TEACHER RETIREMENT SYSTEM OF TEXAS

Actuarial Experience Study

As of August 31, 2021

P: 469.524.0000 | www.grsconsulting.com

July 15, 2022

Board of Trustees
Teacher Retirement System of Texas
1000 Red River Street
Austin, TX 78701-2698

Dear Members of the Board

Subject: Results of 2022 Experience Study

We are pleased to present our report on the results of the 2022 Experience Study for the Teacher Retirement System of Texas (TRS). It includes our recommendations for new actuarial assumptions to be effective for the August 31, 2022 actuarial valuation.

With the Board's approval of the recommendations in this report, we believe the actuarial condition of the System will be more accurately portrayed. The Board's decisions should be based on the appropriateness of each recommendation, not on their collective effect on the funding period or the unfunded liability.

This study was conducted in accordance with generally accepted actuarial principles and practices, and with the Actuarial Standards of Practice issued by the Actuarial Standards Board. The undersigned meet all of the Qualification Standards of the American Academy of Actuaries. In addition, both of the undersigned have extensive experience as retained public sector actuaries for several large, statewide public retirement systems.

We wish to thank the TRS staff for their assistance in providing data for this study.

Respectfully submitted,
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Section I – Executive Summary

In determining liabilities, contribution rates and funding periods for retirement plans, actuaries must make assumptions about the future. Overall, we have found that most of the assumptions used in the TRS valuations are currently reasonable or only need minor adjustments. However, while the investment return assumption and the general wage inflation assumption were both found to likely be reasonable, both are also in the high end of their respective ranges and a lower assumption for both would be more defendable. Thus, we have recommended lowering both assumptions further into their reasonable ranges. Our general findings and recommended changes to the current actuarial assumptions may be summarized as follows:

Economic Assumptions

1. We recommend no change to the inflation assumption of 2.30%.

2. While this analysis finds the current 7.25% investment return assumption to be reasonable, it is generally higher than the range of data points produced from this analysis and 7.00% would be closer to the midpoint of the data points. Based on the current capital market assumptions from Aon, TRS' investment consultant, and the System's target asset allocation, the median expected geometric returns over a 10 and 30-year time horizon are 6.90% and 7.23%, respectively. To verify those estimates we used twelve other independent sources and the average result from that survey was 6.28% and 7.11%. Based on the current duration of the liabilities of TRS and recognizing the impact cash flow has on the accumulation of assets, we believe the preferable time horizon for setting this assumption to be approximately 20 years. 7.25% is close to the long-term values above, although slightly higher, and thus is a reasonable assumption, but 7.00% would be closer to the midpoint of the 10 and 30-year results above and is more supportable by peer comparisons.

3. We recommend no change to the assumption that administrative expenses will be 0.14% of covered payroll. This expense is included in the required contribution rate.

4. This analysis finds the current general wage inflation (GWI) assumption of 3.00% to be reasonable. This is made up of price inflation (2.30%) and general productivity (0.70%). However, the data shows this to be in the high end of the range and a lower assumption, perhaps as low as 2.75% could also be reasonable. As such, we are recommending a decrease of 0.10% in this assumption (which would impact all wage related assumptions). This assumption is used primarily to index each cohort of new entrants used in projections and as a starting point for the individual salary scales and the payroll growth assumption (amortization payment growth rate).

5. We currently assume there will be no cost of living increases (COLAs) or supplemental payments provided to retirees. The statute does not allow for automatic COLAs for retired members. It has been past practice for the legislature to periodically grant COLAs when it is determined that the system can afford to absorb the cost in the current contribution strategy. While there has been a supplemental payment provided to retirees in each of the last two legislative sessions, there has also been a lump sum contribution to immediately pay the costs associated with those payments. Future COLAs require Legislative action and whether there will be contribution increases or lump

sum appropriations at the time is currently unknown. As there has not been an authorized COLA without additional financing for more than a decade, at this time we recommend continuing to assume no future COLAs in the annual valuations. If future Legislatures begin to authorize COLAs without additional funding, then this provision could be considered substantively automatic and would require some level of recognition in the actuarial liabilities as described under the Actuarial Standards of Practice No 4. "Measuring Pension Obligations and Determining Pension Plan Costs or Contributions" Section 3.5.3 Plan Provisions That are Difficult to Measure and an assumption of no future enhancement would no longer be appropriate.

Mortality Assumptions

Due to the impact of COVID-19 on mortality patterns in fiscal years 2020 and 2021, we utilized the five-year period ending August 31, 2019 for the mortality patterns in this analysis.

6. We recommend updating the post-retirement mortality tables for non-disabled retirees to reflect recent TRS member experience. These tables will be labeled the 2021 TRS of Texas Healthy Pensioner Mortality Tables. We also recommend continuing to assume mortality rates will improve in the future using a fully generational approach, and updating that assumption based on the ultimate rates of the most recently published projection scale ("U–MP").

7. We recommend updating post-retirement mortality tables for disabled retirees to reflect recent TRS member experience, with no change to the current procedures. We also recommend continuing to assume mortality rates will improve in the future using a fully generational approach, but with the ultimate rates of the most recently published projection scale ("U–MP").

8. We recommend updating pre-retirement mortality tables for active employees to the recently published PUB(2010) mortality tables for Teachers, using the below median table. For males, we recommend including a 2-year setback. We also recommend continuing to assume mortality rates will improve in the future using a fully generational approach, but with the ultimate rates of the most recently published projection scale ("U–MP").

Other Demographic Assumptions

9. We recommend combining male and female experience into one termination pattern for members consistent with experience and future expectations. Overall, the proposed assumptions will slightly decrease the probabilities of termination.

10. We recommend small decreases to the retirement probabilities for members consistent with experience and future expectations, focusing on the years after the changes to TRS-Care.

11. We recommend combining male and female experience into one disability pattern for members consistent with experience and future expectations. The proposed assumptions will expect more disabilities in the future than the current tables, but it will still be a very small minority of the population. We propose continuing to add 1% increases on top of the proposed pattern for members in cohorts that reach rule of 80 but are not eligible for unreduced benefits.

12. For members that become disabled in the future, no change to the assumption that 20% of them will choose a 100% joint and survivor annuity option.

13. We recommend no change to the current marriage assumption and spousal age difference.

Actuarial Methods and Policies

14. We recommend no change to the current process of estimating the valuation payroll for the upcoming fiscal year, which is to use the actual known covered payroll for the previous fiscal year and increase it by one year's payroll growth assumption.

15. We recommend no change to how the contributions from employers on non-OASDI payroll are projected.

16. We recommend no change to the current asset smoothing method or the smoothing period.

17. We recommend no change to the use of the Individual Entry Age (IEAN) actuarial cost method.

18. We recommend continuing to use individual data records in the valuation process. However, the use of individual data extends the computer run time dramatically. Thus, we will continue to use celled data in legislative analyses and adjust for any difference between the two data sets.

Illustrated Impact of all recommended changes:

Item	2021 Actuarial Valuation Current Assumptions	Projected 2022 Valuation Assuming a 7.00% Market Return for FY22 Recommended Package of Assumptions
(1)	(2)	
Unfunded Actuarial Accrued Liability ($ in Billions)	$47.6	$49.7
Funded Ratio	79.1%	79.6%
Funding Period (years)	23	26
Investment Return Assumption	7.25%	7.00%
General Wage Inflation	3.00%	2.90%

Section II – Introduction

A periodic review and selection of the actuarial assumptions is one of many important components of understanding and managing the financial aspects of the Teacher Retirement System of Texas (TRS). Use of outdated or inappropriate assumptions can result in understated costs which will lead to higher future contribution requirements or perhaps an inability to pay benefits when due; or, on the other hand, produce overstated costs which place an unnecessarily large burden on the current generation of members, employers, and taxpayers.

A single set of assumptions is typically not expected to be suitable forever. As the actual experience unfolds or the future expectations change, the assumptions should be reviewed and adjusted accordingly.

It is important to recognize that the impact from various outcomes and the ability to adjust from experience deviating from the assumption are not symmetric. Due to compounding economic forces, legal limitations, and moral obligations, outcomes from underestimating future liabilities are much more difficult to manage than outcomes of overestimates, and that un-symmetric risk should be considered when the assumption set, investment policy and funding policy are created. As such, the assumption set used in the valuation process needs to represent the best estimate of the future experience of the System and be at least as likely, if not more than likely, to overestimate the future liabilities versus underestimate them.

Using this strategic mindset, each assumption was analyzed compared to the actual experience of TRS and general experience of other large public employee retirement systems. Changes in certain assumptions and methods are suggested upon this comparison to remove any bias that may exist and to perhaps add in a slight margin for future adverse experience where appropriate. Next, the assumption set as a whole was analyzed for consistency and to ensure that the projection of liabilities was reasonable and consistent with historical trends.

The following report provides our recommended changes to the current actuarial assumptions.

Summary of Process

In determining liabilities and contribution rates for retirement plans, actuaries must make assumptions about the future. Among the assumptions that must be made include:

- Retirement rates
- Mortality rates
- Turnover rates
- Disability rates
- Investment return rate
- Salary increase rates

- Inflation rate

For some of these assumptions, such as the mortality rates, past experience provides important evidence about the future. For others, such as the investment return assumption, the link between past and future results is much weaker. In either case, actuaries should review the plan's assumptions periodically and determine whether these assumptions are consistent with actual past experience and with anticipated future experience.

The last such actuarial experience investigation was performed immediately following the August 31, 2017 actuarial valuation. For this experience study, we have added TRS' experience for the four-year period from August 31, 2017 through August 31, 2021 (FY 2018 – FY 2021) to the previous data.

In conducting experience studies, actuaries generally use data over a period of several years. This is necessary in order to gather enough data so that the results are statistically significant. In addition, if the study period is too short, the impact of the current economic conditions may lead to misleading results. It is known, for example, that the health of the general economy can impact salary increase rates and termination rates. Using results gathered during a short-term boom or bust will not be representative of the long-term trends in these assumptions. Also, the adoption of legislation, such as plan improvements or changes in salary schedules, will sometimes cause a short-term distortion in the experience. For example, if an early retirement window was opened during the study period, we would usually see a short-term spike in the number of retirements followed by a dearth of retirements for the following two to four years. Using a longer period prevents giving too much weight to such short-term effects. On the other hand, using a much longer period could water down real changes that may be occurring, such as mortality improvement or a change in the ages at which members retire.

For this analysis, we used between five and twenty years of data, depending on the assumption being studied as follows:

Assumption	Data Used	Comment
Payroll Growth	20 Years	Long-term trends are needed, also prospective changes must be considered
Individual Salary Increases	10 Years	Longer period will capture a longer economic cycle
Termination	10 Years	Longer period will capture a longer economic cycle
Post-Retirement Mortality	7 Years	Longer period allows for low volatility in the assumption.
All other	5 Years	The assumptions react quicker to changing trends and are less correlated with the economic cycle

In an experience study, we first determine the number of deaths, retirements, etc. that occurred during the period. Then we determine the number expected to occur, based on the current actuarial

assumptions. The number of “expected” decrements is determined by multiplying the probability of the occurrence at the given age, by the “exposures” at that same age. For example, let’s look at a rate of retirement at age 55. The number of exposures can only be those members who are age 55 and eligible for retirement at that time. Thus they are considered “exposed” to that assumption. Finally, we calculate the A/E ratio, where "A" is the actual number (of retirements, for example) and "E" is the expected number. If the current assumptions were “perfect”, the A/E ratio would be 100%. When it varies much from this figure, it is a sign that new assumptions may be needed. (However, in some cases we prefer to set our assumptions to produce an A/E ratio a little above or below 100%, in order to introduce some conservatism.) Of course we not only look at the assumptions as a whole, but we also review how well they fit the actual results by gender, by age, and by service.

If the data leads the actuary to conclude that new tables are needed, the actuary may "graduate" or smooth the results, since the raw results can be quite uneven from age to age or from service to service.

Organization of Report

Section III contains our findings and recommendations for each actuarial assumption. The impact of adopting our recommendations on liabilities and contribution rates is shown in Section IV. Section V presents a summary of all the actuarial assumptions and methods, including the recommended changes.

Section VI Exhibits

The exhibits in Section VI should generally be self-explanatory. For example, on page 50, we show an exhibit analyzing the termination rates for members with 10 or more years of service. The second column shows the actual termination weighted by salary with at least 10 years of service who terminated during the study period. This excludes members who died, became disabled or retired. Column (3), labeled “Total Salary” shows the total exposures of this group. This is the total salary associated with members who meet the criteria who could have terminated during any of the ten years. On this exhibit, the exposures exclude anyone eligible for unreduced retirement. A member’s salary is counted in each year they could have terminated, so the total shown is the total salary for the period of members exposed to termination decrements. Column (4) is the actual rate of termination that was experienced. Columns (5) and (6) show the probability of termination based on the raw data for both Current and Proposed rates. Columns (7) and (8) show the expected termination salary based on the current and proposed termination assumptions. Columns (9) and (10) show the Actual-to-Expected ratios under the current and proposed termination assumptions.

Section III - Analysis of Experience and Recommendations

We will begin by discussing the economic assumptions: inflation, the investment return rate, the salary increase assumption, the cost-of-living increases, and the payroll growth rate. Then we will discuss the demographic assumptions: mortality, disability, termination and retirement. Finally we will discuss the actuarial methods used.

Actuarial Standards of Practice for Setting Economic Assumptions

Actuarial Standards of Practice (ASOP) No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, provides guidance to actuaries on giving advice on selecting economic assumptions for measuring obligations for defined benefit pension plans. As no one knows what the future holds, it is necessary for an actuary to estimate possible future economic outcomes. Recognizing that there is not one right answer, the current standard calls for an actuary to develop a reasonable economic assumption. A reasonable assumption is one that:

1. Is appropriate for the purpose of the measurement,
2. reflects the actuary's professional judgment,
3. takes into account historical and current economic data that is relevant as of the measurement date,
4. is an estimate of future experience; an observation of market data; or a combination thereof, and
5. has no significant bias except when provisions for adverse deviation or plan provisions that are difficult to measure are included.

However, the standard explicitly advises an actuary not to give undue weight to recent experience.

Each economic assumption should individually satisfy this standard. Furthermore, with respect to any particular valuation, each economic assumption should be consistent with every other economic assumption over the measurement period. Generally, the economic assumptions are much more subjective in nature than the demographic assumptions.

