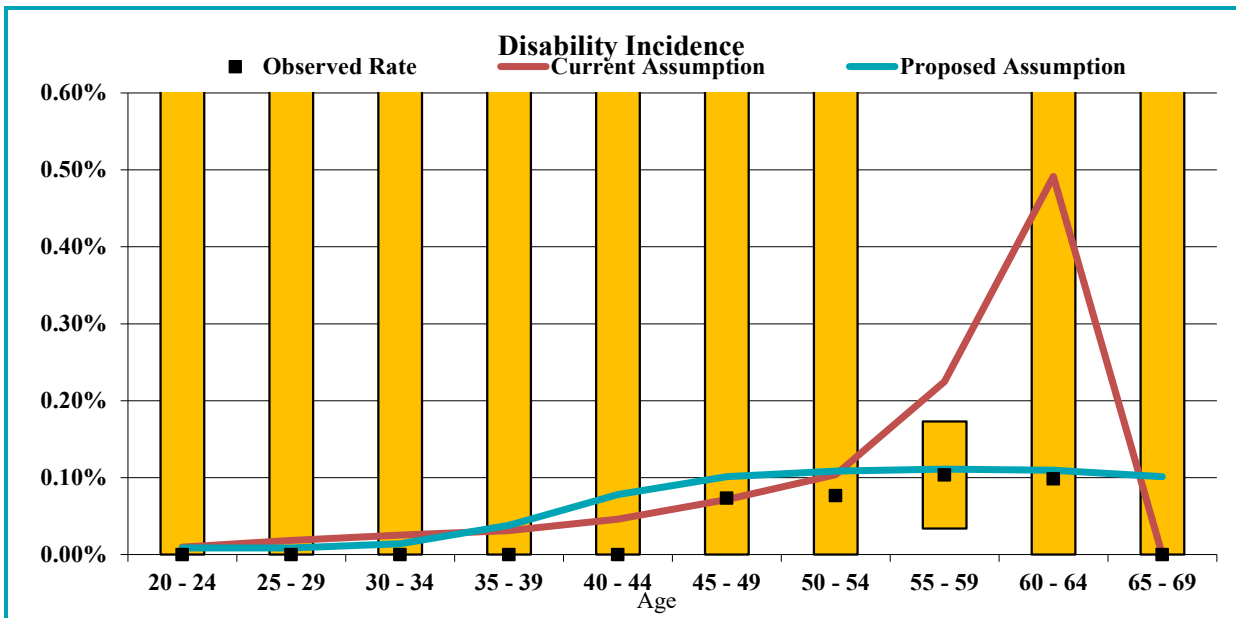
**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**B. Experience and Alternative**

**All Employees**

Due to the small number of disabilities, they were reviewed in aggregate for municipal and uniform plans. While the data is not very credible, there is an increased trend in disability rates as participants get older. The proposed disability incidence table is **40% of the 2017 CalPERS Public Miscellaneous Groups rate table blended 70%/30% Male/Female**. This table provides a better fit with the PMRS disability rates.

**Chart II-8**



A number of plans under PMRS provide separate benefit structures for service-related disabilities. The experience shown does not distinguish between those that are service-related versus not. It is currently assumed that 15% of all municipal plan disabilities and 50% of all uniform plan disabilities are service related. Due to the limited rates of incidence, we reviewed this portion of the assumption in total versus by age. Based on the data outlined below, we suggest increasing these assumptions to 20% of all municipal plan and 70% of all uniform plan disabilities to be considered service related.

| Plan      | Current | Total Disabilities* | Service-Related Disabilities* | % Service-Related | Proposed |
|-----------|---------|---------------------|-------------------------------|-------------------|----------|
| Municipal | 15%     | 421                 | 104                           | 25%               | 20%      |
| Uniform   | 50%     | 56                  | 43                            | 77%               | 70%      |

\*Disabilities provided in the table above represent all disabled participants over each year during the Study Period.

Due to a lack of data for worker’s compensation payments for municipal disability benefits, we are not proposing any changes to the current assumption.



**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

C. Results

The following tables and graphs compare three items: the number of people eligible to become disabled, the number of people expected to become disabled based on the current assumptions, and the number of people expected to become disabled based on the proposed assumptions. This data was used to determine the graph provided above.

**Table II-9**

| <b>Counts of Disability Incidence</b> |               |              |              |              |                           |            |
|---------------------------------------|---------------|--------------|--------------|--------------|---------------------------|------------|
| Age Band                              | Exposures     | Disabilities |              |              | Actual to Expected Ratios |            |
|                                       |               | Actual       | Current      | Proposed     | Current                   | Proposed   |
| 20 - 24                               | 522           | 0            | 0            | 0            | 0%                        | 0%         |
| 25 - 29                               | 1,461         | 0            | 0            | 0            | 0%                        | 0%         |
| 30 - 34                               | 2,101         | 0            | 1            | 0            | 0%                        | 0%         |
| 35 - 39                               | 2,411         | 0            | 1            | 1            | 0%                        | 0%         |
| 40 - 44                               | 2,845         | 0            | 1            | 2            | 0%                        | 0%         |
| 45 - 49                               | 4,091         | 3            | 3            | 4            | 102%                      | 72%        |
| 50 - 54                               | 5,216         | 4            | 5            | 6            | 74%                       | 71%        |
| 55 - 59                               | 5,794         | 6            | 13           | 6            | 46%                       | 93%        |
| 60 - 64                               | 4,070         | 4            | 20           | 4            | 20%                       | 90%        |
| 65 - 69                               | 1,248         | 0            | -            | 1            | 0%                        | 0%         |
| 70 +                                  | 390           | 0            | -            | 0            | 0%                        | 0%         |
| <b>Total</b>                          | <b>30,149</b> | <b>17</b>    | <b>44</b>    | <b>26</b>    | <b>38%</b>                | <b>66%</b> |
| <b>R-squared</b>                      |               |              | <b>22.6%</b> | <b>34.9%</b> |                           |            |

The counts of disability incidence represent new disability occurrences over the Study Period.

**4. Mortality**

A. Current Assumptions

The mortality assumption is used to estimate when participants will die in the future. For PMRS, this assumption is the same for Municipal and Uniform Plans. The mortality assumptions are sex-distinct assumptions broken down into the following groups:

- Rates for non-annuitant participants, which means active or vested terminated participants
- Rates for healthy retirees
- Rates for disabled retirees

All Non-Annuitant Participants

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

RP-2000 Combined Healthy Mortality tables projected to 2015 with Scale AA mortality improvement

All Healthy Retired Participants

RP-2000 Combined Healthy Mortality tables projected to 2005 for males and 2010 for females with Scale AA mortality improvement

Disabled Participants:

RP-2000 Combined Healthy Mortality tables set-forward 10 years for males and females.

**B. Experience and Alternatives**

As shown in the table below, deaths among non-annuitant participants are typically few and may not provide meaningful statistics on pre-retirement mortality in a five-year period. Deaths among the retired population are much higher. Within each group, there are more deaths for males because of the higher concentration of male participants in PMRS. Because of the higher credibility that the male experience provides, this subset was considered first to determine the appropriate updated baseline mortality table to apply for each group.

|                   |        | Table II-10 |        |             |
|-------------------|--------|-------------|--------|-------------|
| Group             | Gender | Exposures   | Deaths | Credibility |
| Non-Annuitant     | Male   | 27,042      | 55     | 23%         |
|                   | Female | 10,774      | 10     | 10%         |
| Healthy Retirees  | Male   | 15,697      | 581    | 73%         |
|                   | Female | 7,577       | 236    | 46%         |
| Disabled Retirees | Male   | 383         | 19     | 13%         |
|                   | Female | 84          | 4      | 6%          |

By actuarial standards, a minimum of 1,082 deaths is considered a fully credible dataset for adjusting a standard mortality table. The greatest number of deaths over the five year period for PMRS based on the grouping above was 581 deaths for the healthy male retirees. Therefore, the standard tables will not be adjusted to “fit” the PMRS death rates and the A/E ratios and R-squared factor have less significance when setting this assumption. Instead, the general “shape” of the graphs is considered against various standard mortality tables.

In addition, ASOP No. 35 states the actuary may want to consider the “use of different assumptions for different participant subgroups”, which for PMRS might mean Municipal and Uniform Plans. If death rates are further divided in the table above for participants from Municipal and Uniform Plans, there will be even less credible data to determine the appropriate mortality tables. Therefore, the mortality assumptions are not subdivided into further subgroups.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

Based on ASOP No. 35, “The actuary should reflect the effect of mortality improvement both before and after the measurement date.” Therefore, when setting the mortality assumption, the first step is to determine the base table to fit the actual mortality rates from the past experience. There have been many studies of mortality rates published in recent years. Based on the data for PMRS, the proposed tables will be based on the following tables:

- RP-2014 Tables published in Oct 2014
  - Study period from 2004 to 2008
  - Data from private pension plans
  - The RP-2014 tables, as published, included mortality improvement projections from 2006 to 2014 using MP-2014. The tables used in this study are the tables prior to the inclusion of the MP-2014 mortality improvements.
  - Referred to herein as the RP-2006 tables
  
- PUB-2010 Tables published Jan 2019
  - Study period from 2008 to 2013
  - Data from public retirement systems
  - Referred to herein as the PUB-2010 tables

For the healthy annuitant review, these tables were compared to the benefits-weighted (or amounts-weighted) death rates from PMRS over the Study Period. Benefits-weighted death rates provide a weighted rate associated with a death of a participant based on the amount of their benefit. Benefits-weighted death rates are considered to provide a better estimate for the future rates of death for a pension plan.

The second step is to build in future mortality improvements, as mortality is expected to improve over time as people are living longer. Not anticipating this trend for the retired population could create an underfunding of the plan. The proposed mortality improvement table is MP-2018. To review the base table, these proposed mortality improvement tables were projected to 2016, the mid-point of the Study Period. For the actuarial valuations using the updated mortality tables, the proposed assumption is to use MP-2018 projected to 2023, the mid-point for the 5 year period over which these new assumptions will be applied.

