Celebrating 20 years

Teachers' Pension and Annuity Fund of New Jersey

Actuarial Experience Study for July 1, 2018 through June 30, 2021

Produced by Cheiron

November 2022

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November 9, 2022

Board of Trustees
Teachers' Pension and Annuity Fund of New Jersey
State of New Jersey
Department of the Treasury
Division of Pension and Benefits, CN 295
Trenton, NJ 08625-0295

Dear Board Members:

The purpose of this report is to present the Actuarial Experience Study of the Teachers' Pension and Annuity Fund of New Jersey (TPAF, the Fund) in accordance with Title 18A, Chapter 66-58 of the NJ State Statute. This Statute requires the actuary to conduct an actuarial investigation into the mortality, service and salary experience of the members and beneficiaries of the Fund at least once every three years.

This study covers the actuarial experience from July 1, 2018 through June 30, 2021. The report includes analyses and results of our study as well as recommended assumptions for consideration by the Board to be used beginning with the July 1, 2022 actuarial valuation. It also includes the estimated financial impact of these assumption changes. The prior experience study was performed by Cheiron and covered the period July 1, 2015 through June 30, 2018.

If you have any questions about the report or would like additional information, please let us know.

Sincerely,
Cheiron

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Principal Consulting Actuary

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SECTION I – EXECUTIVE SUMMARY

Actuarial assumptions (economic and demographic) are intended to be long-term in nature, and should be both individually reasonable and consistent in the aggregate. That is particularly important considering the major economic impact and consequential changes in membership behavior due to the COVID-19 pandemic which may be short term in nature. The purpose of this experience study is to evaluate whether or not the current assumptions adequately reflect the long-term expectations for TPAF, and if not, to recommend adjustments. It is important to note that frequent and significant changes in the actuarial assumptions are not typically recommended, unless there are known fundamental changes in expectations of the economy, or with respect to TPAF's membership, membership's future behavior or assets that would warrant such frequent or significant changes.

SUMMARY OF ASSUMPTION ANALYSIS

This experience study specifically analyzes and makes the following recommendations for the demographic assumptions.

- **Retirement rates** – Continue with the current assumptions.
- **Termination rates** – Modify termination rates and the percentage of members electing a deferred retirement benefit.
- **Disability rates** – Modify ordinary disability rates. Continue with current accidental disability rates.
- **Mortality rates** – Continue to use Pub-2010 base mortality tables with the same adjustment as recommended in the prior study. Update generational mortality improvement scale to MP-2021.
- **Family composition** – Modify the assumed percentage of participants that are married and the age difference between males and females based on recent experience.
- **Price and wage inflation rates –** Continue with the current assumptions.
- **Salary increase rates –** Modify rates based on recent experience and long-term inflation expectations.

The recommended changes to the assumptions in aggregate would increase the actuarial liability and Statutory contribution.

Further information about the impact of these changes to overall contribution rates can be found on the following page. We illustrate the cost impact based on the July 1, 2021 valuation results. However, assumption changes adopted by the Board will first impact the July 1, 2022 actuarial valuation.

The body of this report provides additional detail and support for our conclusions and recommendations.

SECTION I – EXECUTIVE SUMMARY

Table I-1 Cost Impact of Assumption Changes on July 1, 2021 Valuation Results				
	Current Assumptions	Recommended Assumptions	Change in $	% Change
Assets and Liabilities				
Actuarial Liability	$ 70,520,215,914	$ 70,901,466,356	$ 381,250,442	0.5%
Actuarial Value of Assets (AVA)[1]	29,103,426,597	29,103,426,597	0	0.0%
Unfunded Actuarial Liability/(Surplus)	$ 41,416,789,317	$ 41,798,039,759	$ 381,250,442	0.9%
Funded Ratio	41.3%	41.0%		-0.3%
Contribution Amounts				
Gross Normal Cost at End of Year	$ 1,425,672,143	$ 1,474,820,186	$ 49,148,043	3.4%
Expected Member Contributions	(891,517,075)	(900,293,114)	(8,776,039)	1.0%
State Normal Cost at End of Year	$ 534,155,068	$ 574,527,072	$ 40,372,004	7.6%
Amortization Payment of UAL	3,412,409,136	3,443,821,095	31,411,959	0.9%
Total Statutory Contribution for FYE	$ 3,946,564,204	$ 4,018,348,167	$ 71,783,963	1.8%

[1] Includes discounted State appropriations receivable and Lottery proceeds

The State normal cost increased 7.6% due to the recommended changes in assumptions, resulting in an increase of 1.8% in the total Statutory contribution. The increase in normal cost was primarily driven by the change in the salary increase assumption. The gross normal cost increased 3.4% due to assumption changes. Because the member contribution rate is fixed, a large portion of the increase in gross normal cost flows into the State's share of the normal cost resulting in the 7.6% increase in State normal cost.

SECTION II – CERTIFICATION

The purpose of this report is to provide the results of an Actuarial Experience Study of the Teachers' Pension and Annuity Fund of New Jersey (TPAF) covering the three-year period from July 1, 2018 through June 30, 2021. This report is for the use of the Division of Pensions and Benefits and the TPAF Board of Trustees in selecting assumptions to be used in actuarial valuations beginning July 1, 2022. This experience study was completed in accordance with the provisions of Title 18A, Chapter 66-58 of the NJ State Statute which requires periodic review of the experience of the Fund.

In preparing our report, we relied on information (some oral and some written) supplied by the Division of Pensions and Benefits. This information includes, but is not limited to, the plan provisions, employee data, and financial information. 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, Data Quality.

Cheiron utilizes ProVal, an actuarial valuation software leased from Winklevoss Technologies (WinTech) to calculate liabilities and project benefit payments. We have relied on WinTech as the developer of ProVal. We have reviewed ProVal and have a basic understanding of it and have used ProVal in accordance with its original intended purpose. We have not identified any material inconsistencies in assumptions or output of ProVal that would affect this actuarial valuation.

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.

This report was prepared for the Teachers' Pension and Annuity Fund of New Jersey for the purposes described herein. This report is not intended to benefit any other party, and Cheiron assumes no duty or liability to any such party.

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SECTION III – DEMOGRAPHIC ASSUMPTIONS

Demographic assumptions are used to predict membership behavior, including rates of retirement, termination, disability, and mortality. These assumptions are based primarily on the historical experience of TPAF, with some adjustments where future experience is expected to differ from historical experience and with deference to standard tables where TPAF experience is not fully credible, which means there is insufficient data to support an assumption, and a standard table is available.

ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS

For all of the demographic assumptions, we determined the ratio of the actual (A) number of decrements for each membership group compared to the expected (E) number of decrements (A/E ratio or actual-to-expected ratio). Generally, the goal is to get as close as possible to an A/E ratio of 100%. Appropriate assumptions are often dependent on the amount of data available, and if there is insufficient data, then the best assumption may be a reflection of standard tables. For example, there are typically relatively low incidences of pre-retirement deaths so using standard mortality tables may be more appropriate. This could result in the A/E ratio moving further away from 100%. Also, we aggregate members for demographic assumptions review when the data at individual ages is not credible. For example, we may reduce the number of service bands for an assumption with low incidences, if retaining those service bands do not materially improve the quality of the results.

We also calculate an *r-squared statistic* for each assumption. R-squared measures how well the assumption fits the actual data and can be thought of as the percentage of the variation in actual data explained by the assumption. Ideally, r-squared would equal 1.000, although this is never the case in reality. Any recommended assumption change should increase the r-squared compared to the current assumption, making it closer to 1.000, unless the pattern of future decrements is expected to be different from the pattern experienced during the period of study.

In addition, we calculate the 90% confidence interval, which represents the range within which the true decrement rate during the experience study period is expected to fall 90% of the time. In the graphs, the black squares represent the actual experience observed and the gray bars represent the 90% confidence interval around that experience. The red and green lines represent the current and recommended assumptions, respectively. When the recommended assumption is the same as the current assumption, the green line sits over the red line and the red line does not show. Where there is sufficient experience, the confidence interval is relatively narrow, and where there is little experience, the confidence interval can be very wide. We generally recommend assumption changes when the current assumption is outside the 90% confidence interval of the observed experience. However, adjustments are made to account for differences between future expectations and historical experience, to account for the past experience represented by the current assumption, and to maintain a neutral to slight conservative bias in the selection of the assumption. For mortality rates, we compare TPAF's experience to that of a standard table.

SECTION III – DEMOGRAPHIC ASSUMPTIONS

NON-CONTRIBUTING MEMBERS

The valuation census data provided by the Division of Pensions and Benefits includes non-contributing members. These members previously contributed to the Fund and, therefore, accrued benefits. However, they no longer contribute or accrue benefits. Typically, these members have terminated employment or applied for a retirement, disability, or death benefit and their paperwork was not processed in time to be reflected in the fiscal year end census data.

We reviewed the experience among members who became non-contributing members during the three-year period to determine the status reported for these non-contributing members in subsequent years. This experience was used to estimate the proportion of this population that returned to work, elected a refund of their contributions, retired, became disabled, and died.

Based on this experience, for those who became non-contributing members during the study, 30% were assumed to return to active contributing status. Of the 70% of members not assumed to return to work, 3.0% of members eligible for ordinary disability were assumed to have become ordinarily disabled, 0.5% were assumed to have died, and all others were assumed to have permanently terminated employment. Among members assumed to terminate employment, those eligible for a retirement benefit were assumed to have retired. Among members assumed to terminate employment prior to eligibility for a retirement benefit, 80% of members eligible for a deferred annuity were assumed to elect the deferred annuity and all other members were assumed to elect a refund of their contributions.

The available experience data is limited because the experience period is relatively short and some non-contributing members maintain that status for several years before electing a refund or returning to work. Therefore, we will continue to monitor this experience and may update the assumptions during the next experience study.

RETIREMENT RATES

The current retirement rates vary by tier, age and service, and are applied to all members who are eligible to retire. As a result, a member who is age 60 with 20 years of service, for example, is assumed to be less likely to retire than a member who is age 60 with 25 years of service. In reviewing the data for TPAF, we find that at many ages, members are more likely to retire once they have attained 25 years of service, and those with less than 25 years of service are less likely to retire.

TPAF is not large enough to justify assumptions for each age, service and tier combination, so we recommend assumptions by service groups separately for Tiers 1-4 and for Tier 5. The actual results shown on the following pages reflect eligible members and retirements in all five tiers.

We did not show results separately by tier because very few members in Tiers 2 through 5 are eligible for retirement. As of June 30, 2021, members in Tiers 2 through 5 can only retire under a service retirement allowance since they do not have sufficient service to meet early retirement eligibility. In addition, Tiers 2 through 4 are closed to new members so there likely will not be significant experience for these tiers. Due to these limited exposures for Tiers 2 through 5, the current assumed rates shown on the following pages are based only on the current Tier 1 retirement rates.

We recommend separate retirement rates for Tier 5 because Tier 5 members need 30 years of service to retire early whereas Tiers 1 through 4 only require 25 years of service to retire early. The recommended retirement rates for Tier 5 members are based on professional judgement due to limited experience.

We recommend separate assumptions for the following service groups and tiers:

Tiers 1-4 Members

- Members with less than 25 years of service,
- Members with 25 years of service, and
- Members with 26 or more years of service.

Tier 5 Members

- Members with less than 25 years of service,
- Members with 25 years of service,
- Members with 26 to 29 years of service,
- Members with 30 years of service, and
- Members with 31 or more years of service.

SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES

In Table III-R1 we show the calculation of actual-to-expected ratios and the r-squared statistic for Tier 1-5 members with less than 25 years of service, and Chart III-R1 shows the information graphically along with the 90% confidence interval. For retirements with less than 25 years of service, we recommend continuing with the current assumption.

