
Texas Emergency Services Retirement System

2020 Experience Study and Review of Assumptions

July 23, 2020



Rudd and Wisdom, Inc.

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July 23, 2020

Via E-Mail: Kevin.Deiters@tesrs.texas.gov

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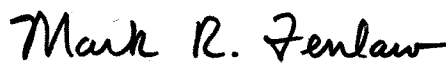
Members of the Board of Trustees:

At the request of the Board of Trustees of the Texas Emergency Services Retirement System (the System), we have prepared a study of the experience of the System in order to comply with the state law governing the System. This study covers the experience for the six plan years 2013-2018.

We have also reviewed each of the actuarial assumptions used in the prior actuarial valuation and have prepared, based on this review and the experience study, our recommendation of assumptions to be used in the System's August 31, 2020 actuarial valuation. This report documents our analysis. Once the board has accepted this report, a copy should be sent to the Texas Pension Review Board.

We certify that we are members of the American Academy of Actuaries who meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained in this report.

Sincerely,



Mark R. Fenlaw, F.S.A.



Rebecca B. Morris, A.S.A.



Brandon L. Fuller, F.S.A.

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Section I – Executive Summary

A. Scope and Purpose

This study of experience and review of assumptions has been conducted in order to determine whether the assumptions used in the most recent actuarial valuation should be adjusted to better fit recent experience and to recommend the assumptions to be used in the August 31, 2020 actuarial valuation of the System.

Actual plan experience over the six-year period from August 31, 2012 to August 31, 2018 has been studied in order to evaluate the following assumptions:

- Retirement Rates
- Termination Rates
- Disability Rates
- Deferred Benefit Commencement
- Marital Status at Benefit Commencement

In addition to the experience study and evaluation of the assumptions listed above, we have also reviewed all other actuarial assumptions used in the August 31, 2018 actuarial valuation to determine if they remain appropriate or if they need to be adjusted.

Actuarial assumptions form the basis for actuarial valuations which are used to determine appropriate contribution levels and to model costs of a retirement fund, but it is important to remember that the results of an actuarial valuation do not determine either the year by year costs or the ultimate cost of a retirement fund. The ultimate cost will be equal to the total benefits and expenses paid by a fund in excess of the investment income of the fund, including realized gains and losses on sales of fund investments. However, the results of an actuarial valuation can determine whether the existing contribution policy can reasonably be expected to be adequate for the current benefit formula over a long period of time or whether a new benefit formula should be studied for consideration. The accuracy and usefulness of actuarial valuations are dependent upon the use of actuarial assumptions that will reasonably reflect a fund's future experience as it unfolds over a long period of time.

We are guided in our review and selection of assumptions by the relevant actuarial standards of practice. As a result of our review, we have selected actuarial assumptions we consider to be reasonable and appropriate estimates of future experience for the System for the long-term future.

B. Summary of Recommended Changes

The table below provides a general description of our recommended changes. Details for each assumption can be found in Section II of this report. A summary of all assumptions and methods recommended for use in the August 31, 2020 actuarial valuation can be found in Section III of this report. We consider the recommended assumptions to be reasonable and appropriate for the System

for the long-term future, and each recommendation complies with applicable actuarial standards of practice.

Assumption	Recommendation	Additional Details
1. Investment Return	Lower rate from 7.75% to 7.5%	See Section II.A.
2. Retirement Rates	Change retirement rates to reflect experience (minor adjustments)	See Section II.B.
3. Termination Rates	Increase termination rates to reflect experience of higher termination rates	See Section II.C.
4. Disability Rates	Reduce to 55% of current assumed rates	See Section II.D.
5. Mortality Rates	Update to new PubS-2010 below-median income mortality projected generationally with MP-2019 (longer life expectancies) and reduce the rate of on-duty deaths	See Section II.E.
6. Deferred Benefit Commencement	Increase from age 56 to age 58	See Section II.F.
7. Marital Status	Change assumed married at benefit commencement to 90% of males and 50% of females, with males two years older than their spouse (all minor adjustments)	See Section II.G.

In summary, our report documents our review of the experience of the active members of the System during the six-year study period and of the actuarial assumptions used in the most recent actuarial valuation of the System. In addition, we will continue our regular review of the assumptions and experience that is a part of each actuarial valuation.

C. Impact of Recommended Assumptions

We updated the August 31, 2018 actuarial valuation using the recommended assumptions to see what their effect would have been as of that date compared to the current actuarial assumptions. The recommended reduction in the investment return assumption alone from 7.75% to 7.5% increased the actuarial accrued liability by 3.3%. However, the combined effect of all other recommended assumptions more than offset the effect of the lower investment return assumption. The primary offsetting elements were the recommended higher termination rates and the recommended increase in the average age of commencement of vested deferred benefits. The net result of all recommended assumptions would have been the reduction in the required years of state contributions from 24 years to 12 years in order to amortize the unfunded actuarial accrued liability in 30 years. There would have been no need for Part Two contributions based on the August 31, 2018 actuarial valuation with the recommended assumptions.

Section II – Actuarial Assumptions for Actuarial Valuations

A. Investment Return

Introduction

Our review of the investment return assumption, summarized in the attached Exhibit 1, looked at the four elements of the building block analytical approach: (1) the asset allocation by investment class, (2) the gross annual real rate of investment return assumption for each investment class, (3) the estimated annual rate of investment expenses for each investment manager, and (4) the assumed annual rate of price inflation. The first and third elements are specific to the System. The other two are assumptions.