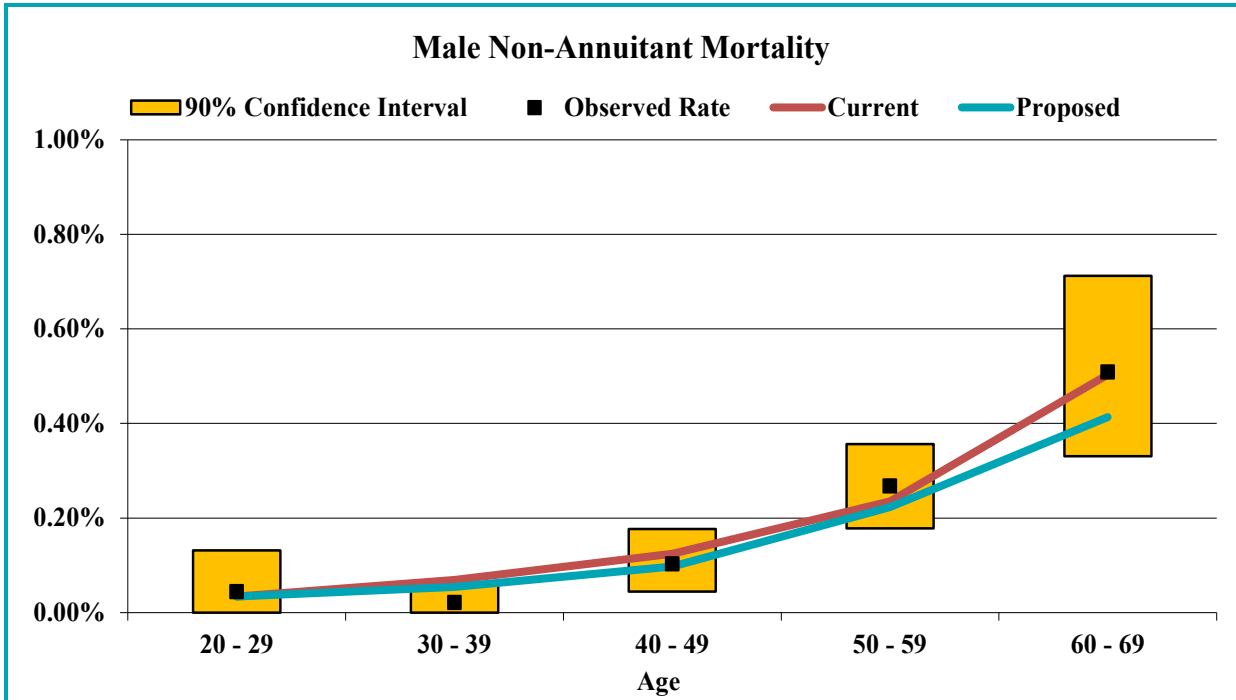
All Non-Annuitant Participants

As stated above, the male death rates have more credibility than the female deaths rates because there are more male participants in PMRS. Reviewing the non-annuitant death rates below, **the proposed table shown is the PUB-2010 General Healthy Male Employee Table with Mortality Improvements using MP-2018.**

PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
 EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
 FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018

SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS

Chart II-9

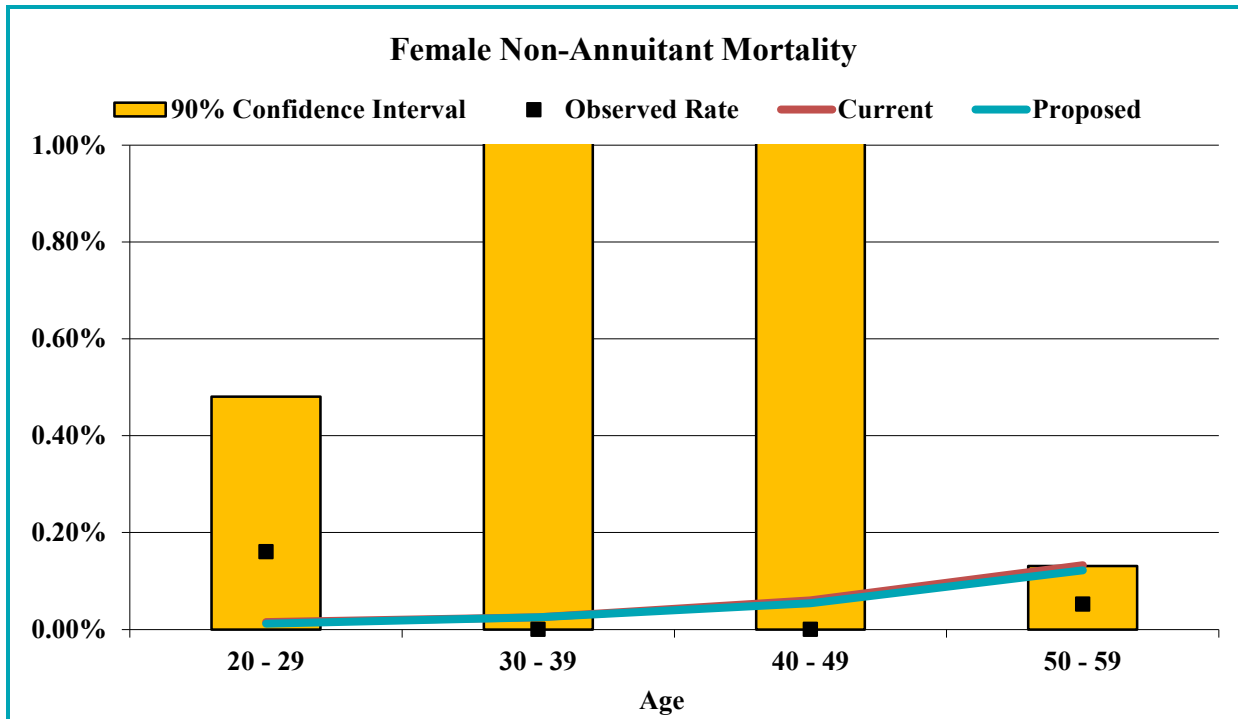


The data for the female non-annuitant death rates is not credible, as can be viewed by the taller golden bars. Therefore, **the proposed table shown is the PUB-2010 General Healthy Female Employee Table with Mortality Improvements using MP-2018** based on the same table above but for females now.

PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018

SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS

Chart II-10



For the non-annuitant population, the credibility of experience is too low for these groups to develop a recommendation. In addition, the materiality of this assumption to the PMRS plan is considered. Non-annuitant deaths over the past 5 years totaled 55 out of the exposed population of over 27,000. These factors result in our proposed assumption to be based on the most recent mortality study that was derived from similar plans. We reviewed various tables from this study and chose the general employee tables because they provided the highest correlation in employment type to the PMRS population.

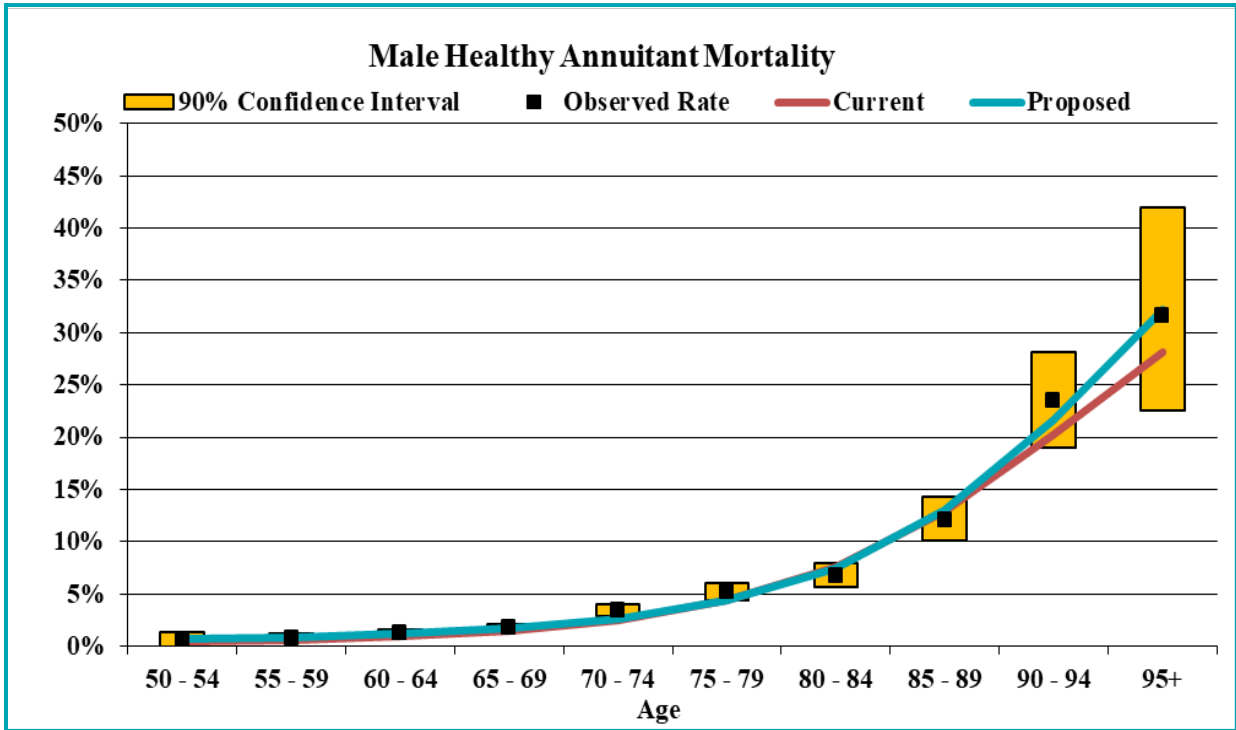
All Current or Future Healthy Retired Participants

The male retiree group provides the most credible data for the death rate. The table below shows that the death rates were fairly in line with the actual death rates except for the participants aged 90+, where the current assumption is less than the actual rates. **The proposed table shown is the RP-2006 General Healthy Annuitant Male Employee Table with Mortality Improvements using MP-2018.** The PUB-2010 Healthy Annuitant Male table was considered; however, the mortality rates for the later years were much greater than the experience which implied the table was not the right match for annuitants. This assumption has significant materiality to the Plan as it determines how long participants are in receipt of their defined benefits. Therefore it is important to consider the credibility of the data (which is high) in the decision to rely on the table that is the best “fit” to the data.

PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
 EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
 FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018

SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS

Chart II-11

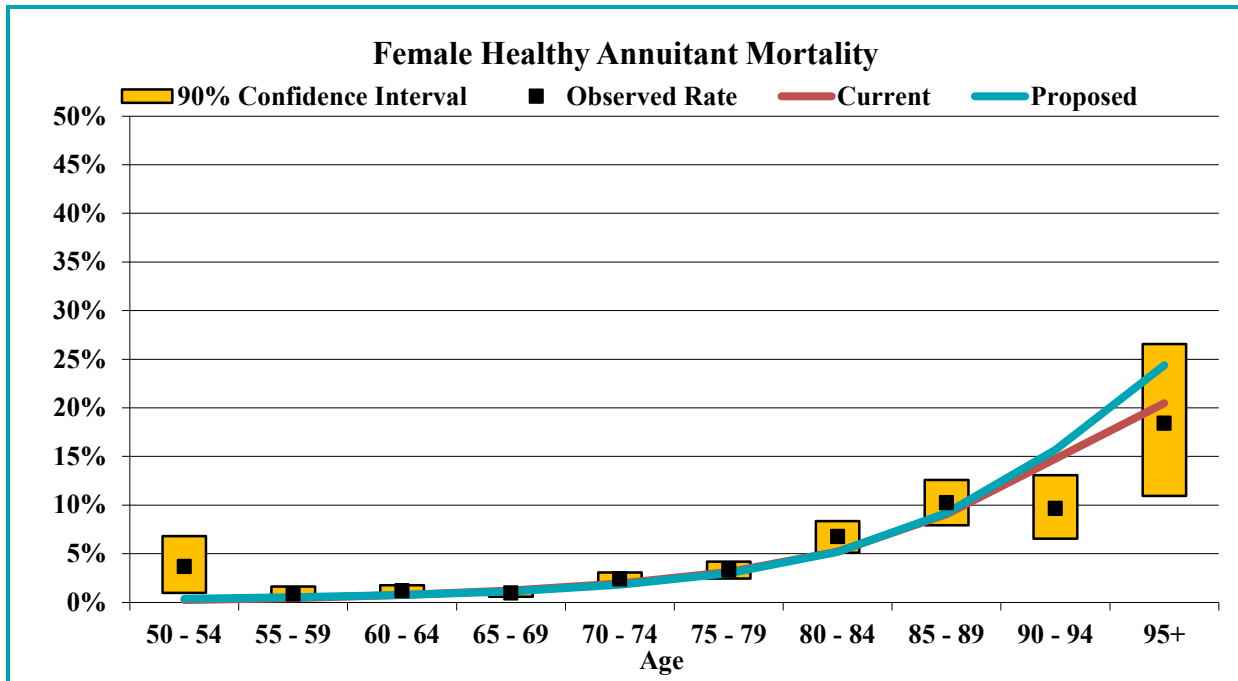


The female retiree group is based on a fewer number of retirees compared to the males, but this still appears to have credible data at most data intervals. Applying the female rates for the **proposed table of RP-2006 General Healthy Annuitant Female Employee Table with Mortality Improvements using MP-2018** this table fits well to the actual death rates.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**Chart II-12**



**All Disabled Annuitants**

Mortality for disabled annuitants provides an even smaller group to analyze actual versus expected experience at individual age groups as provided above. Over the five year period of this study, the number of disabled male and female deaths was 19 and 4, respectively, illustrating the lack of credible data for this analysis.

| <b>Table II-11</b>  |               |                 |                 |
|---|---------------|-----------------|-----------------|
| <b>Uniformed and Municipal Divisions - Disabled Mortality</b> |               |                 |                 |
| <b>Males and Females Combined</b>                             |               |                 |                 |
| <b>Exposed</b>  | <b>Actual</b> | <b>Expected</b> | <b>Proposed</b> |
| <b>420</b>  | <b>23</b>     | <b>14</b>       | <b>13</b>       |

Similar to prior experience the disability mortality table can be based on the same mortality study used to develop the healthy retiree basis, but using the disability death rates RP-2006 Disability Annuitant Male and Female Tables with Mortality Improvements using MP-2018.

**C. Results**

The following tables and graphs compare three items; the number of people exposed to the mortality assumption, the number of people expected to die based on the current assumptions, and the number of people expected to die based on the proposed assumptions. This data was used to determine the graphs provided above.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

Due to the lack of credible data overall, the A/E ratio is less important than the fit of the mortality rate curve.

**Table II-12**

| <b>Non-Annuitant Mortality - Base Table for Males</b> |               |               |                    |                 |           |           |             |             |
|---|---------------|---------------|--------------------|-----------------|-----------|-----------|-------------|-------------|
| Age Band  | Exposures     | Actual Deaths | Weighted Exposures | Weighted Deaths |           |           | A/E Ratio   |             |
|   |               |               |                    | Actual          | Current   | Proposed  | Current     | Proposed    |
| 20 - 29   | 2,280         | 1             | 2,280              | 1               | 1         | 1         | 129%        | 129%        |
| 30 - 39   | 4,797         | 1             | 4,797              | 1               | 3         | 3         | 30%         | 38%         |
| 40 - 49   | 6,795         | 7             | 6,795              | 7               | 8         | 7         | 83%         | 105%        |
| 50 - 59   | 8,974         | 24            | 8,974              | 24              | 21        | 20        | 114%        | 120%        |
| 60 - 69   | 3,931         | 20            | 3,931              | 20              | 20        | 16        | 101%        | 123%        |
| 70 +  | 250           | 2             | 250                | 2               | 0         | 2         | 429%        | 85%         |
| <b>Total</b>  | <b>27,027</b> | <b>55</b>     | <b>27,027</b>      | <b>55</b>       | <b>54</b> | <b>49</b> | <b>102%</b> | <b>113%</b> |

**Table II-13**

| <b>Non-Annuitant Mortality - Base Table for Females</b> |               |               |                    |                 |           |           |            |            |
|---|---------------|---------------|--------------------|-----------------|-----------|-----------|------------|------------|
| Age Band  | Exposures     | Actual Deaths | Weighted Exposures | Weighted Deaths |           |           | A/E Ratio  |            |
|   |               |               |                    | Actual          | Current   | Proposed  | Current    | Proposed   |
| 20 - 29   | 624           | 1             | 624                | 1               | 0         | 0         | 1050%      | 1374%      |
| 30 - 39   | 1,531         | 0             | 1,531              | 0               | 0         | 0         | 0%         | 0%         |
| 40 - 49   | 2,476         | 0             | 2,476              | 0               | 1         | 1         | 0%         | 0%         |
| 50 - 59   | 3,826         | 2             | 3,826              | 2               | 5         | 5         | 39%        | 43%        |
| 60 - 69   | 2,119         | 5             | 2,119              | 5               | 7         | 5         | 76%        | 98%        |
| 70 +  | 197           | 2             | 197                | 2               | 1         | 1         | 202%       | 169%       |
| <b>Total</b>  | <b>10,773</b> | <b>10</b>     | <b>10,773</b>      | <b>10</b>       | <b>15</b> | <b>13</b> | <b>68%</b> | <b>78%</b> |

In the *Selecting and Documenting Mortality Assumptions for Pensions* report published by the American Academy of Actuaries in June 2015, the Society of Actuaries' Retirement Plans Experience Committee (RPEC) "indicated that they believe the use of amount-weighted mortality rates continues to be appropriate for the measurement of pension plan obligations." The RP-2014 mortality rates were all based on benefit-weighted exposures and deaths.

For annuitants, the amount-weighted exposures were considered in the determination of the appropriate mortality tables. Amount-weighted mortality tables weights the exposures and deaths based on the amount of the retirement benefit participants receive. In the tables below, the amount-weighted exposures are provided along with the actual and expected amount weighted deaths.

Based on the data, the most credible data below is the healthy male annuitant table. For the male healthy annuitant table the A/E ratio under the updated assumption is closer to one. This underlying table of RP-2006 was then used to determine the female healthy annuitant and disabled annuitant mortality tables.



**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**Table II-14**

| <b>Healthy Annuitant Mortality - Base Table for Males</b> |                  |                      |                           |                        |                |                 |                   |                 |
|---|------------------|----------------------|---------------------------|------------------------|----------------|-----------------|-------------------|-----------------|
| <b>Age Band</b>   | <b>Exposures</b> | <b>Actual Deaths</b> | <b>Weighted Exposures</b> | <b>Weighted Deaths</b> |                |                 | <b>A/E Ratios</b> |                 |
|   |                  |                      |                           | <b>Actual</b>          | <b>Current</b> | <b>Proposed</b> | <b>Current</b>    | <b>Proposed</b> |
| 50 - 54   | 365              | 2                    | 687,630                   | 4,689                  | 3,533          | 4,551           | 133%              | 103%            |
| 55 - 59   | 1,226            | 10                   | 2,488,803                 | 19,390                 | 15,365         | 22,100          | 126%              | 88%             |
| 60 - 64   | 3,001            | 47                   | 5,630,823                 | 74,567                 | 53,809         | 68,608          | 139%              | 109%            |
| 65 - 69   | 4,047            | 79                   | 6,597,949                 | 120,689                | 101,488        | 113,907         | 119%              | 106%            |
| 70 - 74   | 3,033            | 99                   | 4,099,308                 | 140,114                | 102,305        | 108,125         | 137%              | 130%            |
| 75 - 79   | 1,850            | 104                  | 2,157,820                 | 113,649                | 93,606         | 94,022          | 121%              | 121%            |
| 80 - 84   | 1,246            | 91                   | 1,271,182                 | 86,172                 | 96,454         | 94,891          | 89%               | 91%             |
| 85 - 89   | 635              | 81                   | 558,762                   | 67,691                 | 71,839         | 72,613          | 94%               | 93%             |
| 90 - 94   | 231              | 48                   | 168,839                   | 39,699                 | 34,220         | 36,639          | 116%              | 108%            |
| 95 +  | 62               | 19                   | 31,939                    | 10,102                 | 9,002          | 10,270          | 112%              | 98%             |
| <b>Total</b>  | <b>15,696</b>    | <b>580</b>           | <b>23,693,054</b>         | <b>676,762</b>         | <b>581,621</b> | <b>625,727</b>  | <b>116%</b>       | <b>108%</b>     |