Table III-R1

Tiers 1-5 Retirement Rates For Less than 25 Years of Service								
		Retirements			Retirement Rates			A/E Ratios	
Age	Exposures	Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
60	4,094	190	163.8	163.8	4.6%	4.0%	4.0%	116%	116%
61	3,926	201	235.6	235.6	5.1%	6.0%	6.0%	85%	85%
62	3,850	249	231.0	231.0	6.5%	6.0%	6.0%	108%	108%
63	3,495	257	279.6	279.6	7.4%	8.0%	8.0%	92%	92%
64	3,031	215	242.5	242.5	7.1%	8.0%	8.0%	89%	89%
65	2,785	338	334.2	334.2	12.1%	12.0%	12.0%	101%	101%
66	2,185	393	393.3	393.3	18.0%	18.0%	18.0%	100%	100%
67	1,566	310	281.9	281.9	19.8%	18.0%	18.0%	110%	110%
68	1,116	199	200.9	200.9	17.8%	18.0%	18.0%	99%	99%
69	831	143	149.6	149.6	17.2%	18.0%	18.0%	95%	95%
70	587	101	105.7	105.7	17.2%	18.0%	18.0%	95%	95%
71	394	89	70.9	70.9	22.5%	18.0%	18.0%	125%	125%
72	267	44	48.1	48.1	16.3%	18.0%	18.0%	91%	91%
73	175	30	31.5	31.5	17.4%	18.0%	18.0%	96%	96%
74	123	20	22.1	22.1	16.6%	18.0%	18.0%	92%	92%
Total	**28,425**	**2,777**	**2,790.5**	**2,790.5**	**9.8%**	**9.8%**	**9.8%**	**100%**	**100%**
R-squared			**0.974**	**0.974**					

Chart III-R1

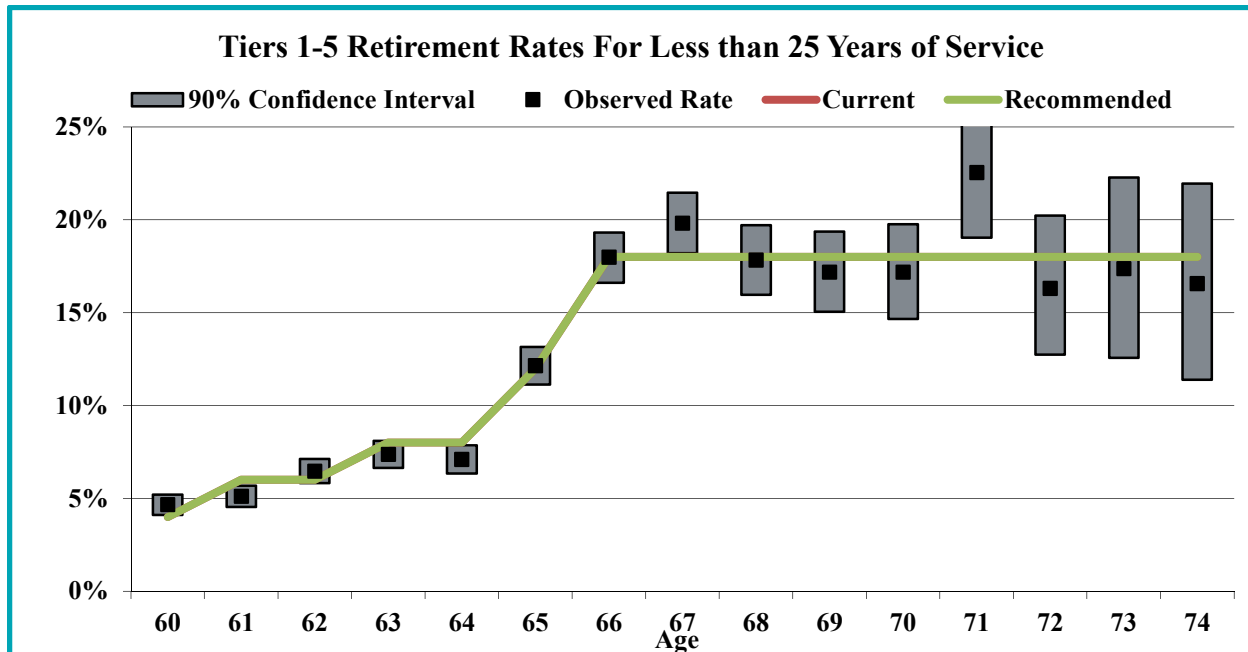Tiers 1-5 Retirement Rates For Less than 25 Years of Service

SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES

Table III-R2 shows the calculation of actual-to-expected ratios and the r-squared statistic for members with 25 years of service, and Chart III-R2 shows the information graphically along with the 90% confidence interval. For retirements with 25 years of service, we recommend continuing with the current assumption.
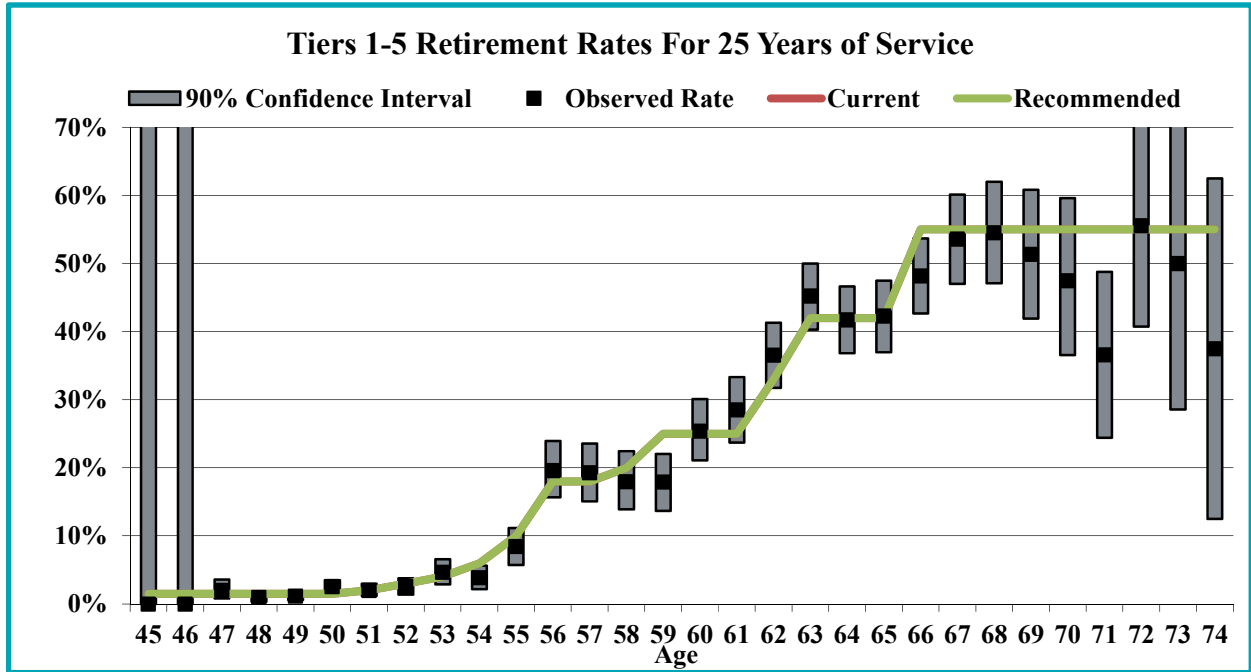
Table III-R2

		Retirements			Retirement Rates			A/E Ratios	
Tiers 1-5 Retirement Rates For 25 Years of Service									
Age	**Exposures**	**Actual**	**Current**	**Recommended**	**Actual**	**Current**	**Recommended**	**Current**	**Recommended**
45	8	0	0.1	0.1	0.0%	1.5%	1.5%	0%	0%
46	15	0	0.2	0.2	0.0%	1.5%	1.5%	0%	0%
47	251	5	3.8	3.8	2.0%	1.5%	1.5%	133%	133%
48	622	6	9.3	9.3	1.0%	1.5%	1.5%	65%	65%
49	869	10	13.0	13.0	1.2%	1.5%	1.5%	77%	77%
50	801	20	12.0	12.0	2.5%	1.5%	1.5%	170%	170%
51	675	13	13.5	13.5	2.0%	2.0%	2.0%	99%	99%
52	503	13	15.1	15.1	2.6%	3.0%	3.0%	86%	86%
53	381	18	15.2	15.2	4.6%	4.0%	4.0%	116%	116%
54	319	12	19.1	19.1	3.9%	6.0%	6.0%	65%	65%
55	296	25	29.6	29.6	8.4%	10.0%	10.0%	84%	84%
56	255	50	45.9	45.9	19.6%	18.0%	18.0%	109%	109%
57	246	47	44.3	44.3	19.2%	18.0%	18.0%	107%	107%
58	223	40	44.6	44.6	17.9%	20.0%	20.0%	90%	90%
59	227	41	56.8	56.8	17.9%	25.0%	25.0%	72%	72%
60	256	65	64.0	64.0	25.4%	25.0%	25.0%	102%	102%
61	249	71	62.3	62.3	28.5%	25.0%	25.0%	114%	114%
62	271	99	89.4	89.4	36.5%	33.0%	33.0%	111%	111%
63	278	126	116.8	116.8	45.2%	42.0%	42.0%	108%	108%
64	266	111	111.7	111.7	41.7%	42.0%	42.0%	99%	99%
65	238	101	100.0	100.0	42.3%	42.0%	42.0%	101%	101%
66	218	105	119.9	119.9	48.2%	55.0%	55.0%	88%	88%
67	168	90	92.4	92.4	53.6%	55.0%	55.0%	97%	97%
68	121	66	66.6	66.6	54.5%	55.0%	55.0%	99%	99%
69	74	38	40.7	40.7	51.4%	55.0%	55.0%	93%	93%
70	52	25	28.6	28.6	47.5%	55.0%	55.0%	86%	86%
71	41	15	22.6	22.6	36.6%	55.0%	55.0%	67%	67%
72	27	15	14.9	14.9	55.6%	55.0%	55.0%	101%	101%
73	14	7	7.7	7.7	50.0%	55.0%	55.0%	91%	91%
74	8	3	4.4	4.4	37.5%	55.0%	55.0%	68%	68%
Total	**7,972**	**1,237**	**1,264.4**	**1,264.4**	**15.5%**	**15.9%**	**15.9%**	**98%**	**98%**
R-squared			**0.976**	**0.976**					

SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES

Chart III-R2

Tiers 1-5 Retirement Rates For 25 Years of Service

SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES

Table III-R3 shows the calculation of actual-to-expected ratios and the r-squared statistic for members with 26 or more years of service, and Chart III-R3 shows the information graphically along with the 90% confidence interval. For retirements with 26 or more years of service, we recommend continuing with the current assumption.

Table III-R3

		Retirements			Retirement Rates			A/E Ratios	
Age	Exposures	Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
45	8	0	0.1	0.1	0.0%	1.5%	1.5%	0%	0%
46	9	0	0.1	0.1	0.0%	1.5%	1.5%	0%	0%
47	25	1	0.4	0.4	4.0%	1.5%	1.5%	267%	267%
48	268	3	4.0	4.0	1.1%	1.5%	1.5%	75%	75%
49	870	9	13.1	13.1	1.0%	1.5%	1.5%	66%	66%
50	1,659	30	24.9	24.9	1.8%	1.5%	1.5%	119%	119%
51	2,186	27	43.7	43.7	1.2%	2.0%	2.0%	62%	62%
52	2,452	59	61.3	61.3	2.4%	2.5%	2.5%	97%	97%
53	2,591	94	77.7	77.7	3.6%	3.0%	3.0%	121%	121%
54	2,722	107	95.3	95.3	3.9%	3.5%	3.5%	112%	112%
55	2,868	391	372.8	372.8	13.6%	13.0%	13.0%	105%	105%
56	2,715	523	461.6	461.6	19.3%	17.0%	17.0%	113%	113%
57	2,441	418	415.0	415.0	17.1%	17.0%	17.0%	101%	101%
58	2,263	382	384.7	384.7	16.9%	17.0%	17.0%	99%	99%
59	2,180	408	370.6	370.6	18.7%	17.0%	17.0%	110%	110%
60	2,044	411	408.8	408.8	20.1%	20.0%	20.0%	101%	101%
61	1,923	425	423.1	423.1	22.1%	22.0%	22.0%	100%	100%
62	1,852	531	500.0	500.0	28.7%	27.0%	27.0%	106%	106%
63	1,691	498	507.3	507.3	29.5%	30.0%	30.0%	98%	98%
64	1,517	420	455.1	455.1	27.7%	30.0%	30.0%	92%	92%
65	1,342	398	402.6	402.6	29.6%	30.0%	30.0%	99%	99%
66	1,211	444	423.9	423.9	36.7%	35.0%	35.0%	105%	105%
67	972	343	388.8	388.8	35.3%	40.0%	40.0%	88%	88%
68	742	251	222.6	222.6	33.8%	30.0%	30.0%	113%	113%
69	554	151	166.2	166.2	27.3%	30.0%	30.0%	91%	91%
70	450	127	135.0	135.0	28.2%	30.0%	30.0%	94%	94%
71	359	108	107.7	107.7	30.1%	30.0%	30.0%	100%	100%
72	259	71	77.7	77.7	27.4%	30.0%	30.0%	91%	91%
73	169	48	50.7	50.7	28.4%	30.0%	30.0%	95%	95%
74	111	32	33.3	33.3	28.5%	30.0%	30.0%	95%	95%
Total	**40,453**	**6,707**	**6,628.0**	**6,628.0**	**16.6%**	**16.4%**	**16.4%**	**101%**	**101%**
R-squared			**0.989**	**0.989**					

SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES

Chart III-R3

Tiers 1-5 Retirement Rates For 26 or More Years of Service
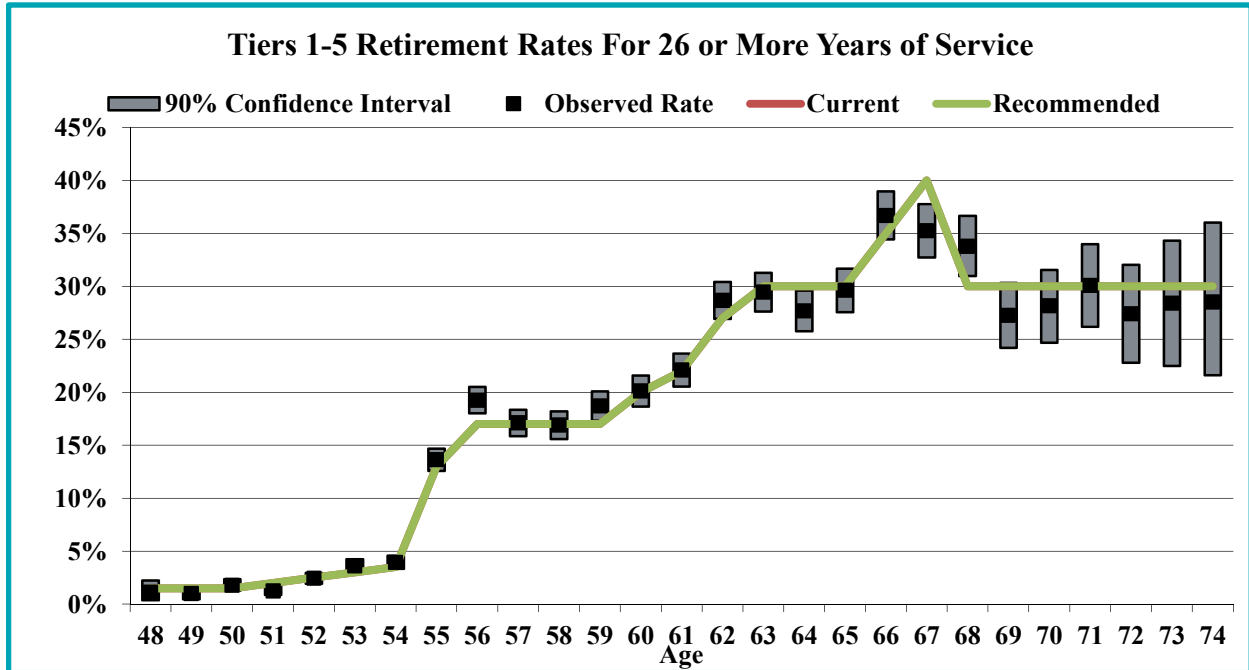
There is insufficient data to show tables and charts for Tier 5 members separately. The recommended Tier 5 specific retirement rates are shown in Appendix A.

SECTION III – DEMOGRAPHIC ASSUMPTIONS
TERMINATION RATES

Termination rates reflect the frequency at which active members leave employment for reasons other than retirement, death, or disability. Table III-T1 shows the number of terminations, our recommended termination rates based on years of service, the calculation of actual-to-expected ratios for each year of service and the r-squared statistic. Chart III-T1 shows the information graphically along with the 90% confidence interval. We recommend lowering the termination rates at most service thresholds.

Table III-T1

| | | Terminations | | | Termination Rates | | | A/E Ratios | |
Service	Exposures	Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
1	19,437	1,285	1,360.6	1,312.0	6.61%	7.00%	6.75%	94%	98%
2	18,901	1,038	1,181.3	1,039.6	5.49%	6.25%	5.50%	88%	100%
3	18,161	814	998.9	817.2	4.48%	5.50%	4.50%	82%	100%
4	18,306	710	778.0	732.2	3.88%	4.25%	4.00%	91%	97%
5	17,992	555	674.7	539.8	3.09%	3.75%	3.00%	82%	103%
6	17,210	474	559.3	473.3	2.75%	3.25%	2.75%	85%	100%
7	15,814	388	474.4	395.4	2.45%	3.00%	2.50%	82%	98%
8	13,361	328	334.0	334.0	2.45%	2.50%	2.50%	98%	98%
9	12,352	246	308.8	277.9	1.99%	2.50%	2.25%	80%	88%
10	12,592	277	283.3	283.3	2.20%	2.25%	2.25%	98%	98%
11	14,564	304	320.4	305.8	2.08%	2.20%	2.10%	95%	99%
12	15,551	307	303.2	303.2	1.97%	1.95%	1.95%	101%	101%
13	16,057	252	273.0	264.9	1.57%	1.70%	1.65%	92%	95%
14	16,393	218	229.5	221.3	1.33%	1.40%	1.35%	95%	99%
15	16,301	168	195.6	171.2	1.03%	1.20%	1.05%	86%	98%
16	16,031	155	160.3	160.3	0.97%	1.00%	1.00%	97%	97%
17	15,984	147	143.9	143.9	0.92%	0.90%	0.90%	102%	102%
18	15,898	108	143.1	111.3	0.68%	0.90%	0.70%	75%	97%
19	15,220	85	106.5	83.7	0.56%	0.70%	0.55%	80%	102%
20	13,317	74	73.2	73.2	0.56%	0.55%	0.55%	102%	102%
21	11,469	57	63.1	57.3	0.49%	0.55%	0.50%	90%	99%
22	9,267	33	51.0	37.1	0.35%	0.55%	0.40%	64%	88%
23	7,636	21	30.5	22.9	0.27%	0.40%	0.30%	69%	91%
24	6,374	19	19.1	19.1	0.30%	0.30%	0.30%	98%	98%
Total	**354,188**	**8,063**	**9,065.8**	**8,180.0**	**2.28%**	**2.56%**	**2.31%**	**89%**	**99%**
R-squared		**0.992**	**0.999**						

SECTION III – DEMOGRAPHIC ASSUMPTIONS
TERMINATION RATES

Chart III-T1
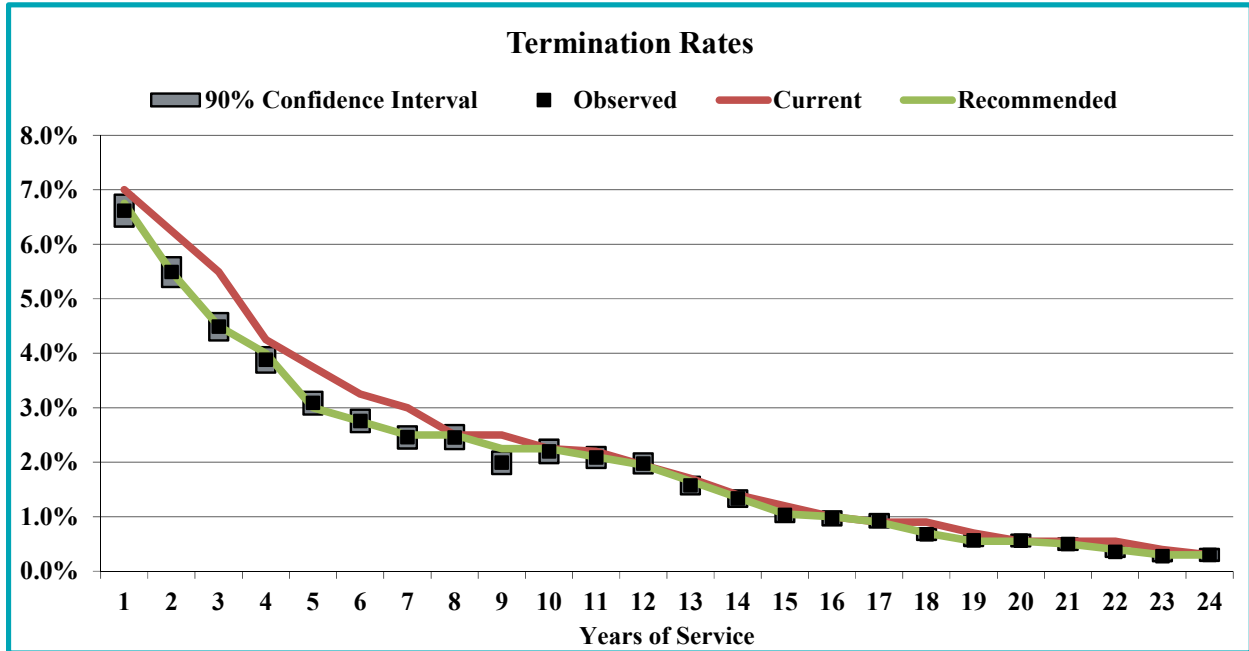
The current assumption is that all members who terminate employment with less than 10 years of service are assumed to elect a refund of contributions. 67% of members with 10 or more years of service are assumed to elect deferred annuities. Of the 2,225 members who terminated employment with 10 or more years of service in the three-year experience study period, 1,590 elected a deferred annuity and 635 elected a refund of contributions. We recommend that 70% of members terminating with 10 or more years of service are assumed to elect a deferred annuity; all other members terminating are assumed to receive a refund of accumulated deductions with credited interest.

SECTION III – DEMOGRAPHIC ASSUMPTIONS
DISABILITY RATES

Table III-D1 shows the calculation of actual-to-expected ratios and the r-squared statistic for accidental disability. The experience shows very low incidence of accidental disability and therefore we recommend continuing with the current assumption.

Table III-D1

| Age Band	Exposures	Disabilities			Disability Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
25 - 29	12	0	0.0	0.0	0.000%	0.006%	0.006%	0%	0%
30 - 34	9,191	0	0.6	0.6	0.000%	0.006%	0.006%	0%	0%
35 - 39	46,474	1	2.8	2.8	0.002%	0.006%	0.006%	36%	36%
40 - 44	58,817	2	3.5	3.5	0.003%	0.006%	0.006%	57%	57%
45 - 49	54,320	2	3.3	3.3	0.004%	0.006%	0.006%	61%	61%
50 - 54	47,635	3	2.9	2.9	0.006%	0.006%	0.006%	105%	105%
55 - 59	39,718	3	2.4	2.4	0.008%	0.006%	0.006%	126%	126%
60 - 64	30,665	7	1.8	1.8	0.023%	0.006%	0.006%	380%	380%
65 - 69	14,223	4	0.9	0.9	0.028%	0.006%	0.006%	469%	469%
Total	**301,055**	**22**	**18.1**	**18.1**	**0.007%**	**0.006%**	**0.006%**	**122%**	**122%**
R-squared			**0.018**	**0.018**					

SECTION III – DEMOGRAPHIC ASSUMPTIONS
DISABILITY RATES

Table III-D2 shows the calculation of actual-to-expected ratios and the r-squared statistic for ordinary disability, and Chart III-D2 shows the information graphically along with the 90% confidence interval. We recommend lowering the rates for most ages.