The Inflation Assumption

The most widely recognized and discussed measure of inflation is the Consumer Price Index for Urban Consumers (CPI-U). The CPI-U is a measure of price inflation, and it is not clear to what extent price inflation flows through to yield rates on investments. It is, however, probably the best measure that is readily available, and it is widely enough recognized and publicized that it impacts investment return. The second page of Exhibit 1 shows average annual rates of the CPI-U over selected periods, based on December to December calculations.

Inflation is an aspect of our economy that is studied, debated, and forecasted without arriving at any definitive answers. People holding one school of thought agree that inflation is caused primarily by an increase in the economy's money supply without an offsetting increase in the real gross national product. People holding another school of thought disregard monetary growth but focus instead on the federal deficit. Still other economists study business cycles to get insight into inflation. A number of other factors within our economy such as changes in wages and productivity, our savings versus our spending habits, and the unemployment rate have some effect on inflation. As the world economy has grown more complex and interdependent, other outside factors increasingly affect the economy of our country such as third world debt, levels of trade with other countries, the dollar's relative strength or weakness compared to the currency of other countries, inflation in other countries, business cycles in other countries, and the prices of food and oil. In recent years, the actions of the Federal Reserve Bank have been another influence.

Because the investment return assumption is for the long-term future, we believe that the long-term perspective is particularly important, especially in the current low interest rate and low inflation environment. In our opinion, most inflation forecasts are too short-term in perspective for a pension plan. For example, the Survey of Professional Forecasters published quarterly and the semiannual Livingston Survey, both published by the Federal Reserve Bank of Philadelphia, include a forecast of the average annual rate of inflation for the next 10 years. It was 2.00% per year in the June 2020 Livingston Survey.

Another source of forecasts is a survey early each year sponsored by LCG Associates of Atlanta, Georgia called the Wall Street Consensus. For example, the 2020 Wall Street Consensus surveyed 50 investment firms asking for their expected rates of return on various asset classes and also their

expected rate of inflation. These forecasts are generally made at the end of a calendar year for the next 10 years. In the 2020 survey, the lowest forecast for inflation was 1.5%, the highest 3.0% and the average was 2.1%.

However, 10 years is much too short a forecast period for a public employee defined benefit plan. Yet longer period forecasts, other than assumptions made by actuaries for pension plans, are not very common. In addition, the expectations for the next 10 years strongly influence longer term forecasts. The longer the period, the more challenging it is to discern what is reasonable. In the 2020 annual report of the OASDI Trust Funds (Social Security), the ultimate inflation assumptions for their 75-year projections were 3.0%, 2.4%, and 1.8% for the low-cost, intermediate, and high-cost assumptions, respectively.

Looking at the average annual increase in the CPI-U over historical periods on the second page of Exhibit 1 of 30 to 65 years ending in 2019, the average annual rate of inflation has exceeded 3.5% in five of those eight periods. We do not believe that over the long term inflation will be at rates that average over 3.5% per year; however, we expect long-term inflation to be higher than it was from 1994 through 2019 when it averaged 2.18% annually. It is our opinion that reasonable assumed rates of inflation would be in the range of 2.25% to 3.25% for the long-term future; yet shorter term considerations argue for being in the bottom half of that range.

The Gross Real Rates of Return Assumption

There have been a number of theories and studies about gross real rates of return. One widely quoted study by Robert G. Ibbotson of the University of Chicago and Rex A. Sinquefeld of the American National Bank & Trust Company placed real rates of return at 6.7% on common stocks, 1.7% on long-term corporate bonds and 1.0% on long-term government bonds over the period 1926-1976. Their study has been updated since it was published to add additional years to the observation period.

It should be pointed out that there are a number of weaknesses and criticisms of the historical studies of real rates of return. One of the primary weaknesses is that the studies compare actual investment experience to actual inflation and do not recognize expected inflation. For example, in the Wall Street Journal a number of years ago, Lindley H. Clark, Jr. said in a column that "the real cost of money has always been especially hard to measure because it is based not on the actual inflation rate but on a rate expected sometime in the future." Another criticism is that the historical studies are not of actual portfolios but are of market indices or a theoretical group of securities. A related criticism is that the historical studies do not consider the timing of cash flows in a portfolio but rather only look at the market-value results of buying and holding indices.

Many investment firms annually provide their capital market expectations or forecasts for different classes of assets. Generally, the capital market expectations are for only a 10-year period. There are two characteristics of these forecasts, in addition to being for only 10 years, that limit their usefulness for making assumptions for 40 years or more. First, there is often a wide diversity of opinion on the capital market expectations. Second, it is not unusual for the same investment firm to issue reports just one year apart with a significant change in some of the forecasts. For example, the firms responding to the Wall Street Consensus Survey early in 2015 had forecasted returns for large cap domestic equities ranging from 3% to 10%, with an average of 7.0%. A year later the range was 2% to 9%, with an average of 6.4%. In 2020, the range was -1.7% to 10.0%, with an average of 5.7%.