**Table II-15**

| <b>Healthy Annuitant Mortality - Base Table for Females</b> |                  |                      |                           |                        |                |                 |                   |                 |
|---|------------------|----------------------|---------------------------|------------------------|----------------|-----------------|-------------------|-----------------|
| <b>Age Band</b>   | <b>Exposures</b> | <b>Actual Deaths</b> | <b>Weighted Exposures</b> | <b>Weighted Deaths</b> |                |                 | <b>A/E Ratios</b> |                 |
|   |                  |                      |                           | <b>Actual</b>          | <b>Current</b> | <b>Proposed</b> | <b>Current</b>    | <b>Proposed</b> |
| 50 - 54   | 103              | 3                    | 119,862                   | 4,419                  | 295            | 435             | 1497%             | 1015%           |
| 55 - 59   | 369              | 3                    | 508,445                   | 4,345                  | 2,213          | 2,588           | 196%              | 168%            |
| 60 - 64   | 1,137            | 12                   | 1,317,746                 | 15,421                 | 10,034         | 9,989           | 154%              | 154%            |
| 65 - 69   | 1,909            | 18                   | 1,966,984                 | 18,525                 | 23,567         | 22,159          | 79%               | 84%             |
| 70 - 74   | 1,602            | 34                   | 1,480,868                 | 35,696                 | 28,688         | 26,715          | 124%              | 134%            |
| 75 - 79   | 1,099            | 41                   | 933,198                   | 30,793                 | 29,205         | 27,735          | 105%              | 111%            |
| 80 - 84   | 647              | 44                   | 504,233                   | 34,003                 | 26,325         | 26,140          | 129%              | 130%            |
| 85 - 89   | 429              | 44                   | 298,399                   | 30,522                 | 27,031         | 27,397          | 113%              | 111%            |
| 90 - 94   | 214              | 22                   | 121,440                   | 11,710                 | 17,930         | 19,050          | 65%               | 61%             |
| 95 +  | 64               | 12                   | 37,016                    | 6,817                  | 7,577          | 9,024           | 90%               | 76%             |
| <b>Total</b>  | <b>7,573</b>     | <b>233</b>           | <b>7,288,192</b>          | <b>192,251</b>         | <b>172,865</b> | <b>171,234</b>  | <b>111%</b>       | <b>112%</b>     |

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**Table II-16**

| <b>Disabled Annuitant Mortality - Base Table for Males</b> |            |               |                    |                 |               |               |             |             |
|--|------------|---------------|--------------------|-----------------|---------------|---------------|-------------|-------------|
| Age Band   | Exposures  | Actual Deaths | Weighted Exposures | Weighted Deaths |               |               | A/E Ratios  |             |
|  |            |               |                    | Actual          | Current       | Proposed      | Current     | Proposed    |
| 50 - 54  | 29         | 3             | 28,430             | 2,127           | 267           | 653           | 796%        | 326%        |
| 55 - 59  | 85         | 3             | 99,314             | 1,543           | 1,663         | 2,569         | 93%         | 60%         |
| 60 - 64  | 131        | 6             | 168,363            | 6,220           | 4,663         | 5,020         | 133%        | 124%        |
| 65 - 69  | 54         | 2             | 75,339             | 1,591           | 3,465         | 2,694         | 46%         | 59%         |
| 70 - 74  | 39         | 2             | 47,719             | 1,442           | 3,710         | 2,196         | 39%         | 66%         |
| 75 - 79  | 5          | 1             | 3,133              | 539             | 379           | 188           | 142%        | 286%        |
| 80 - 84  | 1          | 1             | 1,186              | 1,186           | 237           | 104           | 501%        | 1140%       |
| 85 - 89  | -          | -             | -                  | -               | -             | -             | 0%          | 0%          |
| 90 - 94  | 1          | 1             | 389                | 389             | 139           | 78            | 279%        | 495%        |
| 95 +   | -          | -             | -                  | -               | -             | -             | 0%          | 0%          |
| <b>Total</b>   | <b>345</b> | <b>19</b>     | <b>423,873</b>     | <b>15,037</b>   | <b>14,524</b> | <b>13,503</b> | <b>104%</b> | <b>111%</b> |

**Table II-17**

| <b>Disabled Annuitant Mortality - Base Table for Females</b> |           |               |                    |                 |              |              |             |             |
|--|-----------|---------------|--------------------|-----------------|--------------|--------------|-------------|-------------|
| Age Band   | Exposures | Actual Deaths | Weighted Exposures | Weighted Deaths |              |              | A/E Ratios  |             |
|  |           |               |                    | Actual          | Current      | Proposed     | Current     | Proposed    |
| 50 - 54  | 8         | 0             | 8,483              | 0               | 53           | 132          | 0%          | 0%          |
| 55 - 59  | 11        | 0             | 9,293              | 0               | 123          | 189          | 0%          | 0%          |
| 60 - 64  | 35        | 2             | 33,412             | 1,597           | 723          | 789          | 221%        | 202%        |
| 65 - 69  | 17        | 1             | 28,744             | 3,547           | 952          | 815          | 372%        | 435%        |
| 70 - 74  | 4         | 1             | 7,692              | 659             | 371          | 277          | 177%        | 238%        |
| 75 - 79  | 0         | 0             | 0                  | 0               | -            | -            | 0%          | 0%          |
| 80 - 84  | 0         | 0             | 0                  | 0               | -            | -            | 0%          | 0%          |
| 85 - 89  | 0         | 0             | 0                  | 0               | -            | -            | 0%          | 0%          |
| 90 - 94  | 0         | 0             | 0                  | 0               | 0            | 0            | 0%          | 0%          |
| 95 +   | 0         | 0             | 0                  | 0               | 0            | 0            | 0%          | 0%          |
| <b>Total</b>   | <b>75</b> | <b>4</b>      | <b>87,624</b>      | <b>5,803</b>    | <b>2,224</b> | <b>2,201</b> | <b>261%</b> | <b>264%</b> |

PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

**5. Marriage Percentage and Spouse’s Age**

A. Current Assumptions

All Municipal and Uniform Plans

Currently, it is assumed that 80% of active employees are married at the time they retire and husbands are three years older than their wives. This assumption is used to determine the beneficiary pension payments that may be paid for future retirees that elect a joint and survivor benefit option.

B. Experience and Alternative

All Municipal and Uniform Plans

The experience shows that 80% of current retirees are currently married. However when this is reviewed by gender, 84% of male retirees are married and 67% of female retirees are married.

On average, husbands are 2.6 years older than their wives.

**The proposed marriage assumption is that 85% of male participants are married and 65% of female participants are married. The proposed assumption for the age difference is that no change is to be made to the age difference assumption for married participants.**

**6. Male/Female Percentages**

A. Current Assumptions

All Municipal and Uniform Plans

Currently, it is assumed that the overall population for PMRS is 70% male and 30% female. While this assumption is not used explicitly for the actuarial valuations, this is used to determine the blended male/female unisex mortality table applied by PMRS for administration of the System. For example, this blended unisex table is used to determine present values of accrued benefits for transfers to the Retiree Reserve Account, to convert pension benefits to optional forms of payment, and to convert cash balance accounts to annuity pension benefits.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION II – ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS**

B. Experience and Alternative

All Municipal and Uniform Plans

For the overall PMRS population, there are 72% male participants and 28% female participants. Therefore, it is **proposed to make no changes in the male/female percentage assumption** at this time.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

The following economic assumptions are included in this analysis:

1. Inflation/Cost of Living Rate (if applicable)
2. Salary Increase
3. Discount Rate

Both the discount rate and salary increase assumptions are interrelated with inflation. Inflation is also the basis for the cost of living increase rate for plans that provide this. The discount rate (or rate of investment return) consists of two components: the "real rate" of return and inflation. Similarly, the rate of salary increase is separated into different components: inflation and merit increases (inclusive of promotional increases).

**1. Inflation**

**A. Current Assumptions**

Inflation is a building-block of all economic assumptions. This means that all economic assumptions, either directly or indirectly, are impacted by inflation. It is also the assumption used to project cost-of-living increases for those municipalities that provide this benefit. The current rate of inflation is 2.8%.

Social Security Taxable Wage Base is assumed to be 50 basis points above the assumed inflation rate.

**B. Experience**

**(i) General Historical Experience**

Based on the Consumer Price Index for All Urban Consumers U.S. City Average (all items) (CPI), Table III-1 shows the inflation rates for the past 30 years:

**Table III-1**

| Year Ending December 31 | Increase in CPI | Year Ending December 31 | Increase in CPI |
|-------------------------|-----------------|-------------------------|-----------------|
| 1990                    | 5.40%           | 2005                    | 3.40%           |
| 1991                    | 4.20%           | 2006                    | 3.20%           |
| 1992                    | 3.00%           | 2007                    | 2.90%           |
| 1993                    | 3.00%           | 2008                    | 3.80%           |
| 1994                    | 2.60%           | 2009                    | -0.40%          |
| 1995                    | 2.80%           | 2010                    | 1.60%           |
| 1996                    | 2.90%           | 2011                    | 3.20%           |
| 1997                    | 2.30%           | 2012                    | 2.10%           |
| 1998                    | 1.60%           | 2013                    | 1.50%           |
| 1999                    | 2.20%           | 2014                    | 1.60%           |
| 2000                    | 3.40%           | 2015                    | 0.10%           |
| 2001                    | 2.80%           | 2016                    | 1.30%           |
| 2002                    | 1.60%           | 2017                    | 2.10%           |
| 2003                    | 2.30%           | 2018                    | 2.40%           |
| 2004                    | 2.70%           | 2019                    | 1.80%           |

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

The CPI has fluctuated year-over-year, but has been less than the current 2.80% inflation assumption since 2011. This table provides the average CPI over different historical time horizons.