Table III-D2

Age Band	Exposures	Disabilities			Disability Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
30 - 34	6,139	6	1.6	1.6	0.091%	0.026%	0.026%	353%	353%
35 - 39	43,335	34	27.2	27.2	0.078%	0.063%	0.063%	125%	125%
40 - 44	57,544	42	63.2	54.0	0.073%	0.110%	0.094%	66%	78%
45 - 49	53,295	65	85.3	68.3	0.121%	0.160%	0.128%	76%	95%
50 - 54	46,590	74	110.6	88.5	0.158%	0.237%	0.190%	67%	83%
55 - 59	25,192	94	123.0	86.1	0.372%	0.488%	0.342%	76%	109%
60 - 64	19,754	92	168.7	106.2	0.466%	0.854%	0.538%	55%	87%
65 - 69	8,112	64	101.3	60.7	0.783%	1.248%	0.748%	63%	105%
Total	**259,961**	**469**	**680.9**	**492.6**	**0.180%**	**0.262%**	**0.189%**	**69%**	**95%**
R-squared			**0.727**	**0.763**					

Chart III-D2
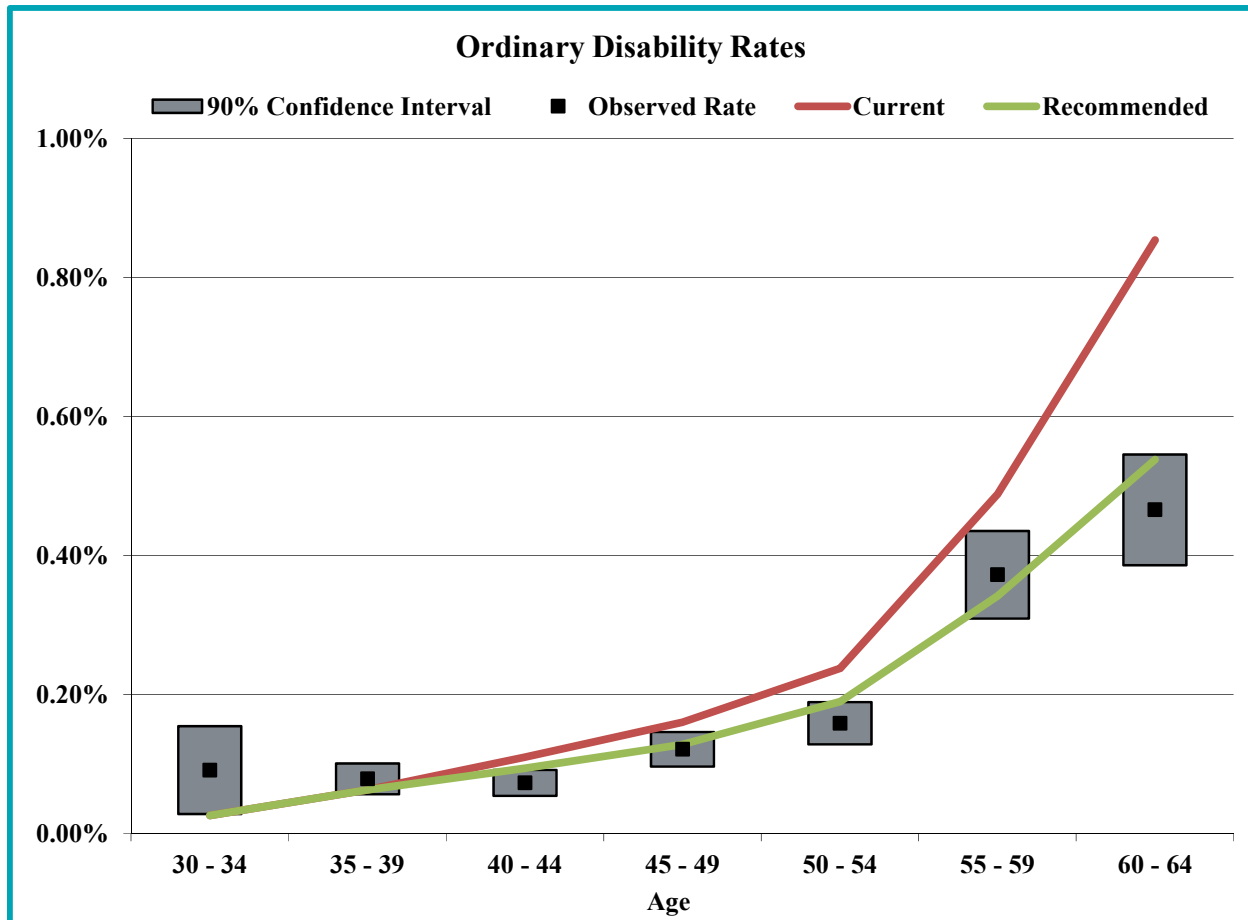
SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Mortality assumptions are typically developed separately by gender. Unlike most of the other demographic assumptions that rely exclusively on the experience of the plan, for mortality, standard mortality tables and projection scales, reflecting future life expectancy improvements, serve as the primary basis for the assumption which is then modified to better reflect the Fund's experience.

The Society of Actuaries (SOA) completed an extensive mortality study of public pension plan experience and issued a set of mortality tables named the Pub-2010 mortality tables which provide insights into the composition of gender-specific pension mortality by factors such as job category (e.g. General Employees, Teachers, Public Safety), salary/benefit amount, health status (e.g. healthy or disabled), geographic region and duration since event.

In addition, there has been a long history of mortality improvement among pensioners in the U.S., and there is an expectation that mortality rates will continue to improve in the future. The SOA annually publishes a mortality improvement scale that reflects continued mortality improvement trends. The SOA's MP-2021 scale is the most recent mortality improvement projection scale at the time this analysis was prepared. However, the MP-2021 scale reflects historical mortality data through calendar year 2019. The COVID-19 pandemic may have caused a temporary change in mortality patterns.

The steps in our analysis of the mortality assumptions are as follows:

1.   Select a standard mortality table that reflects the anticipated experience of the Fund.
2.   Compare actual experience of the Fund to what would have been predicted by the selected standard table for the period of the experience study.
3.   Adjust the standard table either fully or partially depending on the level of credibility for the Fund's experience. This adjusted table is called the base table.
4.   Select an appropriate standard mortality improvement projection scale and apply it to the base table.

Similar to the methodology used to develop the Pub-2010 tables, when actual experience of the Fund is compared to that of the standard table, the experience is weighted based on the amount of income (salary for pre-retirement mortality and pension benefit for post-retirement mortality). Mortality studies in the U.S. have consistently shown that individuals with higher salaries if active or higher benefit income if retired, have longer life expectancies than individuals with lower income. It is important for a pension plan to use assumptions that are weighted by income to reflect not just the incidence of a decrement but the impact on liabilities.

SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

In the prior study, TPAF adopted the following assumptions:

Active members (Non-Annuitants): The Pub-2010 Teachers Above-Median Income Employee mortality table *[PubT-2010(A) Employee]* as published by the Society of Actuaries with a 93.9% adjustment for males and 85.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018. All pre-retirement deaths are assumed to be ordinary deaths.

Healthy retirees and beneficiaries (Healthy Annuitants): The Pub-2010 Teachers Above-Median Income Healthy Retiree mortality table *[PubT-2010(A) Healthy Retiree]* as published by the Society of Actuaries with a 114.7% adjustment for males and 99.6% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

Disabled retirees (Disabled Annuitants): The Pub-2010 Non-Safety Disabled Retiree mortality table *[PubNS-2010 Disabled Retiree]* as published by the Society of Actuaries with a 106.3% adjustment for males and 100.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

There are enough deaths for TPAF to provide meaningful statistics in the three-year period. For healthy annuitants, there were 8,285 deaths over this period, for disabled retirees there were 424 deaths, and for active members there were 282 deaths. For reference, a fully credible sample would include 1,082 deaths. We therefore recommend continuing to use the same standard Pub-2010 table for teachers, with the same adjustments from the prior experience study to account for TPAF experience.

We note that the recommended tables do not always match the experience as well as in the prior experience study. However, the COVID-19 pandemic may have caused a temporary change in mortality patterns. Future mortality experience may be more similar to experience in the prior study.

We recommend no changes to the base mortality tables and updating the mortality improvement scale from MP-2018 to MP-2021 as described below:

Active members (Non-Annuitants): The Pub-2010 Teachers Above-Median Income Employee mortality table *[PubT-2010(A) Employee]* as published by the Society of Actuaries with a 93.9% adjustment for males and 85.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2021. All pre-retirement deaths are assumed to be ordinary deaths.

SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Healthy retirees and beneficiaries (Healthy Annuitants): The Pub-2010 Teachers Above-Median Income Healthy Retiree mortality table *[PubT-2010(A) Healthy Retiree]* as published by the Society of Actuaries with a 114.7% adjustment for males and 99.6% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2021.

Disabled retirees (Disabled Annuitants): The Pub-2010 Non-Safety Disabled Retiree mortality table *[PubNS-2010 Disabled Retiree]* as published by the Society of Actuaries with a 106.3% adjustment for males and 100.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2021.
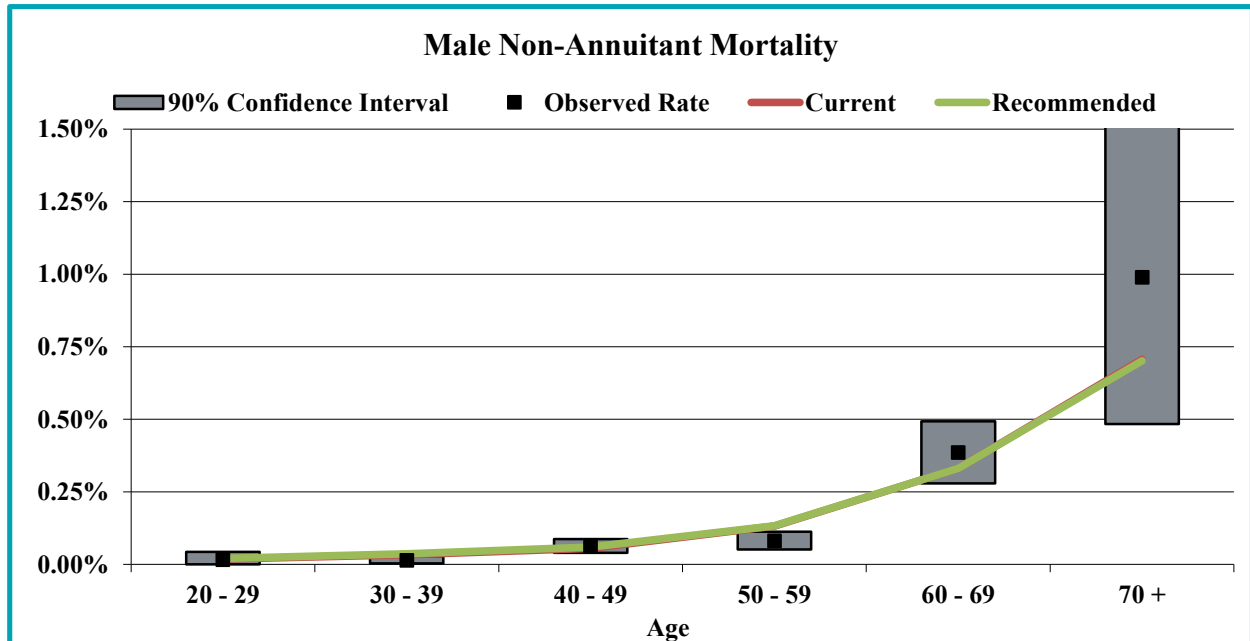
SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M1 – Active Males

Non-Annuitant Mortality - Base Table for Males								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratio	
				Actual	Current	Recommended	Current	Recommended
20 - 29	6,845	1	382,138,354	61,116	73,401	78,059	83%	78%
30 - 39	27,640	4	1,854,518,134	269,243	616,983	671,542	44%	40%
40 - 49	32,075	20	2,867,343,699	1,824,421	1,596,777	1,698,802	114%	107%
50 - 59	21,302	19	2,068,659,614	1,681,698	2,732,263	2,756,961	62%	61%
60 - 69	9,319	36	904,585,549	3,487,232	2,996,911	2,995,857	116%	116%
70 +	1,033	9	108,765,865	1,075,785	768,528	762,893	140%	141%
Total	**98,214**	**89**	**8,186,011,215**	**8,399,496**	**8,784,862**	**8,964,114**	**96%**	**94%**
R-Squared					**0.361**	**0.358**		

Chart III-M1

SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M2 – Active Females

				Weighted Deaths			A/E Ratio	
Non-Annuitant Mortality - Base Table for Females								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Actual	Current	Recommended	Current	Recommended
20 - 29	31,865	6	1,788,051,217	324,161	186,436	198,528	174%	163%
30 - 39	95,259	29	6,204,089,278	1,818,782	1,250,972	1,316,006	145%	138%
40 - 49	96,946	30	7,878,200,272	2,313,910	2,939,481	2,921,382	79%	79%
50 - 59	70,718	54	6,098,362,971	4,794,668	5,122,598	4,986,521	94%	96%
60 - 69	35,940	62	3,251,374,827	5,521,649	5,954,994	5,929,535	93%	93%
70 +	2,483	12	241,923,280	1,157,222	1,149,113	1,136,383	101%	102%
Total	**333,211**	**193**	**25,462,001,845**	**15,930,392**	**16,603,594**	**16,488,355**	**96%**	**97%**
R-Squared					**0.682**	**0.683**		