Even though there is no real consensus on expected or forecasted real rates of return, most people will agree that equities are riskier investments compared to fixed income securities and that a reward is expected for taking on that risk in the form of higher returns for equities compared to bonds. Similarly, most people expect that the real rate of return on government bonds should be less than on corporate bonds because of the absence of the risk of call or prepayment or default on government bonds. Therefore, the asset mix of a system's investment portfolio is a key factor in determining an appropriate assumed real rate of return for that system.

Based on reviews of historical real rates of return by asset class and of various sets of real return capital market forecasts (including the 2020 assumptions of J.P. Morgan and of AndCo both provided by the System's consultant Mr. Jon Breth) and recognizing the limitations of both, we have selected assumed long-term future gross real rates of return for each asset class in the new TESRS target asset allocation. Using these assumed gross real rates of return and estimated investment expenses based on information from AndCo and from Mr. Wayne Oberhoff, we have calculated an expected portfolio annual net real rate of return of 4.60% for the target asset allocation on the first page of Exhibit 1. This result is lower than it was two years ago at 5.01%, resulting primarily from planned changes in asset allocation.

Recommendation

Based on our review, we believe that 7.5% would be an appropriate net investment return assumption. An inflation assumption of 3% plus a real rate of return assumption net of investment expenses of 4.5% equals an investment return assumption of 7.5%. Our recommendation rounds down the sum of the 3% inflation assumption and the calculated net real rate of return assumption of 4.60% from 7.60% to 7.5%. Therefore, **we recommend a change for the System in the assumed investment return assumption net of investment-related expenses from 7.75% to 7.5% for use in the August 31, 2020 actuarial valuation.**

If the board prefers a lower assumption, such as 7.25%, that would also be reasonable for the System. We are willing to use an investment return assumption that is lower than we recommend if we believe it is also reasonable and if the board is willing to deal with the consequences of the lower assumption, such as lowering the benefit formula. The third page of Exhibit 1 compares our recommended assumption of 7.5% to the assumptions of the statewide and the largest local retirement systems in Texas.

Considerations for Lowering the Investment Return Assumption

Many public pension funds are using a lower investment return assumption today than ten years ago. The National Association of State Retirement Administrators (NASRA) began publishing a survey of statewide and large local public employee pension plans in 2001, and for the first ten years, the median assumption was 8%. Things began to change after that, and the median is now 7.25%. The table below compares the pattern of the investment return assumptions for the 99 defined benefit plans in Texas (most recent actuarial valuation and prior one) to the 130 plans in the most recent NASRA survey.

Most Recent Investment Return Assumptions			
Assumption	All Texas Funds (April 2020)		NASRA Survey (April 2020)
	Most Recent	Prior	
8%	3	13	3
> 7.5% < 8%	19	26	9
7.5%	23	14	36
> 7% < 7.5%	21	20	33
7%	19	14	29
< 7%	<u>14</u>	<u>12</u>	<u>20</u>
	99	99	130
Median Assumption	7.25%	7.50%	7.25%

There are a number of reasons for the reductions in the investment return assumption of public pension plans in the last ten years:

- The Great Recession of 2008
- Below average growth of the economy since 2009
- Sustained period of low interest rates since 2009
- Sustained period of low inflation since 1991
- Increasing scrutiny of public pension plans, including the investment return assumption

There are also a number of reasons for different investment return assumptions from plan to plan:

- Different asset allocations
- Different assumptions of gross real rates of return for major asset classes
- Different assumptions for inflation
- Different levels of investment-related expenses
- Different inclinations of the governing bodies (e.g., boards of trustees)
- Different actuarial conditions of funds

Two of the considerations for the System of lowering the investment return assumption would be the effect on the Part Two contributions and the possibility of the board needing to reduce the benefit formula. We are comfortable with an assumption less than 7.5% as long as the board is willing to accept all the implications of such a change.

B. Retirement

Active members eligible for early or normal retirement are assumed to retire based on annual rates that vary by age. A member is eligible to retire at age 55 or above. Early retirement requires at least ten years. Normal retirement requires at least 15 years of qualified service. The only reduction for early retirement is the vesting percent.

The table below compares the actual number of retirements by active members to the number expected according to the current rates. Based on the pattern we observed for the six-year period,

we developed a proposed set of rates that better reflects the recent experience and that we believe is appropriate for the future. The table also contains the expected number of retirements according to the proposed rates.

Ages	Years of Exposure	Actual Retirements	Expected Retirements		Actual/Expected	
			Current Rates	Proposed Rates	Current Rates	Proposed Rates
55	299	58	89.70	74.75	65%	78%
56-58	715	101	92.95	100.10	109	101
59-61	507	71	65.91	70.98	108	100
62	132	17	33.00	18.48	52	92
63-64	220	31	22.00	30.80	141	101
65-69	276	50	27.60	55.20	181	91
55-69*	2,149	328	331.16	350.31	99	94

*Excludes all retirements age 70 and above.

Both the current and proposed sets of rates include the assumption that all active members will retire at age 70, even though there were a number of active members age 70 and above, and 27 of them retired during the six years. Using a retirement rate of 100% at age 70 is a pragmatic simplification.

We believe the experience of the six-year study period is an appropriate basis for assumptions for the future. The rates will be applied only to active members who meet both the service and age requirements.