Inflation Assumption

"Inflation" refers to price inflation, as measured by annual increases in the Consumer Price Index (CPI). This inflation assumption underlies all of the other economic assumptions we employ, such as the investment return, the salary increase pattern, and the payroll growth assumption. The current annual inflation assumption is 2.30%. We are proposing no change to this assumption.

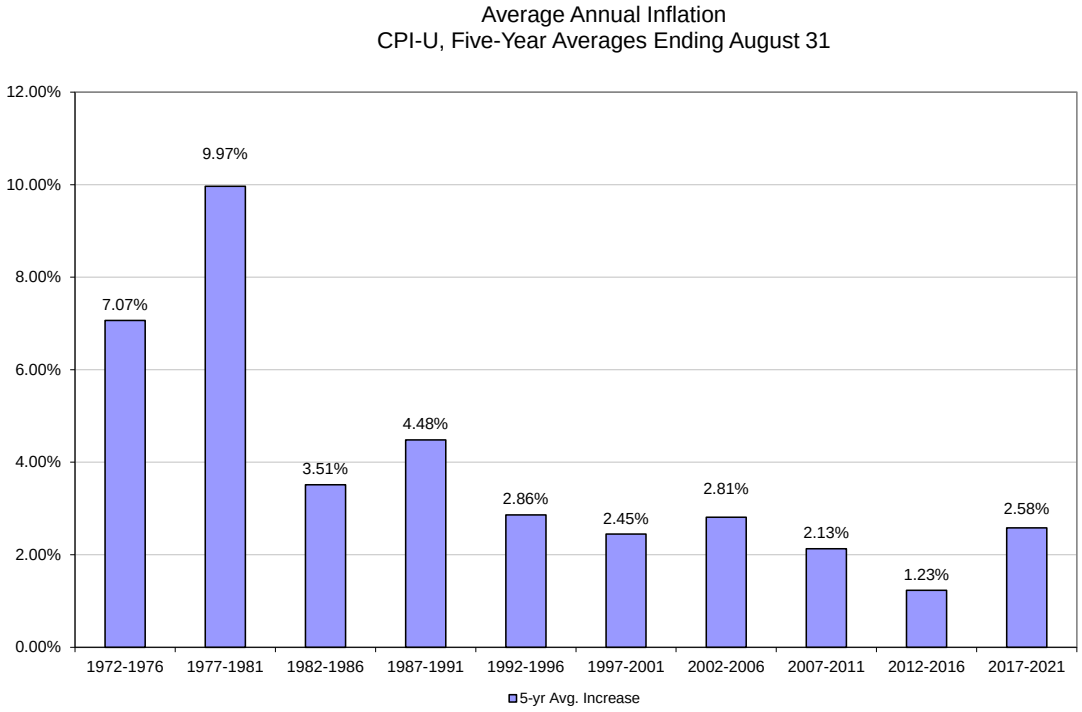
Over the five-year period from August 2016 through August 2021, the CPI-U has increased at an average rate of 2.58%. However, the prospective inflation rate is only weakly tied to past results.

The table below shows the average inflation over various periods, ending August 2021:

Periods Ending August 2021	Average Annual Increase in CPI-U
Last five (5) years	2.58%
Last ten (10) years	1.90%
Last fifteen (15) years	1.98%
Last twenty (20) years	2.19%
Last twenty-five (25) years	2.24%
Last fifty (30) years	2.34%

Source: Bureau of Labor Statistics, CPI-U, all items, not seasonally adjusted

The chart on the following page shows the average annual inflation in each of the ten consecutive five-year periods over the last fifty years:



As the table shows, inflation has been relatively low over the last twenty-five years, but has recently risen to more traditional levels.

Forecasts from Investment Consulting Firms

We examined the 2021 capital market assumption sets for several investment consulting firms and found the average assumption for inflation was 2.19%, with a range of 2.11% to 2.31%. This is 0.1% lower than the previous experience study. However, most of the data points from our survey were from early 2021 before the recent high inflation data. TRS' investment consultant, Aon, has a prospective assumption of 2.20%.

Forecasts from Social Security Administration

In the Social Security Administration's 2021 Trustees Report, the Office of the Chief Actuary is projecting a long-term average annual inflation rate of 2.4% under the intermediate cost assumption. The low cost and high cost scenarios are 1.8% and 3.0%, respectively. All three of these numbers are 0.2% lower than the 2017 experience study.

Survey of Professional Forecasters and Fed Policy

The Philadelphia Federal Reserve conducts a quarterly survey of the Society of Professional Forecasters. Their most recent forecast (fourth quarter of 2021) was for inflation over the next ten years (2021 to 2030) to average 2.55%. This is up 0.35% since the last study.

Additionally, the Fed has openly stated recently that they have a target 2.00% inflation rate.

Recommendation

Using these sources, we recommend no change to the 2.30% assumption.

INVESTMENT AND ADMINISTRATIVE EXPENSES

Since the trust fund pays expenses in addition to member benefits and refunds, assumptions must be made about these. Almost all actuaries treat investment expenses as an offset to the investment return assumption. That is, the investment return assumption represents expected return after payment of investment expenses.

In regards to investment expenses, investment consulting firms periodically issue reports that describe their capital market assumptions. The estimates for core investments (i.e., fixed income, equities, and real estate) are generally based on anticipated returns produced by passive index funds that are either net of or have very small investment related fees. The investment return expectations for the alternative asset class such as private equity and hedge funds are also net of investment expenses. Therefore, we did not make any adjustments to account for investment related expenses. Some of the retirement systems may also employ active management investment strategies that result in higher investment expenses compared to strategies that invest in passive index funds. For this analysis, we have assumed that active management strategies would result in the same returns, net of investment expenses, as passive management strategies.

On the other hand, for TRS, the practice for administrative expenses has been to explicitly add a load onto the normal cost. This is also our preferred approach and we recommend continuing this practice. Using an explicit load onto the normal cost maximizes transparency, aligns better with the standards of the Governmental Accounting Standards Board, and maintains a parallel between the investment returns used by the investment consultant and the actuary.

The following table provides the actual administrative expenses as a percentage of covered payroll for the last four years, along with our recommended assumptions.

	FY21	FY20	FY19	FY18	Average	Current Assumption	Recommended Assumption
TRS	0.143%	0.138%	0.134%	0.149%	0.141%	0.14%	0.14%

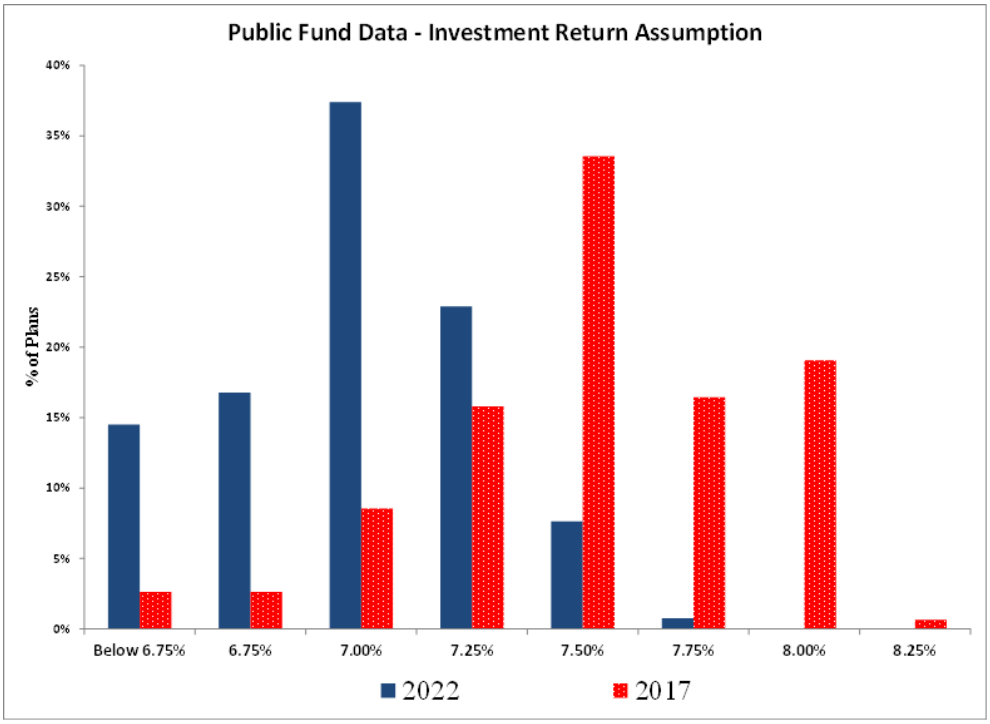
INVESTMENT RETURN RATE

The investment return assumption is one of the principal assumptions used in any actuarial valuation of a retirement plan. It is used to discount future expected benefit payments to the valuation date in order to determine the liabilities of the plan. Even a small change to this assumption can produce significant changes to the liabilities and contribution rates. Currently, it is assumed that future investment returns will average 7.25% per year, net of investment expenses. This was lowered from 8.00% in the previous study.

Similar to the inflation assumption, past performance is not a reliable indicator of future performance, even when averaged over a long time period. Also, the actual asset allocation of the trust fund will significantly impact the overall performance, so returns achieved under a different allocation may not be meaningful.

Assumption Comparison to Peers

We do not recommend the selection of an investment return assumption based on peer information. However, it is still informative to identify where the investment return assumption for TRS is compared to its peers as it does inform about general future return expectations across a large number of decision makers. The chart below shows the distribution of the investment return assumptions in the NASRA Public Fund Data as of March 2022 compared to the data as of 2017.



We have included the same information from the 2017 survey to show the national trends in this assumption. The median and average rate of return have dropped from 7.50% and 7.54% to 7.00% and 6.99%, respectively over recent years.

Asset Allocation

We believe the most appropriate approach to selecting an investment return assumption is to identify expected returns given the funds' asset allocation mapped to forward-looking capital market assumptions. We view the investment return assumption as having two components: the assumed rate of (price) inflation plus the real return net of inflation. This "building block" approach is one explicitly permitted under ASOP 27. The inflation assumption has already been discussed, so we will proceed with the analysis of the real rate of return assumption.

To do this, we will examine the results of applying a set of capital market assumptions to the plan's target asset allocation. Because GRS is a benefits consulting firm and does not develop or maintain our own capital market assumptions, we typically will utilize the forward-looking return expectations developed by several investment consulting firms. The following is an excerpt from ASOP 27 on the topic of using experts:

> ***Section 3.5.6 Other Sources of Economic Data and Analyses***—*When the actuary is responsible for selecting or giving advice on selecting economic assumptions, the actuary may incorporate economic data and analyses from a variety of other sources, including representatives of the plan sponsor and administrator, investment advisors, economists, and other professionals. However, the selection or advice should reflect the actuary's professional judgment.*

In our professional judgement, the consulting firms we included in our survey are experts with specialized knowledge and it is appropriate to incorporate their outlooks in our analysis.

We will give a higher emphasis to the estimates produced by Aon, TRS' investment consultant as they are more familiar with TRS' specific investments, but we will also verify with other independent sources.

Below is a table with the plan's long-term target asset allocation and the development of the plan's expected nominal investment returns using capital market assumptions provided by Aon:

Asset Class	Long-Term Target Asset Allocation	10 Year Expected Geometric Rate of Return	30 Year Expected Geometric Rate of Return
(1)	(2)	(3)	(4)
U.S. Equity	18%	5.7%	6.2%
Non-US Developed	13%	6.5%	6.9%
Emerging Markets	9%	7.0%	7.5%
Private Equity	13%	8.8%	9.3%
Long Duration U.S. Treasuries	16%	2.3%	2.5%
Stable Value Hedge Funds	5%	4.5%	4.9%
Private Real Estate	15%	5.6%	5.4%
Energy and Natural Resources	6%	7.1%	7.2%
Risk Parity (12% Vol)	8%	5.0%	5.2%
Cash	2%	1.5%	1.9%
Leverage	-6%	1.7%	2.2%
Gross Expected Return		**6.90%**	**7.23%**
Probability of Achieving:			
7.50%		45%	46%
7.25%		**47%**	**50%**
7.00%		49%	54%
6.75%		52%	58%

As you can see, the expected return (geometric/compound), even on a very long-time horizon, is approximately equal to the 7.25% assumption. However, the probabilities of achieving the 7.25% assumption over the next decade appear to be lower.

Within our direct GRS survey of other investment firms, five of the firms provide longer term expectations (20 years or longer). Based on the average of these five sets of expectations and the TRS asset allocation, the expected compound return over the next 20-30 years is 7.11%, with a range of outcomes from 6.86% to 7.47%.

Our survey includes twelve sets of expectations based on a 7-10 year time horizon. Based on the average of these sets of expectations and the TRS asset allocation, the expected compound return over the next 10 years is 6.28%, with a range of 5.90% to 7.08%. This shows much of the investment community is anticipating lower returns over the next decade compared to longer time frames.

In our opinion, the process above meets all of the requirements needed to use that as a basis for our analysis. The results were appropriate for the purpose of the measurement as the estimates were medium to longer term forecasts of market expectations, they took into account historical and current economic data that is relevant as of the measurement date, they represent an estimate of future experience and an observation of market data, and they had no significant bias (i.e., it is not significantly optimistic or pessimistic).

RECOMMENDATION

If the liability stream of TRS were compared to a portfolio of bonds, it would behave similarly to a bond with 23-year duration. Or put another way, the average interest discounted benefit payment will occur 23 years from the valuation date. Also, in Board education sessions, we have shown that the order of returns matters when a System has negative cash flows, with scenarios that underperform first accumulating less assets over time even if returns are met, on average, over the longer term.

Based on the current duration of the liabilities of TRS and recognizing the impact cash flow has on the accumulation of assets, we believe the preferable time horizon for setting this assumption to be approximately 20 years.

In our professional judgement, we believe a 7.00% assumption meets the requirements under ASOP 27 for being a reasonable assumption and is the most defendable of the choices. Although 7.25% may continue to be reasonable as of 2022, we have concerns about the 7.25% as an optimal choice as it is already higher than all of the individual data points provided in this analysis and could easily not be found to be reasonable for one of the individual valuations before the next scheduled experience study in 2026. Also, the choice of this assumption will have an impact on the possible portfolio choices in the next Strategic Asset Allocation study, and the data present shows a 7.00% expected return will be easier to build a portfolio for than a 7.25% expected return.

Thus, we are recommending a 7.00% investment return assumption.