**Table III-2**

| <b>Time Period</b> | <b>Number of Years</b> | <b>Compound Average</b> |
|--------------------|------------------------|-------------------------|
| 2015 - 2019        | 5                      | 1.50%                   |
| 2010 - 2019        | 10                     | 1.80%                   |
| 2005 - 2019        | 15                     | 2.00%                   |
| 2000 - 2019        | 20                     | 2.20%                   |
| 1995 - 2019        | 25                     | 2.20%                   |
| 1990 - 2019        | 30                     | 2.40%                   |

The CPI reviewed during the previous experience study was at a relatively historic low level compared to the rates in the past. However, since the last experience study, inflation rates have declined even more. This data alone indicates that lowering the inflation could be appropriate.

(ii) Outlook for the Future

Due to the recent COVID-19 pandemic, inflation may decrease even more as a result of increased unemployment and the decrease of the Federal Reserve Rate to 0% in response to the pandemic. The following provides a survey of about 45 economic forecasters published May 15, 2020 by the Research Department of Federal Reserve Bank of Philadelphia on their expectations on CPI over the next ten years.

This graph provides a wide range in views of CPI in the future. The colors of the bars represent the percentile of the expected CPI ranging from the lowest expected inflation rate of 1.44% up to the highest expected inflation rate of 2.80%.

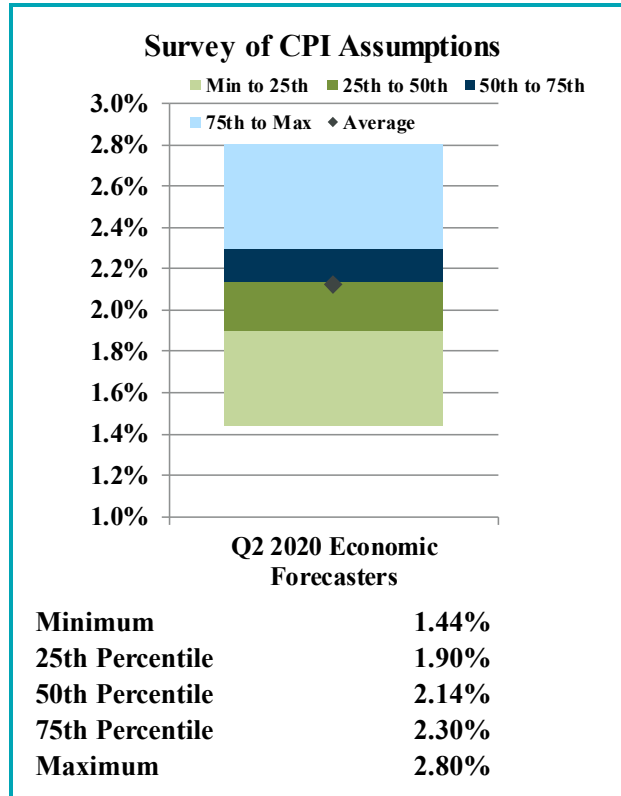
The top 25% of the economic forecasters (light blue bar) estimated that CPI will range between 2.3% and 2.8%. 50% of the economic forecasters (dark green and the dark blue bars) estimated that CPI will range between 1.9% and 2.3%, a smaller range than the top 25% of responses. The 50th percentile of responses showed an expected inflation rate of 2.14%.

This survey also supports lowering the inflation assumption for PMRS. Furthermore, the wide range of projected future inflation shows uncertainty in terms of how inflation will change.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

**Chart III-1**



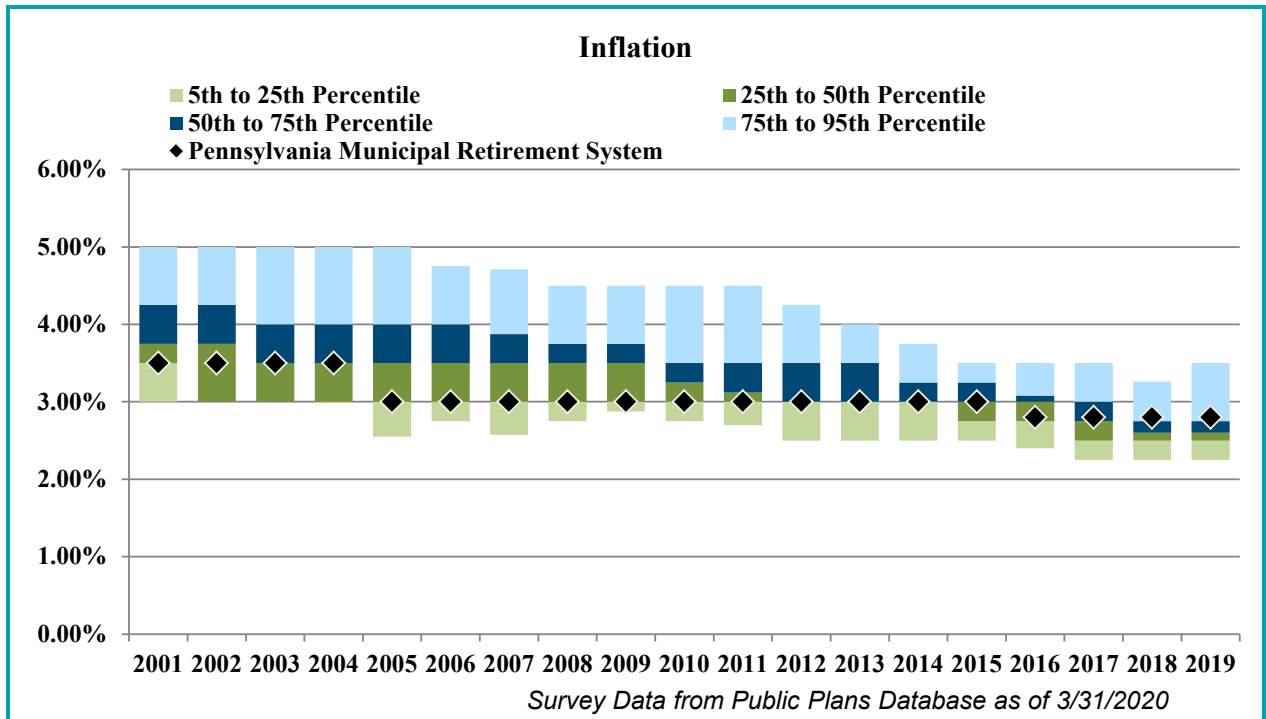
(iii) Other Public Sector Plans

The Boston College’s Center for Retirement Research, National Association of State Retirement Administrators (NASRA) and Center for State and Local Government Excellence maintain the Public Plan Database that contains the majority of state plans as well as many large municipal plans. Survey data from this Public Plan Database shows that the inflation assumption used by these plans continues to trend downward. The black dots in the graph below show the PMRS inflation assumption compared to other public sector inflation assumptions.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

**Chart III-2**



At the time of the last study, the 2.80% inflation assumption was within the 25<sup>th</sup> to 50<sup>th</sup> percentile range in 2015. This same inflation assumption in 2019 has moved to the top 75<sup>th</sup> to 95<sup>th</sup> percentile range. This shows that there has been a trend downward of the inflation assumption for other public sector plans and supports the decrease of the inflation assumption for PMRS.

(iv) Other Considerations

The PMRS investment consultant’s inflation assumption is 2.2% for the 2020 plan year. This assumption is based on current market trends and is updated frequently and across all plans. Investment time horizons are typically shorter than an actuary’s for valuation purposes. Furthermore, the actuarial inflation assumption selected by the Board does not need to match the investment consultant’s assumption.

Public Policy Practice Note titled *Forecasting Investment Returns and Expected Return Assumptions for Pension Actuaries*, published by the American Academy of Actuaries in February 2019, Topic 12 reviews the coordination of inflation assumptions by actuaries and investment consultants. According to this publication, “Often, the capital market assumptions used by an investment consultant to develop the expected return for a portfolio incorporate a different inflation assumption than the inflation assumption used to project the benefit payments in the actuarial valuation.” However, if the difference in these assumptions is “relatively small”, then making no change to either the investment consultant’s or the actuary’s inflation assumption is “straightforward and quite common.”



**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

C. Alternative

Based on the above factors, the **proposed assumption change is to lower the inflation rate from 2.80% to 2.20%. However, in response to the COVID-19 pandemic crisis, an interim review of the inflation assumption in 2021 and 2022 may be warranted.**

**2. Salary Increase**

A. Current Assumptions

The current salary increase assumption for all employees is based on the following table:

| <b>Table III-3<br/>Salary Scale</b> |   |
|-------------------------------------|---|
| <b>Age</b>                          | <b>Total Rate*<br/>(including 2.8% inflation)</b> |
| 25                                  | 7.05%   |
| 30                                  | 5.44%   |
| 35                                  | 4.55%   |
| 40                                  | 4.26%   |
| 45                                  | 3.97%   |
| 50                                  | 3.72%   |
| 55                                  | 3.44%   |
| 60                                  | 3.28%   |
| 65                                  | 2.80%   |

*\*Add 2% for each of the first 3 years of service.*

This is an age based table with decreasing rates with age. There are three components of the current salary scale assumption:

- (i) Early Employment Year Increases – additional 2% increase for the first 3 years of employment. This indicates that there are higher increases in the salary for the early employment years and is referred to a select period for these increases.
- (ii) Merit and Promotional Increases – to review this component of salary scale increases, the inflation rate is removed and pay increases are analyzed based on merit/promotions only
- (iii) Prior to Retirement Increases – additional 6% increase assumed before retirement. This estimates salary loading behavior that participants may use before retirement.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

B. Experience and Alternatives

*Early Employment Year Increases:*

This table displays the average salary increases for participants with less than 6 years of service, after removing inflation and merit and promotional increase assumptions. The weighted average salary increases support a longer select period with decreasing rates.

