Houston Municipal Employees Pension System

2021 ACTUARIAL EXPERIENCE STUDY

FOR DATA THROUGH THE PERIOD ENDING JUNE 30, 2020

P: 469.524.0000 | www.grsconsulting.com

August 11, 2021

Board of Trustees
Houston Municipal Employees Pension System
1201 Louisiana
Suite 900
Houston, TX 77002

Dear Members of the Board:

Subject: Results of 2021 Experience Study

We are pleased to present our report of the results of the 2021 Experience Study for the Houston Municipal Employees Pension System ("HMEPS" or "the System"). It includes our recommendations for new actuarial assumptions to be effective for the July 1, 2021 actuarial valuation, and it describes the estimated actuarial impact produced by these recommendations as though they had been effective for the July 1, 2020 actuarial valuation.

In general, we find the current assumption set reasonable and are only recommending minor adjustments consistent with the experience and industry best practices. With the Board's approval of the recommendations in this report, we believe the actuarial condition of the System will be more accurately portrayed. The Board's decisions should be based on the appropriateness of each recommendation, not on their collective effect on the funding period or the unfunded liability.

This study was conducted in accordance with generally accepted actuarial principles and practices, and with the Actuarial Standards of Practice issued by the Actuarial Standards Board. Mr. Newton meets all of the Qualification Standards of the American Academy of Actuaries and has extensive experience as a retained public sector actuary for several large public retirement systems.

Sincerely,
Gabriel, Roeder, Smith & Company

Joseph P. Newton, FSA, MAAA
Pension Market Leader and Actuary

Lewis Ward
Consultant

j:\2585\exp\report\hmepsexpstudy20.doc

TABLE OF CONTENTS

SECTION I

EXECUTIVE SUMMARY

Executive Summary

Overall, the current assumptions are reasonable and only need minor adjustments. The items below that have a measurable impact to the funding requirements are the change to the productivity component of the salary scale, the reduction in the future anticipated rate of improvement in the mortality assumptions, the reduction in the rate of turnover for females with more than ten years of service, and the reduction in the overall pattern of retirement for Group D members. More detail for each assumption is provided in Section IV. Our recommended changes to the current actuarial assumptions may be summarized as follows:

Economic Assumptions

1. Recommend no change to the current 2.25% general inflation assumption. The 2.25% rate is close to most current sources of expectations and slightly higher than the FED's target of 2.00%.

2. Recommend no change to the current investment net real return assumption of 4.75%. A blending of the current capital market assumptions from twelve independent sources and the System's target asset allocation produces a 10-year expectation of 4.5%, with a middle range of 4.2% to 4.8%. Thus, a 4.75% real return is within a reasonable range of expectations. In addition, these values are 10-year expectations, which are currently lower than longer period expectations. In our survey, 6 consultants provided 20-year to 30-year expectations that were approximately 0.75% higher than their 10-year expectations. Thus, even a modest adjustment for time equal to half the 0.75% would bring the expected geometric return to over 4.75%.

3. Based on the combination of (1) and (2), recommend continuing the use of a 7.00% per annum nominal investment return assumption.

4. Recommend no change to the current assumption that administrative expenses will be 1.25% of covered payroll.

5. We recommend increasing the ultimate merit assumption for long-service employees from 0.75% to 1.00%. This means we will assume members with more than 25 years of service will receive increases equal to 3.25% per year. Over the last ten years, the actual data has shown a nominal 3.18% average annual increase for members with 25 years of service or more, and this was during a time when inflation was lower than the 2.25% assumption.

6. In accordance with the observed experience, we are recommending decreasing the step rate portion of the salary scale by 0.25% for members between 20 and 25 years of service. Combining with item 5, the total impact will be a 0.19% per year increase over the member's career compared to current expectations.

7. Recommend no change to the payroll growth assumption at 2.75%. The payroll growth assumption has no impact on the liabilities. The increase in average salaries over the last decade has been 2.90%. The active population has declined over that time period, but most of that was prior to 2012. The active population has mostly stabilized since then. This assumption is used to determine the contribution rate necessary to amortize the System's UAAL over the individual amortization periods.

8. Recommend no change to the current assumption that the interest crediting rate on DROP accounts will average 4.0% per year.