We also believe the experience of the six-year study period is an appropriate basis for assumptions for the future in spite of the different levels of benefits due to different contribution rates and to various amounts of service at retirement. Because of the physical requirements to provide the emergency services and because the level of the monthly retirement benefit is modest in most departments, the decision to retire as a volunteer will probably be more often affected by a person’s physical condition and less affected by the amount of the monthly benefit. We believe that the retirement experience by age is an adequate indicator of retirement rate experience for the active members expected in future years. **We recommend the adoption of the proposed rates based on the recent experience. The full set of rates is shown in Exhibit 2.**

C. Termination

The active members are assumed to terminate their volunteer service for causes other than death, disability, or retirement in accordance with annual rates that are based on years of qualified service and entry age group, e.g., entry age group 35 is for entry ages 33-37. The termination rates stop at the later of attaining age 55 or 10 years of qualified service.

The experience of the System during the six-year study period followed the general pattern of the current set of termination rates. Generally, we found that the recent experience had somewhat

greater rates of termination than the currently assumed rates for years of service less than five and 10 through 14, and considerably greater for years of service five through nine and 15 or more.

The table below groups all of the experience by service and compares the actual number of terminations to the number expected according to the current rates. Based on the patterns we observed for each entry age group and across the entry age groups, we developed a proposed set of rates that better reflects the recent experience. The table below also contains the expected number of terminations according to the proposed rates. The ratios in the last two columns are the actual number of terminations divided by the expected number. The closer a ratio is to 100%, the better the termination rates fit the actual experience of the study period.

Years of Service	Years of Exposure	Actual Terminations	Expected Terminations		Actual/Expected	
			Current Rates	Proposed Rates	Current Rates	Proposed Rates
0-4	10,187	2,160	2,043.87	2,132.00	106%	101%
5-9	5,042	616	451.43	598.56	136	103
10-14	2,801	260	216.44	259.59	120	100
15-19	1,728	163	95.04	148.13	172	110
20+	1,438	122	79.09	100.66	154	121
Total	21,196	3,321	2,885.87	3,238.94	115	103

We recommend the adoption of the proposed rates based on the recent experience. The full set of rates is shown in Exhibit 3.

D. Disability

Active members are assumed to become disabled as defined by System provisions during the performance of emergency service duties based on rates that vary by age. There is no minimum service requirement. A disability benefit is payable during each month that the member is unable to perform his duties for the member’s participating department or the duties of any other occupation for which the member is reasonably suited by education, training and experience. The disability benefit formula is different from the formula for a retirement benefit and would produce a greater benefit than for retirement in most cases.

A member whose service terminates as a result of becoming disabled while not performing emergency service duties is not eligible for a disability benefit. Instead the member is eligible to receive an immediate or deferred benefit based on his age, years of qualified service, and vesting percent that is computed in the same manner for retirement.

There were two disability retirees whose benefit commenced during the six-year study period. The expected number of on-duty disabilities according to the current rates during the six-year study period was 3.65, almost twice as many as the two actual disabilities. Based on the limited experience, we developed a proposed set of rates that better fits the recent experience. The table below compares the actual number of on-duty disabilities to the number expected according to both the current rates and the proposed rates.

Ages	Years of Exposure	Actual Disabilities	Expected Disabilities		Actual/Expected	
			Current Rates	Proposed Rates	Current Rates	Proposed Rates
Total	23,642	2	3.65	2.01	55%	100%

We recommend the adoption of the proposed rates shown in Exhibit 4.

E. Mortality

The System is not large enough to use its own mortality experience as the basis of the mortality assumption. We have always used a published mortality table we considered appropriate for our public plan clients, and since 2006, making changes periodically for projecting mortality improvement. The Society of Actuaries (SOA) recently conducted the first ever mortality study of public pension plans, which was finalized in January 2019. The study resulted in three sets of mortality tables; one for teachers, one for public safety, and one for general employees. We believe that the tables for public safety are appropriate for the System. Within each set of tables, there are separate sex-distinct tables for employees and for retirees. In addition, the employee and retiree tables are subdivided into above-median income tables, below-median income tables and total dataset tables. We believe that the below-median income tables are appropriate for the System. The mortality experience comes from calendar years 2008-2013, with a midpoint of July 1, 2010. The naming convention uses Pub-2010 as the core acronym, with PubS-2010 the acronym for the public safety set of tables.

The base tables are designed to be projected for future mortality improvement. In the prior actuarial valuation, we used static projection to a future year (2024) with projection Scale AA. We recommend that the mortality assumption for the August 31, 2020 actuarial valuation include generational projection of mortality improvement (a different effective mortality table for each year of birth cohort) using one of the recent mortality improvement projection scales developed by the SOA, the MP-2019.

The table below shows the remaining years of life expectancy at various ages for the new mortality assumption (PubS-2010 projected generationally by MP-2019) and the previous assumption (RP-2000 projected to 2024). The last column in the table indicates the relative effect of the new assumption on the present value of future benefits (or the actuarial liability).