COST-OF-LIVING INCREASE ASSUMPTION

We currently assume there will be no cost of living increases or supplemental payments provided to retirees (COLAs). The statute does not allow for automatic COLAs for retired members. It has been past practice for the legislature to periodically grant COLAs when it is determined that the system can afford to absorb the cost in the current contribution strategy. While there has been a supplemental payment provided to retirees in each of the last two legislative sessions, there has also been a lump sum contribution to immediately pay the costs associated with those payments. Future COLAs require Legislative action and whether or not there will be contribution increases or lump sum appropriations at the time is currently unknown. As there has not been an authorized COLA without additional financing for more than a decade, at this time we recommend continuing to assume no future COLAs in the annual valuations. If future Legislatures begin to authorize COLAs without additional funding, then this provision could be considered substantively automatic and would require some level of recognition in the actuarial liabilities as described under the Actuarial Standards of Practice No 4. “Measuring Pension Obligations and Determining Pension Plan Costs or Contributions” Section 3.5.3 Plan Provisions That are Difficult to Measure and an assumption of no future enhancement would no longer be appropriate.

GENERAL WAGE INFLATION

A General Wage Inflation (GWI) assumption represents the real wage growth over time in the general economy, or, is the assumption on how much the pay scales themselves will change year to year, not necessarily how much the pay increases received by individuals are, or even necessarily how the payroll

in total may change, which can be impacted by population changes, etc. This assumption should be applicable to a local economy, not necessarily one group inside a retirement system. This assumption is used primarily to index the pay of each group of new entrants used in the open group projections. In an open group projection, projected terminations from the current active population are replaced with projected new entrants.

Historically, General Wage Inflation has almost always exceeded price inflation. This is because wage inflation is in theory the result of (a) price inflation, and (b) productivity gains being passed through to wages. Since 1951, for the national economy as a whole, wage inflation has been about 0.90% larger than price inflation on average. For the last 20 years, for the national economy as a whole, wage inflation has been 2.78%, outpacing price inflation by about 0.75%.

For TRS specifically, the average salary has grown at an annualized rate of 2.55% for the past twenty years, or 0.52% above inflation. For the past decade, the value is 1.93%, or basically equal to inflation. The average salary for a new entrant hasn't even kept pace with inflation the last decade.

For these reasons, we find the current 0.70% above inflation assumption to be reasonable, as it is approximately equal to the 0.75% average increase for the economy as a whole. However, we also find that a lower assumption based more specifically on TRS data could also be reasonable, and more defendable. We are recommending lowering of this assumption by 0.10%.

Lowering this wage assumption would lower liabilities and funding periods, while lowering the investment return assumption would increase those same items. Thus, there is an offsetting impact from these two assumptions, which are also the most subjective, and therefore we would prefer to take care to balance the risk between both decisions.

SALARY INCREASE RATES

In order to project future benefits, the actuary must project future salary increases for individuals. Salaries may increase for a variety of reasons:

- Across-the-board increases for all employees;
- Across-the-board increases for a given group of employees;
- Increases to a minimum salary schedule;
- Additional pay for additional duties;
- Step or service-related increases;
- Increases for acquisition of advanced degrees or specialized training;
- Promotions; or
- Merit increases, if available.

Our salary increase assumption is meant to reflect all of these types of increases.

The actuary should not look at the overall increases in payroll in setting this assumption, because payroll can grow at a rate different from the average pay increase for individual members. To analyze salary increases, we examine the actual increase in salary for each member who is active in two consecutive fiscal years.

Most actuaries recommend salary increase assumptions that include an element that depends on the member's age or service, especially for large, public retirement systems. It is typical to assume larger pay increases for younger or shorter-service employees. This is done in order to reflect pay increases that accompany step increases, changes in job responsibility, promotions, demonstrated merit, etc. The experience shows salaries have been more closely correlated to service (rather than age), as promotions and productivity increases tend to be greater in the first few years of a career, even if the new employee is older than the average new hire.

We analyzed the salary increases based on the change in the member's reported pay from one year to the next. That is, we looked at each member who appeared as an active member in two consecutive valuations individually, and measured his/her salary increase. Then we grouped the increases for all members with the same service, and determined their average increase.

The current assumption is composed of the general wage inflation assumption plus a merit and promotion component that is based on the service of an individual. The gross current schedule ranges from 9.05% for new members to 3.05% for members with 25 or more years of service.

Salary increases for governmental employees can vary significantly from year to year. When the employer's tax revenues stall or increase slowly, salary increases often are small or nonexistent. During good times, salary increases can be larger. Our experience across many governmental plans also shows several occasions in which salary increases will be low for a period of several years followed by a significant increase in one year. Therefore, for this assumption in particular, we prefer to use data over a longer period in establishing our assumptions. We used a ten-year period for this analysis (but also looked back at older studies). The average pay increases for members active in both valuations with two years of service or more are as follows:

Period	Increase	Inflation	Increase Above Inflation
FY 2011 to FY 2012	1.22%	1.69%	-0.47%
FY 2012 to FY 2013	2.05%	1.52%	0.53%
FY 2013 to FY 2014	3.68%	1.70%	1.98%
FY 2014 to FY 2015	3.14%	0.20%	2.94%
FY 2015 to FY 2016	4.76%	1.06%	3.70%
FY 2016 to FY 2017	3.14%	1.94%	1.20%
FY 2017 to FY 2018	2.96%	2.70%	0.26%
FY 2018 to FY 2019	3.54%	1.75%	1.79%
FY 2019 to FY 2020	5.87%	1.31%	4.56%
FY 2020 to FY 2021	2.78%	5.25%	-2.47%
Average	3.31%	1.90%	1.41%

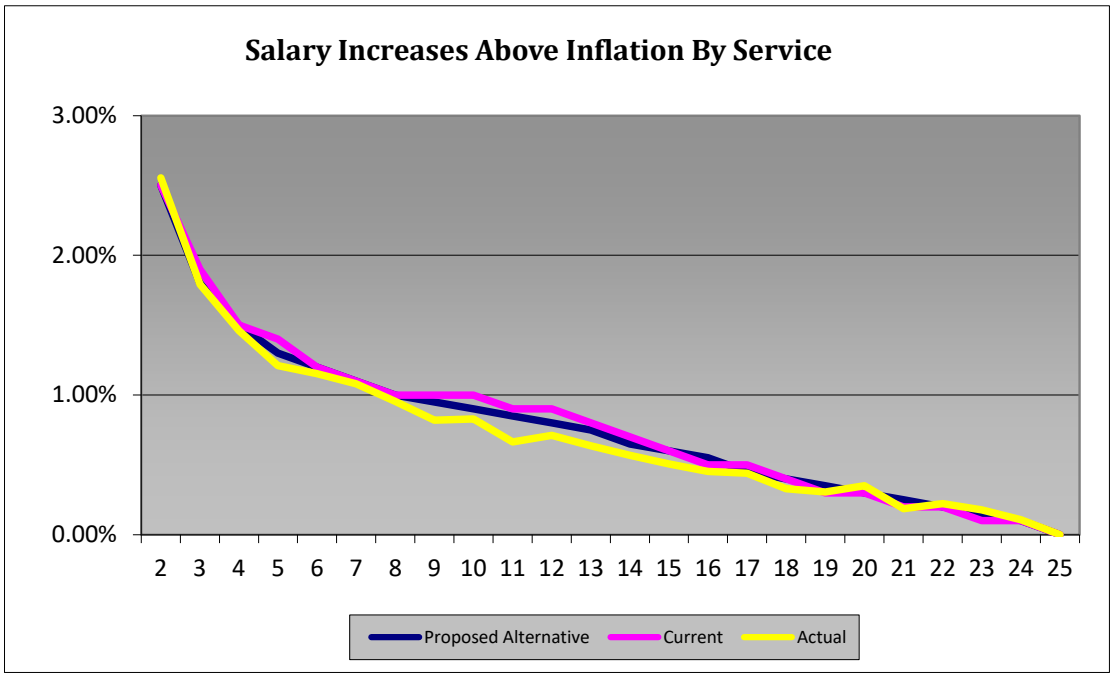
The average increase is 3.31%, or 1.41% above inflation. The expected increase above inflation was 1.66%, meaning the actual increases have been lower than expected, even on real terms.

To separate the steps, or promotional component of the schedule, we segregated out members with more than 25 years of service. Most of these members should be past the promotional and step portions of their careers and therefore, only receive the general increases granted. The current assumption is that these members will receive average increases of 3.05% per year, or 0.75% above the

2.30% inflation assumption. The actual productivity increase during the ten year period was 0.55%, lower than the assumed 0.75%, and this was during a time of very low actual inflation.

Period	Overall Increase for Long Service Members	Inflation	Increase Above Inflation
FY 2011 to FY 2012	1.03%	1.69%	-0.66%
FY 2012 to FY 2013	1.38%	1.52%	-0.14%
FY 2013 to FY 2014	2.75%	1.70%	1.05%
FY 2014 to FY 2015	2.32%	0.20%	2.12%
FY 2015 to FY 2016	3.44%	1.06%	2.38%
FY 2016 to FY 2017	2.18%	1.94%	0.24%
FY 2017 to FY 2018	2.21%	2.70%	-0.49%
FY 2018 to FY 2019	2.49%	1.75%	0.74%
FY 2019 to FY 2020	4.86%	1.31%	3.55%
FY 2020 to FY 2021	1.95%	5.25%	-3.30%
Average	2.45%	1.90%	0.55%

Consistent with the data presented with the GWI section, the current 0.75% is reasonable but is on the high end of the range and a lower assumption could be reasonable. We are recommending a 0.65% individual productivity, merit, and promotion compared to the 0.75% of the current assumption. Or an overall increase of 2.95% compared to the current 3.05%.



The above exhibit models the portion of the salary increases for short term members that exceeded the salary increases for long term members based on the current assumptions, the actual experience, and a new set of assumptions. Based on this alternative schedule, the cumulative increases from service 1 to 25 decreases approximately 3%, meaning for a new member, the projected salary at the end of 25

years is expected to be 3% lower than under the current assumption. This would create a decrease in the normal cost and unfunded liability.

PAYROLL GROWTH RATE

The salary increase rates discussed above are assumptions applied to individuals. They are used in projecting future benefits. We also use an overall payroll growth assumption, currently 3.00%, in determining the contributions needed to amortize the unfunded actuarial accrued liability. The "Funding Period" determined in the valuation is answering the question: "when is the current UAAL expected to be reduced to $0." This calculation reflects the fact that contributions are received as a percentage of payroll, so as payroll increases over time, these contributions do too. Thus, the funding period is dependent on the rate at which payroll is assumed to increase.

Over the past decade, the overall payroll for TRS has grown by 2.9% per year on average, almost exactly equal to the current 3.00% assumption. However, 1.0% of that has been due to population growth, with the actual underlying payroll only growing at 1.9% per year, basically equal to inflation, once population growth has been removed.

The default should be that the Payroll Growth Rate is equal to the GWI assumption. And over the longer term in a stable population, it will. However, the payroll growth rate used to determine the funding period should reflect how fast payroll is expected to grow *over that specific period* if the demographics of the group are not uniform. For example, due to the baby boom generation, the current demographic of many pension plans has an abnormally high number of people eligible to retire. When those people retire, they will be replaced by members at the beginning of the pay scale. Thus, even if salary increases for individuals are changing as expected, overall payroll growth can be dampened over the short to medium term.

One way to estimate this assumption is to produce an open group projection assuming increases in the pay of the new entrants changes at the GWI assumption and compare the rates of growth. We have performed open group projections that show payroll will grow over the next couple of decades at approximately 2.88% per year as the baby boom generation reaches retirement. Thus, we have recommended a payroll growth assumption, a decrease by the same 0.10% to be consistent with the other changes.

DEMOGRAPHIC ASSUMPTIONS

Actuaries are guided by the Actuarial Standards of Practice (ASOP) adopted by the Actuarial Standards Board (ASB). One of these standards is ASOP No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. This standard provides guidance to actuaries giving advice on selecting noneconomic assumptions for measuring obligations under defined benefit plans. We believe the recommended assumptions in this report were developed in compliance with this standard.

POST-RETIREMENT MORTALITY RATES

The most critical demographic assumption used in pension valuations is post-retirement mortality. Rates of mortality affect our estimate of how long each individual is expected to live and consequently

how long each individual is expected to receive a pension. Life expectancy in turn has a direct impact on pension plan liabilities.

Mortality rates have generally decreased over time in the U.S., meaning that life expectancies have generally increased over time. The assumption for future decreases in mortality is referred to as the mortality improvement assumption. In general, the current rates of mortality and mortality improvement assumption are two separate assumptions. Thus, we will discuss this in two parts, the recommended base mortality assumption, and the recommended mortality improvement assumption.

The relevant ASOP, ASOP 35, and published practice notes require pension actuaries to make and disclose an assumption as to expected mortality improvement after the valuation date. To meet this standard, the best practice actuarial model is to use mortality tables that explicitly incorporate projected mortality improvements over time. This type of table (or series of tables) is called "generational mortality." Specifically, mortality rates are assumed to decline each year in the future so that life expectancies for each annual cohort of retirees will be slightly higher than the previous year. Therefore, the life expectancy at age 60 for someone reaching in 2040 is longer than the life expectancy for someone reaching 60 in 2025, and their life expectancy is longer than someone reaching 60 now, etc.

Because of this assumption of continuous improvement, life expectancies for today's younger active members are expected to be materially longer than those of today's retirees. By utilizing generational mortality, the improvement over time is built into the contributions for individual members while they are employed.

The mortality table currently being used for non-disabled retirees and for beneficiaries receiving benefits is the 2017 TRS of Texas Healthy Pensioner Mortality Tables, which is a TRS-specific table created in the 2017 Experience Study. The table has separate rates for males and females. Our strategy is to update this table with each experience study to ensure that our Base tables are as current as possible, while leaving the projected improvement unchanged. This strategy allows for making minor, frequent adjustments instead of large adjustment every decade or so and minimizes the volatility that can come from changing mortality assumptions.

Approach and Data

We have seven years of experience available to increase the credibility of the analysis and minimize any variance created by timing of data collection from year to year. However, the last two years of data have been heavily impacted by the pandemic, and we are not ready to reflect those higher mortality years in the assumption, but would rather wait and see if experience returns back to previous levels. Thus, we have only included the five years from fiscal year 2015 through 2019 in the analysis. During this time, mortality improvement may have occurred and thus a general procedure is to adjust the actual experience for mortality improvements during the study period to the central year, in this case 2017.

