GRS Gabriel Roeder Smith & Company
Consultants & Actuaries

# TEXAS MUNICIPAL RETIREMENT SYSTEM

## MORTALITY EXPERIENCE INVESTIGATION STUDY
## FOR THE PERIOD ENDING DECEMBER 31, 2011

GRS
Gabriel Roeder Smith & Company
Consultants & Actuaries
5605 N. MacArthur Blvd.
Suite 870
Irving, TX 75038-2631
469.524.0000 phone
469.524.0003 fax
www.gabrielroeder.com

December 31, 2013

Board of Trustees
Texas Municipal Retirement System
Austin, Texas

Dear Members of the Board:

**Subject: Results of Mortality Analysis**

This report documents our findings and recommendations on the mortality experience of the Texas Municipal Retirement System (TMRS), especially pertaining to the current annuity purchase factors. Our report includes a discussion of the recent experience of the System, it presents our recommendations for new actuarial assumptions and methods, and it provides information about the actuarial impact of these recommendations on the liabilities and other key actuarial measures of TMRS.

With the Board of Trustees' having approved the recommendations in this report, we believe the actuarial condition of the System will be more accurately measured and portrayed. As a result, current employer contribution rates will remain stable and there will be less pressure on increasing employer rates in the future.

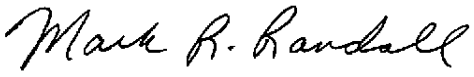
The following is a summary of our recommendation on the mortality assumption and methodologies which were approved by the Board at the October 9, 2013 meeting to be first reflected in the December 31, 2013 actuarial valuation:

1. Change the valuation assumption for healthy retirees and beneficiaries to the RP-2000 Combined Mortality Table with Blue Collar Adjustment for males and females, with the male rates increased by 109% and the female rates increased by 103%, with full generational mortality projections by Scale BB.
2. Change the annuity purchase factors to be based on a 70%/30% male/female weighting of the RP-2000 Combined Mortality Table with Blue Collar Adjustment with the rates increased by 107.5% , with full generational mortality projections by Scale BB. Mortality for beneficiaries will be the reverse 30%/70% weighting.
3. Phase into the new annuity purchase factors over a 13 year period beginning in Calendar Year 2015.
4. Avoid any employer contribution rates from decreasing/increasing to the extent possible by decreasing/increasing the amortization period to the extent allowable under TMRS Statute and Board Rules.

This experience investigation study was conducted in accordance with generally accepted actuarial principles and practices, and in full compliance with the Actuarial Standards of Practice as issued by the Actuarial Standards Board. All of the undersigned are members of and meet the Qualification Standards of the American Academy of Actuaries.

We wish to thank TMRS staff for its assistance in this project, in particular, Ms. Leslee Hardy, Director of Actuarial Services.

Respectfully submitted,



Mark R. Randall, MAAA, FCA, EA
Executive Vice President

Joseph P. Newton, FSA, EA, MAAA
Senior Consultant and Actuary

Brad Stewart, ASA, EA, MAAA

# Table of Contents

# SECTION I

## ANALYSIS OF EXPERIENCE AND RECOMMENDATIONS

# Analysis of Experience and Recommendations

**Introduction**

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

- Retirement rates
- Mortality rates
- Termination 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 other assumptions, such as the investment return rate, the link between past and future results is much weaker. In either case, though, actuaries should review their assumptions periodically and determine whether these assumptions are consistent with actual past experience and with anticipated future experience. This current study is focused solely on retiree mortality rates and the related factors used to annuitize members' account balances.

This study is generally based on experience during the three-year period of January 1, 2009 to December 31, 2011. Additional analysis that included the calendar year 2012 data confirmed the original results described in this report. The last experience study was prepared in 2011, in conjunction with the completion of the December 31, 2010 actuarial valuation report. That report generally covered experience during the period of January 1, 2005 to December 31, 2009.

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 and deemed credible.

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 "expected" is determined by multiplying the probability of the occurrence at the given age, by the "exposures" at that same age. 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 a new assumption 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.

Finally, if the data leads the actuary to conclude that new tables are needed, the actuary typically "graduates" or smoothes the results since the raw results can be quite uneven from age to age or from service year to service year.

Please bear in mind that, while the recommended assumption set represents our best current estimate, there are other reasonable assumption sets that could be supported. Some reasonable assumption sets would show higher or lower liabilities or costs.

## ACTUARIAL STANDARDS OF PRACTICE

The issue of future mortality improvement is one that the governing bodies of our profession have recently become more concerned about. This has resulted in recent changes to the relevant Actuarial Standard of Practice, ASOP 35, Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations and published practice notes. The standard now requires pension actuaries to make and disclose an assumption as to expected mortality improvement after the valuation date. The following are excerpts directly from the Standard:

*"As mortality rates have continued to decline over time, concern has increased about the impact of potential future mortality improvements on the magnitude of pension commitments. Section 3.5.3 of current ASOP No. 35 lists "the likelihood and extent of mortality improvement in the future" as a factor for the actuary to consider in selecting a mortality assumption. In the view of many actuaries, the guidance regarding mortality assumptions should more explicitly recognize estimated future mortality improvement as a fundamental and necessary assumption, and the actuary's provision for such improvement should be disclosed explicitly and transparently."*

*"**The resources reviewed by the Pension Committee showed that demographers generally expect that mortality will continue to improve**. These resources noted that some scientists argue that human life has biological limits, and that the rate of mortality improvement could slow as a result of obesity or other emerging health issues, but that such limits and countervailing factors do not alter the scientific consensus of likely continuing improvements in mortality."*

*"The actuary should consider the effect of mortality improvement both prior to and subsequent to the measurement date. With regard to mortality improvement, the actuary should do the following:*

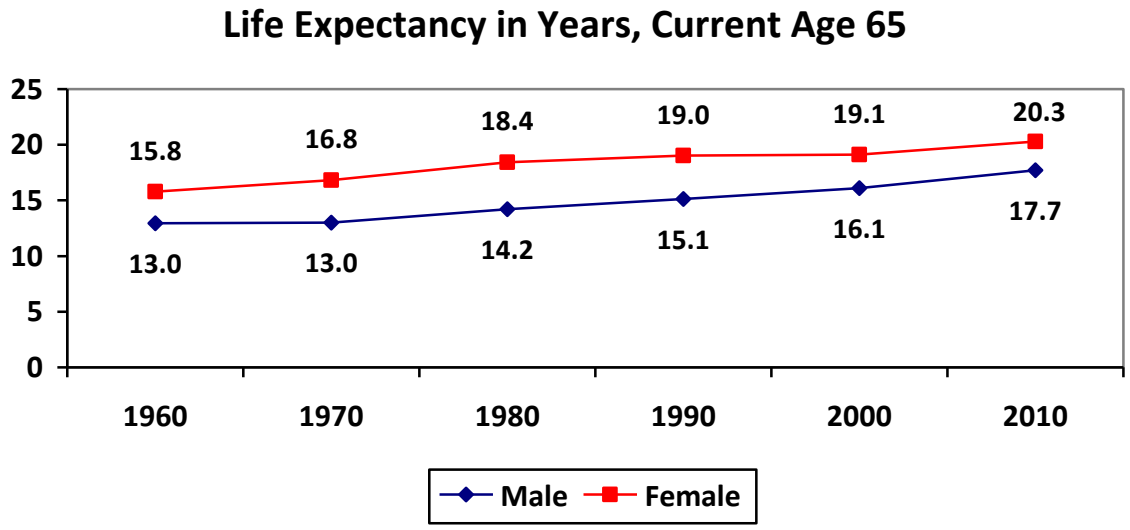
- *i.* ***adjust mortality rates to reflect mortality improvement prior to the measurement date**. For example, if the actuary starts with a published mortality table, the mortality rates may need to be adjusted to reflect mortality improvement from the effective date of the table to the measurement date. Such an adjustment is not necessary if, in the actuary's professional judgment, the published mortality table reflects expected mortality rates as of the measurement date.*
- *ii.* ***include an assumption as to expected mortality improvement after the measurement date**. This assumption should be disclosed in accordance with*