Chart III-M2

Chart III-M2 – Female Non-Annuitant Mortality
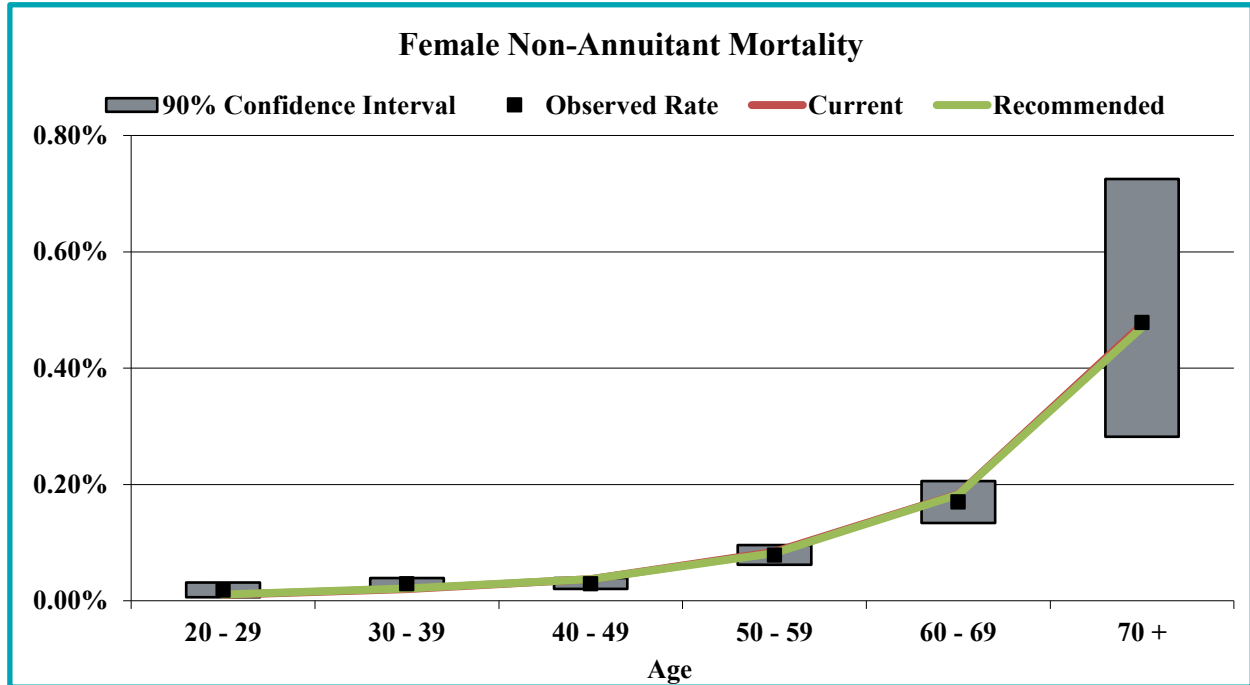
During the three-year period, there were 282 deaths in active service. Of these deaths, none were accidental. We recommend maintaining the assumption that all pre-retirement deaths are ordinary deaths.
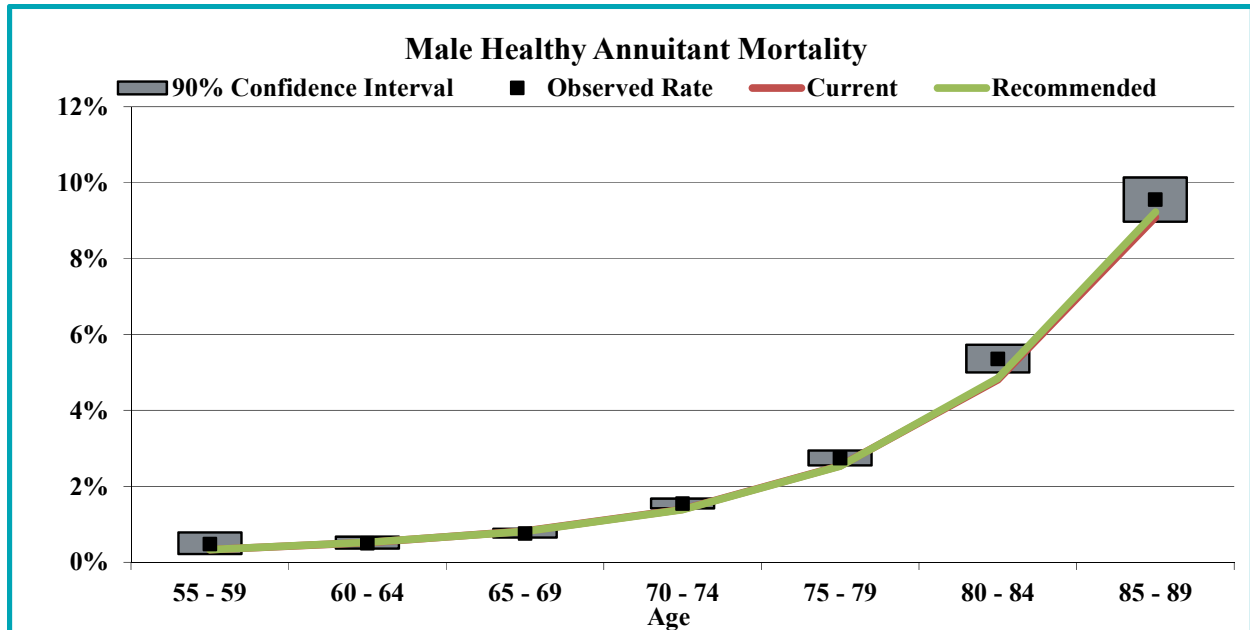
SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M3 – Healthy Annuitant Males

Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths Actual	Current	Recommended	A/E Ratios Current	Recommended
55 - 59	1,402	10	66,179,268	319,968	218,641	219,478	146%	146%
60 - 64	5,344	29	258,922,474	1,296,838	1,344,147	1,347,104	96%	96%
65 - 69	14,767	128	715,626,282	5,461,254	5,867,079	5,833,532	93%	94%
70 - 74	25,764	434	1,233,850,514	19,063,419	17,176,296	17,021,775	111%	112%
75 - 79	18,784	545	857,866,887	23,553,579	21,744,638	21,710,770	108%	108%
80 - 84	10,358	563	453,965,723	24,343,964	21,810,681	21,983,248	112%	111%
85 - 89	6,875	676	283,871,956	27,128,218	25,803,753	26,179,037	105%	104%
90 - 94	3,032	556	109,074,185	19,671,755	17,274,719	17,592,239	114%	112%
95 +	633	188	18,031,970	5,209,866	4,732,143	4,818,794	110%	108%
Total	**86,959**	**3,129**	**3,997,389,259**	**126,048,861**	**115,972,098**	**116,705,978**	**109%**	**108%**
R-Squared					**0.965**	**0.965**		

Chart III-M3

Male Healthy Annuitant Mortality

SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M4 – Healthy Annuitant Females

Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	**Current**	**Recommended**	**Current**	**Recommended**
55 - 59	5,354	12	252,977,740	460,327	635,412	624,649	72%	74%
60 - 64	19,893	84	864,885,268	3,417,848	3,078,190	3,073,515	111%	111%
65 - 69	48,934	291	2,111,755,841	12,484,727	11,094,627	10,985,829	113%	114%
70 - 74	60,582	557	2,533,339,682	23,247,652	22,441,119	22,158,610	104%	105%
75 - 79	37,900	654	1,477,878,084	25,346,281	25,048,887	24,924,706	101%	102%
80 - 84	21,434	755	771,219,780	26,635,926	25,542,813	25,588,950	104%	104%
85 - 89	14,093	1,030	457,911,290	33,663,448	28,905,222	29,155,896	116%	115%
90 - 94	8,347	1,119	229,708,430	30,039,427	25,990,705	26,359,951	116%	114%
95 +	2,787	654	59,780,586	13,677,642	11,954,470	12,113,366	114%	113%
Total	**219,324**	**5,156**	**8,759,456,701**	**168,973,278**	**154,691,444**	**154,985,473**	**109%**	**109%**
R-Squared					0.970	0.973		

Chart III-M4
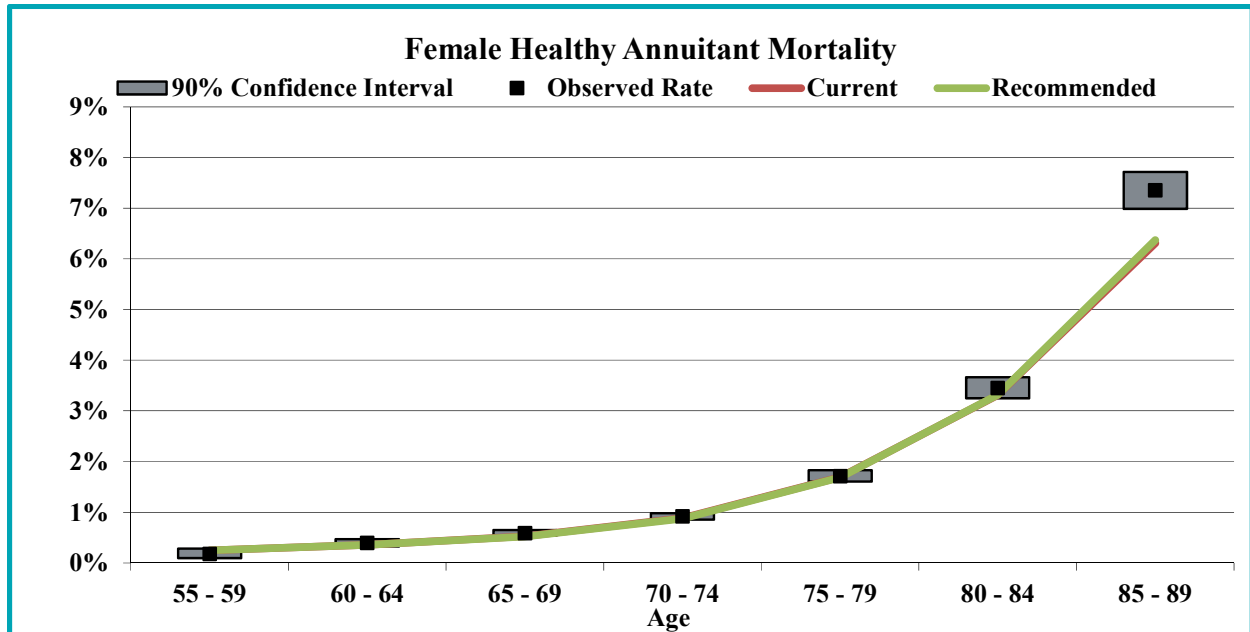
SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M5 – Disabled Annuitant Males

Disabled Annuitant Mortality - Base Table for Males								
Age		Actual	Weighted	Weighted Deaths			A/E Ratios	
Band	Exposures	Deaths	Exposures	Actual	Current	Recommended	Current	Recommended
35 - 44	49	0	1,446,162	0	12,409	13,446	0%	0%
45 - 54	198	4	6,294,492	159,656	104,513	106,689	153%	150%
55 - 64	466	13	15,191,114	442,520	419,933	421,142	105%	105%
65 - 74	988	48	30,074,003	1,403,543	1,179,726	1,170,967	119%	120%
75 - 84	462	40	12,883,421	1,016,161	828,507	830,002	123%	122%
85 +	93	17	1,826,302	377,586	265,891	270,145	142%	140%
Total	**2,256**	**122**	**67,715,494**	**3,399,466**	**2,810,979**	**2,812,390**	**121%**	**121%**
R-Squared					0.613	0.613		