The analysis uses only the retirees, not the beneficiaries, joint annuitants, or survivors as the vast majority of the liability is based on this group of members and data from the beneficiaries can often have a survivorship bias which would skew the results. We will use a liability-weighted analysis by weighting members by the amount of their annuity. There are two reasons for using a liability-weighted

approach. First, mortality experience across the U.S. has been shown to vary depending on income level. Liability-weighting takes into account differing benefit levels. Second, selecting an assumption based on headcount-weighting is consistent with estimating expected deaths, but selecting an assumption based on liability-weighting is consistent with minimizing the actuarial gains and losses associated with expected deaths. By weighting the data by annuity amounts, we are giving more weight to members who have larger annuities (and thus have larger liabilities).

Credibility

When choosing an appropriate mortality assumption, actuaries typically use standard mortality tables, unlike when choosing other demographic assumptions. They may choose to adjust these standard mortality tables, however, to reflect various characteristics of the covered group, and to provide for expectations of future mortality improvement (both up to and after the measurement date). If the plan population has sufficient credibility to justify its own mortality table, then the use of such a table also could be appropriate. Factors that may be considered in selecting and/or adjusting a mortality table include the demographics of the covered group, the size of the group, the statistical credibility of its experience, and the anticipated rate of future mortality improvement.

We first measured the credibility of the dataset to determine whether standard, unadjusted tables should be used or if statistical analysis of TRS specific data was warranted. The method for this approach can be found in the article *"Selecting Mortality Tables: A Credibility Approach" October 2008*. Statistical analysis suggests 1,082 deaths per gender is sufficient to be considered fully credible, as at that amount of experience we are 90% confident that the observed experience is within +/- 5% of the actual pattern. However, when weighting on benefit amounts, it should be even higher. The following table gives the number of deaths needed by gender to have a given level of confidence that the data is +/- X% of the actual pattern.

Standard Score	Confidence	99% – 101%	97% – 103%	95% – 105%	90% – 110%	80% – 120%
0.674	75%	4,543	505	182	45	11
1.282	80%	16,435	1,826	657	164	41
1.645	90%	27,060	3,007	1,082	271	68
1.96	95%	38,416	4,268	1,537	384	96
2.576	99%	66,358	7,373	2,654	664	166

TRS had 13,587 male and 27,692 female observed deaths during the period analyzed. The following provides the full details with p=95% and r=5%.

	Male	Female
Actual Deaths	13,587	27,692
Deaths needed for full credibility		
Based on Count	1,537	1,537
Based on Annuity Amount	2,490	2,317
Z Factor		
Based on Count	100.0%	100.0%
Based on Annuity Amount	100.0%	100.0%

Considering there is no published table based on data similar to TRS in geography or exactly matching by occupation (would need to be a combination of published tables), and that the data from this experience study is much more recent than the data used to create the nationally published mortality tables, we will continue to develop client specific mortality tables utilizing the TRS data. This also allows for smaller, more frequent adjustments than waiting for the next series of published tables.

Summary of Experience

We begin by determining the expected number of weighted deaths in each year at each age for males and females. Then we compare the actual number to the expected number. The ratio of the actual deaths to the expected deaths (the A/E ratio) tells us whether the assumptions are reasonable. When using a generational approach for mortality improvement, an A/E of 100% is targeted.

The experience is a relatively good match to the current assumption. The following is a summary of the data.

	Male	Female
Actual Deaths ($100,000 Annuities)	$3,191	$5,326
Expected Deaths based on Current Assumptions	$3,118	$5,247
A/E Ratio	102.3%	101.5%
Actual Deaths Static Life Expectancy for 65 Year Old	19.9	20.6
Expected Static Life Expectancy for 65 Year Old	19.8	20.4
A/E Ratio	100.5%	100.9%

The actual experience came in very close to expected. The A/E ratios in total (across all ages) for males and females were 102.3% and 101.5%, respectively. The static life expectancy came within 0.2 of the expectation.

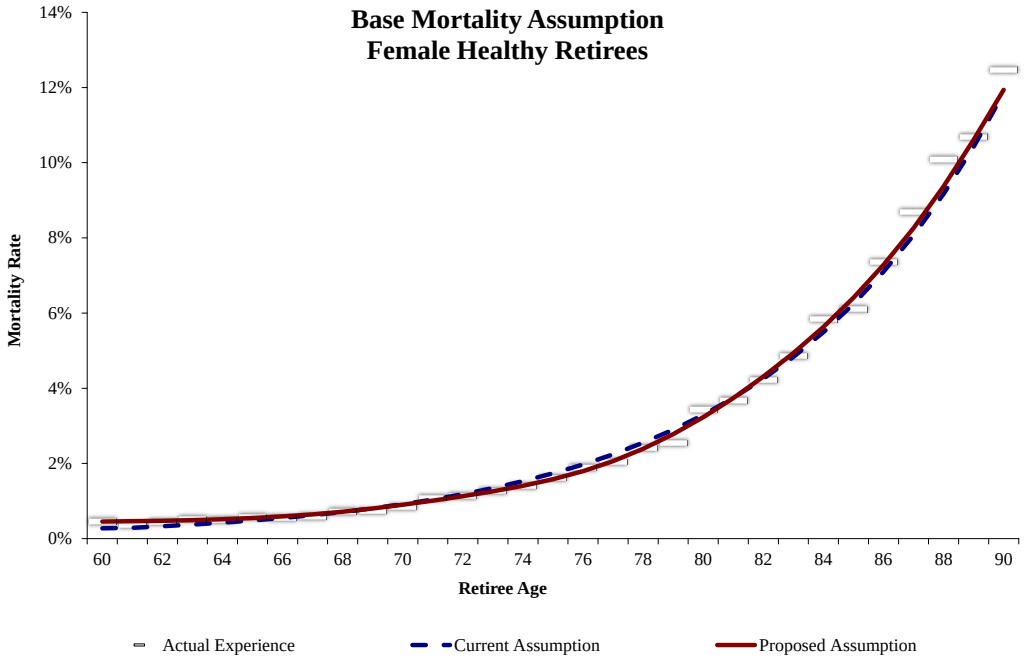
This is close enough that it would be reasonable to leave the assumption unchanged. However, it is also close enough that any adjustments towards the actual data would not make a meaningful difference to the liabilities or contribution requirements. It is preferable to keep the assumption as current as possible and to follow the process that has been established, which is to update the full assumption with each experience study, and so we are recommending a new base table.

Recommended Base Mortality Assumption

To develop the recommended mortality assumptions, we grouped the data into five-year ages bands. Mortality rates for ages after 60 are based on the System's experience, while mortality rates for ages under 60 and after age 95 are equal to a credibility adjusted version of the most recently published Pub-2010 mortality assumptions for Teachers (adjusted forward to the central point of the experience period). These results were then graduated using a cubic spline method to provide a smooth fit to the experience. This produced an R^2 of .998 for both males and females, respectively when compared to the underlying data.

The final step in the creation of the base mortality assumption was to project the preliminary table from the center point of the analysis period (i.e., 2017) to the year 2021 using the recommended projection scale below. We will refer to this new table as the 2021 TRS of Texas Healthy Pensioner Mortality Table.

The following is a chart that shows the actual mortality experience assumption for females.



For the new assumptions, the A/E ratios in total (across all ages) for males and females would have been 101% at the core ages. A better way to examine the base table is to compare the life expectancies created at various ages. The following table provides the life expectancies calculated from the given age based on the actual data, the current assumption, and the recommended tables.

Static Life Expectancy, in years – Females with Base Year 2017			
Retiree Age	Actual in Data	Current Assumption	Proposed Table
60	26.9	27.0	27.0
65	22.5	22.4	22.6
70	18.2	18.0	18.3
75	14.1	14.0	14.2
80	10.4	10.4	10.5

Overall, this change has a minimal impact to the current valuation results and is mostly just updating dates on the tables. More detail is shown on the tables in Section VI.

Recommended Mortality Improvement Assumption

We use a fully generational approach to this assumption. Because of this strategy of building in continuous improvement, life expectancies for today's younger active members are expected to be

materially longer than those of today's retirees, and this provides substantial stability and dependability on costs and liabilities. We currently use a 1% improvement assumption per year across most ages.

There is an annual report published by the Retirement Plans Experience Committee of the Society of Actuaries to provide commentary on national trends in mortality experience and provide updated projection scales. The initial report was in 2014, with annual updates every year since. In every update, rates of improvement were materially decreased, meaning the original MP-2014 table was found to be too conservative. In addition, the amount of change from year to year has been significant. The amount of volatility produced by changing annually to each "most recent" table has been on the same order as the actual investment performance. Thus, we find that the use of the full version of these tables to produce an overly complex, volatile pattern of results that has actually had minimal, if any, predictive power.

After approximately 15 years, all of the versions prior to the 2020 version of the MP tables reflected the same improvement rate at each future calendar year (the ultimate mortality improvement rates) at the 1% per year across most ages we currently use. In order to balance the two objectives of reflecting the most recent data available, while maintaining stability of results from year to year, we currently use the ultimate mortality improvement rates in the MP tables for all years, which is again approximately 1% per year improvement across most ages.

In the 2020 report the ultimate mortality improvement rates were modified to be higher at some ages and more precise across different age groups based on historical trends. Specifically, the pattern is 1.35% of the rate for ages 62 and younger, decreasing linearly to 1.10% at age 80, further decreasing linearly to 0.40% at age 95, and then decreasing linearly to 0.00% at age 115 (and thereafter). In general, the net change in overall liabilities if a retirement system was using the ultimate rates of the MP-2019 table to the ultimate rates of the MP-2020 version is minimal. Basically, the rates at individual ages were changed but the overall pattern over a lifetime is not much different.

We find it would be reasonable to use either set of improvement scales, but give preference to the more recently published report all else being equal. Given the material increase in healthcare costs required over the last few decades to allow for the rates of improvement that have existed, and the general worsening in morbidity factors in the United States, we find it reasonable to assume the future improvement would be approximate to or less than it has been historically across most ages. The 2020 report provides several pages of rationale and disclosure of the process used to generate the new long-term rates, including comparing to historical trends, and we find the analysis thorough and reasonable. Thus, we are recommending use of the ultimate rates in the MP-2020 scales, applied for all years.

The following is a table with the life expectancy for a retired member who attains age 65 based on the proposed assumption set, by calendar year. As shown, the life expectancy is expected to increase into the future.

Current Mortality Assumption - Life Expectancy for an Age 65 Retiree in Years					
Group	**Year of Retirement**				
	2021	2026	2031	2036	2041
Male	21.2	21.6	22.0	22.3	22.7
Female	23.9	24.3	24.6	24.9	25.2

DISABLED MORTALITY RATES

This is a minor assumption, and it has little impact on the liabilities of TRS. The experience produced A/E ratios of 112% and 120% for males and females, respectively, which are reasonable matches in total considering this data has much less credibility. We currently assume members that live past normal retirement age will use the same table as healthy retirees, with a 3-year set-forward, meaning a disabled member age 70 will use the same mortality rate as a healthy member age 73. For ages prior to normal retirement age, we will assume the same 3-year set forward, but we are applying a minimum rate of 4% for males and 2% for females to reflect impaired mortality during those ages. Aside from the updating of the underlying healthy table, we are recommending no changes to these procedures.

ACTIVE MORTALITY RATES

A separate mortality table is used for active members. It is typical for active mortality to be much lower than the retiree mortality. The current mortality assumption is the RP-2014 mortality table for active employees, and applying a 90% multiplier. We recommend updating pre-retirement mortality tables for active employees to the recently published PUB(2010) mortality tables for Teachers, using the below median table (based on a combination of the group including non-teachers and for Teachers in Texas being one of the lowest paid in the country). For males, we recommend including a 2-year setback. We also recommend continuing to assume mortality rates will improve in the future using a fully generational approach, but with the ultimate rates of the most recently published projection scale ("U–MP").

DISABILITY RATES

Disability is also a minor assumption, relative to other more significant assumptions. We currently separate this assumption between members who have achieved 10 years of service and thus are eligible for a lifetime annuity and those with less than 10 years who would only receive a temporary annuity. We performed additional analysis on these reconciliations to capture members who appeared to have gone from active to terminated in one valuation, but then terminated to disabled in the next valuation, and was just a processing delay. Overall, the number of members qualifying for disability was higher than the current tables, and the difference between males and females was not meaningful. Thus, we have combined the data into one group and re-graduated the probabilities based on recent data. We will continue to add in a 1% load for members who reach the Rule of 80, but based on their benefit tier, are not eligible for unreduced benefits to reflect the fact that some members in our historical data would have qualified for disability but were eligible for unreduced retirement and thus did not apply.

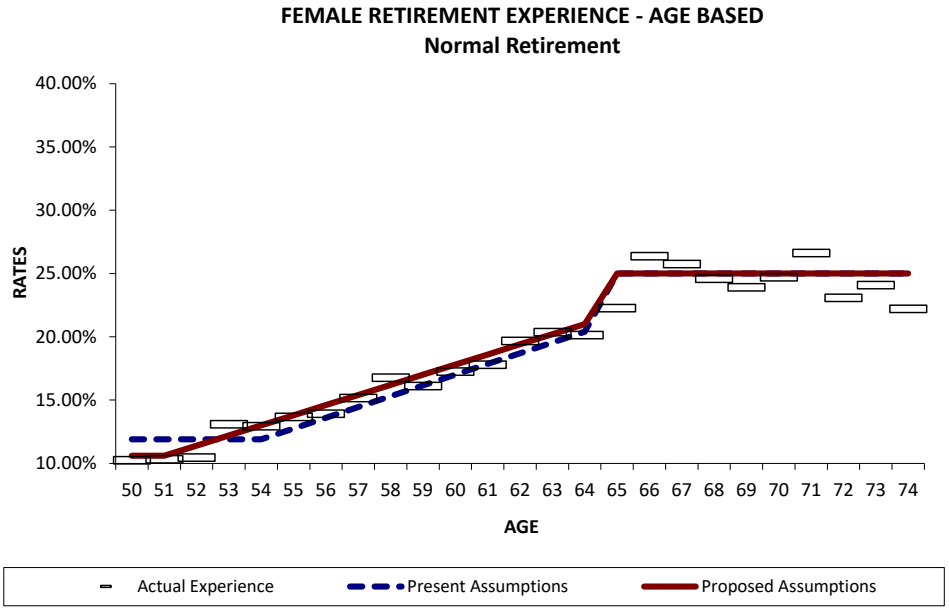
RETIREMENT RATES

We currently use retirement rates that vary by age, sex, and reduced versus unreduced retirement. There were significant changes to the TRS-Care program in 2017 and we made an adjustment at that time to reduce probabilities prior to age 65 by 15% and to add in a load at age 65 of 5%. In this analysis, we have only used data from the years since the TRS-Care changes, and overall the adjustments were close to what the actual change in behavior was. However, we would prefer a simpler approach that is not piecemeal and thus have produced a new pattern based on the post TRS-Care change period.