*section 4.1.1, even if the actuary concludes that an assumption of zero future improvement is reasonable as described in section 3.1.* ***Note that the existence of uncertainty about the occurrence or magnitude of future mortality improvement does not by itself mean that an assumption of zero future improvement is a reasonable assumption.****"*

As you will note, we have highlighted the above sentences we feel need to be emphasized. To meet this standard, a recent trend in actuarial models 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." Historically, actuarial models have been constrained to static mortality tables due to two reasons (1) a general belief that there was a limit on the ultimate longevity and (2) the added complexity of a generational mortality type model and limitations in computational power. A static mortality table would be used and updated with each experience study to reflect the most recent mortality. Historically, this would almost always result in adoption of lower mortality rates creating losses for plans and unfunded past service liabilities.

With advances in computing power, it has become a more mainstream practice to incorporate generational mortality models. The idea behind adopting a generational mortality model is to avoid the experience study "correction" factor. While minor adjustments may need to be made in the future, the constant bias towards needing to reduce mortality rates is avoided.

The expectation of continued increases in longevity is supported by national trends. The following graph provides the expected remaining lifetime in years for a 65 year old retiree measured beginning in 1960. Notice the recent uptrend in female longevity after almost two decades of relatively minimal improvement. This significant change in pattern (most of which has occurred since 2004) has led most of the actuarial profession to agree that future improvements will likely continue.




National Vital Statistics Reports, Vol 58, No 21, June 2010

National Vital Statistics Reports, Vol 60, No 4, January 2011

The most current mortality tables were provided in a recent report by the Society of Actuaries' Retirement Plans Experience Committee's (RPEC) published in September of 2012. The following are excerpts from that report:

*"As part of its periodic review of retirement plan mortality experience, RPEC initiated a Pension Mortality Study in 2010. This study, which is still in progress, includes a comprehensive review of recent mortality experience of uninsured retirement plans in the United States. The SOA anticipates publishing a new set of retirement plan mortality tables and mortality improvement rates in late 2013, or early 2014, that would be the successors to the RP-2000 tables and Scale AA.*

*At an early stage of its analysis, the Mortality Improvement Sub-team of RPEC noticed that mortality improvement experience in the United States since 2000 has differed from that anticipated by Scale AA. In particular, there was a noticeable degree of mismatch between the Scale AA rates and actual mortality experience for ages under 50, and the Scale AA rates were lower than the actual mortality improvement rates for most ages over 55. Given that the Pension Mortality Study is still many months from completion, RPEC is publishing an interim improvement Scale BB, which can be used by pension actuaries as an alternative to Scale AA for the projection of base mortality rates beyond calendar year 2000. Scale BB was developed using certain techniques that have not been used previously in the construction of mortality improvement scales published by the SOA. These techniques, including the analysis of US mortality trends on a two-dimensional (age and calendar year) basis, are described in Sections 4 and 5. These important new techniques notwithstanding, the final gender-specific Scale BB rates published in this report vary solely by age, and hence can be used with existing pension valuation software."*

*"RPEC recognizes that there is a wide range of opinion with respect to future levels of mortality in the United States and that the assumptions underlying any set of mortality improvement rates must necessarily reflect some degree of subjectivity. RPEC characterizes the assumptions that underpin Scale BB (including a 1.0% long-term rate of mortality improvement and limited cohort effects) as middle-of–the road, being neither overly optimistic nor too pessimistic with respect to future longevity improvements in the United States."*

*"In light of the nearly continuous pattern of increasing longevity in the United States over the past century, the Committee recommends that actuaries incorporate adequate provisions for future mortality improvement into their calculations. Taking into consideration the methodology used to develop Scale BB (Section 5.3) and RPEC's preference for generational projection of mortality over static approximations (Section 7.1),* ***the committee encourages users of Scale BB to do so on a fully generational basis.****"*

Based on the recent strengthening of the Standards of Practice, we are recommending the application of Scale BB, the most recent industry standard mortality improvement table used in both pension and life insurance work. By doing this, future mortality rates will be projected to continually decrease each year in the future. Therefore, the life expectancy at age 60 for someone

reaching 60 now will not be as long as the life expectancy for someone reaching 60 in 2020, and their life expectancy will not be as long as someone reaching 60 in 2040, etc. The following table provides the life expectancy for individuals retiring in future years based on the proposed assumption with full generational projection.

| Proposed Life Expectancy for an Age 60 Retiree in Years | | | | | |
|---|---|---|---|---|---|
| Gender | Year of Retirement | | | | |
| | 2010 | 2015 | 2020 | 2025 | 2030 |
| Male | 23.1 | 23.7 | 24.3 | 24.8 | 25.4 |
| Female | 26.4 | 26.9 | 27.4 | 27.9 | 28.4 |

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, and this has a significant impact on costs and liabilities.

## TMRS Specific Analysis

TMRS' actuarial liabilities and retirement contribution rates depend in part on how long retirees live. If members live longer, benefits will be paid for a longer period of time, and the liability and ultimate retirement contribution rates will be larger.

The mortality table currently being used in the annual valuation for non-disabled retirees and for beneficiaries receiving benefits is the RP-2000 Combined Mortality Table, projected to 2003 using scale AA. This table has separate rates for males and females. The current application is what we refer to as a "static" table. The mortality rate for a 65-year male is projected to be the same in 30 years as it is today, with no accommodations for *continued* mortality improvements expected over time.

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 and the statistical credibility of its experience, and future mortality improvement.

We first measured the credibility of the dataset to determine whether the standard, unadjusted tables should be used or if statistical analysis of TMRS specific data was warranted. During the three year period, there were 1,733 male deaths and 483 female deaths. Based on a practice note issued by the American Academy of Actuaries in the fall of 2011, a dataset needs 96 expected

deaths for each gender to be declared fully credible with 95% confidence. Other sources state higher requirements, such as 1,000 deaths per gender, but the total deaths in excess of 2,000 suggests the data is fully credible and a TMRS specific assumption is appropriate.

The analysis itself was performed on the amount of annuity, not on the individual lives. Or, each member was weighted by the amount of their annuity. This is consistent with the methods utilized to develop the RP-2000 table and with several published reports documenting the relationship between the level of income (or economic wealth) and longevity.

We begin by determining the expected number of 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—then tells us whether the assumptions are reasonable. Historically for this assumption, using a static mortality table, an A/E ratio of between 110% and 120% has traditionally been desired for conservatism and to build in a margin for continued future improvements in mortality rates. For example, in the last experience study, the A/E ratio was 107% under the old assumptions and 113% after the change.

There were 1,733 deaths among the male retirees and 483 deaths among female retirees during the study period. However, weighted by the amount of annuity, this represented $2.28 million in monthly annuity payments for men and $0.45 million for females. Based on the current mortality assumption, we expected $2.01 million and $0.49 million deaths, respectively. This produced A/E ratios of 113% for males, 91% for females, or 109% in total. Based on these ratios, the overall static mortality assumption has lost some of its conservatism for future mortality improvements since the prior study, although it may still be reasonable if the prior methodology were being continued.