Chart III-M5
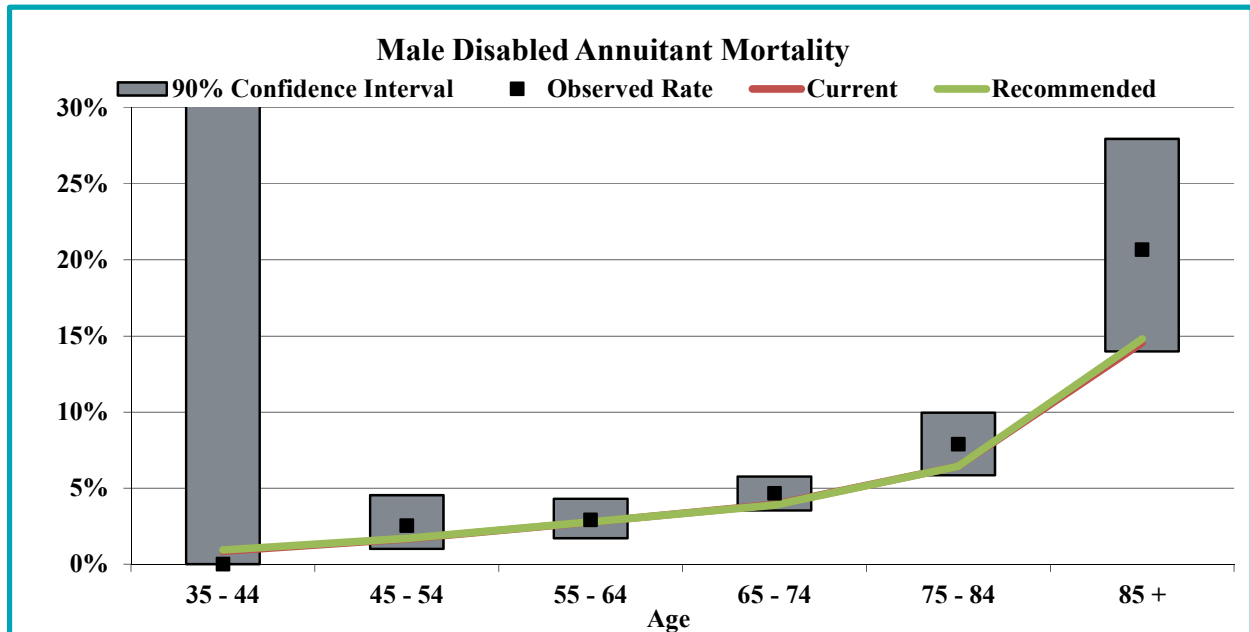
SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M6 – Disabled Annuitant Females

Disabled Annuitant Mortality - Base Table for Females								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
35 - 44	192	5	5,224,989	115,489	40,457	40,899	285%	282%
45 - 54	792	18	24,604,324	485,336	351,692	341,438	138%	142%
55 - 64	2,101	43	66,511,985	1,321,894	1,367,441	1,356,821	97%	97%
65 - 74	3,559	100	109,345,541	2,986,004	2,841,931	2,810,947	105%	106%
75 - 84	1,766	82	48,839,663	2,250,322	2,465,115	2,459,647	91%	91%
85 +	377	54	8,473,207	1,146,442	979,889	989,930	117%	116%
Total	**8,787**	**302**	**262,999,709**	**8,305,487**	**8,046,525**	**7,999,683**	**103%**	**104%**
R-Squared					0.732	0.731		

Chart III-M6
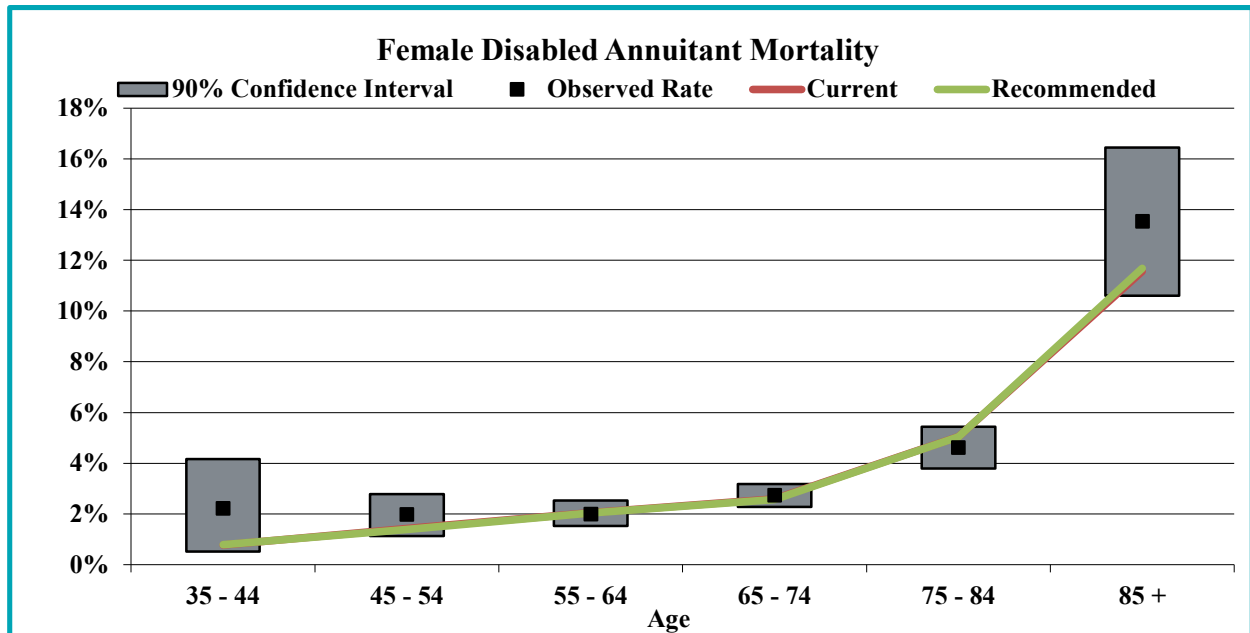
Female Disabled Annuitant Mortality

SECTION III – DEMOGRAPHIC ASSUMPTIONS
FAMILY COMPOSITION

In the event of a member death, pension benefits may extend to a surviving spouse. Spousal demographic information is important in determining the value of their potential future benefit. However, marital information is not always readily available. In the case of an unmarried active member, they could marry before commencing benefits. Even married retirees are sometimes reported without a beneficiary date of birth. With this uncertainty, we make assumptions regarding the frequency with which participants are married at the time of benefit commencement as well as the age difference between the retirees and their spouses.

We currently assume the following:

- For members not currently receiving a benefit, 100% of members are assumed married to spouses of the opposite sex.
- Males are assumed to be three years older than females.

Based on healthy and disabled retirees that have commenced benefits between July 1, 2018 and June 30, 2021, approximately 49.7% are married with males being older than females by an average of 1.9 years. For purposes of determining the percent married, we assumed that all retirees reported with a beneficiary date of birth are married.

As a result, we recommend the following:

- The percent married assumption is reduced from 100% to 60%.
- The age difference between males and females is reduced from three years to two years.

SECTION IV – ECONOMIC ASSUMPTIONS

The economic assumptions used in actuarial valuations are intended to be long-term in nature and should be both individually reasonable and consistent with each other. The specific assumptions analyzed in this report are:

- **Price inflation** – used to project increases in the 401(a)(17) pay limit and to determine Local employer Early Retirement Incentive Program (ERI) payments for those Local employers who elected to amortize their ERI liability as a level percent of payroll. This assumption is also used indirectly as an underlying component of other economic assumptions.
- **Wage inflation** – across the board wage growth which is used to project the Social Security Wage Base.
- **Salary increase rate** – used to project expected increases in pay for active members in determining liabilities and costs of the Fund.

We have not studied the investment rate of return assumption since that assumption is set by the NJ State Treasurer.

In order to develop recommendations for each of these assumptions, we considered historical data, both nationally and for the Fund, expectations for the future and assumptions used by other public sector plans.

PRICE INFLATION

Long-term price inflation rates are the foundation of other economic assumptions. In a growing economy, wages and investments are expected to grow at the underlying inflation rate plus an additional real growth rate, whether it reflects productivity in terms of wages, or risk premiums in terms of investments.

Historical Data

Chart IV-1 below shows inflation based on CPI-U for the U.S. by individual year from 1950 through 2022.
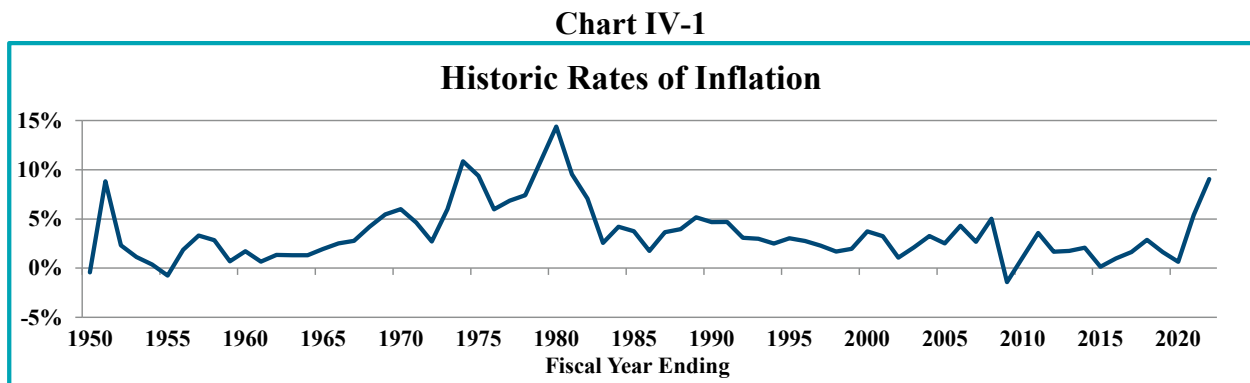
Chart IV-1

SECTION IV – ECONOMIC ASSUMPTIONS

Over the 50 years ending June 2022, the geometric average inflation rate for the U.S. has been about 4.0%, but this average is heavily influenced by the high inflation rates in the 1970s and early 1980s. Over the last 30 years, the geometric average inflation rate has been 2.5%, and it has been 2.6% over the last ten years.

Inflation broke from the recent long-term trend with annual rates of 5.4% and 9.1% for the years ending June 2021 and 2022, respectively. This short-term deviation bears monitoring but does not require an immediate revision to expectations. Economic assumptions frequently deviate significantly from expectations. Often those deviations are followed by offsetting deviations in the opposite direction. The assumptions used in actuarial valuations are long-term in nature and are not necessarily driven by the most recent events. That is particularly important considering the major economic impact of the recent COVID-19 pandemic.

Future Expectations

A measure of the market consensus of expected future inflation rates is the difference in yields between conventional Treasury bonds and Treasury inflation-protected securities (TIPS) at the same maturity. Table IV-1 shows the yields on both types of bonds and the break-even inflation rate as of August 2022. Break-even inflation is the level of inflation needed for an investment in TIPS to "break even" with an investment in conventional treasury bonds of the same maturity.

Table IV-1

Break-Even Inflation Based on Treasury Bond Yields			
Time to Maturity	Conventional Yield	TIPS Yield	Break Even Inflation
5 Years	3.03%	0.34%	2.69%
10 Years	2.90%	0.39%	2.51%
20 Years	3.35%	0.65%	2.70%

Data Source: Federal Reserve, Constant Maturity Yields, Monthly Series

The Federal Reserve Bank of Philadelphia publishes a quarterly survey of professional economic forecasters that includes their forecasts of inflation over the next 10 years. The survey for the third quarter of 2022 shows a median inflation forecast of 2.8%, a minimum forecast of about 2.1%, and a maximum forecast of 4.5%.

The National Conference on Public Employee Retirement Systems (NCPERS) February 2022 Public Retirement Systems Study includes the following graphic of respondents' inflation assumptions:

SECTION IV – ECONOMIC ASSUMPTIONS

Chart IV-2
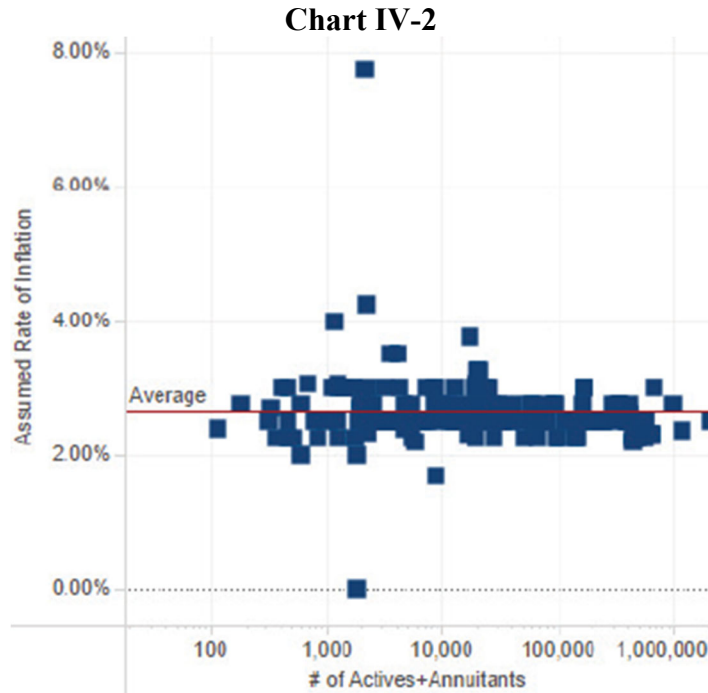
The average inflation assumption among the 156 systems that responded to this study was 2.70%.