9. Recommend no change to the current assumption that post-retirement adjustments will average 1.0% per year.

Mortality Assumptions

10. Update the post-retirement mortality tables for non-disabled retirees to the most recently published PUB(10) public sector mortality tables. Adjusting for actual HMEPS experience, we recommend the use of the below median income tables for general employees, with a 2-year set-forward. In addition, we recommend changing the rate of future improvements in longevity to use the ultimate rates in the most recently published MP-2020 scales for all years. 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 produces stability and dependability in the costs and liabilities. In general, there is a lowering of future life expectancies based on the combination of the new base tables and projection scales compared to current assumptions, but only modestly so. It should also be noted that the proposed assumption currently provides a modest level of conservatism based on the actual experience of the System.

11. Update the post-retirement mortality assumption for disabled retirees to be the same table as used for the healthy annuitants, except there will be an additional five-year set-forward, meaning a disabled member age 70 will be valued as if they were a 75-year-old healthy retiree. In addition, continue to use the additional provision to apply a minimum mortality probability of 4% for males and 3% for females to reflect additional impairment for this population.

12. For pre-retirement mortality tables, update to the PUB(10) mortality tables for employees in a manner consistent with the post-retirement mortality experience (below median income tables with a 2-year set forward).

Other Demographic Assumptions

13. Recommend modest adjustments to the termination patterns except for a more meaningful adjustment for females with more than 10 years of service. The net impact will be to assume more turnover for males and less for females.

14. Recommend simplifying the assumed retirement pattern and having one base pattern for all groups of members. Probabilities for Group D members will be reduced when eligible for reduced benefits and a 10% load will be added at age 62 if the member has more than 20 years of service.

15. Recommend simplifying the DROP participation assumption to assume 100% of eligible members who reach eligibility for unreduced retirement before age 60 will participate in DROP and 0% of members who reach eligibility at or after age 60.

16. Recommend no changes to the patterns of disability.

17. Recommend no change to the assumption that the retiree will take their DROP balance in eight installments.

18. Recommend no change to the current marriage assumption and spousal age difference.

19. Recommend no change to the 70% marriage assumption for determining post-retirement survivor benefits for Group A & B.

Actuarial Methods and Policies

20. Recommend no change to the current process of estimating the valuation payroll for the upcoming fiscal year.

21. Recommend no change to the current asset smoothing method or the smoothing period.

- ***Impact of all recommended changes:***

Item	2020 Valuation	Recommended Assumptions
(1)	(2)	(3)
Total Normal Cost %	11.44%	11.20%
Unfunded Actuarial Accrued Liability ($ in Millions)	$2,122	$2,085
Funded Ratio	59.2%	59.6%
Calculated Contribution Rate	7.89%	7.30%
City Contribution Rate	8.41%	8.41%

SECTION II

SUMMARY OF PURPOSE AND PROCESS

Summary of Purpose and Process

A periodic review and selection of the actuarial assumptions is one of many important components of understanding and managing the financial aspects of the Houston Municipal Employees Pension System ("HMEPS" or "the System"). Assumptions that no longer predict the expected experience of the System can result in understated costs or overstated costs resulting in contribution obligations that are not in line with expectations.

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

It is important to recognize that the impact from various outcomes and the ability to adjust from experience deviating from the assumption are not symmetric. As such, the assumption set used in the valuation process needs to represent the best estimate of the future experience of the System and be at least as likely, if not more than likely, to overestimate the future liabilities versus underestimate them.

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

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

Summary of Process

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

- Retirement patterns
- Mortality rates
- Turnover rates
- Disability patterns
- Investment returns
- Salary increase
- Inflation

For some of these assumptions, such as the termination or retirement rates, past experience provides important evidence about the future. For other assumptions, such as the investment return rate, the relationship between past and future results is much less connected. In either case, though, actuaries should review their assumptions periodically and determine whether these assumptions are consistent with actual past experience and with future expectation.

In conducting experience studies, actuaries generally use data over a period of several years. This is necessary in order to gather enough data so that the results are statistically significant. In addition, if the study period is too short, the impact of the current economic conditions may lead to misleading results. For example, it is known that the strength of the national and local economy can impact salary increase rates and withdrawal rates. Using results gathered during a short-term boom or bust will not be representative of the long-term economic trends. Also, the adoption of new legislation that impacts benefits or compensation may cause a short-term distortion in the experience. For example, if an early retirement window was opened during the study period, we would usually see a short-term spike in the number of retirements followed by a dearth of retirements for the following two to four years. Using a longer period to observe the plan's experience reduces the influence of such short-term effects. On the other hand, using a much longer period may not immediately reflect real changes that may be occurring, such as mortality improvement or a change in the ages at which members retire. In our view, using a period of four to six years appropriately balances these effects.