Another approach when measuring mortality experience is to estimate the life expectancy from a given age based on the statistical results. Based on the current assumption, it would be expected that a male member who has attained age 60 to live 22.1 more years to age 82.1 and a female who has attained age 60 to live 24.6 years to age 84.6. Based on the actual data, males were living 21.3 years and females were living 24.6 years. Combined, the assumption was 22.6 with an actual experience of 21.9 years. Again, there was some margin from improvement in the current assumption, but the amount of margin was decreasing.

Unlike a static mortality table where an A/E ratio between 110% and 120% is generally desired to allow for a margin, the change in the underlying structure of the assumption to the use of generational projections, an A/E ratio of 100% is desirable because the margin is built into future mortality rates. Utilizing life expectancy, the goal would be to have actual life expectancy and the assumed expectancy exactly match at as many points as possible.

The following table illustrates the life expectancy at various ages as well as the A/E ratio of actual to expected deaths based on the RP-2000 Combined Mortality Table with Blue Collar Adjustment

for males and females, with the male rates increased by 109% and the female rates increased by 103%.

| | Males | | | Females | | |
|---|---|---|---|---|---|---|
| | Actual | Expected | A/E | Actual | Expected | A/E |
| Deaths | $2.28M | $2.27M | 100% | $0.47M | $0.49M | 91% |
| Life Expectancy at Age: | | | | | | |
| 55 | 25.4 | 25.6 | 100.8% | 29.1 | 29.2 | 100.1% |
| 60 | 21.3 | 21.3 | 100.2% | 24.6 | 24.6 | 100.0% |
| 65 | 17.4 | 17.4 | 99.7% | 20.4 | 20.4 | 100.1% |
| 70 | 13.9 | 13.9 | 99.4% | 16.4 | 16.5 | 100.9% |
| 75 | 10.8 | 10.7 | 99.2% | 12.7 | 13.1 | 103.0% |
| 80 | 8.2 | 8.1 | 99.2% | 9.5 | 10.1 | 106.1% |

As shown, the adjusted tables provide a very close match to the actual experience, especially based on life expectancy.

In addition, we are recommending the application of Scale BB onto the base tables, which will build in continuous increases in life expectancy into the future. The base year for both tables is 2000. That is, improvement is projected from that year to each year in the future. In setting the base tables, we compared the base tables, projected to 2010, roughly the midpoint of the experience study data, with actual deaths. This is what is shown on the detailed tables in Section IV, pages 22-24.

The following table provides the life expectancy for individuals retiring in future years based on the proposed assumption with full generational projection.

| Proposed Life Expectancy for an Age 60 Retiree in Years | | | | | |
|---|---|---|---|---|---|
| Gender | Year of Retirement | | | | |
| | 2010 | 2015 | 2020 | 2025 | 2030 |
| Male | 23.1 | 23.7 | 24.3 | 24.9 | 25.5 |
| Female | 26.4 | 26.9 | 27.4 | 27.9 | 28.4 |

As you can see from these tables, the new assumption set, when compared to the current assumption set, would increase the life expectancy for a 60 year old male in the current valuation from 22.1 to 23.1 years. Likewise, for females the life expectancy would increase from 24.6 to 26.4 years. This change would increase the actuarial liabilities and employer contribution rates.

## ANNUITY PURCHASE FACTORS

Members of TMRS have their annuities calculated by taking their total member contributions plus employer match plus any updated service credit balance at the date of retirement and dividing by an annuity purchase factor based on the member's age. The current annuity purchase factors were developed based on the UP-1984 Mortality Table, with a 2 year setback. A setback is an actuarial technique to extend the life expectancy. The probability of mortality for a member in a given year will not be based on the member's age at the time of the calculation, but instead will be calculated as if the member were two years younger. The current annuity purchase factors were developed in 1981 and have not been updated since.

The following table provides the life expectancy by age based on the current annuity purchase factors and the actual experience in the analysis. The results have been blended to not be gender specific.

| | Actual | Expected | A/E |
|---|---|---|---|
| Deaths | $2.73M | $3.42M | 80% |
| Life Expectancy at Age: | | | |
| 55 | 26.3 | 24.4 | 107.7% |
| 60 | 22.1 | 20.4 | 108.0% |
| 65 | 18.0 | 16.8 | 107.7% |
| 70 | 14.2 | 13.5 | 105.7% |
| 75 | 10.9 | 10.6 | 102.5% |
| 80 | 7.8 | 8.1 | 96.2% |

As shown, the current annuity factors are underestimating the life expectancy of the retiring members, and this is without margin for any future improvements in life expectancy. Assuming a unisex version of the same mortality assumptions recommended for the employer liability calculations, the current annuity purchase factors underestimate the future life expectancy of a 60 year old retiring member by almost 4 years. This gap will continue to widen over time.

The following table provides example annuity purchase factors for various ages, both based on a 5% discount rate. The first column is the current annuity factors. The second column, entitled "2014" is our recommended annuity purchase factors illustrated as if the factors were going to be applicable for 2015. Our recommended factors are based on a 70%/30% male/female weighting of the recommended valuation assumptions, with full projected generational mortality. We have also included what the factor would be in 2019, 2024, 2029, and 2034 to show that the annuity purchase factor by age would increase each year as the mortality rates are projected.

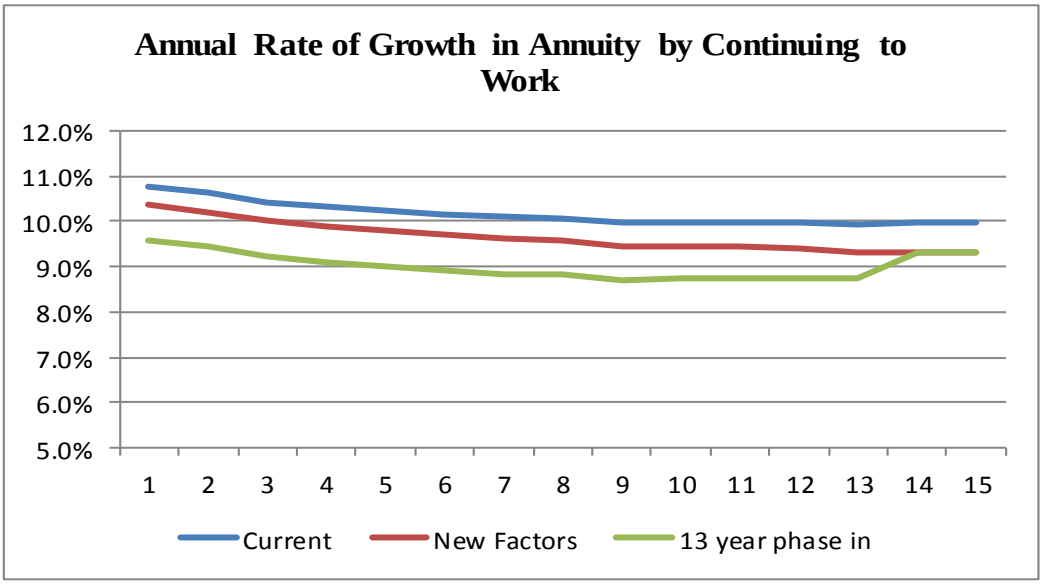
| | Annuity Purchase Factor by Age based on Recommended Assumptions and a 5% Discount Rate | | | | | |
|---|---|---|---|---|---|---|
| Age | Current Factor | Proposed Factor by Year of Retirement | | | | |
| | | 2014 | 2019 | 2024 | 2029 | 2034 |
| 50 | 174.55 | 190.63 | 191.92 | 193.17 | 194.39 | 195.57 |
| 55 | 160.34 | 176.79 | 178.46 | 180.08 | 181.66 | 183.19 |
| 60 | 144.61 | 160.48 | 162.59 | 164.65 | 166.65 | 168.59 |
| 65 | 127.62 | 142.15 | 144.65 | 147.09 | 149.46 | 151.77 |

As shown, the new factors would be substantially larger than the current factors. For a retiring 60 year old, the change from 2013 to 2014 would mean a member's benefit would be approximately 10% lower than using the current factors.