For this assumption, we weight the analysis by the liability of the member, to better align the pattern with the amount of liability retiring each year, vs the number of retirees. This way, a member with 30 years of service would be reflected more in the probability than a member with 10 years of service.

When we examine the core retirement ages (55 – 69) for unreduced retirement, $16.2 billion of liability retired during the three-year period compared to $16.3 billion expected. Using the weighted analysis, the A/E ratio for the core ages was approximately 99.7%, which is almost exact, but a little higher than our preferred range of 95-97%. However, the ratios were higher at the younger ages and lower at the later ages.

We have re-centered our patterns, and slightly increased our probabilities for retirement across the spectrum, but have removed the additional 5% bump at age 65. The following exhibit shows the analysis of the female experience.



These changes are immaterial to the liabilities and contribution requirements.

TERMINATION RATES

Termination rates reflect members who leave for any reason other than death, disability or service retirement. They apply whether the termination is voluntary or involuntary, and whether the member takes a refund or keeps his/her account balance on deposit in TRS. The current termination rates are composed of two distinct assumptions, one for the first ten years of service called the "select" period and a separate assumption for terminations after the ten year period called the "ultimate." The select assumption reflects the members' service and we want to continue this practice. The ultimate assumption is based on the member's time from retirement eligibility and service, and we would also recommend continuing that practice. We have analyzed the two assumption periods separately. The current tables are distinct based on gender, but the analysis of the last ten years shows there is not a meaningful difference between the genders in this pattern, and for simplification have condensed the assumption to one pattern for each.

For this assumption, we used 10 years of data. In addition, we have weighted the experience by salary, meaning instead of counting members and the number of members that terminate, we have counted payrolls and the portion of the payroll that terminates. A higher paid member has more liability than a lower paid member, and thus the termination pattern for the higher paid member will have more impact on the future liabilities of the plan. Also, in school districts, higher paid members are hired in to positions that have lower turnover (teachers, school administrators, etc.) versus lower paid members (support staff, teacher aids, etc.).

For the select period, the current assumptions produce an A/E ratio for males of 109%, but a pretty good fit to shape overall. For the ultimate period, the current assumptions produce an A/E ratio of 107%, tilted to underestimate terminations closer to retirement.

For this assumption, A/E ratios over 100% are conservative, and we prefer to be in the 105% range to allow for rehiring and returning to employment after a period of inactivity, either due to a non-school district period of employment or a period of years of maternity leave.

We have recommended adjustments to the slope and the magnitude of the assumption to better match experience. These changes will slightly lower the liabilities and contribution requirements.

OTHER ASSUMPTIONS AND REFUNDS

There are other assumptions made in the course of a valuation, such as the percentage of members who are married, the age difference between members and spouses, the likelihood that a terminating employee will take a refund, etc. We reviewed these, and believe these are generally realistic or conservative, so we decided to recommend no changes to these other assumptions.

ACTUARIAL METHODS

We have received all of the actuarial methods, such as the funding method, the asset smoothing methods, and how contribution rates and funding period are determined. We recommend no changes to any of those methods.

SECTION IV – ACTUARIAL IMPACT OF RECOMMENDATIONS

Item	2021 Valuation Current Assumptions	Projected 2022 Valuation Recommended Package of Assumptions
(1)	(2)	(4)
1. Investment Return Assumption	7.25%	7.00%
2. Ultimate Salary Scale Assumption	3.05%	2.95%
3. Payroll Growth Assumption	3.00%	2.90%
4. Unfunded actuarial accrued liability	$47.6	$49.7
5. Funding period (years)	23	26
6. Funded ratio	79.1%	79.6%

All dollar amount in $ billions

Funding period is based on member, employer, and state contribution rates for fiscal year 2022 and beyond as specified by statute.

*Includes load for administrative expenses

Section V – Summary of Assumptions and Methods Incorporating the Recommended Assumptions

1. Investment Return Rate — 7.00% per annum, compounded annually, composed of an assumed 2.30% inflation rate and a 4.70% real rate of return, net of investment expenses

2. Mortality, Termination, Disability Retirement, and Service Retirement Rates:

   Rates and scales developed in the actuarial investigation as August 31, 2021, with values at specimen ages shown in the tables below:

   a. Active Mortality: Based on the PUB(2010), Amount-Weighted, Below-Median Income, Teacher, Male and Female tables, with a 2-year set forward for male. The rates are projected on a fully generational basis by the long-term rates of scale UMP 2021 to account for future mortality improvements. Below are the samples rates for 2021 and 2051.

	2021 Mortality Rates			2051 Mortality Rates	
Age	**Male**	**Female**	**Age**	**Male**	**Female**
20	0.000250	0.000112	**20**	0.000166	0.000074
30	0.000293	0.000146	**30**	0.000195	0.000097
40	0.000577	0.000344	**40**	0.000384	0.000229
50	0.001550	0.000801	**50**	0.001031	0.000533
60	0.003729	0.001757	**60**	0.002480	0.001168
70	0.009921	0.005370	**70**	0.006823	0.003693
80	0.036755	0.020525	**80**	0.026375	0.014729
90	0.157790	0.096885	**90**	0.130539	0.080152

   b. Rates of Termination

Probability of Decrement Due to Termination

Years of Service	Male/Female
1	0.143011
2	0.121016
3	0.101138
4	0.080224
5	0.072583
6	0.064553
7	0.056077
8	0.049875
9	0.044869
10	0.041029

The following table is used for all years after the first ten years of employment.

Probability of Decrement Due to Termination Based on Years from Normal Retirement

Years from NR	Male/Female	Years from NR	Male/Female
1	0.016910	**17**	0.026005
2	0.018788	**18**	0.026231
3	0.019981	**19**	0.026448
4	0.020874	**20**	0.026654
5	0.021593	**21**	0.026853
6	0.022200	**22**	0.027043
7	0.022726	**23**	0.027226
8	0.023191	**24**	0.027403
9	0.023610	**25**	0.027573
10	0.023991	**26**	0.027738
11	0.024341	**27**	0.027898
12	0.024664	**28**	0.028052
13	0.024966	**29**	0.028202
14	0.025249	**30**	0.028348
15	0.025515	**31**	0.028489
16	0.025766	**32**	0.028627

c. Rates of Disability Retirement

The disability retirement rates for members once they reach the Rule of 80 but not eligible for unreduced retirement are adjusted by an additional 1%.

Probability of Decrement Due to Disability

	For Service >= 10	For Service < 10
Age	**Male/Female**	**Male/Female**
20	0.000149	0.000006
30	0.000249	0.000010
40	0.000332	0.000013
50	0.001692	0.000068
60	0.005945	0.000238

d. Rates of Retirement

Age	Normal Retirement		Age	Early Retirement
	Male	Female		Male/Female
50	0.1100	0.1060	**45**	0.0060
51	0.1100	0.1060	**46**	0.0060
52	0.1100	0.1140	**47**	0.0060
53	0.1100	0.1220	**48**	0.0060
54	0.1100	0.1300	**49**	0.0060
55	0.1100	0.1380	**50**	0.0060
56	0.1200	0.1460	**51**	0.0060
57	0.1300	0.1540	**52**	0.0060
58	0.1400	0.1620	**53**	0.0060
59	0.1500	0.1700	**54**	0.0060
60	0.1500	0.1780	**55**	0.0060
61	0.1600	0.1860	**56**	0.0060
62	0.1700	0.1940	**57**	0.0060
63	0.1800	0.2020	**58**	0.0060
64	0.1900	0.2100	**59**	0.0060
65	0.2300	0.2500	**60**	0.0100
66	0.2300	0.2500	**61**	0.0200
67	0.2300	0.2500	**62**	0.0300
68	0.2300	0.2500	**63**	0.0400
69	0.2300	0.2500	**64**	0.0500
70	0.2500	0.2500	**65**	0.0500
71	0.2500	0.2500		
72	0.2500	0.2500		
73	0.2500	0.2500		
74	0.2500	0.2500		
75	1.0000	1.0000		

For members hired after August 31, 2007 and who are vested as of August 31, 2014, the retirement rates for members once they reach unreduced retirement eligibility at age 60 are increased 10% for each year the member is beyond the Rule of 80 (i.e. if the member reached the Rule of 80 at age 58 then the probability of retirement at age 60 is 120% of the rate shown above).

For members hired after August 31, 2007 and who are not vested as of August 31, 2014, or, for members hired after August 31, 2014, the retirement rates for members once they reach unreduced retirement eligibility at age 62 are increased 10% for each year the member is beyond the Rule of 80 (i.e. if the member reached the Rule of 80 at age 58 then the probability of retirement at age 62 is 140% of the rate shown above).

3. Rates of Salary Increase

Inflation rate of 2.30%, plus a merit and productivity component of 0.65%, plus step-rate/promotional component as shown:

Years of Service	Merit, Promotion, Longevity		General		Total	
1	6.00	%	2.95	%	8.95	%
2	2.50		2.95		5.45	
3	1.80		2.95		4.75	
4	1.50		2.95		4.45	
5	1.30		2.95		4.25	
6	1.20		2.95		4.15	
7	1.10		2.95		4.05	
8	1.00		2.95		3.95	
9	0.95		2.95		3.90	
10	0.90		2.95		3.85	
11	0.85		2.95		3.80	
12	0.80		2.95		3.75	
13	0.75		2.95		3.70	
14	0.65		2.95		3.60	
15	0.60		2.95		3.55	
16	0.55		2.95		3.50	
17	0.45		2.95		3.40	
18	0.40		2.95		3.35	
19	0.35		2.95		3.30	
20	0.30		2.95		3.25	
21	0.25		2.95		3.20	
22	0.20		2.95		3.15	
23	0.15		2.95		3.10	
24	0.10		2.95		3.05	
25 & up	0.00		2.95		2.95	

4. Post-retirement Mortality: The 2021 TRS of Texas Healthy Pensioner Mortality Tables. The rates are projected on a fully generational basis by the long-term rates of scale UMP 2021 to account for future mortality improvements. These tables are developed based on the experience in the actuarial investigation as of August 31, 2021 Below are the samples rates for 2021 and 2051.

	2021 Mortality Rates			2051 Mortality Rates	
Age	**Male**	**Female**	**Age**	**Male**	**Female**
40	0.000611	0.000419	**40**	0.000406	0.000279
50	0.001782	0.001096	**50**	0.001185	0.000729
60	0.006049	0.004261	**60**	0.004036	0.002834
70	0.013223	0.008454	**70**	0.009205	0.005623
80	0.044291	0.030552	**80**	0.033162	0.020321
90	0.156994	0.115687	**90**	0.135483	0.076948
100	0.380070	0.317033	**100**	0.353636	0.210871
110	0.390080	0.473135	**110**	0.385426	0.314701
120	1.000000	1.000000	**120**	1.000000	1.000000

For disabled retirees, a three-year set forward of the above tables are used, with a minimum mortality rates of 0.0200 for female and 0.0400 for male.

	2021 Mortality Rates			2051 Mortality Rates	
Age	**Male**	**Female**	**Age**	**Male**	**Female**
40	0.040000	0.020000	**40**	0.040000	0.020000
50	0.040000	0.020000	**50**	0.040000	0.020000
60	0.040000	0.020000	**60**	0.040000	0.020000
70	0.040000	0.020000	**70**	0.040000	0.020000
80	0.064255	0.047041	**80**	0.048109	0.031289
90	0.212628	0.156813	**90**	0.183494	0.104303
100	0.472711	0.414316	**100**	0.439834	0.275578
110	0.271640	0.440120	**110**	0.268399	0.292741
120	1.000000	1.000000	**120**	1.000000	1.000000

HANDLING OF ACTIVE DATA WITH MISSING INFORMATION:

As of the close of each fiscal year there is a large number of records for whom no statistical data has been received. The only information TRS has are social security number and initial contributions. Any of these records that were in the prior year's data are treated as non-vested terminated members. The remaining records are treated as new entrants. These records are added to the count of active members, but have no liability.

There are other records provided by TRS that have missing gender and/or missing date of births. These records are handled as follows:

1. 80% of records with missing gender are assumed to be female. The overall male/female ratio of the active membership is used to set this assumption.

2. Records with missing dates of birth are assigned a date of birth that produces an entry age equal to the average entry age for the overall active population, based on the member's actual service.

ASSUMPTION FOR DROP PARTICIPATION

Current active members are not eligible to participate in DROP, therefore no new DROP members are assumed.

BENEFIT ELECTION OF VESTED TERMINATING MEMBERS:

In determining the liabilities developed for future terminating vested members, it is assumed that the member elects either a refund or a deferred vested benefit, whichever is more valuable. The deferred benefit is assumed to commence at the earliest age the member is eligible for unreduced retirement.

ELECTION RATES FOR ACTIVE MEMBER DEATH BENEFITS:

It is assumed that the beneficiary will elect the death benefit option with the greatest value.

DECREMENT TIMING:

Retirement is assumed to occur at the end of the year. Termination from service is assumed to occur at the beginning of the year. All other decrements are assumed to occur mid-year.

BENEFIT ELECTION OPTIONS:

It is assumed that future healthy retirees will select the normal form of payment. For disabled members, 80% are assumed to select the normal form of payment and 20% to select the 100% joint and survivor option.

MARRIAGE ASSUMPTION:

While not implicitly used in the valuation, 100% of active members are assumed to be married when setting other benefit election and eligibility assumptions.

SPOUSAL AGE DIFFERENCE:

Husbands are assumed to be three years older than their wives.

CLASSIFICATION OF WHO ARE ACTIVE MEMBERS:

Members who contributed during the just-completed plan year but did not retire before August 31st are considered active.

AVERAGE SURVIVOR BENEFIT LIABILITY:

One of the options on the death of an active member, a disabled member, or a retired member is a survivor benefit. To determine the liability for this benefit the following average values are used.