This study is generally based on experience during the ten-year period of July 1, 2010 to June 30, 2020. The prior experience study was completed following the July 1, 2014 actuarial valuation. The recommended assumptions from that study were adopted by the Board effective with the July 1, 2015 actuarial valuation.

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 using the probability of the occurrence at the given age, times the "exposures" at that same age. For example, let's look at a rate of retirement at age 55. The number of exposures can only be those members who are age 55 and eligible for retirement at that time. Thus, they are considered "exposed" to that assumption. Finally, we calculate the A/E ratio, where "A" is the actual number (of retirements, for example) and "E" is the expected number. If the current assumptions precisely predicted the actual experience the A/E ratio would be 100%. When it varies much from this figure, it is a sign that new assumptions may be needed. Of course, we not only look at the assumptions as a whole, but we also review how well they fit the actual results by sex, age, and service.

Finally, if the data leads the actuary to conclude that new tables are needed, the actuary "graduates" or smooths 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 estimate, there are other reasonable assumption sets that could be supported. Some reasonable assumption sets would show higher or lower liabilities or costs.

Organization of Report

Section I of this report summarizes our recommended changes. Section III contains our findings and a more detailed analysis of our recommendation for each actuarial assumption. The impact of adopting our recommendations on liabilities and contribution rates is shown in Section IV. Section V shows a summary of the recommended assumptions. Finally, Section VI presents detailed summaries of the data and comparisons of the A/E ratios.

Section VI Exhibits

The exhibits in Section VI should generally be self-explanatory. For example, on page 51, we show the exhibit analyzing the select termination rates for males with less than 10 years of service weighted by present value of benefits. The second column shows the present value of benefits of male members who terminated during the study period. This excludes members who died, became disabled or retired. Column (3) shows the total exposures. This is the total present value of benefits of male members who could have terminated during any of the years. In this exhibit, the exposures exclude anyone eligible for retirement. A member is counted in each year they could have terminated, so the total shown is the total exposures for the study period. Column (4) shows the probability of termination based on the raw data. That is, it is the result of dividing the actual present value of benefits of terminations (col. 2) by the present value of benefits exposed (col. 3). Column (5) shows the current termination rate and column (6) shows the new recommended termination rate. Columns (7) and (8) show the expected terminations weighted by present value of benefits based on the current and proposed termination assumptions.

SECTION III

ANALYSIS OF EXPERIENCE AND RECOMMENDATIONS

Analysis of Experience and Recommendations

We will begin by covering the economic assumptions: inflation, investment return rate, salary increase assumption, cost-of-living increases, and the payroll growth rate. Next, we will discuss the demographic assumptions: mortality, disability, termination and retirement. Finally, we will discuss the actuarial methods used to calculate the liability, funded status, and contribution rate.

Actuarial Standards of Practice for Setting Economic Assumptions

Actuarial Standards of Practice (ASOP) No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, provides guidance to actuaries on giving advice on selecting economic assumptions for measuring obligations for defined benefit pension plans.

As no one knows what the future holds, it is necessary for an actuary to estimate possible future economic outcomes. Recognizing that there is no one right answer, the current standard calls for an actuary to develop a reasonable economic assumption. A reasonable assumption is one that:

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

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

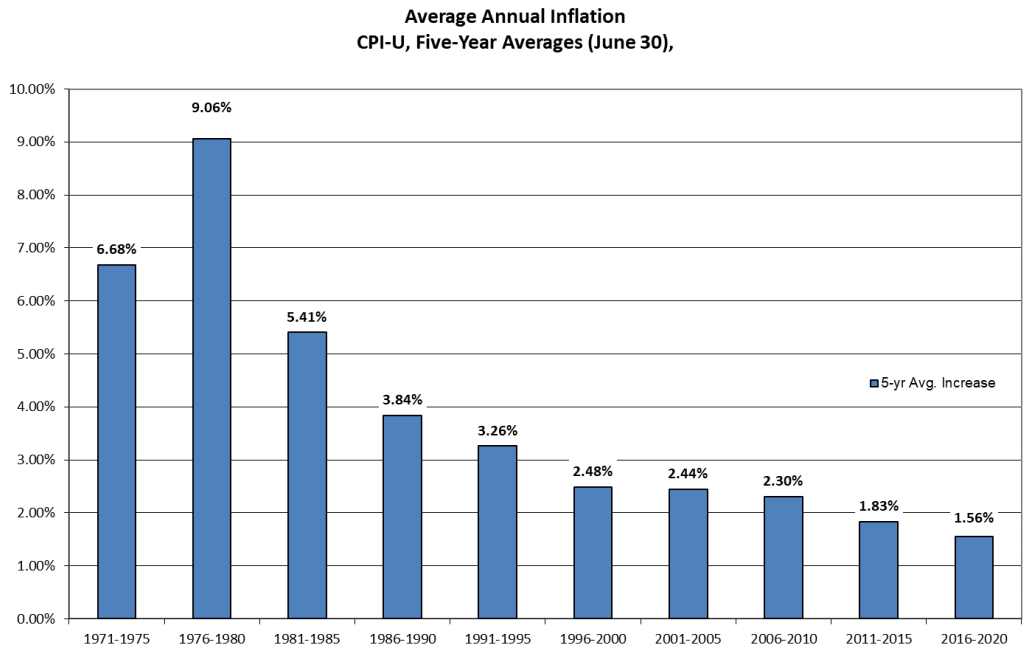
Each economic assumption should individually satisfy this standard. Furthermore, with respect to any particular valuation, each economic assumption should be consistent with every other economic assumption over the measurement period. Generally, the economic assumptions are much more subjective in nature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

Inflation Assumption

By "inflation," we mean price inflation, as measured by annual increases in the Consumer Price Index (CPI). This inflation assumption underlies most of the other economic assumptions, including the investment return, salary increases, and payroll growth rate. The current annual inflation assumption is 2.25%.

Actual Change in CPI-U

The chart below shows the average annual inflation, as measured by the increase in the Consumer Price Index (CPI-U) in each of the ten consecutive five-year periods over the last fifty years.



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

The table below shows the average inflation over various periods.

Periods Ending June 30, 2020	Average Annual Increase in CPI-U
Last five (5) years	1.56%
Last ten (10) years	1.69%
Last fifteen (15) years	1.90%
Last twenty (20) years	2.03%
Last twenty-five (25) years	2.12%
Last thirty (30) years	2.31%
Since 1913 (first available year)	3.08%

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

Forecasts from Investment Consulting Firms

Most of the investment consulting firms forecast inflation when setting their capital market assumptions. We examined the ten-year 2020 capital market assumption sets for twelve investment consulting firms. The average assumption for inflation was 2.08%, with a range of 1.75% to 2.30%.

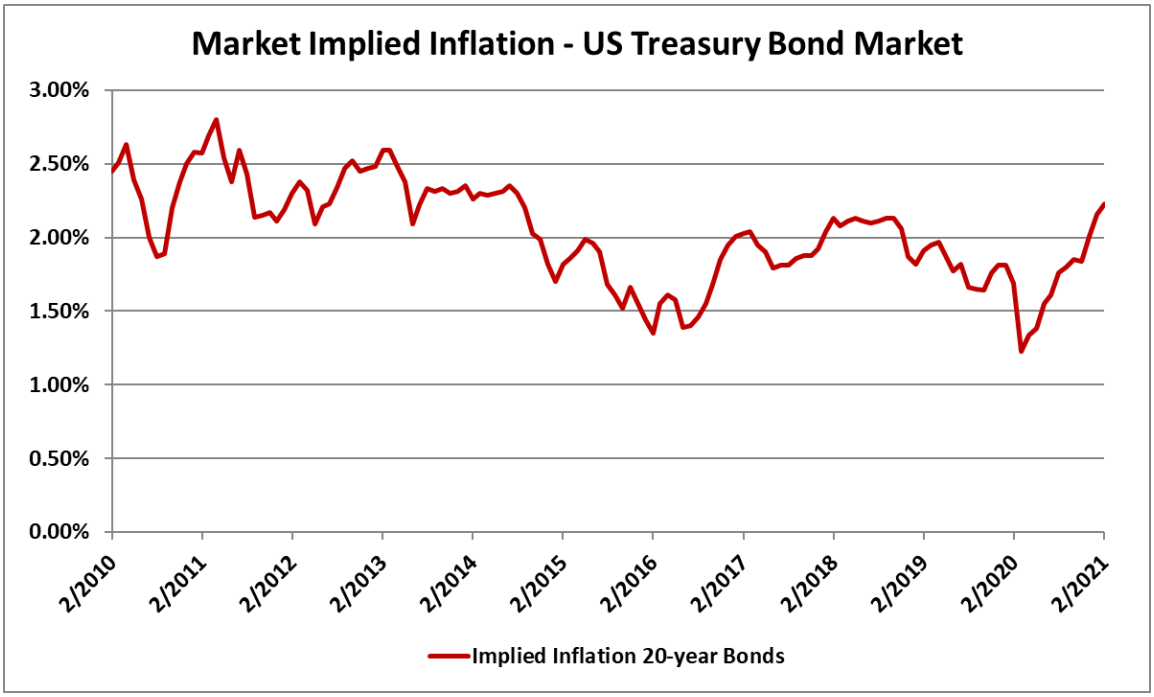
Forecasts from Social Security Administration