The impact from this type of immediate change would cause many members to retire before the new factors were adopted, which would have negative consequences to all stakeholders. We would recommend the new factors be phased into over a number of years so that individual members would not have an economic incentive to retire before they are ready. The following table provides three benefit estimations for a member reaching 20 years of service at age 50 with a current salary of $45,000, a current employee balance of $81,000 and matching employer funds of $162,000. In each scenario, the member is assumed to continue to work earning a 3% salary increase each year until age 65. The line represents the monthly dollar amount of benefit the member would be entitled to if the member retired at the stated age. The three scenarios show the growth in benefit based on (1) the current factors, (2) the proposed factors implemented immediately, and (3) a 13 year phase into the new factors.

| Age | Current | New Factors | 13 year phase in |
|---|---|---|---|
| 50 | 1,392 | 1,274 | 1,392 |
| 51 | 1,541 | 1,406 | 1,525 |
| 52 | 1,705 | 1,550 | 1,669 |
| 53 | 1,883 | 1,705 | 1,823 |
| 54 | 2,078 | 1,874 | 1,989 |
| 55 | 2,290 | 2,058 | 2,168 |
| 56 | 2,523 | 2,258 | 2,361 |
| 57 | 2,778 | 2,475 | 2,570 |
| 58 | 3,058 | 2,712 | 2,796 |
| 59 | 3,363 | 2,968 | 3,040 |
| 60 | 3,699 | 3,249 | 3,306 |
| 61 | 4,068 | 3,555 | 3,595 |
| 62 | 4,474 | 3,889 | 3,910 |
| 63 | 4,920 | 4,251 | 4,251 |
| 64 | 5,411 | 4,648 | 4,648 |
| 65 | 5,951 | 5,082 | 5,082 |

The following graph shows the rate of growth in a member's annuity under the same 3 scenarios. Notice the member's annuity would grow in excess of 9.9% per year under the current factors. Once the new factors were implemented, the member's annuity would grow at approximately 9.3% per year, with the difference being that the annuity purchase factor is not decreasing as fast as the individual ages. Under the phase in scenarios, the member's annuity would increase by about 1.1% less than the current factors, or 8.8% per year.




The trade off in the phase in period is the employer contribution rate. If the proposed factors were immediately implemented, employers would likely see significant savings, although a lot of those savings would likely be offset by higher than normal retirement patterns and human resource transition costs. However, under the 13 year scenario, some employers would have a modest contribution rate increase (less than 0.30%). This is due to the increase in liabilities from the change in valuation assumptions being larger than the savings from the change in annuity purchase factors. However, in both cases, the employer rates would be significantly lower than they will if the annuity purchase factors are not changed and the valuation assumptions are changed, which will occur in conjunction with the next experience study.

The member-only annuity purchase factors also include a cash refund feature, so the final assumption needed in the development of the factors is the portion of the annuitized balance attributable to employee contributions. A retiree's benefit comes from three sources: employee contributions, employer matches, and updated service credit (or prior service credit). Based on an analysis of current active members who have 20 or more years of service with their municipality and the valuation assumption that, on average, 40% of employee balances are taken as a lump sum at retirement, 20% of the annuitized balance is assumed to be due to employee contributions.

## IMPACT ON JOINT OPTIONS

It should be noted that the cost to provide coverage to a joint annuitant will decrease substantially in comparison to the Life Only benefit. Choosing a joint option is the same as purchasing a life insurance product on the retiree's life. Thus, the longer the retiree lives, the less valuable the life insurance product becomes. Similarly, the increased lifespan of the beneficiary decreases the value of the popup feature included in the joint benefit forms. Even though the beneficiary is assumed to live longer under the new assumptions, this increase in life expectancy is more than offset by the increase in the amount of time expected to lapse before the beneficiary's annuity is payable. The following table provides some sample ages based on the current and proposed factors in the year 2030:

| **Joint and Survivor w/ Pop-up Reduction Factors Under Current and Proposed Assumptions in 2030** | | | | | | |
|---|---|---|---|---|---|---|
| | 100% Joint and Survivor | | 75% Joint and Survivor | | 50% Joint and Survivor | |
| Age* | Current | Proposed | Current | Proposed | Current | Proposed |
| 45 | 0.87443 | 0.92465 | 0.90321 | 0.94253 | 0.93388 | 0.96111 |
| 50 | 0.84658 | 0.90625 | 0.88099 | 0.92816 | 0.91819 | 0.95116 |
| 55 | 0.81496 | 0.88297 | 0.85541 | 0.90982 | 0.89987 | 0.93835 |
| 60 | 0.77952 | 0.85552 | 0.82622 | 0.88793 | 0.87853 | 0.92289 |
| 65 | 0.74049 | 0.82393 | 0.79346 | 0.86237 | 0.85406 | 0.90457 |

*Assumes beneficiary is the same age as the retiree.

## EMPLOYER CONTRIBUTION RATES

We would recommend that employer rates not be allowed to decrease due to the change of the annuity purchase rates for any of the scenarios unless an employer is well above 100% funded. If the employer is less than 100% funded, we would rather see the amortization period be decreased so that the contribution rate is held constant. We do not feel it is equitable for members to have a potential decrease in benefit due to a change in the annuity purchase factors while employers are having contribution decreases. The change in the annuity purchase factors should be seen as keeping employer contribution rates from increasing in the future due to assumption changes, not an offset to current costs.

## RECOMMENDATIONS

The following is a summary of our recommendations on the mortality assumption and methodologies:

1. Change the valuation assumption for healthy retirees and beneficiaries to the RP-2000 Combined Mortality Table with Blue Collar Adjustment for males and females, with the male rates increased by 109% and the female rates increased by 103%, with full generational mortality projections by Scale BB.
2. Change the annuity purchase factors to be based on a 70%/30% male/female weighting of the RP-2000 Combined Mortality Table with Blue Collar Adjustment with the rates increased by 107.5% , with full generational mortality projections by Scale BB. Mortality for beneficiaries will be the reverse 30%/70% weighting.
3. Phase into the new annuity purchase factors over a 13 year period beginning in Calendar Year 2015.
4. Avoid any employer contribution rates from decreasing/increasing to the extent possible by decreasing/increasing the amortization period to the extent allowable under TMRS Statute and Board Rules.

## ATTACHED EXHIBITS

The following Section II summarizes the estimated actuarial cost impact of our recommendations System-wide on page 16 followed by two charts on page 17 summarizing the estimated impact on contribution rate on TMRS cities. Section III then details our new mortality assumptions to be employed going forward.