Based on all of these considerations, we believe a reasonable range for long-term price inflation for use in the Fund's actuarial valuations is between 2.25% and 3.25%. Despite recent high inflation, we recommend keeping the current assumption of 2.75% as it aligns with longer term expectations from both markets and forecasters. If, at the time of the next review of economic assumptions, higher inflation persists and expectations for the future increase, increases to the assumption could be considered.

WAGE INFLATION

Wage inflation can be thought of as the annual across-the-board increase in wages. Individuals often receive salary increases in excess of the wage inflation rate, and we study these increases as a part of the merit salary scale assumption. Wage inflation generally exceeds price inflation by some margin reflecting the history of increased purchasing power.
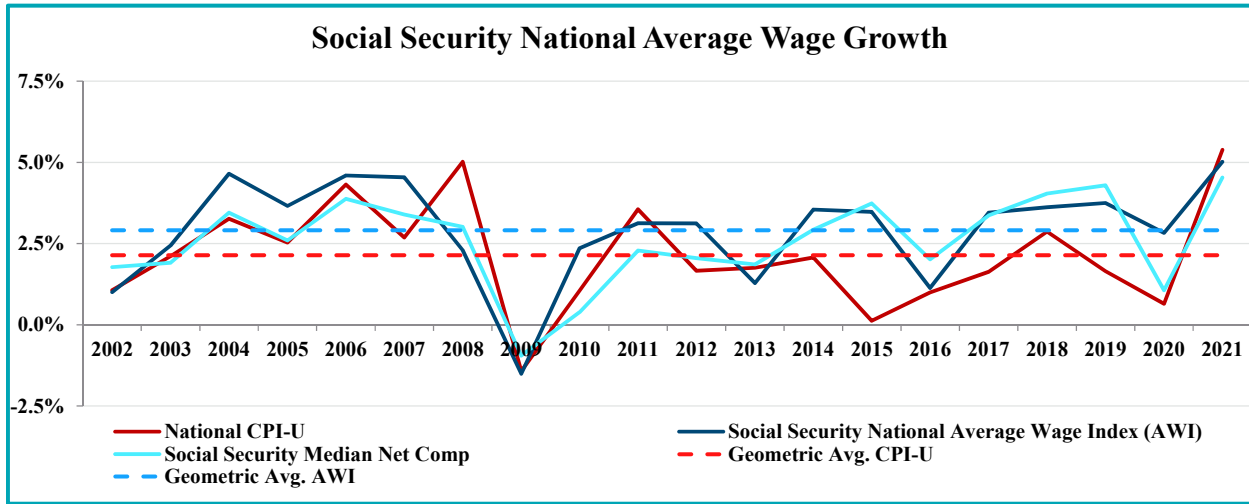
Wage inflation is used in the actuarial valuation to project the Social Security Wage Base in determining the actuarial liability.

Chart IV-3 shows the increase in national average wages (as reported by the Social Security Administration) compared to inflation from 2002 through 2021.

SECTION IV – ECONOMIC ASSUMPTIONS

Chart IV-3

Over this period, national wage inflation averaged approximately 2.9% compared to annual price inflation of 2.1%, making real wage increases about 0.8% above inflation. However, over the same time period, the increase in the median real wage was only 0.4% per year, as much of the growth in wages was clustered at the top end of the wage scale.

It is acceptable to assume some additional level of base payroll increase beyond general inflation. Potential reasons contributing to the increase may include the presence of strong union representation in the collective bargaining process, competition in hiring among other similar employers, and regional factors – such as the local inflation index exceeding the national average. Also, the Social Security Administration projects real wage growth of 0.5% to 1.8% going forward in their Social Security solvency projections included in the 2022 annual Trustees Report. However, recent higher rates of inflation have resulted in negative real wage growth for US workers, and the expectation of higher inflation in the short term is anticipated to continue to put downward pressure on real wages, at least in the short term.

We recommend maintaining a small non-inflationary base payroll growth assumption of 0.5% annually. As a result, after factoring in inflation, the annual expected wage base increase assumption remains at 3.25%.

SALARY INCREASE RATE

The salary increase rate represents the year over year increase in pay of continuing actives. Salary increases consist of three components: Increases due to cost of living maintenance (inflation), increases related to non-inflationary pressures on base pay (such as productivity increases), and increases in individual pay due to merit, promotion, and longevity.

The current assumption varies by years of service and time period. Salary increases are assumed to occur on October 1.

SECTION IV – ECONOMIC ASSUMPTIONS

In Chart IV-4 we show the total actual salary increases based on years of service for continuing active members for FYE 2019 through FYE 2021, the current assumption based on the period ending June 30, 2026 and the recommended assumption for all years, which is same as the current assumption for the period after June 30, 2026.

Chart IV-4
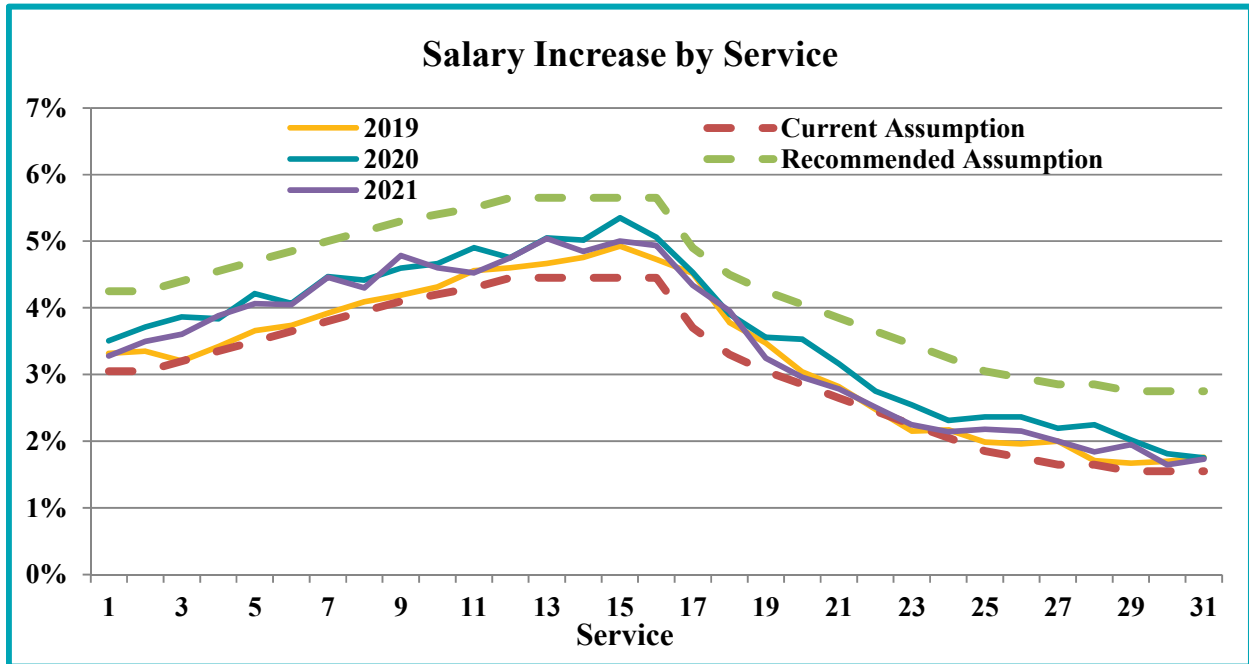
As can be seen from Chart IV-4, TPAF experience for the period FYE 2019 through FYE 2021 shows that actual salary increases have been consistently greater than expected in the short-term. In light of this experience, along with recent high inflation, we recommend eliminating the select and ultimate period used for the current assumption, which assumed lower increases in the short-term relative to the long-term. Instead, we recommend using the current ultimate salary increase rates for all years (i.e., accelerating the use of the ultimate rates from June 30, 2026 to June 30, 2022).

SECTION IV – ECONOMIC ASSUMPTIONS

The following table shows both the current and recommended assumptions.

Years of Service	Current Assumption Period Ending June 30, 2026	Current Assumption Ultimate Period	Recommended Assumption
0-2	3.05%	4.25%	4.25%
3	3.20	4.40	4.40
4	3.35	4.55	4.55
5	3.50	4.70	4.70
6	3.65	4.85	4.85
7	3.80	5.00	5.00
8	3.95	5.15	5.15
9	4.10	5.30	5.30
10	4.20	5.40	5.40
11	4.30	5.50	5.50
12-16	4.45	5.65	5.65
17	3.70	4.90	4.90
18	3.30	4.50	4.50
19	3.05	4.25	4.25
20	2.85	4.05	4.05
21	2.65	3.85	3.85
22	2.45	3.65	3.65
23	2.25	3.45	3.45
24	2.05	3.25	3.25
25	1.85	3.05	3.05
26	1.75	2.95	2.95
27-28	1.65	2.85	2.85
29+	1.55	2.75	2.75

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

1. Salary Increases Salary increases vary by years of service. Annual salary increases are shown below.

Years of Service	Rate
0-2	4.25%
3	4.40
4	4.55
5	4.70
6	4.85
7	5.00
8	5.15
9	5.30
10	5.40
11	5.50
12-16	5.65
17	4.90
18	4.50
19	4.25
20	4.05
21	3.85
22	3.65
23	3.45
24	3.25
25	3.05
26	2.95
27-28	2.85
29+	2.75

Salary increases are assumed to occur on October 1.

2. 401(a)(17) Pay Limit $290,000 in 2021 increasing 2.75% per annum, compounded annually.

3. Social Security Wage Base $142,800 in 2021 increasing 3.25% per annum, compounded annually.

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

4. Termination

Termination rates are as follows:

Service	Rates
0	6.75%
1	6.75
2	5.50
3	4.50
4	4.00
5	3.00
6	2.75
7	2.50
8	2.50
9	2.25
10	2.25
11	2.10
12	1.95
13	1.65
14	1.35
15	1.05
16	1.00
17	0.90
18	0.70
19	0.55
20	0.55
21	0.50
22	0.40
23	0.30
24-29	0.30

No termination is assumed after attainment of retirement eligibility.

70% of members with 10 or more years of service at termination are assumed to elect a deferred retirement benefit.

All other members are assumed to receive a refund of Accumulated Deductions with credited interest.

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

5. Disability

Disability rates are as follows:

Age	Ordinary Disability	Accidental Disability	Age	Ordinary Disability	Accidental Disability
20	0.005%	0.006%	48	0.135%	0.006%
21	0.005	0.006	49	0.145	0.006
22	0.005	0.006	50	0.160	0.006
23	0.005	0.006	51	0.175	0.006
24	0.005	0.006	52	0.190	0.006
25	0.005	0.006	53	0.210	0.006
26	0.005	0.006	54	0.225	0.006
27	0.005	0.006	55	0.245	0.006
28	0.005	0.006	56	0.295	0.006
29	0.005	0.006	57	0.345	0.006
30	0.005	0.006	58	0.390	0.006
31	0.010	0.006	59	0.440	0.006
32	0.015	0.006	60	0.495	0.006
33	0.020	0.006	61	0.515	0.006
34	0.030	0.006	62	0.520	0.006
35	0.040	0.006	63	0.570	0.006
36	0.050	0.006	64	0.620	0.006
37	0.060	0.006	65	0.670	0.006
38	0.070	0.006	66	0.725	0.006
39	0.080	0.006	67	0.780	0.006
40	0.085	0.006	68	0.835	0.006
41	0.090	0.006	69	0.890	0.006
42	0.095	0.006	70	0.950	0.006
43	0.095	0.006	71	1.010	0.006
44	0.105	0.006	72	1.070	0.006
45	0.110	0.006	73	1.130	0.006
46	0.120	0.006	74	1.190	0.006
47	0.130	0.006			

Accidental disability rates apply at all ages.

Ordinary disability rates apply upon attainment of 10 years of service until the attainment of age 55 with at least 25 years of service.