Sex	Age	Remaining Years of Life Expectancy				Relative Increase in Actuarial Liability
		PubS-2010 Projected by MP-2019	RP-2000 Projected to 2024	Increase [(1)-(2)]	Relative Increase [(3)/(2)]	
		(1)	(2)	(3)	(4)	(5)
Male	50	33.75	33.09	0.66	2.0%	-1.2%
	55	28.88	28.35	0.53	1.9	-1.1
	60	24.22	23.75	0.47	2.0	-0.8
	65	19.86	19.42	0.44	2.3	-0.3
	70	15.78	15.43	0.35	2.3	-0.2
	75	12.06	11.74	0.32	2.7	0.5
	80	8.85	8.51	0.34	4.0	1.8
Female	50	36.96	34.79	2.17	6.2%	1.0%
	55	31.85	30.03	1.82	6.1	1.3
	60	26.98	25.46	1.52	6.0	1.9
	65	22.37	21.15	1.22	5.8	2.4
	70	18.01	17.19	0.82	4.8	2.4
	75	13.97	13.57	0.40	2.9	1.4
	80	10.43	10.30	0.13	1.3	0.5

In summary, we recommend that the mortality assumption for the August 31, 2020 actuarial valuation consist of the PubS-2010 (public safety) below-median income mortality tables for employees and for retirees, projected for mortality improvement generationally using the projection scale MP-2019.

We also reviewed the on-duty mortality experience. There were three on-duty deaths during the six-year study period. The assumption used in the most recent valuation was a mortality rate of 0.2 per 1,000 life years, with the same rate applied at each age. Using this assumption, the expected number of on-duty deaths during the six years was 4.73. Because the expected number based on the prior assumption was greater than the actual three on-duty deaths, we recommend a change. The actual on-duty death rate during the six years was 0.13 per 1,000 life years. **We recommend a change in the assumed on-duty mortality rate to 0.15 per 1,000 life years.** This rate will be added to the mortality rate for each age in the base mortality tables for actives. Then the generational projection of mortality improvement will gradually reduce the effective rate over the years.

F. Deferred Benefit Commencement for Vested Terminated Members

An active member who terminates service before age 55 with at least enough years of qualified service to be vested (five years before 2007 and 10 years beginning in 2007), is entitled to a monthly retirement benefit upon attainment of age 55 and application for the retirement benefit. During the six-year study period, there were 426 vested terminated members whose monthly retirement benefit commenced. The table below shows the 426 by their age at the commencement of the benefit.

Age at Commencement	Number of Vested Terminated Members Commencing Benefit
55	120
56	59
57	49
58	35
59	30
60	21
61-65	82
66+	<u>30</u>
Total	426

It is surprising that more of the vested terminated members did not apply for their deferred benefit shortly after attaining age 55. However, some may have terminated many years before age 55 and forgot they were entitled to a benefit at age 55, especially if the benefit was for service in a department contributing the minimum monthly contribution and was based on only ten years of service. The average age at commencement for the 426 was over 58.

In the prior valuation, we used an assumption that on average the deferred benefits of the vested terminated members would commence at age 56. We used age 56 even though the prior experience study revealed that the average age at commencement of their benefits was 57 based on the review of 258 vested terminated members during the previous study period. Any vested terminated member over age 56 on a valuation date was assumed to have had his benefit commence on the valuation date.

Our expectation for the future is that if the System continues notifying vested terminated members who delay in applying for their benefits, the average age of benefit commencement should decrease over time. However, according to the data we received for the experience study, there were still a surprising number of vested terminated members 55 and older as of August 31, 2018, as shown in the table below:

Age as of August 31, 2018	Number of Vested Terminated Members Whose Benefit Had Not Yet Commenced
55	127
56	57
57	48
58	47
59	34
60	42
61-65	108
66+	<u>72</u>
Total	535

In light of the number of vested terminated members whose benefit commenced at ages over 56 during the current six-year study period and of vested terminated members at ages over 56 whose benefit had not commenced as of August 31, 2018, **we recommend a change so that terminated members entitled to deferred benefits are assumed to begin their benefits at age 58 or their age on the valuation date, if older.**

G. Other Assumptions

There are three other assumptions used in the August 31, 2018 actuarial valuation which we have reviewed.

- Marital Status at Benefit Commencement

In the August 31, 2018 actuarial valuation, 92% of all male members and 67% of all female members were assumed to be married at the time benefits commence. Males were assumed to be three years older than female spouses. Once a benefit is being paid, the System provides the marital status of the retiree and the date of birth of the spouse, if applicable. We reviewed the members whose benefit began during the six-year study period. We found that 89% of the males were married and 50% of the females were married at the time they began receiving benefits. The males were 2.2 years older than their female spouse on average. **We recommend adjusting the marital status assumptions to assume 90% of all male members and 50% of all female members are married at the time benefits commence, with males assumed to be two years older than their female spouses.**

- Administrative Expenses

The normal cost under the actuarial cost method is increased by an assumed amount to reflect annual administrative expenses expected to be incurred and paid with System assets in each year following the valuation date. The assumed amount is based on the average of (1) the budgeted administrative expenses for the year following the valuation date and (2) the estimated administrative expenses for the second year following the valuation date, reduced by the amount appropriated by the State of Texas for the System to pay part of the administrative expenses for the year following the valuation date. We assume continuation of similar amounts appropriated by the State of Texas to pay part of the administrative expenses. **We recommend no change in this assumption.**

- Contributions

The total annual Part One contributions to be paid by all governing bodies for the participating departments for qualified service as it is earned is assumed to be the total contributions based on the number of active members in each department and known monthly contribution rates for each department as of the valuation date. We assume no changes in number of active members. **We recommend no change in this assumption.**