Finally, the exhibits in Section IV should generally be self-explanatory. For example, on page 22, we show the exhibit analyzing the unisex post retirement mortality rates. The second column shows the total amount of annuity payments of retirees who died during the study period. Column (3) shows the total exposures. This is the total amount of annuities for retirees who were alive during any of the years. Column (4) shows the probability of death based on the raw data. That is, it is the result of dividing the actual amount of benefits of retirees who died (col. 2) by the amount exposed (col. 3). Column (5) shows the current mortality rate and column (6) shows the new recommended mortality rate. Columns (7) and (8) show the expected amount of annuities of retirees who died 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 II

## ACTUARIAL IMPACT OF RECOMMENDATIONS

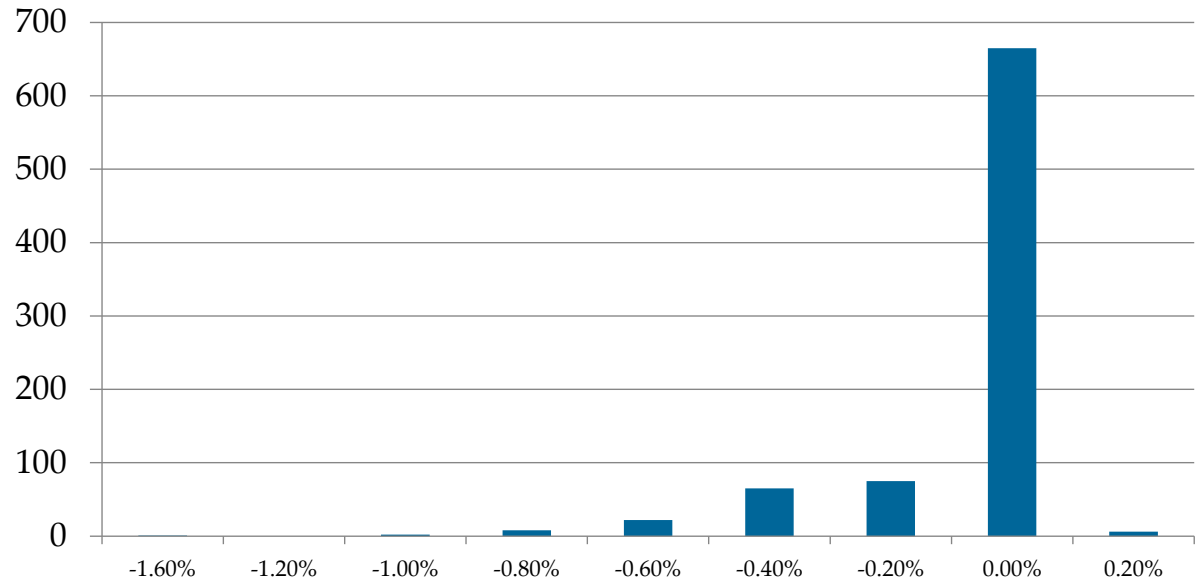
# Estimated Actuarial Impact of Recommendations

For illustrative purposes, the following tables compare key statistics from the January 1, 2012 actuarial valuation report before and after taking into account the recommended new assumptions. Any actual changes, if any, in our recommendations concerning contribution rates will be addressed in the upcoming December 31, 2013 actuarial valuation report.

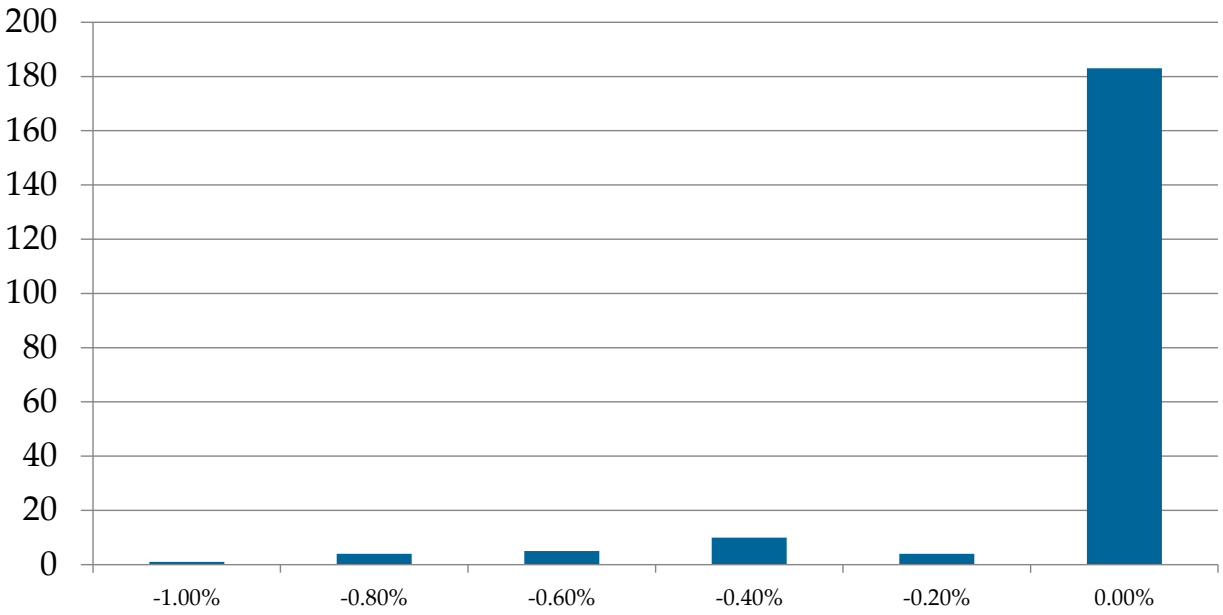
## Comparison of System-wide Funded Status and Rates ($ amounts in millions)

| | Current | With Updated Mortality and 13 Year Phase In |
|---|---|---|
| Present Value of Benefits | $30,293 | $29,880 |
| Actuarial Accrued Liability (AAL) | $22,545 | $22,541 |
| Actuarial Value of Assets | $19,646 | $19,646 |
| Unfunded Actuarial Accrued Liability | $2,899 | $2,895 |
| Funded Ratio | 87.1% | 87.2% |
| Full Retirement Contribution Rates: | | |
| Straight Average | 8.34% | 8.27% |
| Payroll Weighted Average | 13.10% | 13.05% |
| Normal Cost % | 9.51% | 9.09% |
| Prior Service % | 3.59% | 3.96% |

Distribution of Impact on Rates (All Cities)




Distribution of Impact on Rates for Cities with 100 or More Actives



# SECTION III

## SUMMARY OF NEW ASSUMPTIONS

# SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS REGARDING MORTALITY

The following presents a summary of the new actuarial assumptions regarding mortality. All other assumptions remain unchanged from the last experience study investigation dated May 20, 2011.

Service Retirees and Beneficiary Mortality Rates

For calculating the actuarial liability and the retirement contribution rates, the Gender-distinct RP2000 Combined Healthy Mortality Tables with Blue Collar Adjustment are used with male rates multiplied by 109% and female rates multiplied by 103%. The rates are projected on a fully generational basis by Scale BB to account for future mortality improvements.

| | Annual Rate | | | | |
|---|---|---|---|---|---|
| Attained Age in 2013 | Males | Females | Attained Age in 2013 (cont.) | Males | Females |
| (1) | (2) | (3) | (4) | (5) | (6) |
| 40 | 0.001437 | 0.000870 | 65 | 0.014477 | 0.009154 |
| 45 | 0.001880 | 0.001374 | 70 | 0.023964 | 0.016405 |
| 50 | 0.002528 | 0.001944 | 75 | 0.038627 | 0.027194 |
| 55 | 0.004398 | 0.002697 | 80 | 0.063179 | 0.043098 |
| 60 | 0.008228 | 0.004473 | 85 | 0.103059 | 0.073161 |

Annuity Purchase Rates

For determining the amount of the monthly benefit at the time of retirement for both healthy and disabled annuitants, the annuity purchase rates (APRs) for 2014 are based on the UP-1984 Table with an age setback of two years for retirees and an age setback of eight years for beneficiaries. Beginning in 2027 the APRs will be based on a unisex blend of the RP-2000 Combined Healthy Mortality Tables with Blue Collar Adjustment for males and females with both male and female rates multiplied by 107.5% and projected on a fully generational basis with Scale BB. For members, a unisex blend of 70% of the males table and 30% of the female table is used, while 30% of the male table and 70% of the female table is used for beneficiaries. From 2015 through 2026, the fully generational APRs will be phased in using non-linear interpolation between the current 2014 APRs and the 2027 APRs.