**Table III-4**

| Weighted Average - Years 2014-2018 |        |         |          |
|------------------------------------|--------|---------|----------|
| Service                            | Actual | Current | Proposed |
| Under 2                            | 5.86%  | 2.00%   | 3.00%    |
| 2                                  | 6.33%  | 2.00%   | 3.00%    |
| 3                                  | 4.41%  | 2.00%   | 2.00%    |
| 4                                  | 3.55%  | 0.00%   | 2.00%    |
| 5                                  | 2.93%  | 0.00%   | 1.00%    |
| 6                                  | 2.77%  | 0.00%   | 1.00%    |
| Over 6                             | 1.90%  | 0.00%   | 0.00%    |

*Merit and Promotional Increases*

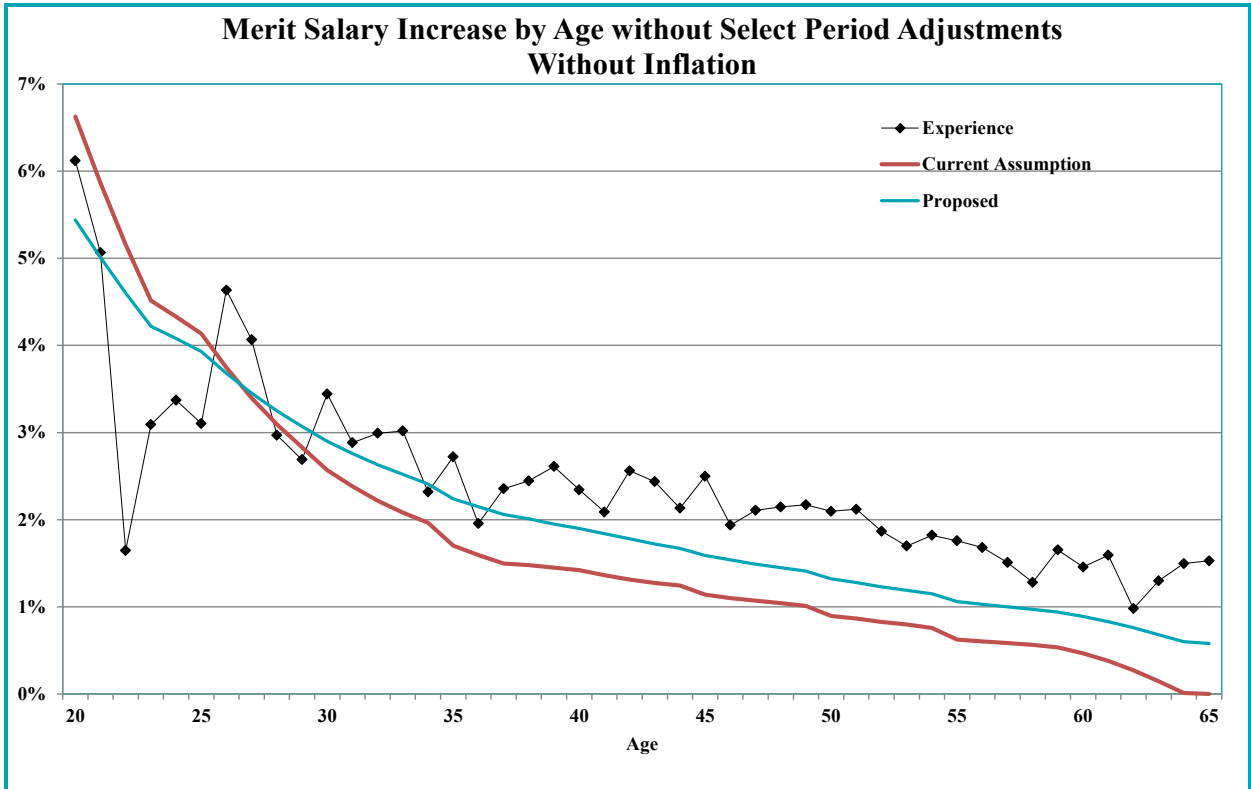
To review the merit and promotional increases, the Early Employment Year increases for first 6 years based on the proposed assumptions were first removed from the pay increases for all applicable participants. Next, the inflation rate for each year during the Study Period was removed from the pay increases. The inflation rate for each year was based on the CPI (as defined above) increase for the year. Because all data used reflected continuing active participants from one year to the next, there was no need to remove the 6% pay increase assumption for participants prior to retirement.

The experience of the System (the black line) shows for ages 36 and later that the merit and promotional salary increases have been consistently greater than expected salary increases (red line). Furthermore, for ages 20 – 26 the increases appear to be less than the expected salary increases, although there is significantly more variability in this group. The proposed merit and promotional salary increase assumption (the teal line) is lower for ages 20 – 25 and greater for ages 26+.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

**Chart III-3**



According to ASOP No. 27 under the Change in Circumstance section, “the actuary may learn of an event occurring after the measurement date that would have changed the actuary’s selection of an economic assumption.” Based on this information, “the actuary may reflect this change as of the measurement date.” The COVID-19 pandemic is such a change in circumstances that may be considered.

Due to the current COVID-19 pandemic, there is increased unemployment and projected decreased tax revenues during 2020 for municipalities. Based on the Board’s discussion during the May 21, 2020 meeting of the current market and employment challenges, the following merit-based salary scale was proposed:

- For 2021 and 2022, no merit-based pay increases
- For 2023+, proposed merit-based pay increases (prior page)

For example, active participants in the 1/1/2021 actuarial valuation will have merit-based pay increases for 2023+.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

*Prior to Retirement Increases*

The experience in the past has shown that there is often an increase in pay in the year immediately prior to retirement. This can result from additional overtime to maximize the pay used to calculate benefits or from compensation for unused vacation or sick leave. The current Prior to Retirement salary increase assumption is that pay will increase an additional 6% immediately before retirement. Because the final year of pay is usually not included in the valuation data, quantitative analysis of this assumption is not available. However, based on qualitative feedback from PMRS, this increase in salary prior to retirement continues to occur. Therefore, the proposed assumption is to keep this assumption as is. If in the future payroll data can be provided for new retirees, then this assumption can be reviewed in greater detail for the next experience study.

C. Results

The table below shows the merit and promotional salary increases from the experience study, the current rates, and the proposed rates. These rates do NOT include the inflation assumption but DO reflect the select period adjustments.

**Table III-5**

| <b>Average Salary Increases - Years 2014-2018</b> |               |                |                 |
|---|---------------|----------------|-----------------|
| <b>Includes Early Service Year Adjustments</b>    |               |                |                 |
| <b>Excludes Inflation</b>                         |               |                |                 |
| <b>Rates at Sample Ages</b>                       |               |                |                 |
| <b>Age</b>  | <b>Actual</b> | <b>Current</b> | <b>Proposed</b> |
| 20  | 8.83%         | 8.05%          | 8.15%           |
| 25  | 5.55%         | 5.74%          | 6.38%           |
| 30  | 4.97%         | 3.36%          | 4.43%           |
| 35  | 3.70%         | 2.21%          | 3.22%           |
| 40  | 3.06%         | 1.81%          | 2.62%           |
| 45  | 2.96%         | 1.38%          | 2.05%           |
| 50  | 2.54%         | 1.12%          | 1.76%           |
| 55  | 2.11%         | 0.80%          | 1.41%           |
| 60  | 1.75%         | 0.60%          | 1.18%           |
| 65  | 1.85%         | 0.17%          | 0.90%           |

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

**3. Discount Rate**

A. Current Assumptions

PMRS' assets are assumed to earn 5.25% net of expenses for the measurement of liabilities.

Under the Pennsylvania Municipal Retirement Law Act 15 of 1974 (PMRL), the PMRS Board is required to set the discount rate, which is also referred to as the “regular interest rate” in the PMRL. This is also referred to as the “investment rate” or the “crediting rate.” Per the law, the regular interest rate is applied for the upcoming year to credit municipal and member accounts and used to calculate the actuarial liabilities for the upcoming valuation to determine the funding requirements.

The Board undertakes a comprehensive review of this assumption every fall to determine if a change is needed for the following year. This annual review considers the following:

- Interest Rate Review Tool
- Probability of Future Asset Returns
- Other considerations

*Interest Rate Review Tool*

This tool was first developed to assist the Board with setting the regular interest rates once GASB 67/68 reporting was required starting in 2013. It incorporates PMRS specific details and blends long-term expected returns for active participants and short-term annuity rates for retirees. This is used as a rough proxy of possible rates if the assets associated with retirees were immunized with PBGC rates.

Inflation is an implicit building block of this tool because it is an underlying assumption associated with the PBGC lump sum rates and the long-term expected rate of return. As inflation has declined in the past years, these rates have declined as well.

*Probability of Future Asset Returns*

Prior to 2013, a 90% - 95% probability of the assets earning the assumed investment return was used by the Board to set the discount rate. However, expected asset returns have declined since 2013. The probability of achieving the current expected investment return of 5.25% has decreased to 75% based on data from the investment consultant as outlined in the Long-Term Expected Rate of Return on Plan Assets memo for the December 31, 2018 GASB reports for PMRS.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

This table illustrates how the expected long-term investment returns have steadily declined. In 2016, there was a 90% probability of 5.7% return (or more); in 2020 the probability of the same return is about 73%.

**Table III-6**

| <b>Confidence Interval</b> | <b>Annual Expected Return per Confidence Interval</b> |             |             |             |             |
|----------------------------|---|-------------|-------------|-------------|-------------|
|                            | <b>2016</b>   | <b>2017</b> | <b>2018</b> | <b>2019</b> | <b>2020</b> |
| 95%                        | 4.8%  | 3.6%        | 3.3%        | 3.5%        | 2.8%        |
| 90%                        | 5.7%  | 4.6%        | 4.4%        | 4.4%        | 3.9%        |
| 85%                        | 6.4%  | 5.3%        | 5.0%        | 5.1%        | 4.6%        |
| 80%                        | 6.9%  | 5.5%        | 5.6%        | 5.7%        | 5.1%        |
| 75%                        | 7.4%  | 5.9%        | 6.0%        | 6.1%        | 5.5%        |
| 70%                        | 7.8%  | 6.3%        | 6.5%        | 6.5%        | 5.9%        |
| 50%                        | 9.2%  | 8.2%        | 7.9%        | 7.9%        | 7.3%        |

*Other Considerations*

One consideration for the Board is the ratio of the PMRS Market Value of Assets (MVA) to the PMRS Actuarial Value of Assets (AVA). If the MVA is less than the AVA, then there is a gap which can only be filled currently by investment returns exceeding the regular interest rate. This may be more likely to be achieved if the regular interest rate is reduced. Another consideration is that reducing the investment volatility, which would also reduce the discount rate and fluctuating gaps between the MVA and the AVA ratio in the future.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

B. Experience

(i) Historical Experience in General

This table provides the rates of investment returns experienced by PMRS during the last 10 fiscal years. Rates of return were computed as the ratio of the net investment earnings to market value of asset.