Members are assumed to receive the greater of the applicable disability benefit or the early or service retirement benefit, depending on eligibility.

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

Tier 4 and Tier 5 members are not eligible for the Ordinary or Accidental Disability benefits but the disability rates still apply. Such members terminating under the disability decrement are assumed to separate from service and elect a deferred retirement benefit.

6. Mortality

Pre-Retirement Mortality (Non-Annuitants): The Pub-2010 Teachers Above-Median Income Employee mortality table *[PubT-2010(A) Employee]* as published by the Society of Actuaries with a 93.9% adjustment for males and 85.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2021. All pre-retirement deaths are assumed to be ordinary deaths.

Healthy Retirees and Beneficiaries (Healthy Annuitants): The Pub-2010 Teachers Above-Median Income Healthy Retiree mortality table *[PubT-2010(A) Healthy Retiree]* as published by the Society of Actuaries with a 114.7% adjustment for males and 99.6% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2021.

Disabled Retirees (Disabled Annuitants): The Pub-2010 Non-Safety Disabled Retiree mortality table *[PubNS-2010 Disabled Retiree]* as published by the Society of Actuaries with a 106.3% adjustment for males and 100.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2021.

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

7. Retirement   Retirement rates for Tier 1-4 members are as follows:

Age	Less Than 25 Years of Service	25 Years of Service	26 or More Years of Service
< 50	N/A	1.5%	1.5%
50	N/A	1.5	1.5
51	N/A	2.0	2.0
52	N/A	3.0	2.5
53	N/A	4.0	3.0
54	N/A	6.0	3.5
55	N/A	10.0	13.0
56	N/A	18.0	17.0
57	N/A	18.0	17.0
58	N/A	20.0	17.0
59	N/A	25.0	17.0
60	4.0	25.0	20.0
61	6.0	25.0	22.0
62	6.0	33.0	27.0
63	8.0	42.0	30.0
64	8.0	42.0	30.0
65	12.0	42.0	30.0
66	18.0	55.0	35.0
67	18.0	55.0	40.0
68	18.0	55.0	30.0
69	18.0	55.0	30.0
70	18.0	55.0	30.0
71	18.0	55.0	30.0
72	18.0	55.0	30.0
73	18.0	55.0	30.0
74	18.0	55.0	30.0
75	100.0	100.0	100.0

Rates apply upon retirement eligibility by tier.

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

Retirement rates for Tier 5 members are as follows:

Age	Less Than 25 Years of Service	25 Years of Service	26 to 29 Years of Service	30 Years of Service	31 or More Years of Service
< 50	N/A	N/A	N/A	1.5%	1.5%
50	N/A	N/A	N/A	1.5	1.5
51	N/A	N/A	N/A	2.0	2.0
52	N/A	N/A	N/A	3.0	2.5
53	N/A	N/A	N/A	4.0	3.0
54	N/A	N/A	N/A	6.0	3.5
55	N/A	N/A	N/A	10.0	13.0
56	N/A	N/A	N/A	18.0	17.0
57	N/A	N/A	N/A	18.0	17.0
58	N/A	N/A	N/A	20.0	17.0
59	N/A	N/A	N/A	25.0	17.0
60	N/A	N/A	N/A	25.0	20.0
61	N/A	N/A	N/A	25.0	22.0
62	N/A	N/A	N/A	33.0	27.0
63	N/A	N/A	N/A	42.0	30.0
64	N/A	N/A	N/A	42.0	30.0
65	12.0	42.0	42.0	42.0	30.0
66	18.0	55.0	35.0	35.0	35.0
67	18.0	55.0	40.0	40.0	40.0
68	18.0	55.0	30.0	30.0	30.0
69	18.0	55.0	30.0	30.0	30.0
70	18.0	55.0	30.0	30.0	30.0
71	18.0	55.0	30.0	30.0	30.0
72	18.0	55.0	30.0	30.0	30.0
73	18.0	55.0	30.0	30.0	30.0
74	18.0	55.0	30.0	30.0	30.0
75	100.0	100.0	100.0	100.0	100.0

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

8. Family Composition Assumptions

For members not currently in receipt, 60% of members are assumed married to spouses of the opposite sex. Males are assumed to be two years older than females.

For purposes of the optional form of payment death benefit for members currently in receipt, beneficiary status is based on the beneficiary allowance reported. If no beneficiary date of birth is provided, the beneficiary is assumed to be the member's spouse of the opposite sex with males assumed to be two years older than females.

No additional dependent children or parents are assumed.

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

The following are the assumptions used in the actuarial valuation as of July 1, 2021. The economic and demographic assumptions and methods for that valuation were determined in the Actuarial Experience Study covering the period July 1, 2015 – June 30, 2018 and approved by the Board of Trustees on February 6, 2020.

1. Salary Increases   Salary increases vary by years of service and time period. Annual salary increases are shown below.

Years of Service	Period Ending June 30, 2026	Ultimate Period
0-2	3.05%	4.25%
3	3.20	4.40
4	3.35	4.55
5	3.50	4.70
6	3.65	4.85
7	3.80	5.00
8	3.95	5.15
9	4.10	5.30
10	4.20	5.40
11	4.30	5.50
12-16	4.45	5.65
17	3.70	4.90
18	3.30	4.50
19	3.05	4.25
20	2.85	4.05
21	2.65	3.85
22	2.45	3.65
23	2.25	3.45
24	2.05	3.25
25	1.85	3.05
26	1.75	2.95
27-28	1.65	2.85
29+	1.55	2.75

Salary increases are assumed to occur on October 1.

2. 401(a)(17) Pay Limit $290,000 in 2021 increasing 2.75% per annum, compounded annually.

3. Social Security Wage Base $142,800 in 2021 increasing 3.25% per annum, compounded annually.

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

4. Termination   Termination rates are as follows:

Service	Rates
0	7.00%
1	7.00
2	6.25
3	5.50
4	4.25
5	3.75
6	3.25
7	3.00
8	2.50
9	2.50
10	2.25
11	2.20
12	1.95
13	1.70
14	1.40
15	1.20
16	1.00
17	0.90
18	0.90
19	0.70
20	0.55
21	0.55
22	0.55
23	0.40
24-29	0.30

No termination is assumed after attainment of retirement eligibility.

67% of members with 10 or more years of service at termination are assumed to elect a deferred retirement benefit.

All other members are assumed to receive a refund of Accumulated Deductions with credited interest.

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

5. Disability   Disability rates are as follows:

Age	Ordinary Disability	Accidental Disability	Age	Ordinary Disability	Accidental Disability
20	0.005%	0.006%	48	0.170%	0.006%
21	0.005	0.006	49	0.180	0.006
22	0.005	0.006	50	0.200	0.006
23	0.005	0.006	51	0.220	0.006
24	0.005	0.006	52	0.240	0.006
25	0.005	0.006	53	0.260	0.006
26	0.005	0.006	54	0.280	0.006
27	0.005	0.006	55	0.350	0.006
28	0.005	0.006	56	0.420	0.006
29	0.005	0.006	57	0.490	0.006
30	0.005	0.006	58	0.560	0.006
31	0.010	0.006	59	0.630	0.006
32	0.015	0.006	60	0.710	0.006
33	0.020	0.006	61	0.790	0.006
34	0.030	0.006	62	0.870	0.006
35	0.040	0.006	63	0.950	0.006
36	0.050	0.006	64	1.030	0.006
37	0.060	0.006	65	1.120	0.006
38	0.070	0.006	66	1.210	0.006
39	0.080	0.006	67	1.300	0.006
40	0.090	0.006	68	1.390	0.006
41	0.100	0.006	69	1.480	0.006
42	0.110	0.006	70	1.580	0.006
43	0.120	0.006	71	1.680	0.006
44	0.130	0.006	72	1.780	0.006
45	0.140	0.006	73	1.880	0.006
46	0.150	0.006	74	1.980	0.006
47	0.160	0.006			

Accidental disability rates apply at all ages.

Ordinary disability rates apply upon attainment of 10 years of service until the attainment of unreduced retirement eligibility with at least 25 years of service.

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

Members are assumed to receive the greater of the applicable disability benefit or the early or service retirement benefit, depending on eligibility.

Tier 4 and Tier 5 members are not eligible for the Ordinary or Accidental Disability benefits but the disability rates still apply. Such members terminating under the disability decrement are assumed to separate from service and elect a deferred retirement benefit.

6. Mortality

Pre-Retirement Mortality(Non-Annuitants): The Pub-2010 Teachers Above-Median Income Employee mortality table *[PubT-2010(A) Employee]* as published by the Society of Actuaries with a 93.9% adjustment for males and 85.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018. All pre-retirement deaths are assumed to be ordinary deaths.

Healthy Retirees and Beneficiaries (Healthy Annuitants): The Pub-2010 Teachers Above-Median Income Healthy Retiree mortality table *[PubT-2010(A) Healthy Retiree]* as published by the Society of Actuaries with a 114.7% adjustment for males and 99.6% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

Disabled Retirees (Disabled Annuitants): The Pub-2010 Non-Safety Disabled Retiree mortality table *[PubNS-2010 Disabled Retiree]* as published by the Society of Actuaries with a 106.3% adjustment for males and 100.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

7. Retirement   Retirement rates for Tier 1-4 members are as follows:

Age	Less Than 25 Years of Service	25 Years of Service	26 or More Years of Service
< 50	N/A	1.5%	1.5%
50	N/A	1.5	1.5
51	N/A	2.0	2.0
52	N/A	3.0	2.5
53	N/A	4.0	3.0
54	N/A	6.0	3.5
55	N/A	10.0	13.0
56	N/A	18.0	17.0
57	N/A	18.0	17.0
58	N/A	20.0	17.0
59	N/A	25.0	17.0
60	4.0	25.0	20.0
61	6.0	25.0	22.0
62	6.0	33.0	27.0
63	8.0	42.0	30.0
64	8.0	42.0	30.0
65	12.0	42.0	30.0
66	18.0	55.0	35.0
67	18.0	55.0	40.0
68	18.0	55.0	30.0
69	18.0	55.0	30.0
70	18.0	55.0	30.0
71	18.0	55.0	30.0
72	18.0	55.0	30.0
73	18.0	55.0	30.0
74	18.0	55.0	30.0
75	100.0	100.0	100.0

Rates apply upon retirement eligibility by tier.

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

Retirement rates for Tier 5 members are as follows:

Age	Less Than 25 Years of Service	25 Years of Service	26 to 29 Years of Service	30 Years of Service	31 or More Years of Service
< 50	N/A	N/A	N/A	1.5%	1.5%
50	N/A	N/A	N/A	1.5	1.5
51	N/A	N/A	N/A	2.0	2.0
52	N/A	N/A	N/A	3.0	2.5
53	N/A	N/A	N/A	4.0	3.0
54	N/A	N/A	N/A	6.0	3.5
55	N/A	N/A	N/A	10.0	13.0
56	N/A	N/A	N/A	18.0	17.0
57	N/A	N/A	N/A	18.0	17.0
58	N/A	N/A	N/A	20.0	17.0
59	N/A	N/A	N/A	25.0	17.0
60	N/A	N/A	N/A	25.0	20.0
61	N/A	N/A	N/A	25.0	22.0
62	N/A	N/A	N/A	33.0	27.0
63	N/A	N/A	N/A	42.0	30.0
64	N/A	N/A	N/A	42.0	30.0
65	12.0	42.0	42.0	42.0	30.0
66	18.0	55.0	35.0	35.0	35.0
67	18.0	55.0	40.0	40.0	40.0
68	18.0	55.0	30.0	30.0	30.0
69	18.0	55.0	30.0	30.0	30.0
70	18.0	55.0	30.0	30.0	30.0
71	18.0	55.0	30.0	30.0	30.0
72	18.0	55.0	30.0	30.0	30.0
73	18.0	55.0	30.0	30.0	30.0
74	18.0	55.0	30.0	30.0	30.0
75	100.0	100.0	100.0	100.0	100.0

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

8. Family Composition Assumptions

For members not currently in receipt, 100% of members are assumed married to spouses of the opposite sex. Males are assumed to be three years older than females.

For purposes of the optional form of payment death benefit for members currently in receipt, beneficiary status is based on the beneficiary allowance reported. If no beneficiary date of birth is provided, the beneficiary is assumed to be the member's spouse of the opposite sex with males assumed to be three years older than females.

No additional dependent children or parents are assumed.