# SECTION IV

## SUMMARY OF DATA AND EXPERIENCE

# List of Tables

**TEXAS MUNICIPAL RETIREMENT SYSTEM**
**POST-RETIREMENT MORTALITY - TOTAL (For Determining Annuity Purchase Rates)**
**Weighted by Amount of Annuity**

| | | | | Assumed Rate | | Expected Deaths | | Actual / Expected | |
|---|---|---|---|---|---|---|---|---|---|
| Age | Actual Deaths | Total Count | 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 - 54 | 69,183 | 13,015,617 | 0.0053 | 0.0059 | 0.0031 | 76,197 | 39,839 | 91% | 174% |
| 55 - 59 | 143,888 | 23,469,870 | 0.0061 | 0.0092 | 0.0054 | 216,284 | 127,039 | 67% | 113% |
| 60 - 64 | 313,219 | 32,480,018 | 0.0096 | 0.0143 | 0.0098 | 464,105 | 318,107 | 67% | 98% |
| 65 - 69 | 363,240 | 25,594,385 | 0.0142 | 0.0226 | 0.0169 | 577,340 | 433,508 | 63% | 84% |
| 70 - 74 | 452,706 | 18,120,008 | 0.0250 | 0.0346 | 0.0279 | 626,317 | 505,843 | 72% | 89% |
| 75 - 79 | 496,684 | 11,863,625 | 0.0419 | 0.0522 | 0.0450 | 619,433 | 533,952 | 80% | 93% |
| 80 - 84 | 424,668 | 5,882,076 | 0.0722 | 0.0798 | 0.0732 | 469,287 | 430,857 | 90% | 99% |
| 85 - 89 | 313,438 | 2,170,084 | 0.1444 | 0.1189 | 0.1186 | 258,003 | 257,331 | 121% | 122% |
| 90 - 94 | 135,612 | 575,926 | 0.2355 | 0.1738 | 0.1864 | 100,092 | 107,367 | 135% | 126% |
| 95 - 99 | 13,018 | 48,713 | 0.2672 | 0.2570 | 0.2720 | 12,520 | 13,249 | 104% | 98% |
| 100 - 104 | 1,632 | 2,192 | 0.7445 | 0.3736 | 0.3467 | 819 | 760 | 0% | 0% |
| Totals | 2,727,288 | 133,222,514 | | | | 3,420,397 | 2,767,852 | 80% | 99% |

| Life Expectancy | | | | | |
|---|---|---|---|---|---|
| Age | Actual | Current | Margin | Proposed | A/E |
| 50 | 30.5 | 28.7 | -6.0% | 30.9 | 101.3% |
| 55 | 26.1 | 24.4 | -6.4% | 26.3 | 100.9% |
| 60 | 21.9 | 20.4 | -6.6% | 22.0 | 100.4% |
| 65 | 18.0 | 16.8 | -6.7% | 18.0 | 100.1% |
| 70 | 14.4 | 13.5 | -6.2% | 14.4 | 100.1% |
| 75 | 11.2 | 10.6 | -5.2% | 11.2 | 100.3% |

Columns (5) and (6) represent the blended average of the quintile group throughout the period

**TEXAS MUNICIPAL RETIREMENT SYSTEM**
**POST-RETIREMENT MORTALITY - FEMALE (For Valuation Assumptions for Healthy Annuitants)**
**Weighted by Amount of Annuity**

| | | | | Assumed Rate | | Expected Deaths | | Actual / Expected | |
|---|---|---|---|---|---|---|---|---|---|
| Age | Actual Deaths | Total Count | 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 - 54 | 11,816 | 2,879,833 | 0.0041 | 0.0020 | 0.0023 | 5,718 | 6,565 | 207% | 180% |
| 55 - 59 | 9,158 | 4,329,842 | 0.0021 | 0.0035 | 0.0033 | 15,111 | 14,459 | 61% | 63% |
| 60 - 64 | 49,295 | 6,713,708 | 0.0073 | 0.0067 | 0.0064 | 45,013 | 42,965 | 110% | 115% |
| 65 - 69 | 60,495 | 6,042,963 | 0.0100 | 0.0120 | 0.0121 | 72,327 | 72,946 | 84% | 83% |
| 70 - 74 | 50,272 | 4,271,186 | 0.0118 | 0.0202 | 0.0209 | 86,164 | 89,187 | 58% | 56% |
| 75 - 79 | 68,795 | 2,653,824 | 0.0259 | 0.0329 | 0.0333 | 87,307 | 88,314 | 79% | 78% |
| 80 - 84 | 72,841 | 1,463,971 | 0.0498 | 0.0544 | 0.0543 | 79,683 | 79,501 | 91% | 92% |
| 85 - 89 | 71,762 | 660,159 | 0.1087 | 0.0919 | 0.0904 | 60,697 | 59,694 | 118% | 120% |
| 90 - 94 | 45,155 | 221,267 | 0.2041 | 0.1489 | 0.1438 | 32,954 | 31,829 | 137% | 142% |
| 95 - 99 | 7,066 | 23,786 | 0.2971 | 0.2059 | 0.2023 | 4,898 | 4,812 | 144% | 147% |
| 100 - 104 | 618 | 1,178 | 0.5246 | 0.2496 | 0.2530 | 294 | 298 | 0% | 0% |
| Totals | 447,273 | 29,261,717 | | | | 490,166 | 490,570 | 91% | 91% |

| Life Expectancy | | | | | |
|---|---|---|---|---|---|
| Age | Actual | Current | Margin | Proposed | A/E |
| 50 | 33.8 | 33.8 | 0.0% | 33.8 | 100.0% |
| 55 | 29.1 | 29.1 | -0.1% | 29.2 | 100.1% |
| 60 | 24.6 | 24.6 | -0.3% | 24.6 | 100.0% |
| 65 | 20.4 | 20.3 | -0.3% | 20.4 | 100.1% |
| 70 | 16.4 | 16.4 | 0.2% | 16.5 | 100.9% |
| 75 | 12.7 | 12.9 | 1.2% | 13.1 | 103.0% |

Columns (5) and (6) represent the blended average of the quintile group throughout the period