		Males	Females
1.	Active member	$62,200	$59,000
2.	Disabled member	$13,000	$11,000
3.	Retired member	$12,000	$12,000

ACTUARIAL VALUE OF ASSETS:

A. The actuarial value of assets is equal to the market value of assets less a five-year phase in of the excess/(shortfall) between expected investment return and actual income. The actual calculation is based on the difference between actual market value and the expected actuarial value of assets each year, and recognizes the cumulative excess return (or shortfall) over a minimum rate of 20% per year. Each year a base is set up to reflect this difference. If the current year's base is of opposite sign to the deferred bases then it is offset dollar for dollar against the deferred bases. Any remaining bases are then recognized over the remaining period for the base (5 less the number of years between the bases year and the valuation year). This is intended to ensure the smoothed value of assets will converge towards the market value in a reasonable amount of time.

B. Expected earnings are determined using the assumed investment return rate and the beginning of year actuarial value of assets (adjusted for receipts and disbursements during the year). Beginning in fiscal year 2016, the returns are computed net of investment expenses.

ACTUARIAL COST METHOD:

The actuarial valuation is used to determine the adequacy of the State contribution rate (established by Legislative appropriation) and employer contribution rate (established by statute) and to describe the current financial condition of TRS.

The actuarial valuation uses the Entry Age Normal actuarial cost method. Under this method, the first step is to determine the contribution rate (level as a percentage of pay) required to provide

the benefits to each member, or the normal cost rate. The normal cost rate consists of two pieces: (i) the member's contribution rate, and (ii) the remaining portion of the normal cost rate which is the employer's normal cost rate. The total normal cost rate is based on the benefits payable to each individual active member.

The Unfunded Actuarial Accrued Liability (UAAL) is the liability for future benefits which is in excess of (i) the actuarial value of assets, and (ii) the present value of future normal costs. The employer contribution provided in excess of the employer normal cost is applied to amortize the UAAL.

The funding period is calculated as the number of years required to fully amortize the UAAL, and is calculated with the use of an open group projection that takes into account: (a) future market earnings, net of investment-related expenses, will equal 7.00% per year, (b) there will be no changes in assumptions, (c) the number of active members will remain unchanged, (d) active members who leave employment will be replaced by new entrants each year, and (e) State and employer contributions will remain the same percentage of payroll.

The Entry Age actuarial cost method is an "immediate gain" method (i.e., experience gains and losses are separately identified as part of the UAAL). However, they are amortized over the same period applied to all other components of the UAAL.

PROJECTED PAYROLL FOR CONTRIBUTIONS:

The aggregate projected payroll for the fiscal year following the valuation date is calculated by increasing the actual payroll paid during the previous fiscal year by the payroll growth rate.

PROJECTION OF CONTRIBUTIONS FOR FUNDING OF UNFUNDED ACTUARIAL ACCRUED LIABILITY:

Total payroll is expected to grow at 2.90% per year. The total general wage increase assumption of 2.90% is made up of an inflation rate of 2.30% plus a 0.60% productivity component. This value is used to increase the wages for each annual cohort of new entrants in an open group projection based on the current demographics and the current assumptions. In addition, annually, the dollar amount of contributions received from employers on non-OASDI payroll is divided by actual payroll for that fiscal year to determine an estimated effective rate of total payroll, and projected at the same 2.90% growth rate.

USE OF CELLED DATA:

For valuation purposes, every record in the census is valued individually.

For legislative purposes, the active valuation data is celled by benefit tier, gender, years of service, month and year of birth. Each individual cell is valued using the sum of the salary and account balances of the members in the cell. Every year we test this approach against using the individual records and the results are consistently less than 0.02% different in total present value of benefits.

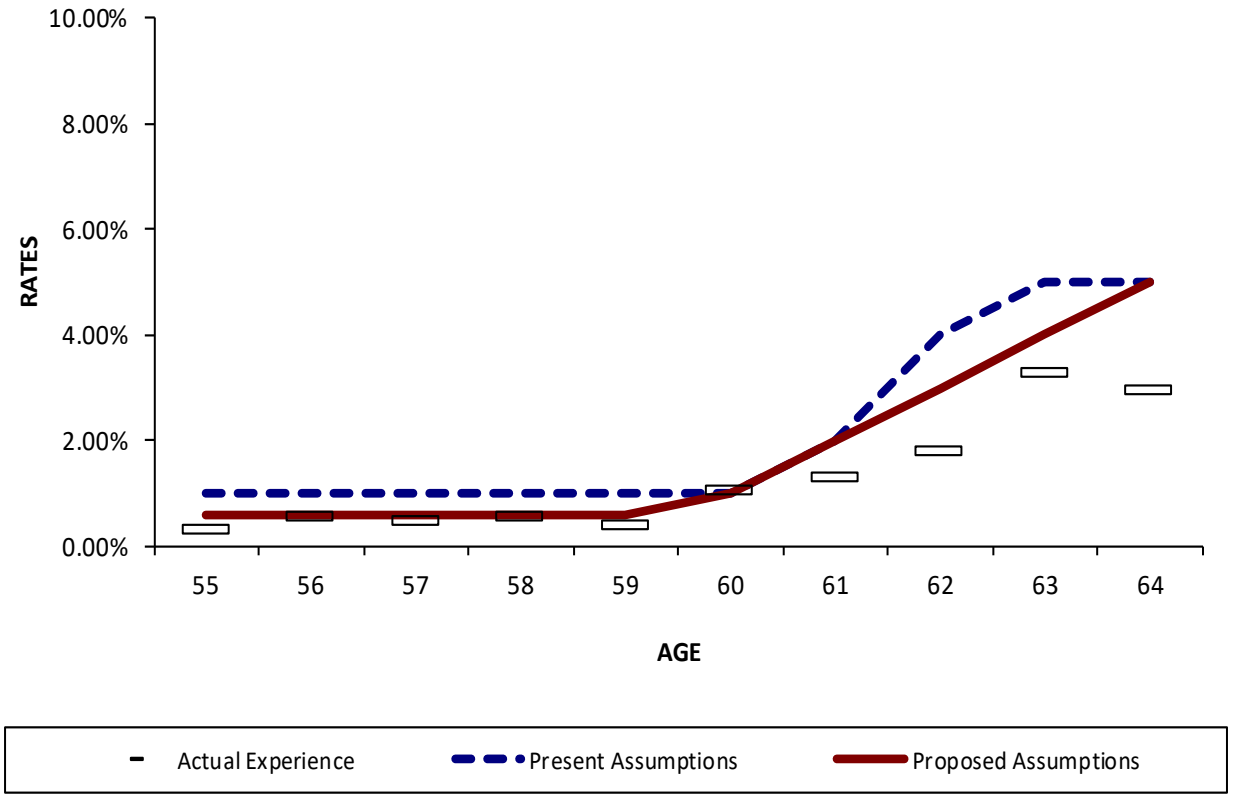
SECTION VI

SUMMARY OF DATA AND EXPERIENCE

TEACHER RETIREMENT SYSTEM
MALE RETIREMENT EXPERIENCE - AGE BASED
Early Retirement

Age	Actual Retirement Weighted By Liability $M	Total Liability $M	Actual Rate	Assumed Rate		Expected Retirement Weighted By Liability $M		Actual/Expected	
				Current	Proposed	Current (3) * (5)	Proposed (3) * (6)	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
55	$71	$20,493	0.003	1.00%	0.60%	$205	$123	35%	58%
56	110	18,500	0.006	1.00%	0.60%	185	111	60%	99%
57	86	17,006	0.005	1.00%	0.60%	170	102	51%	84%
58	86	14,624	0.006	1.00%	0.60%	146	88	59%	97%
59	56	13,018	0.004	1.00%	0.60%	130	78	43%	72%
60	122	11,262	0.011	1.00%	1.00%	113	113	108%	108%
61	124	9,507	0.013	2.00%	2.00%	190	190	65%	65%
62	147	8,021	0.018	4.00%	3.00%	321	241	46%	61%
63	219	6,642	0.033	5.00%	4.00%	332	266	66%	82%
64	158	5,308	0.030	5.00%	5.00%	265	265	60%	60%
Total	$1,178	$124,381	0.009			$2,057	$1,577	57%	75%

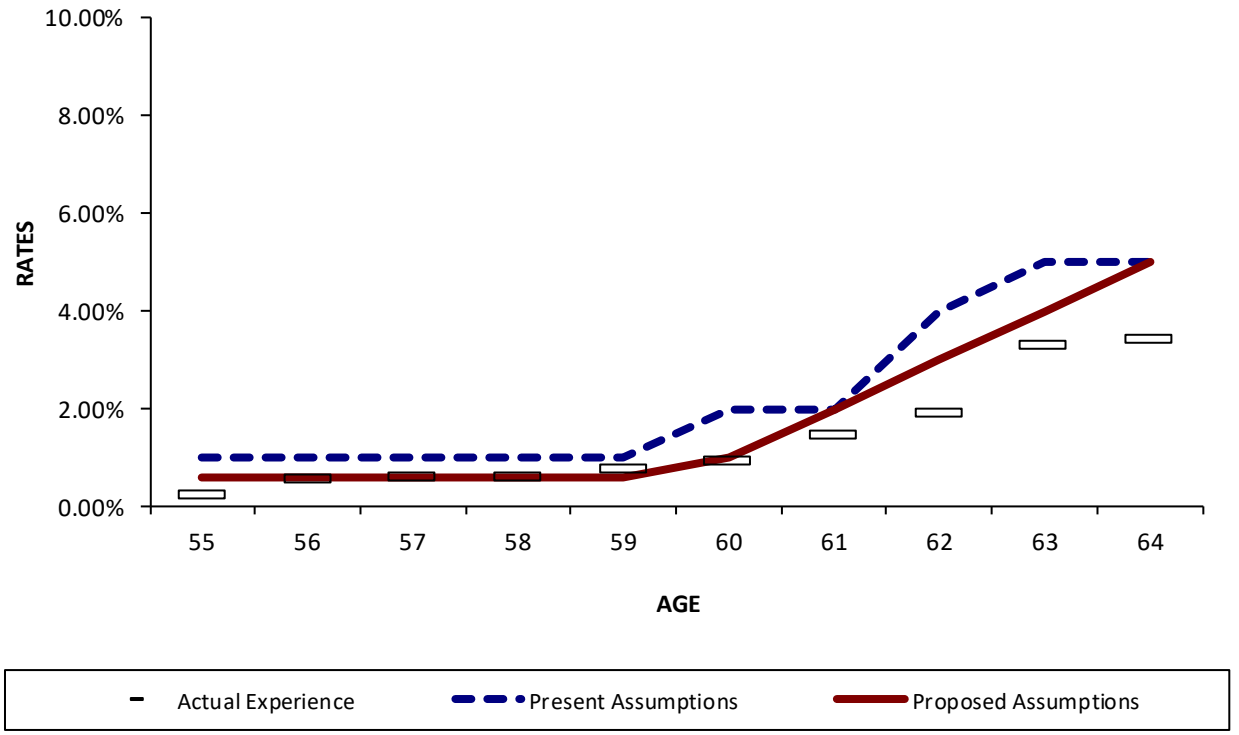
MALE RETIREMENT EXPERIENCE - AGE BASED
Early Retirement



TEACHER RETIREMENT SYSTEM
FEMALE RETIREMENT EXPERIENCE - AGE BASED
Early Retirement

Age	Actual Retirement Weighted By Liability $M	Total Liability $M	Actual Rate	Assumed Rate		Expected Retirement Weighted By Liability $M		Actual/Expected	
				Current	Proposed	Current (3) * (5)	Proposed (3) * (6)	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
55	$144	$57,899	0.002	1.00%	0.60%	$579	$347	25%	42%
56	302	52,770	0.006	1.00%	0.60%	528	317	57%	95%
57	291	47,790	0.006	1.00%	0.60%	478	287	61%	101%
58	258	41,029	0.006	1.00%	0.60%	410	246	63%	105%
59	274	34,212	0.008	1.00%	0.60%	342	205	80%	134%
60	264	27,806	0.009	2.00%	1.00%	556	278	47%	95%
61	326	22,067	0.015	2.00%	2.00%	441	441	74%	74%
62	333	17,094	0.019	4.00%	3.00%	684	513	49%	65%
63	429	12,874	0.033	5.00%	4.00%	644	515	67%	83%
64	327	9,554	0.034	5.00%	5.00%	478	478	68%	68%
Total	$2,949	$323,095	0.009			$5,140	$3,627	57%	81%

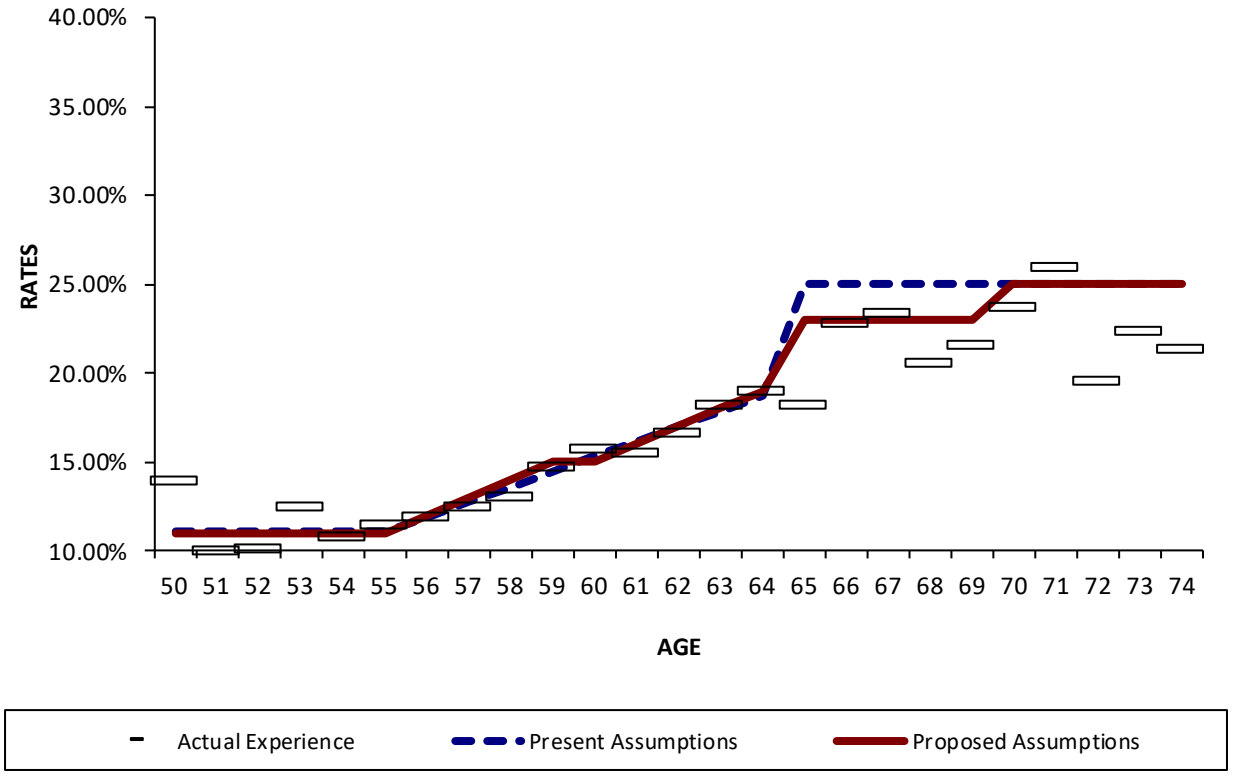
FEMALE RETIREMENT EXPERIENCE - AGE BASED
Early Retirement