Current Assumption: 5.25% per annum

**Table III-7**

| Net Investment Returns for Market Value of Assets* |               |
|--|---------------|
| Calendar Year                                      | Market Return |
| 2001   | -3.9%         |
| 2002   | -8.9%         |
| 2003   | 23.7%         |
| 2004   | 13.1%         |
| 2005   | 8.6%          |
| 2006   | 12.6%         |
| 2007   | 8.2%          |
| 2008   | -24.8%        |
| 2009   | 18.8%         |
| 2010   | 13.8%         |
| 2011   | -1.9%         |
| 2012   | 13.2%         |
| 2013   | 19.4%         |
| 2014   | 5.2%          |
| 2015   | -0.3%         |
| 2016   | 8.2%          |
| 2017   | 17.8%         |
| 2018   | -4.6%         |

\*Time-weighted return prior to 2014, otherwise Dollar-weighted return

| Compound Average Returns |      |
|--------------------------|------|
| 5 years (2014 - 2018)    | 5.0% |
| 10 years (2009 - 2018)   | 8.6% |
| 15 years (2004 - 2018)   | 6.5% |

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

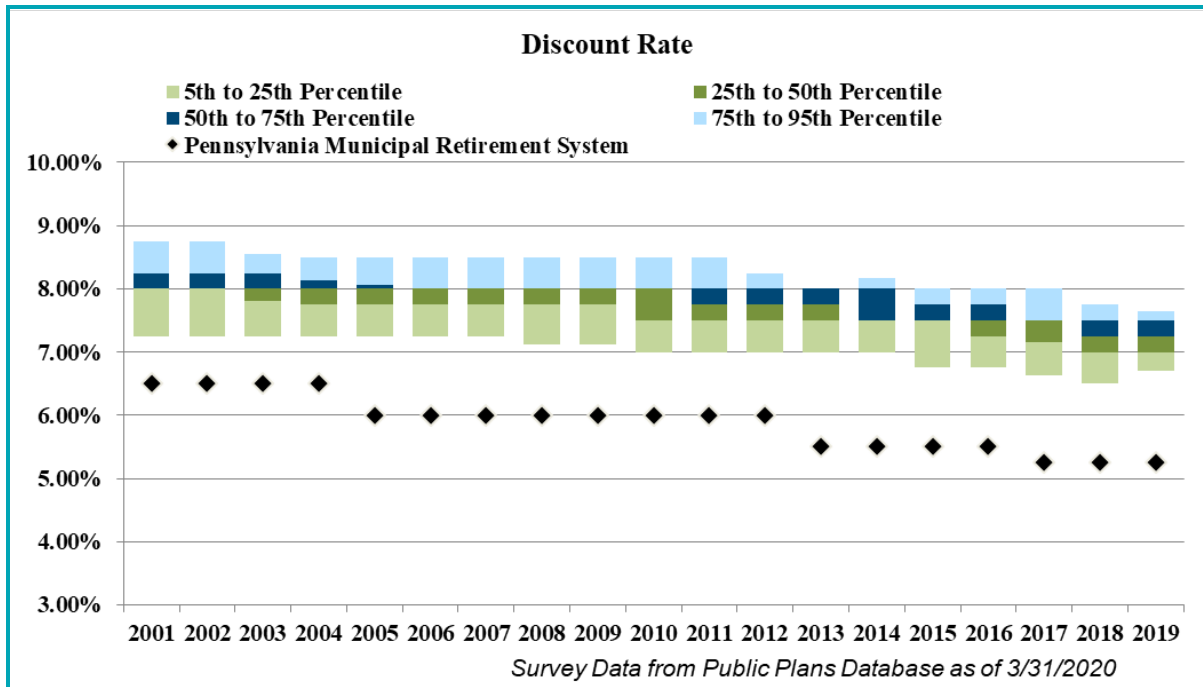
**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

The investment returns on both a ten- and fifteen-year basis are higher than the current assumption. However, historical returns should not provide the sole basis for setting the return assumptions. Historical returns are highly dependent on the period examined. Different periods can yield significantly different historical returns.

(ii) Other Public Sector Plans

The findings from the Public Fund Survey as published by the National Association of State Retirement Administrators (NASRA) in the Research Update as of August 2020 show that the median investment return used by public sector plans is 7.25%, a decrease from 7.75% as of the prior study.

**Chart III-4**



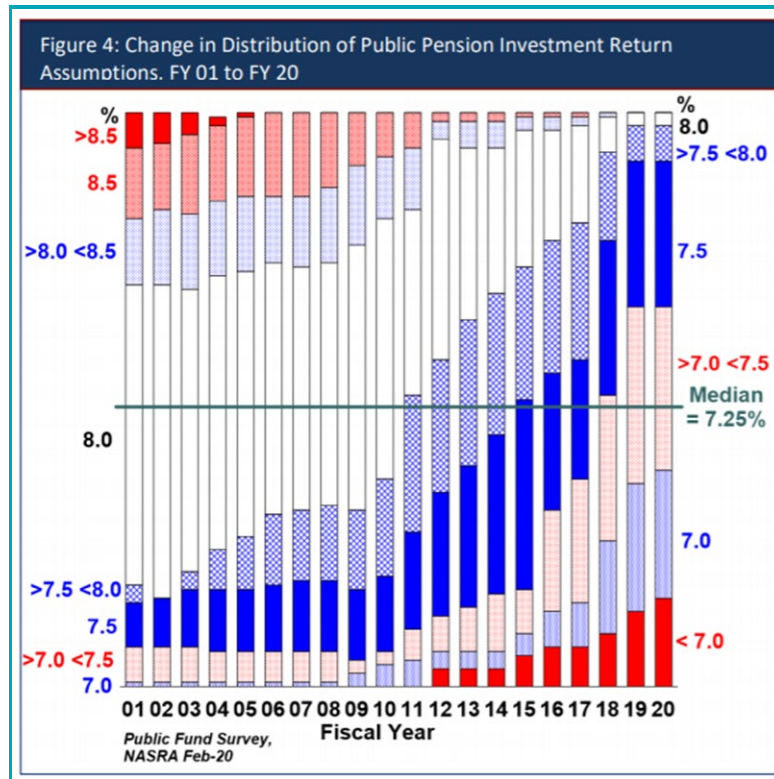
The black dot on the graph indicates PMRS’ historical discount rate compared to other public sector plans. **PMRS’ discount rate is much lower because it is used to credit the member and municipal accounts each year in the funding and calculation of the actuarial asset value without regard to the actual investment return. This is a unique feature to this system.**



**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**SECTION III – ANALYSIS OF ECONOMIC ASSUMPTIONS**

**Chart III-5**



Because PMRS is crediting a defined investment return, it is essential this assumption be considered on a regular basis in terms of the long-term risk of the assumption and the capacity of PMRS to continue to provide this level of return to its members. Although it is common to compare the discount rate to other public sector systems, **for PMRS this comparison is not as relevant as it would be for other public sector plans because very few public sector plans that credit asset accounts at the selected discount rate each year.**

C. Results

Because the discount rate is reviewed annually with the Board, as outlined above, this report does not provide a proposed future assumption.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**APPENDIX A – CURRENT ACTUARIAL ASSUMPTIONS**

**Current Actuarial Assumptions:**

The current PMRS actuarial assumptions used in this study are as follows.

**1. Healthy Life Mortality:**

**Rates of Pre-Retirement Mortality**

Males: RP-2000 Non-Annuitant Male table projected 15 years with Scale AA

Females: RP-2000 Non-Annuitant Female table projected 15 years with Scale AA, setback five years

**Rates of Post-Retirement Mortality**

Males: RP-2000 Annuitant Male table projected 5 years with Scale AA

Females: RP-2000 Annuitant Female table projected 10 years with Scale AA

Service Related Mortality: 15% for municipal plans and 50% for uniform plans

**2. Disabled Life Mortality Rates:**

Males and females: RP-2000 with 10 year set forward

**3. Termination Rates Before Retirement**

| <b>Municipal Participants<br/>Number of Active Members in<br/>Plan</b> |               |            |
|--|---------------|------------|
| <b>Service</b>   | <b>&lt;25</b> | <b>25+</b> |
| <1   | 15.0%         | 18.0%      |
| 1  | 15.0%         | 18.0%      |
| 2  | 11.0%         | 14.0%      |
| 3  | 8.0%          | 12.0%      |
| 4  | 7.0%          | 9.0%       |
| 5  | 6.0%          | 9.0%       |
| 6  | 5.5%          | 8.0%       |
| 7  | 5.5%          | 7.5%       |
| 8  | 5.5%          | 6.5%       |
| 9  | 2.5%          | 5.0%       |
| 10+  | 2.5%          | 4.0%       |

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**APPENDIX A – CURRENT ACTUARIAL ASSUMPTIONS**

| <b>Uniform Participants<br/>Number of Active Members in<br/>Plan</b> |               |            |
|--|---------------|------------|
| <b>Service</b>   | <b>&lt;25</b> | <b>25+</b> |
| <1   | 12.0%         | 13.0%      |
| 1  | 12.0%         | 10.0%      |
| 2  | 12.0%         | 7.0%       |
| 3  | 9.0%          | 7.0%       |
| 4  | 7.0%          | 6.0%       |
| 5  | 5.0%          | 5.0%       |
| 6  | 5.0%          | 4.0%       |
| 7  | 5.0%          | 3.0%       |
| 8  | 4.5%          | 3.0%       |
| 9  | 4.0%          | 3.0%       |
| 10+  | 3.0%          | 3.0%       |

**4. Disability Incidence Rates:**

**Municipal** - 40% of 1964 OASDI (Social Security) with adjustments Experience for Males.  
Sample rates are:

| <b>Age</b> | <b>Rate</b> |
|------------|-------------|
| 25         | 0.014%      |
| 35         | 0.029%      |
| 45         | 0.064%      |
| 55         | 0.134%      |
| 65         | 0.658%      |

**Uniform plans** – 60% of 1964 OASDI (Social Security) with adjustments Experience for Males. Sample rates are:

| <b>Age</b> | <b>Rate</b> |
|------------|-------------|
| 25         | 0.031%      |
| 35         | 0.058%      |
| 45         | 0.136%      |
| 55         | 0.335%      |
| 65         | 1.123%      |

Type of Disability:

- (a) 15% of disablements are assumed to be service related for municipal plans, and
- (b) 50% of disablements are assumed to be service related for uniform plans.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**APPENDIX A – CURRENT ACTUARIAL ASSUMPTIONS**

**5. Workers Compensation:** Service-related disability benefits payable from municipal plans are offset by 25% of final average salary.