Section III

**Impact of Recommended Actuarial Assumptions
on the August 31, 2018 Actuarial Valuation**

	<u>Current Assumptions</u>	<u>Recommended Assumptions</u>
1. Actuarial Present Value of Future Benefits		
a. Active participants	\$ 72,020,812	\$ 69,374,848
b. Terminated Vested Participants	18,424,914	16,636,112
c. Retirees and Beneficiaries – Advance Funded	56,930,805	58,345,953
d. Retirees and Beneficiaries – Reimbursement Funded	<u>1,634,268</u>	<u>1,658,275</u>
e. Total	\$ 149,010,799	\$ 146,015,188
2. Actuarial Present Value of Future Normal Cost	\$ 9,862,186	\$ 7,767,769
3. Actuarial Present Value of Future Reimbursements for (1d)	<u>\$ 1,634,268</u>	<u>\$ 1,658,275</u>
4. Actuarial Accrued Liability [(1e) – (2) – (3)]	\$ 137,514,345	\$ 136,589,144
5. Actuarial Value of Assets	\$ 114,668,709	\$ 114,668,709
6. Unfunded Actuarial Accrued Liability (UAAL) [(4)-(5)]	\$ 22,845,636	\$ 21,920,435

Without State Appropriations

7. Required Annual Contributions without Appropriations from State		
a. Normal Cost Contributions	\$ 3,102,482	\$ 2,806,029
b. 30-Year UAAL Contributions	<u>1,956,805</u>	<u>1,833,494</u>
c. Total	\$ 5,059,290	\$ 4,639,523
8. Expected Annual Part One Contributions	\$ 2,988,312	\$ 2,988,312
9. Amount Available to Amortize UAAL [(8)-(7a)]	\$ (114,170)	\$ 182,283
10. Years to Amortize UAAL	infinity	infinity

With State Appropriations for 30-year Amortization Period

11. Expected Annual Part One Contributions with Appropriations from State		
a. Normal Cost Contributions	\$ 2,331,087	\$ 2,036,118
b. UAAL Contributions	<u>657,225</u>	<u>952,194</u>
c. Total	\$ 2,988,312	\$ 2,988,312
12. Appropriations from State for Administrative Expenses		
a. Annual Appropriation	\$ 725,000	\$ 725,000
b. Number of Years Required	every year	every year
13. Present Value of (11b) for 30 Years	\$ 7,673,083	\$ 11,384,004
14. Appropriations from State for UAAL Amortization		
a. Present Value of Appropriations Necessary [(6)-(13)]	\$ 15,172,553	\$ 10,536,431
b. Present Value of Appropriations for up to 30 Years	\$ 15,172,553	\$ 10,536,431
c. Years Required	24 years	12 years
15. Part Two Contributions Required for 30-Year UAAL Amortization Period as a Percent of Part One Contributions	0	0
16. Funded Ratio [(5) ÷ (4)]	83.4%	84.0%

***Section IV – Summary of Actuarial Assumptions
Recommended for the August 31, 2020 Actuarial Valuation***

- a. Investment Return: Current and future System assets are assumed to yield an annual investment return of 7.5% net of investment expenses, 4.5% net real rate of return plus 3% inflation.
- b. Salary Increase Rates: Not applicable.
- c. Termination: The active members are assumed to terminate their membership for causes other than death, disability or retirement in accordance with annual rates per 1,000 members as illustrated in the rates shown below. The termination rates stop at the later of attaining age 55 or 10 years of qualified service.

Years of Service	Entry Age Group					
	20	25	30	35	40	45, 50, 55
0 - 4	250	250	200	200	170	150
5 - 9	120	130	130	130	100	100
10 - 14	80	90	100	100	90	0
15 - 19	80	80	90	90	0	0
20 - 24	70	70	70	0	0	0
25 - 29	70	70	0	0	0	0
30 - 34	70	0	0	0	0	0
35+	0	0	0	0	0	0

- d. Mortality: The active and terminated members and the retirees and surviving spouses of the System are assumed to exhibit mortality in accordance with the following:
 - i. Pre-retirement Mortality:
 - off duty: PubS-2010 (public safety) below-median income mortality tables for employees (sex distinct), projected for mortality improvement generationally using projection scale MP-2019
 - on duty: Annual mortality rate of 0.015% added to the base mortality rate
 - ii. Post-retirement Mortality: PubS-2010 (public safety) below-median income mortality tables for retirees (sex distinct), projected for mortality improvement generationally using projection scale MP-2019

- e. Retirement: Active members eligible for early or normal retirement are assumed to retire based on rates that vary by age as shown below.

Age	Rate per Year
55	25%
56-64	14
65-69	20
70+	100

Terminated members entitled to deferred benefits are assumed to begin their benefits at age 58 or their age on the valuation date, if older.

- f. Disability: Active members are assumed to become disabled as defined by the System provisions during the performance of emergency service duties based on rates that vary by age as illustrated below.