TEACHER RETIREMENT SYSTEM
MALE RETIREMENT EXPERIENCE - AGE BASED
Normal Retirement

Age	Actual Retirement Weighted By Liability $M	Total Liability $M	Actual Rate	Assumed Rate		Expected Retirement Weighted By Liability $M		Actual/Expected	
				Current	Proposed	Current (3) * (5)	Proposed (3) * (6)	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
50	$85	$609	0.139	11%	11%	$67	$67	127%	127%
51	216	2,152	0.101	11%	11%	238	237	91%	91%
52	960	9,457	0.101	11%	11%	1,045	1,040	92%	92%
53	1,836	14,733	0.125	11%	11%	1,628	1,621	113%	113%
54	1,850	17,102	0.108	11%	11%	1,890	1,881	98%	98%
55	2,197	19,075	0.115	11%	11%	2,108	2,098	104%	105%
56	2,365	19,831	0.119	12%	12%	2,360	2,380	100%	99%
57	2,546	20,450	0.125	13%	13%	2,607	2,658	98%	96%
58	2,748	21,146	0.130	14%	14%	2,876	2,960	96%	93%
59	3,036	20,653	0.147	14%	15%	2,984	3,098	102%	98%
60	3,083	19,608	0.157	15%	15%	3,000	2,941	103%	105%
61	2,959	19,035	0.155	16%	16%	3,074	3,046	96%	97%
62	3,017	18,154	0.166	17%	17%	3,086	3,086	98%	98%
63	3,088	16,901	0.183	18%	18%	3,017	3,042	102%	101%
64	2,927	15,419	0.190	19%	19%	2,883	2,930	102%	100%
65	3,264	17,910	0.182	25%	23%	4,478	4,119	73%	79%
66	3,420	14,984	0.228	25%	23%	3,746	3,446	91%	99%
67	2,792	11,909	0.234	25%	23%	2,977	2,739	94%	102%
68	1,867	9,060	0.206	25%	23%	2,265	2,084	82%	90%
69	1,534	7,089	0.216	25%	23%	1,772	1,630	87%	94%
70	1,248	5,260	0.237	25%	25%	1,315	1,315	95%	95%
71	1,075	4,133	0.260	25%	25%	1,033	1,033	104%	104%
72	611	3,126	0.195	25%	25%	781	781	78%	78%
73	608	2,716	0.224	25%	25%	679	679	90%	90%
74	442	2,070	0.214	25%	25%	517	517	86%	86%
Total	$49,773	$312,582	0.159			$52,426	$51,428	95%	97%

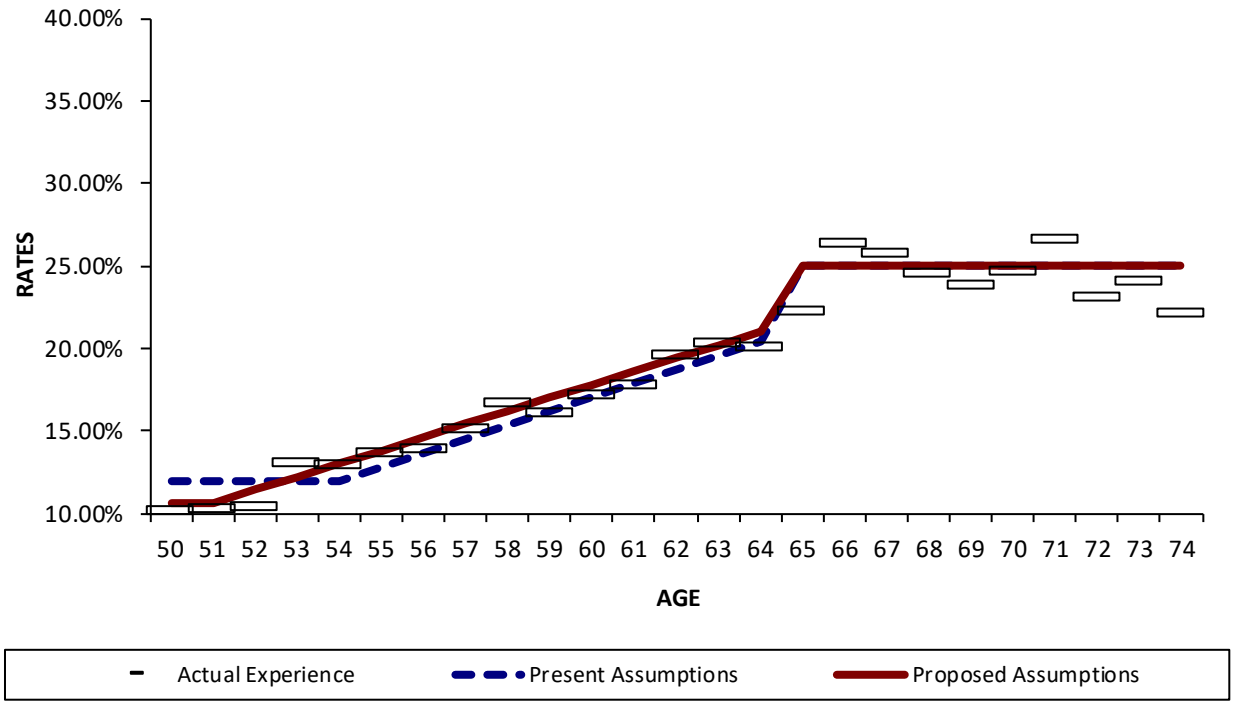
MALE RETIREMENT EXPERIENCE - AGE BASED
Normal Retirement



TEACHER RETIREMENT SYSTEM
FEMALE RETIREMENT EXPERIENCE - AGE BASED
Normal Retirement

				Assumed Rate		Expected Retirement Weighted By Liability $M		Actual/Expected	
Age	Actual Retirement Weighted By Liability $M	Total Liability $M	Actual Rate	Current	Proposed	Current (3) * (5)	Proposed (3) * (6)	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
50	$119	$1,163	0.102	12%	11%	$138	$123	86%	97%
51	815	7,898	0.103	12%	11%	940	837	87%	97%
52	2,844	27,186	0.105	12%	11%	3,235	3,099	88%	92%
53	4,868	37,181	0.131	12%	12%	4,425	4,536	110%	107%
54	5,310	41,067	0.129	12%	13%	4,887	5,339	109%	99%
55	6,189	45,296	0.137	13%	14%	5,775	6,251	107%	99%
56	6,771	48,655	0.139	14%	15%	6,617	7,104	102%	95%
57	8,043	53,025	0.152	14%	15%	7,662	8,166	105%	98%
58	9,229	55,022	0.168	15%	16%	8,418	8,914	110%	104%
59	9,099	56,517	0.161	16%	17%	9,128	9,608	100%	95%
60	9,818	56,892	0.173	17%	18%	9,672	10,127	102%	97%
61	9,787	55,002	0.178	18%	19%	9,818	10,230	100%	96%
62	10,227	51,976	0.197	19%	19%	9,720	10,083	105%	101%
63	9,527	46,764	0.204	20%	20%	9,142	9,446	104%	101%
64	8,511	42,291	0.201	20%	21%	8,627	8,881	99%	96%
65	9,833	44,184	0.223	25%	25%	11,046	11,046	89%	89%
66	9,407	35,682	0.264	25%	25%	8,921	8,921	105%	105%
67	6,834	26,553	0.257	25%	25%	6,638	6,638	103%	103%
68	4,914	19,997	0.246	25%	25%	4,999	4,999	98%	98%
69	3,596	15,049	0.239	25%	25%	3,762	3,762	96%	96%
70	2,875	11,640	0.247	25%	25%	2,910	2,910	99%	99%
71	2,325	8,740	0.266	25%	25%	2,185	2,185	106%	106%
72	1,529	6,626	0.231	25%	25%	1,656	1,656	92%	92%
73	1,188	4,933	0.241	25%	25%	1,233	1,233	96%	96%
74	786	3,542	0.222	25%	25%	885	885	89%	89%
Total	$144,442	$802,882	0.180			$142,439	$146,979	101%	98%

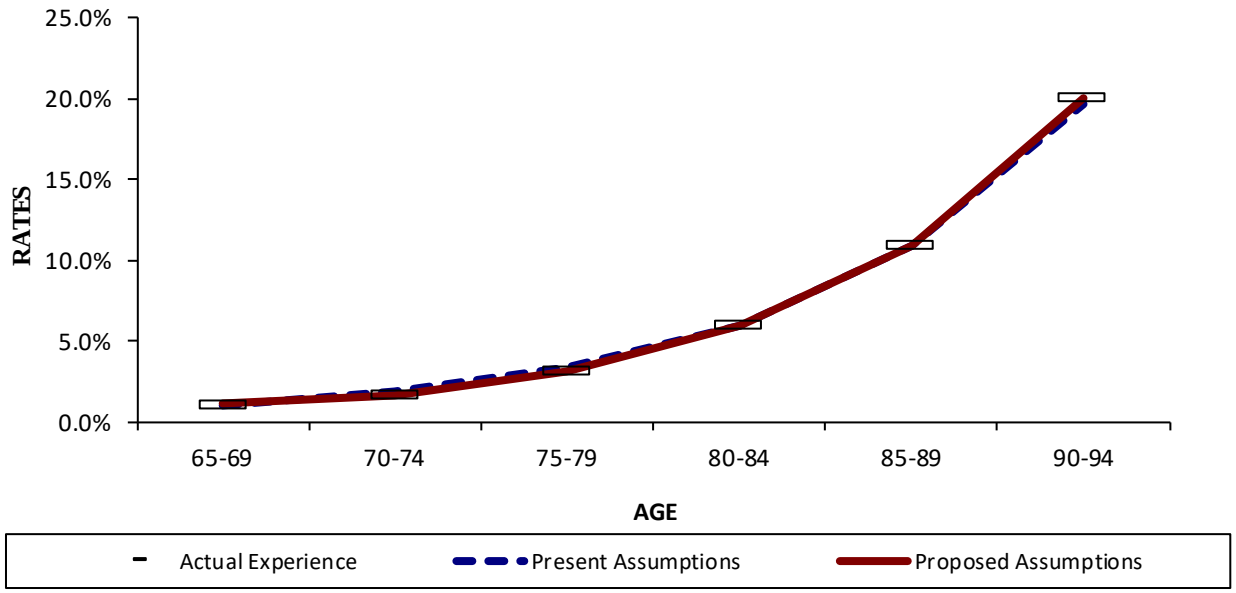
FEMALE RETIREMENT EXPERIENCE - AGE BASED
Normal Retirement



TEACHER RETIREMENT SYSTEM OF TEXAS
POST-RETIREMENT MORTALITY - HEALTHY MALE
Weighted by Annual Benefits in $ in Millions

Age	Actual Death Weighted by Annuity $M	Total Annuity $M	Actual Rate	Assumed Rate		Expected Deaths Weighted By Annuity $M		Actual/Expected	
				Current	Proposed	Current (3) * (5)	Proposed (3) * (6)	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
55-59	$7	$929	0.0072	0.0038	0.0046	$4	$4	190%	157%
60-64	15	1,969	0.0078	0.0057	0.0078	11	15	137%	100%
65-69	31	2,749	0.0112	0.0103	0.0112	28	31	109%	100%
70-74	40	2,318	0.0171	0.0185	0.0171	43	40	92%	100%
75-79	47	1,488	0.0318	0.0335	0.0318	50	47	95%	100%
80-84	61	1,015	0.0600	0.0604	0.0600	61	61	99%	100%
85-89	63	575	0.1093	0.1089	0.1093	63	63	100%	100%
90-94	41	202	0.2004	0.1966	0.2004	40	41	102%	100%
95-99	12	41	0.2957	0.3551	0.2957	14	12	83%	100%
100-104	1	3	0.3532	0.4971	0.4492	2	2	71%	79%
105-109	0	0	0.3765	0.4981	0.5647	0	0	76%	67%
Totals	$317	$11,289	0.0281	0.0280	0.0279	$316	$315	101%	101%

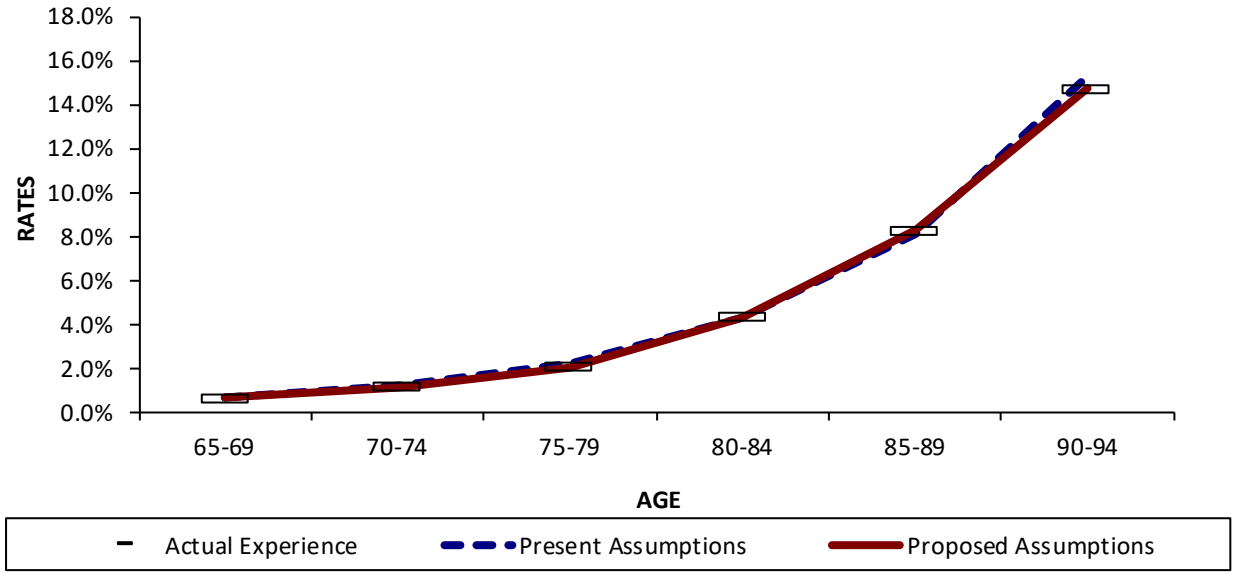
MALE POST-RETIREMENT MORTALITY



TEACHER RETIREMENT SYSTEM OF TEXAS
POST-RETIREMENT MORTALITY - HEALTHY FEMALE
Weighted by Annual Benefits in $ in Millions