In the Social Security Administration's 2020 Trustees Report, the Office of the Chief Actuary is projecting a long-term average annual inflation rate of 2.40% under the intermediate cost assumption. (The low-cost assumption was 1.80% and the high cost assumption was 3.00%).

Expectations Implied in the Bond Market

Another source of information about future inflation is the market for U.S. Treasury bonds. The February 2021 breakeven yield for a 20-year inflation indexed Treasury bond (20-year TIPS) was 2.23%.

The chart on the following page shows the historical market implied inflation.



Survey of Professional Forecasters

The Philadelphia Federal Reserve conducts a quarterly survey of the Society of Professional Forecasters. Their most recent forecast (first quarter of 2021) predicts inflation over the next ten years will average 2.2% per year. The survey forecasts have also remained relatively stable over the last few years.

Recommendation

Based on this historical and forward-looking analysis, we recommend no change to the 2.25% assumption.

Investment and Administrative Expenses

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

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

The governing Statute for HMEPS caps the amount that can be allocated towards administrative expenses to be 1.25% of payroll. Historically, the amounts have been close to this value. Over the past five years, the administrative expenses have been lower than the 1.25%, but these items can fluctuate over time depending on installations of technology or real estate. It is our understanding that the System will be implementing a new administration system over the next several years, which should cause an increase in the administrative expenses for at least the next 3 to 4 years. Therefore, we are recommending no change to this 1.25% assumption at this time.

Investment Return Rate

Currently, HMEPS assumes an annual investment return rate of 7.00%, net of investment expenses. This is the rate used in discounting future benefit payments in calculating the actuarial present value of benefits as of the valuation date. The current assumption assumes inflation of 2.25% per annum and an annual real rate of return of 4.75%, net of expenses. So far, we have addressed the inflation assumption and the treatment of expenses. The following discusses the 4.75% real return assumption.

We believe an appropriate approach to selecting an investment return assumption is to determine the expected portfolio returns, given the fund's targeted allocation and an overall set of capital market assumptions. We looked at the expected real rates of return for the HMEPS portfolio using several investment consultants' capital market assumptions.

The following is the fund's current target asset allocation:

Asset Class	Target Allocation
(1)	(2)
Global Equity	32.5%
Private Equity	17.0%
Fixed Income	10.0%
Private Credit	5.0%
Real Estate	12.5%
Absolute Return	8.0%
Inflation Linked Assets	15.0%

Because GRS is a benefits consulting firm and does not develop or maintain our own capital market assumptions, we utilized the forward-looking return expectations developed by twelve investment consulting firms that work with systems similar to HMEPS.

These investment consulting firms periodically issue reports that describe their capital market assumptions: that is, their estimates of expected returns, volatility, and correlations. While these assumptions are developed based upon historical analysis, the firms also incorporate forward-looking adjustments to better reflect near-term expectations.

Given the plan's current asset allocation and the investment consultant's capital market assumptions, the development of the average nominal return, net of investment expenses, is provided in the following tables. Our only adjustment was to include the difference in the inflation expectations.