Age	Rate per Year
20	0.0020%
25	0.0024
30	0.0037
35	0.0050
40	0.0069
45	0.0087
50	0.0119
55	0.0173
60	0.0255
65	0.0279

- g. Marital Status: 90% of all active male members and 50% of all active female members are assumed to be married at the time benefits commence. Males are assumed to be two years older than female spouses.
- h. Administrative Expenses: The normal cost under the actuarial cost method is increased by an assumed amount to reflect annual administrative expenses expected to be incurred and paid with System assets in each year following the valuation date. The assumed amount is based on the average of (1) the budgeted administrative expenses for the year following the valuation date and (2) the estimated administrative expenses for the second year following the valuation date, reduced by the amount appropriated by the State of Texas for the System to pay part of the administrative expenses for the year following the valuation date.
- i. Contributions: The total annual Part One contributions to be paid by all governing bodies for the participating departments for qualified service as it is earned is assumed to be the total contributions based on the number of active members in each department and known monthly contribution rates for each department as of the valuation date.

- j. Pensioner Data: If the marital status field provided in the data was “married”, “unknown”, or was missing, then the annuity payment form was assumed to be a joint and two-thirds to spouse annuity. For all other marital status codes, the payment form was assumed to be a life annuity. Missing spouse date of birth was assumed to be two years from the retiree’s date of birth, with females two years younger.

Exhibit 1
Review of the Actuarial Investment Return Assumption
for the August 31, 2020 Actuarial Valuation
Asset Allocation and Investment Return Assumption Development

	Gross Annual Real Rate of Investment Return (ROR) ¹	Estimated Investment Expenses ²	Net Real ROR	Asset Allocation	
				12/31/2019 ³	New Target
Domestic Equity					
Large cap growth (ClearBridge)	6.5%	0.62%	5.88%	15.6%	10%
Large cap value (Boston Partners)	6.5	0.73	5.77	15.3	10
SMID cap growth (Jackson Square)	7.0	0.99	6.01	7.3	5
Mid cap blend (Clarkston)	7.0	1.12	5.88	<u>7.7</u>	<u>5</u>
				45.9	30
International Equity					
Developed growth (Invesco and Oakmark)	7.0	0.85	6.15	14.9	15
Emerging markets (Wells Fargo)	8.5	1.25	7.25	<u>4.9</u>	<u>5</u>
				19.8	20
Fixed Income					
Core Plus (Garcia Hamilton)	2.5	0.37	2.13	10.6	10
Core (Richmond Capital)	2.0	0.37	1.63	10.6	10
Non-Core (TBD)	3.0	0.80	2.20	<u>0.0</u>	<u>10</u>
				21.2	30
Alternatives					
Global Infrastructure (IFM)	7.5	1.09	6.41	3.4 ⁴	5
Real Estate (Morgan Stanley)	5.5	1.02	4.48	4.3	10
Multi Asset Income (Blackrock)	4.5	0.66	3.84	<u>5.0</u>	<u>5</u>
				12.7	20
Cash	0.5	0.29	0.21	<u>0.4</u>	<u>0</u>
				100.0%	100%
Weighted Average Net Real ROR Assumption				4.97%	4.60%
Possible Theoretical Annual Investment Return Assumption – Net Real ROR Plus Assumed Annual Rate of Inflation					
Assumed 3.00% Inflation				7.97%	7.60%
Assumed 2.75% Inflation				7.72	7.35
Assumed 2.50% Inflation				7.47	7.10

¹ A gross annual real rate of investment return assumption is the long-term total average annual rate of investment return, before any expenses, that is in excess of the assumed annual inflation rate. These are assumptions made by Rudd and Wisdom, Inc.

² These assumed investment-related expenses as a percent of assets are based on information from AndCo and include both direct and indirect expenses, with an addition of 0.05% for the fees of the custodial bank and 0.07% for the fees of AndCo (average annual fees as a percent of assets for consulting fee, any manager searches and an asset/liability study periodically).

³ From the December 31, 2019 report of AndCo.

⁴ Energy MLP was the 3.4% allocation as of December 31, 2019. It is to eventually be replaced by global infrastructure in the new target asset allocation.

Exhibit 1 (continued)

Price Inflation in the USA – Average Annual Rates of Increase in the CPI-U

<u>Years (Dec. to Dec.)</u>	<u>Number of Years</u>	<u>Average Annual Increase</u>
1954 – 2019	65	3.54%
1959 – 2019	60	3.68
1964 – 2019	55	3.91
1969 – 2019	50	3.91
1974 – 2019	45	3.62
1979 – 2019	40	3.07
1984 – 2019	35	2.58
1989 – 2019	30	2.40
1994 – 2019	25	2.18
1999 – 2019	20	2.14

Most inflation forecasts are for 10 years or less. For example, the average 10-year forecast in the June 2020 Livingston Survey published by the Federal Reserve Bank of Philadelphia was 2.0%. Similarly, the 2020 Wall Street Consensus Survey for the next decade included an average inflation forecast of 2.1%. However, 10 years is much too short a forecast period for a public employee defined benefit pension plan. In the 2020 annual report of the OASDI Trust Funds (Social Security), the ultimate inflation assumptions for their 75-year projections are 3.0%, 2.4%, and 1.8% for the low-cost, intermediate, and high-cost assumptions, respectively. Looking at the average annual increase in the CPI-U over historical periods of 30 to 65 years above and considering the Social Security forecasts, we believe that reasonable assumed rates of inflation for the long-term future would range from 2.25% to 3.25%. Shorter term considerations make the bottom half of that range more desirable.