Age	Actual Death Weighted by Annuity $M	Total Annuity $M	Actual Rate	Assumed Rate		Expected Deaths Weighted By Annuity $M		Actual/Expected	
				Current	Proposed	Current (3) * (5)	Proposed (3) * (6)	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
55-59	$11	$2,744	0.0041	0.0022	0.0041	$6	$11	178%	100%
60-64	30	6,262	0.0047	0.0033	0.0047	22	30	137%	98%
65-69	53	8,131	0.0065	0.0062	0.0065	51	54	102%	98%
70-74	66	5,836	0.0113	0.0118	0.0113	68	65	97%	101%
75-79	70	3,389	0.0206	0.0224	0.0206	75	70	93%	100%
80-84	90	2,088	0.0431	0.0425	0.0431	88	89	102%	101%
85-89	101	1,223	0.0826	0.0807	0.0826	97	99	104%	102%
90-94	69	468	0.1472	0.1532	0.1472	69	66	100%	104%
95-99	31	136	0.2307	0.2910	0.2307	38	30	84%	104%
100-104	9	25	0.3589	0.4971	0.3881	12	9	77%	100%
105-109	1	2	0.4714	0.4981	0.5127	1	1	95%	96%
Totals	$530	$30,305	0.0175	0.0174	0.0173	$526	$524	101%	101%

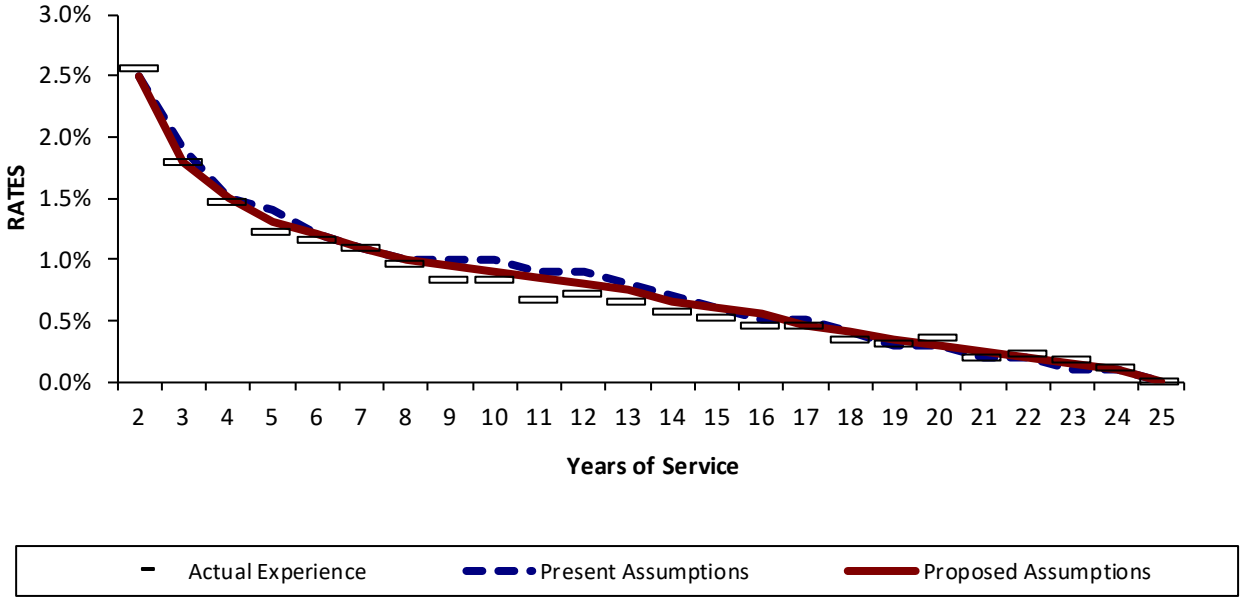
FEMALE POST-RETIREMENT MORTALITY



TEACHER RETIREMENT SYSTEM OF TEXAS
Service-Based Salary Rates

	Current Salary Scale		Actual Experience			Proposed Salary Scale	
Years of Service	Total	Step Rate/ Promotional	Total	Above Inflation	Step Rate/ Promotional	Total	Step Rate/ Promotional
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	9.05%	6.00%	18.25%	16.34%	15.79%	8.95%	6.00%
2	5.55%	2.50%	5.01%	3.11%	2.55%	5.45%	2.50%
3	4.95%	1.90%	4.25%	2.34%	1.79%	4.75%	1.80%
4	4.55%	1.50%	3.91%	2.01%	1.46%	4.45%	1.50%
5	4.45%	1.40%	3.67%	1.76%	1.21%	4.25%	1.30%
6	4.25%	1.20%	3.61%	1.70%	1.15%	4.15%	1.20%
7	4.15%	1.10%	3.53%	1.63%	1.08%	4.05%	1.10%
8	4.05%	1.00%	3.41%	1.51%	0.95%	3.95%	1.00%
9	4.05%	1.00%	3.28%	1.37%	0.82%	3.90%	0.95%
10	4.05%	1.00%	3.28%	1.38%	0.83%	3.85%	0.90%
11	3.95%	0.90%	3.12%	1.21%	0.66%	3.80%	0.85%
12	3.95%	0.90%	3.16%	1.26%	0.71%	3.75%	0.80%
13	3.85%	0.80%	3.09%	1.19%	0.64%	3.70%	0.75%
14	3.75%	0.70%	3.02%	1.12%	0.57%	3.60%	0.65%
15	3.65%	0.60%	2.96%	1.06%	0.51%	3.55%	0.60%
16	3.55%	0.50%	2.91%	1.00%	0.45%	3.50%	0.55%
17	3.55%	0.50%	2.89%	0.99%	0.44%	3.40%	0.45%
18	3.45%	0.40%	2.78%	0.88%	0.33%	3.35%	0.40%
19	3.35%	0.30%	2.76%	0.86%	0.31%	3.30%	0.35%
20	3.35%	0.30%	2.81%	0.90%	0.35%	3.25%	0.30%
21	3.25%	0.20%	2.64%	0.74%	0.19%	3.20%	0.25%
22	3.25%	0.20%	2.68%	0.77%	0.22%	3.15%	0.20%
23	3.15%	0.10%	2.63%	0.73%	0.18%	3.10%	0.15%
24	3.15%	0.10%	2.56%	0.66%	0.11%	3.05%	0.10%
25	3.05%	0.00%	2.45%	0.55%	0.00%	2.95%	0.00%

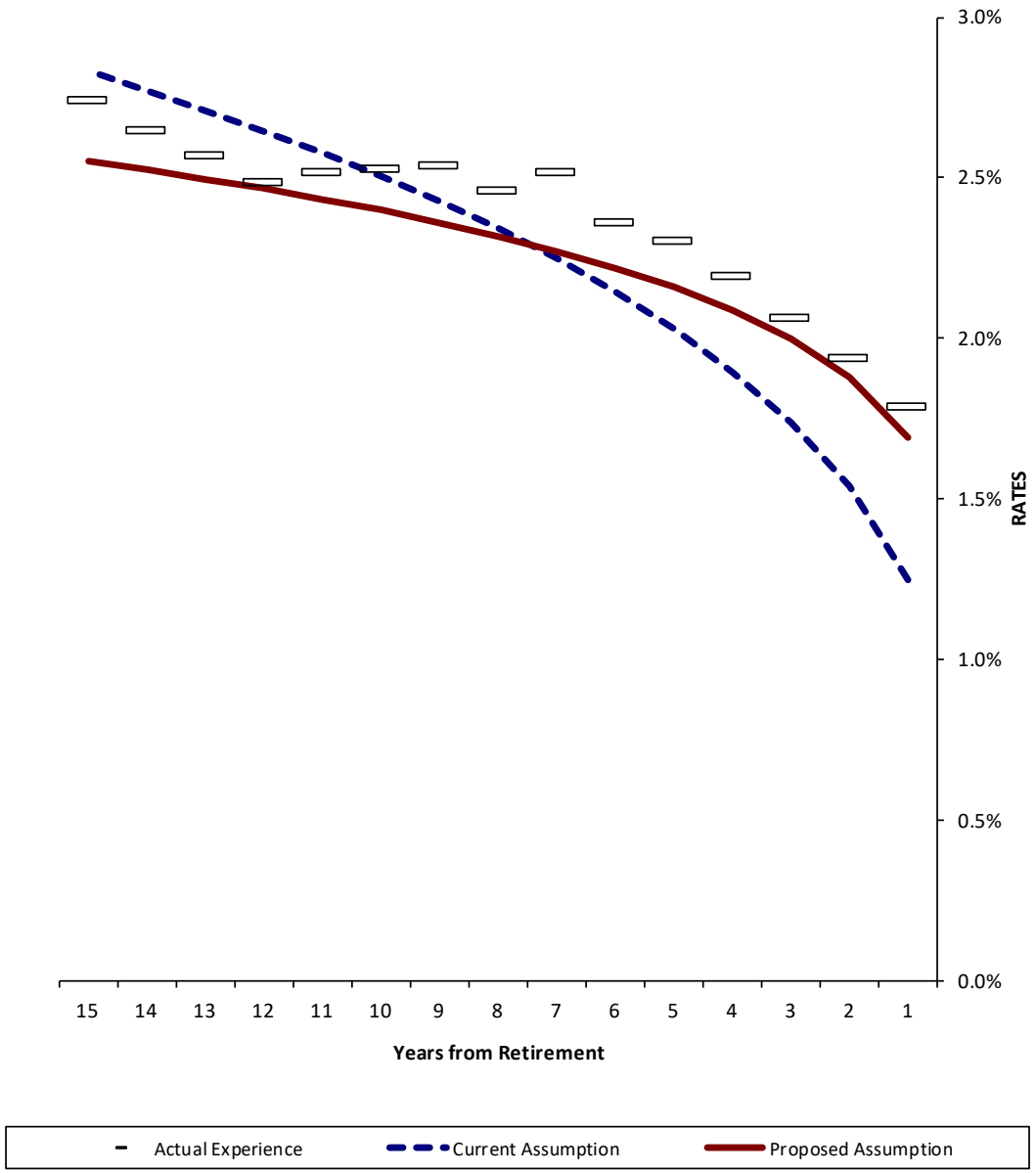
Service-Based Salary Rates
(Step Rates Only)



TEACHER RETIREMENT SYSTEM OF TEXAS
TERMINATION EXPERIENCE - YEARS FROM RETIREMENT

				Assumed Rate		Expected Termination Weighted By Salary		Actual/Expected	
Years from Retirement	Actual Termination Weighted By Salary $M	Total Salary $M	Actual Rate	Current	Proposed	Current	Proposed	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	$1,249	$69,772	0.0179	0.0125	0.0169	$871	$1,180	143%	106%
2	1,425	73,537	0.0194	0.0154	0.0188	1,131	1,382	126%	103%
3	1,592	77,079	0.0206	0.0174	0.0200	1,340	1,540	119%	103%
4	1,759	80,230	0.0219	0.0190	0.0209	1,522	1,675	116%	105%
5	1,870	81,114	0.0231	0.0203	0.0216	1,646	1,752	114%	107%
6	1,901	80,466	0.0236	0.0215	0.0222	1,726	1,786	110%	106%
7	1,995	79,210	0.0252	0.0225	0.0227	1,781	1,800	112%	111%
8	1,920	77,979	0.0246	0.0234	0.0232	1,825	1,808	105%	106%
9	1,925	75,857	0.0254	0.0243	0.0236	1,840	1,791	105%	107%
10	1,882	74,435	0.0253	0.0250	0.0240	1,863	1,786	101%	105%
11	1,858	73,715	0.0252	0.0258	0.0243	1,899	1,794	98%	104%
12	1,732	69,697	0.0249	0.0265	0.0247	1,843	1,719	94%	101%
13	1,670	64,914	0.0257	0.0271	0.0250	1,759	1,621	95%	103%
14	1,563	59,002	0.0265	0.0277	0.0252	1,636	1,490	96%	105%
15	1,415	51,643	0.0274	0.0283	0.0255	1,462	1,318	97%	107%
Totals	$25,755	$1,088,650				$24,144	$24,441	107%	105%

TERMINATION EXPERIENCE - YEARS FROM RETIREMENT



TEACHER RETIREMENT SYSTEM OF TEXAS
TERMINATION EXPERIENCE - DURING SELECT PERIOD

Years of service	Actual Termination Weighted By Salary $M	Total Salary $M	Actual Rate	Assumed Rate		Expected Termination Weighted By Salary $M		Actual/Expected	
				Current	Proposed	Current	Proposed	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	$12,471	$77,190	0.1616	0.1555	0.1535	$12,004	$11,847	104%	105%
2	10,519	78,085	0.1347	0.1250	0.1280	9,758	9,993	108%	105%
3	7,621	69,968	0.1089	0.1008	0.1035	7,056	7,240	108%	105%
4	5,246	61,810	0.0849	0.0754	0.0806	4,662	4,984	113%	105%
5	4,267	57,033	0.0748	0.0652	0.0711	3,717	4,054	115%	105%
6	3,476	52,946	0.0656	0.0580	0.0624	3,069	3,302	113%	105%
7	2,739	49,023	0.0559	0.0492	0.0531	2,413	2,602	114%	105%
8	2,194	44,918	0.0488	0.0433	0.0464	1,943	2,084	113%	105%
9	1,870	42,395	0.0441	0.0386	0.0419	1,636	1,776	114%	105%
10	1,708	41,442	0.0412	0.0352	0.0392	1,461	1,623	117%	105%
Totals	$52,111	$574,811				$47,718	$49,505	109%	105%

TERMINATION EXPERIENCE - DURING SELECT PERIOD