**6. Salary Scale:**

| Age | Total Rate <sup>1</sup><br>(including inflation) |
|-----|--|
| 25  | 7.05%  |
| 30  | 5.44%  |
| 35  | 4.55%  |
| 40  | 4.26%  |
| 45  | 3.97%  |
| 50  | 3.72%  |
| 55  | 3.44%  |
| 60  | 3.28%  |
| 65  | 2.80%  |

<sup>1</sup>Add 2% for each of the first three years of service.

**7. Rates of Retirement:**

(a) Municipal Members:

Members are assumed to retire over a range of ages as shown below.

| Age     | Rate <sup>1</sup> |
|---------|-------------------|
| <45     | 2%                |
| 45      | 8%                |
| 46      | 10%               |
| 47 – 50 | 15%               |
| 51 – 54 | 17%               |
| 55      | 22%               |
| 56 – 59 | 14%               |
| 60 – 64 | 18%               |
| 65      | 25%               |
| 66 – 74 | 20%               |
| 75      | 100%              |

<sup>1</sup> Rates are adjusted by adding 10% for ages 61-63, 5% for ages 60 and 64-70) in the year the member is first eligible for normal retirement.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**APPENDIX A – CURRENT ACTUARIAL ASSUMPTIONS**

(b) Uniform Members:

Members are assumed to retire over a range of ages as shown below.

| Age     | Rate |
|---------|------|
| <49     | 0%   |
| 50      | 30%  |
| 51 – 54 | 10%  |
| 55      | 25%  |
| 56 – 58 | 20%  |
| 59 – 60 | 15%  |
| 61      | 20%  |
| 62      | 30%  |
| 63 – 64 | 20%  |
| 65      | 30%  |
| 66+     | 100% |

**8. Marital Status and Spouse’s Age (if applicable):** 80% of active members and are assumed to be married. Male spouses are assumed to be three years older than female spouses.

**9. Social Security Projections (if applicable):**

- (a) The Social Security Taxable Wage Base will increase by 3.3% compounded annually;
- (b) The Consumer Price Index will increase 2.8% compounded annually; and
- (c) The Average Total Wages of All Workers will increase by 3.3% compounded annually.

**10. Post-Retirement Cost of Living Increases (if applicable)/Inflation:** 2.8% per year, subject to plan limitations.

**11. Investment Return Assumption for municipal assets:** 5.25% compounded annually (net of investment and certain administration expenses) for funding purposes

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**APPENDIX B – PROPOSED ACTUARIAL ASSUMPTIONS**

**Proposed Actuarial Assumptions:**

The proposed PMRS actuarial assumptions used in this study are as follows.

**1. Healthy Life Mortality:**

**Pre-Retirement Mortality**

Males: PUB-2010 General employees’ male table projected to 2023 MP-2018

Females: PUB-2010 General employees’ female table projected to 2023 with MP-2018

**Post-Retirement Mortality**

Males: RP-2006 annuitant male table projected to 2023 with MP-2018

Females: RP-2006 annuitant female table projected to 2023 with MP-2018

Killed-in-Service Related Mortality Rates:

(a) 20% of active deaths are assumed to be service related for municipal plans

(b) 70% of active deaths are assumed to be service related for uniform plans

**2. Disabled Life Mortality Rates:**

Males: RP-2006 disabled annuitant male table projected to 2023 with MP-2018

Females: RP-2006 disabled annuitant female table projected to 2023 with MP-2018

**3. Termination Rates Before Retirement**

| Service | Municipal Plans<br>Rates Based on Number of<br>Active Members in Plan |       |
|---------|---|-------|
|         | <25   | 25+   |
| <1      | 11.0%   | 12.0% |
| 1       | 11.0%   | 12.0% |
| 2       | 10.0%   | 11.0% |
| 3       | 9.0%  | 10.0% |
| 4       | 8.0%  | 9.0%  |
| 5       | 7.0%  | 7.5%  |
| 6       | 8.0%  | 7.5%  |
| 7       | 6.0%  | 7.0%  |
| 8       | 5.0%  | 6.0%  |
| 9       | 4.0%  | 5.0%  |
| 10+     | 3.0%  | 3.5%  |

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**APPENDIX B – PROPOSED ACTUARIAL ASSUMPTIONS**

| <b>Uniform Plans</b> |                                 |
|----------------------|---------------------------------|
| <b>Service</b>       | <b>Rates for All Plan Sizes</b> |
| <1                   | 10.0%                           |
| 1                    | 10.0%                           |
| 2                    | 10.0%                           |
| 3                    | 10.0%                           |
| 4                    | 10.0%                           |
| 5                    | 5.0%                            |
| 6                    | 4.0%                            |
| 7                    | 4.0%                            |
| 8                    | 4.0%                            |
| 9                    | 3.0%                            |
| 10+                  | 3.0%                            |

**4. Disability Incidence Rates:**

40% of the 2017 CalPERS Public Miscellaneous Group disability rate table blended 70%/30% male/female. Sample rates are:

| <b>Age</b> | <b>Rate (%)</b> |
|------------|-----------------|
| 25         | 0.0085%         |
| 35         | 0.0245          |
| 45         | 0.0955          |
| 55         | 0.1105          |
| 65         | 0.1050          |

(a) Service Related Disability Rates:

- (i) 20% of disablements are assumed to be service related for municipal plans,
- (ii) 70% of disablements are assumed to be service related for uniform plans

**5. Workers Compensation:** Service-related disability benefits payable from municipal plans are offset by 25% of final average salary.

**6. Salary Scale:**

| <b>Age</b> | <b>Total Rate<sup>1</sup><br/>(inflation only)<br/>For 2021 and 2022</b> | <b>Total Rate<sup>1</sup><br/>(merit plus inflation)<br/>Years 2023+</b> |
|------------|--|--|
| 25         | 2.20%  | 6.22%  |
| 30         | 2.20%  | 5.16%  |
| 35         | 2.20%  | 4.49%  |
| 40         | 2.20%  | 4.14%  |
| 45         | 2.20%  | 3.82%  |
| 50         | 2.20%  | 3.55%  |
| 55         | 2.20%  | 3.28%  |
| 60         | 2.20%  | 3.11%  |
| 65         | 2.20%  | 2.79%  |

<sup>1</sup>Add 3% for each of the first 2 years of service, 2% for years 3 and 4, and 1% for years 5 and 6.

**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**APPENDIX B – PROPOSED ACTUARIAL ASSUMPTIONS**

**7. Rates of Retirement:**

**(a) Municipal Members:**

Members are assumed to retire over a range of ages as shown below.

| Age     | Rate <sup>1</sup> |
|---------|-------------------|
| <55     | 33%               |
| 55      | 30%               |
| 56 – 57 | 12%               |
| 58 – 59 | 14%               |
| 60      | 18%               |
| 61      | 10%               |
| 62      | 20%               |
| 63      | 18%               |
| 64      | 15%               |
| 65 – 67 | 25%               |
| 68 – 70 | 20%               |
| 71 – 73 | 22%               |
| 74      | 20%               |
| 75      | 100%              |

<sup>1</sup> Rates indicated are adjusted by adding 10% for ages 61-63 and 5% for age 64-70 under current rate assumptions, for the year in which the member is first eligible for normal retirement.

**(b) Uniform Members:**

Members are assumed to retire over a range of ages as shown below.

| Age     | Rate |
|---------|------|
| <49     | 0%   |
| 50      | 25%  |
| 51 – 53 | 10%  |
| 54 – 55 | 15%  |
| 56 – 58 | 17%  |
| 59 – 60 | 15%  |
| 61      | 20%  |
| 62      | 28%  |
| 63      | 22%  |
| 64      | 25%  |
| 65      | 35%  |
| 66      | 30%  |
| 67+     | 100% |



**PENNSYLVANIA MUNICIPAL RETIREMENT SYSTEM  
EXPERIENCE STUDY RESULTS AND RECOMMENDATIONS  
FOR THE PERIOD COVERING JANUARY 1, 2014 – DECEMBER 31, 2018**

**APPENDIX B – PROPOSED ACTUARIAL ASSUMPTIONS**

- 8. Retirement Rate increases attributable to DROP (Deferred Retirement Option Plans) or In-Service Distribution Plans (if applicable):**
- (a) 15% increase in the retirement rates for Municipal Plans
  - (b) 30% increase in the retirement rates for Uniform Plans
- 9. Marital Status and Spouse's Age (if applicable):** 85% of male active members are assumed to be married while 65% of female active members are assumed to be married. Male spouses are assumed to be three years-older than female spouses.
- 10. Social Security Projections (if applicable):**
- (a) The Social Security Taxable Wage Base will increase by 2.7% compounded annually;
  - (b) The Consumer Price Index will increase 2.2% compounded annually; and
  - (c) The Average Total Wages of All Workers will increase by 2.7% compounded annually.
- 11. Post-Retirement Cost of Living Increases (if applicable)/Inflation:** 2.2% per year, subject to plan limitations.
- 12. Investment Return Assumption for municipal assets:** 5.25% compounded annually (net of investment and certain administration expenses) for funding purposes