**Comparison of 8/31/2018 Actuarial Investment Return Assumption
with the 8/31/2020 Proposed Assumption**

<u>Actuarial Assumption¹</u>	<u>8/31/2018 Actuarial Valuation</u>	<u>8/31/2020 Actuarial Valuation</u>	
		<u>Set 1</u>	<u>Set 2</u>
Inflation (Price)	3.00%	3.00%	2.75%
Net real rate of return ²	<u>4.75</u>	<u>4.50</u>	<u>4.50</u>
Net total investment return ²	7.75%	7.50%	7.25%

¹ All assumptions are annual rates.

² Net of investment-related expenses.

Exhibit 1 (continued)

Comparison of Investment Return and Inflation Assumptions
for Large Local and Statewide Retirement Systems

System Name	Valuation Date	Investment Return Assumption	Rate of Inflation	Real Rate of Return
Austin Employees	12/31/2018	7.50%	2.75%	4.75%
Austin Fire	12/31/2018	7.70	3.50	4.20
Austin Police	12/31/2018	7.25	2.50	4.75
Dallas Employees	12/31/2018	7.75	2.75	5.00
Dallas Police and Fire	1/1/2019	7.25	2.75	4.50
El Paso Employees	9/1/2018	7.50	3.00	4.50
El Paso Fire	1/1/2018	7.75	3.00	4.75
El Paso Police	1/1/2018	7.75	3.00	4.75
Fort Worth Employees	12/31/2019	7.00	2.50	4.50
Houston Fire	7/1/2019	7.00	2.75	4.25
Houston Municipal	7/1/2019	7.00	2.25	4.75
Houston Police	7/1/2019	7.00	2.75	4.25
San Antonio Fire and Police	1/1/2019	7.25	3.00	4.25
Employees Retirement System	8/31/2019	7.50	2.50	5.00
Teacher Retirement System	8/31/2019	7.25	2.30	4.95
Texas County and District System	12/31/2019	8.00	3.00	5.00
Texas Municipal Retirement System	12/31/2019	6.75	2.50	4.25
Average		7.36	2.75	4.61

Exhibit 2

**Retirement Rates per Active Members Eligible for Retirement
for the Texas Emergency Services Retirement System**

<u>Ages</u>	<u>Current Rate per Year</u>	<u>Proposed Rate per Year</u>
55	30%	25%
56	13	14
57	13	14
58	13	14
59	13	14
60	13	14
61	13	14
62	25	14
63	10	14
64	10	14
65	10	20
66	10	20
67	10	20
68	10	20
69	10	20
70+	100	100

Current Age

Proposed Age

Terminated members
entitled to deferred
benefits are assumed
to begin their benefits
at the indicated age
or their age on the
valuation date, if older

56

58

Exhibit 3

**Termination Rates per Year per 1,000 Active Members for the
Texas Emergency Services Retirement System**

Current Rates

Years of Service	Entry Age Group					
	20	25	30	35	40	45, 50, 55
0 - 4	260	230	200	190	150	130
5 - 9	100	95	90	85	85	80
10 - 14	80	80	80	80	65	0
15 - 19	55	55	55	55	0	0
20 - 24	55	55	55	0	0	0
25 - 29	55	55	0	0	0	0
30 - 34	55	0	0	0	0	0
35+	0	0	0	0	0	0

Proposed Rates

Years of Service	Entry Age Group					
	20	25	30	35	40	45, 50, 55
0 - 4	250	250	200	200	170	150
5 - 9	120	130	130	130	100	100
10 - 14	80	90	100	100	90	0
15 - 19	80	80	90	90	0	0
20 - 24	70	70	70	0	0	0
25 - 29	70	70	0	0	0	0
30 - 34	70	0	0	0	0	0
35+	0	0	0	0	0	0

Exhibit 4

**Disability Rates per Year per 1,000 Active Members for the
Texas Emergency Services Retirement System**

<u>Age</u>	<u>Current Rates</u>	<u>Proposed Rates</u>	<u>Age</u>	<u>Current Rates</u>	<u>Proposed Rates</u>
20	0.036	0.020	45	0.159	0.087
21	0.037	0.020	46	0.169	0.093
22	0.038	0.021	47	0.180	0.099
23	0.040	0.022	48	0.191	0.105
24	0.042	0.023	49	0.204	0.112
25	0.044	0.024	50	0.217	0.119
26	0.048	0.026	51	0.238	0.131
27	0.053	0.029	52	0.258	0.142
28	0.058	0.032	53	0.277	0.152
29	0.063	0.035	54	0.296	0.163
30	0.068	0.037	55	0.314	0.173
31	0.072	0.040	56	0.346	0.190
32	0.076	0.042	57	0.377	0.207
33	0.080	0.044	58	0.408	0.224
34	0.085	0.047	59	0.436	0.240
35	0.090	0.050	60	0.463	0.255
36	0.100	0.055	61	0.472	0.260
37	0.108	0.059	62	0.481	0.265
38	0.115	0.063	63	0.490	0.270
39	0.120	0.066	64	0.499	0.274
40	0.125	0.069	65	0.508	0.279
41	0.130	0.072	66+	0.000	0.000
42	0.136	0.075			
43	0.143	0.079			
44	0.150	0.083			