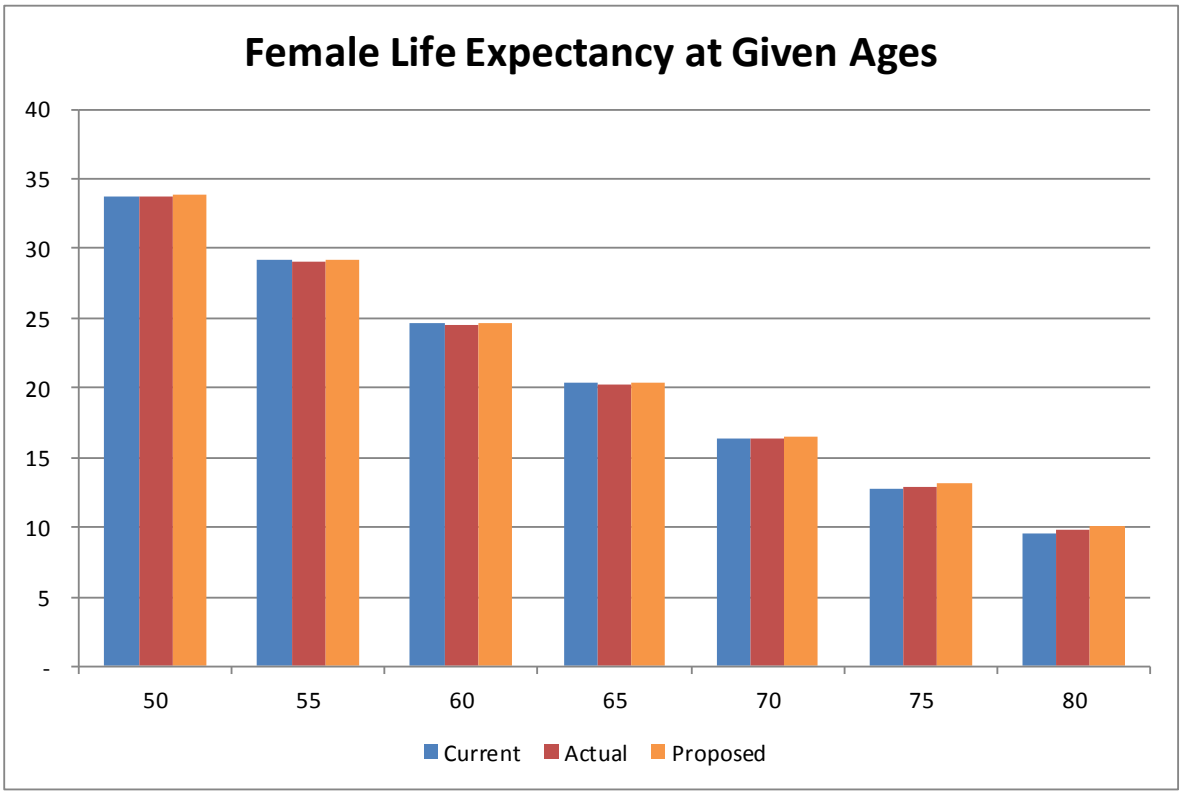
**TEXAS MUNICIPAL RETIREMENT SYSTEM**
**POST-RETIREMENT MORTALITY - MALE (For Valuation Assumptions for Healthy Annuitants)**
**Weighted by Amount of Annuity**

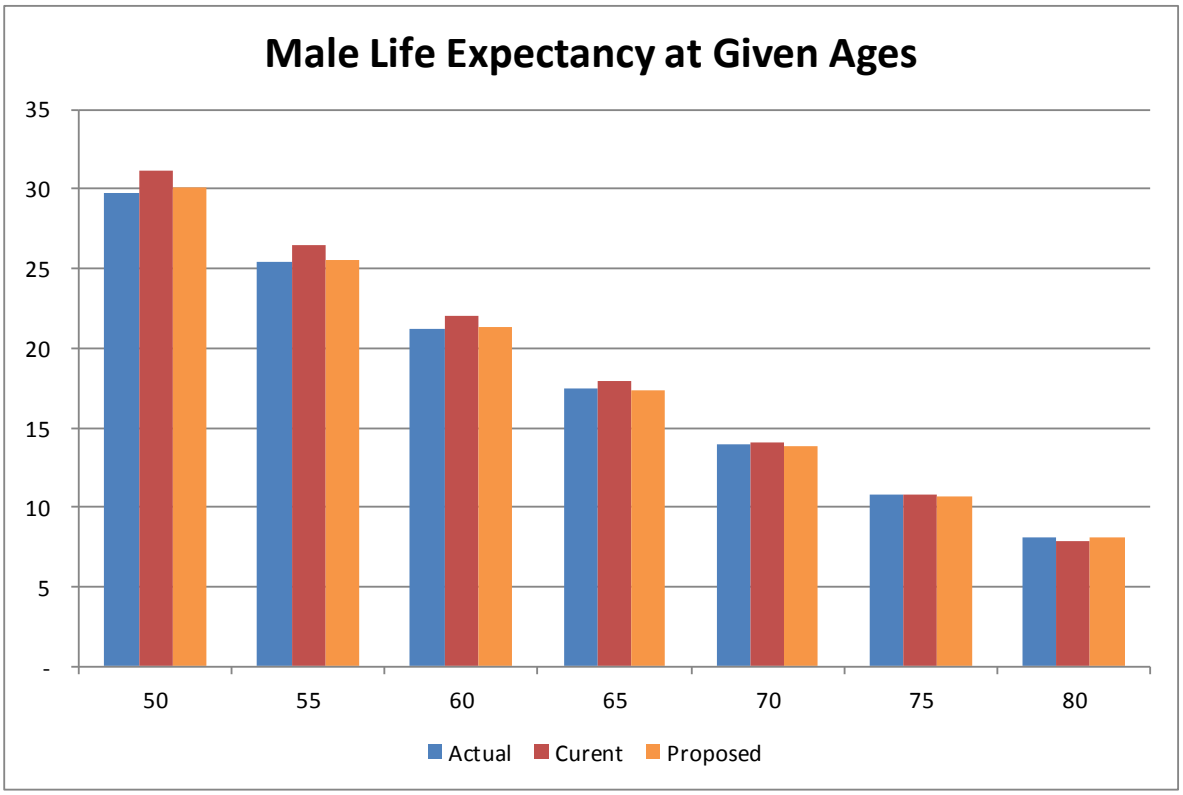
| | | | | Assumed Rate | | Expected Deaths | | Actual / Expected | |
|---|---|---|---|---|---|---|---|---|---|
| Age | Actual Deaths | Total Count | Actual Rate | Current | Proposed | Current (3) * (5) | Proposed (3) * (6) | Current (2) / (7) | Proposed (2) / (8) |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| 50 - 54 | 57,367 | 10,135,784 | 0.0057 | 0.0026 | 0.0033 | 26,399 | 33,497 | 217% | 171% |
| 55 - 59 | 134,730 | 19,140,028 | 0.0070 | 0.0046 | 0.0060 | 87,894 | 115,708 | 153% | 116% |
| 60 - 64 | 263,924 | 25,766,310 | 0.0102 | 0.0085 | 0.0108 | 218,578 | 278,736 | 121% | 95% |
| 65 - 69 | 302,745 | 19,551,422 | 0.0155 | 0.0153 | 0.0184 | 299,958 | 359,913 | 101% | 84% |
| 70 - 74 | 402,434 | 13,848,822 | 0.0291 | 0.0260 | 0.0301 | 360,200 | 416,231 | 112% | 97% |
| 75 - 79 | 427,889 | 9,209,801 | 0.0465 | 0.0444 | 0.0486 | 408,801 | 447,339 | 105% | 96% |
| 80 - 84 | 351,827 | 4,418,105 | 0.0796 | 0.0765 | 0.0790 | 337,851 | 348,850 | 104% | 101% |
| 85 - 89 | 241,676 | 1,509,925 | 0.1601 | 0.1290 | 0.1271 | 194,846 | 191,913 | 124% | 126% |
| 90 - 94 | 90,457 | 354,659 | 0.2551 | 0.2022 | 0.1987 | 71,721 | 70,466 | 126% | 128% |
| 95 - 99 | 5,952 | 24,927 | 0.2388 | 0.2835 | 0.2918 | 7,068 | 7,273 | 84% | 82% |
| 100 - 104 | 1,014 | 1,014 | 1.0000 | 0.3432 | 0.3649 | 348 | 370 | 0% | 0% |
| Totals | 2,280,015 | 103,960,797 | | | | 2,013,664 | 2,270,296 | 113% | 100% |

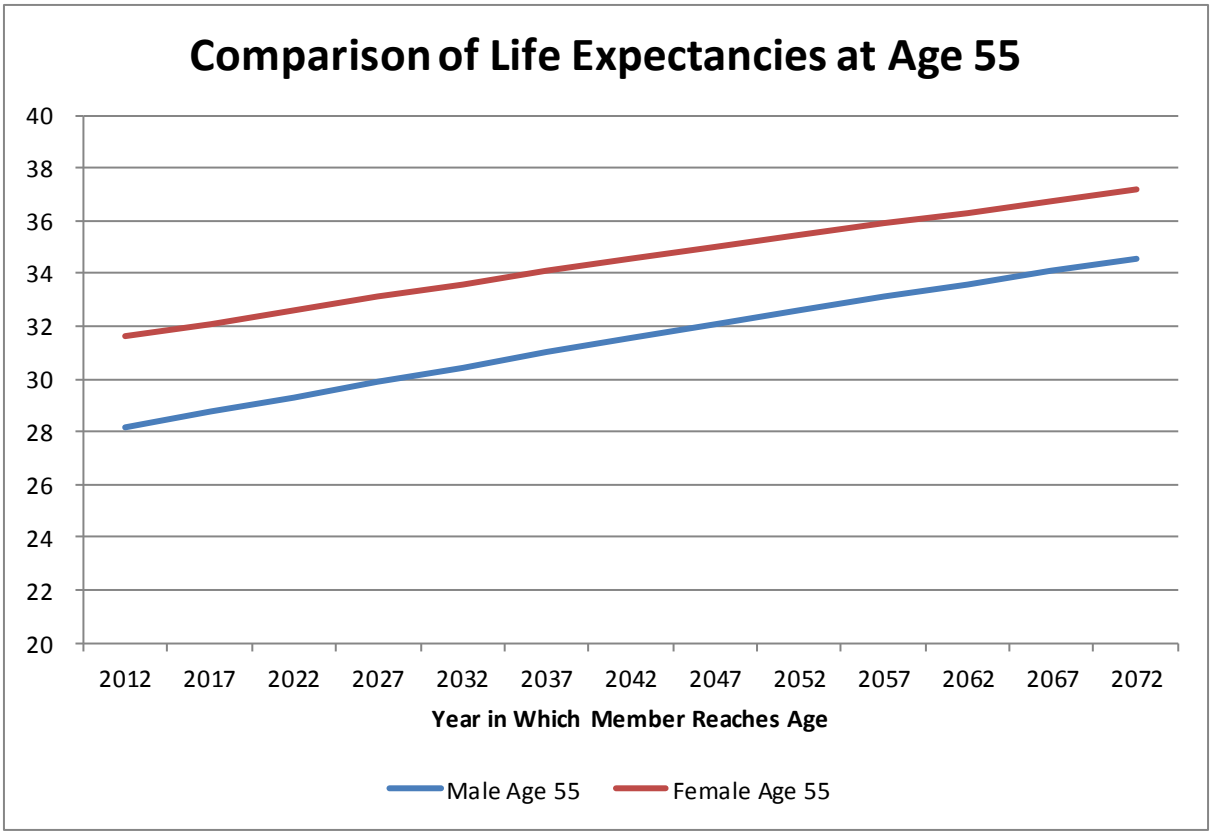
Life Expectancy

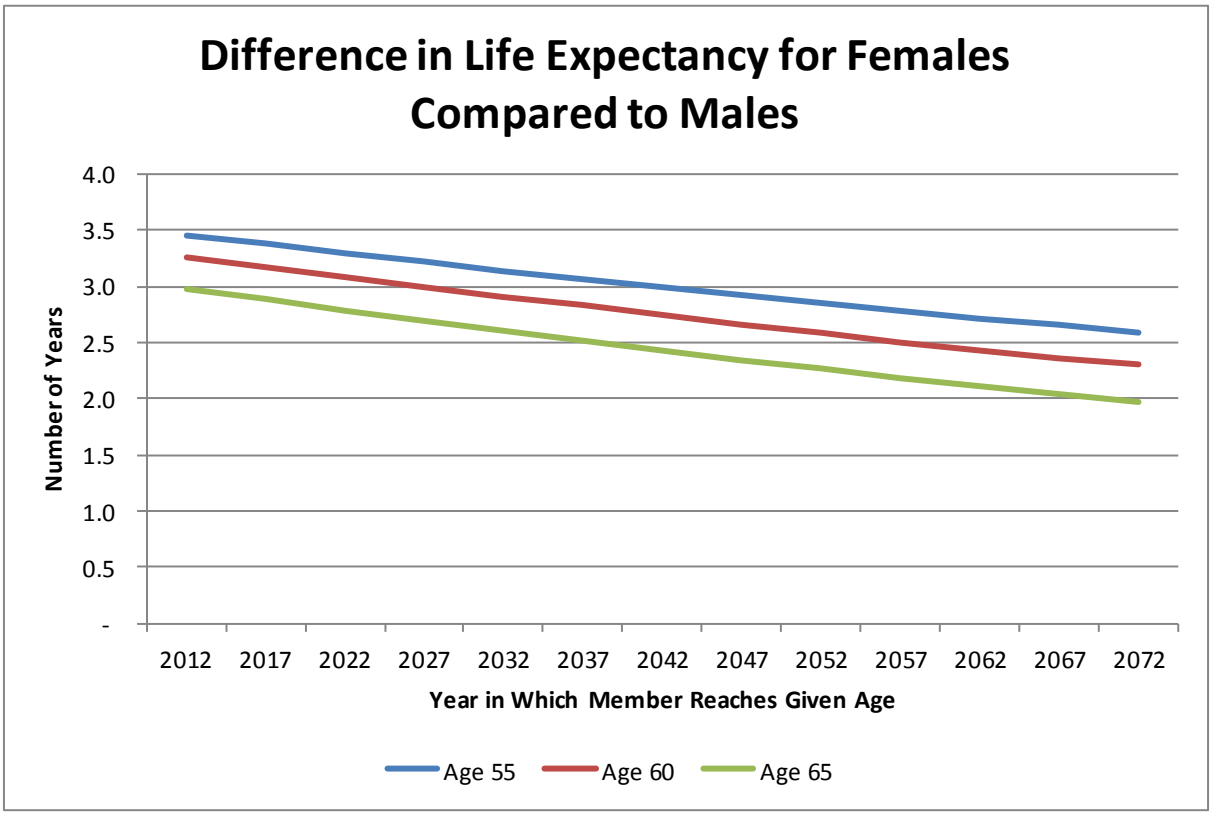
| Age | Actual | Current | Margin | Proposed | A/E |
|---|---|---|---|---|---|
| 50 | 29.7 | 31.1 | 4.7% | 30.1 | 101.3% |
| 55 | 25.4 | 26.5 | 4.4% | 25.6 | 100.8% |
| 60 | 21.3 | 22.1 | 3.6% | 21.3 | 100.2% |
| 65 | 17.4 | 17.9 | 2.6% | 17.4 | 99.7% |
| 70 | 13.9 | 14.1 | 1.3% | 13.9 | 99.4% |
| 75 | 10.8 | 10.8 | -0.7% | 10.7 | 99.2% |

Columns (5) and (6) represent the blended average of the quintile group throughout the period


Female Life Expectancy at Given Ages
40
35
30
25
20
15
10
5
-
50
55
60
65
70
75
80
Current
Actual
Proposed


Male Life Expectancy at Given Ages
35
30
25
20
15
10
5
-
50
55
60
65
70
75
80
Actual
Curent
Proposed


Comparison of Life Expectancies at Age 55
40
38
36
34
32
30
28
26
24
22
20
2012
2017
2022
2027
2032
2037
2042
2047
2052
2057
2062
2067
2072
Year in Which Member Reaches Age
Male Age 55
Female Age 55


Difference in Life Expectancy for Females Compared to Males
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
-
Number of Years
2012
2017
2022
2027
2032
2037
2042
2047
2052
2057
2062
2067
2072
Year in Which Member Reaches Given Age
Age 55
Age 60
Age 65