Expected Annual Geometric Returns and Return Probabilities
(Based on 10-Year Capital Market Assumptions)

Investment Consultant	Distribution of 10-Year Average Geometric Net Nominal Return			Probability of exceeding 7.00%
	40th	50th	60th	
(1)	(2)	(3)	(4)	(5)
1	5.0%	6.0%	6.9%	38.9%
2	5.1%	6.2%	7.2%	41.9%
3	5.4%	6.3%	7.2%	41.7%
4	5.4%	6.5%	7.5%	44.7%
5	5.6%	6.6%	7.6%	45.8%
6	5.6%	6.7%	7.9%	47.7%
7	6.0%	6.9%	7.8%	48.8%
8	5.9%	6.9%	8.0%	49.3%
9	6.0%	7.0%	8.1%	50.5%
10	6.0%	7.1%	8.1%	50.5%
11	6.1%	7.1%	8.2%	51.0%
12	6.3%	7.4%	8.5%	53.6%
Average	**5.7%**	**6.7%**	**7.7%**	**47.0%**

Column (3) provides the 50th percentile outcome based on that investment consultant's expectations. As shown, the average is 6.7%. In addition to examining the middle return, it is important to review anticipated volatility of the investment portfolio and to understand the range of net returns that could be produced by the investment portfolio. Therefore, the table provides the 40th, 50th, and 60th percentiles of the 10-year geometric average of the expected nominal return, net of expenses, as well as the probability of exceeding the 7.00% assumption. As shown, the analysis produces a 47% probability of achieving 7.00% over the next ten years.

However, the capital market assumptions provided by the investment consultants and used in the analysis above are based on a 7-10 year investment horizon. Investment consultants develop their forecast assumptions with this time horizon in part because most pension investment management teams use this time period for developing and monitoring their investment strategies.

On the other hand, the investment return assumption used in the actuarial valuation has a longer investment horizon, with perhaps a horizon as long as 20 years being appropriate. Therefore, it may be necessary to identify and reflect differences in the economy and financial markets over the short-term and long-term time horizons.

6 of the firms provided expectations with a 20-year to 30-year time horizon. On average, the longer-term expectations were 0.75% higher than the 10-year expectations. One approach would be to add the 0.75% to the 6.7% and get an expected 20-30 year return as high as 7.5%. However, this would be an aggressive approach. Based on the duration of the current liabilities of HMEPS, and the fact that any future scenario will have to work through the first ten years to reach the 20-year to 30-year horizon, we would rather focus on a 15-year time horizon, or the point between the two sets of expectations. Using half of the 0.75% would be 0.38%, so 6.7% plus the 0.38% would be approximately 7.1%.

Based on this analysis, we are not recommending a change to the investment return assumption at this time. While 7.00% is near the top end of the reasonable range, current capital market expectations are historically low (and volatile) and HMEPS has historically produced alpha above the benchmarks. In addition, the funding policy is strong, including a dependable amortization of the Legacy Liability, as well as having a portion of the future liabilities contingent on the investment return given the COLA provision.

General Wage Inflation

A General Wage Inflation (GWI) assumption represents the real wage growth over time in the general economy. It is the assumption of how much the pay scales themselves will change year to year, not necessarily the amount of pay increases received by individuals, nor even necessarily how the payroll in total may change, which can be impacted by population changes, etc. This assumption should be applicable to a local economy, not necessarily one group inside a retirement system. This assumption is used primarily to index the pay of each group of new entrants used in the open group projections.

Historically, GWI has almost always exceeded price inflation. This is because wage inflation is in theory the result of (a) price inflation, and (b) productivity gains being passed through to wages. Since 1951, for the national economy as a whole, wage inflation has been about 1.00% larger than price inflation on average. For the past 20 years, for the national economy as a whole, wage inflation has been 2.91%, outpacing price inflation by about 0.73%. However, this was during a time of very low actual inflation, meaning the difference is potentially inflated.

The current assumption for productivity growth above inflation is 0.50%, making a nominal general wage inflation assumption 2.75% (2.25% plus the 0.50%). We are recommending no change to this assumption.

Salary Increase Rates

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

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

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

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

Most actuaries recommend salary increase assumptions that include an element that depends on the member's age or service. Thus, it is typical to assume larger pay increases for younger or shorter-service employees. This is done in order to reflect pay increases that accompany step increases, changes in job responsibility, promotions, demonstrated merit, etc. The experience shows salaries have been more

closely correlated to service (rather than age), as promotions and productivity increases tend to be greater in the first few years of a career, even if the new employee is older than the average new hire.

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

The current assumption is composed of the GWI assumption plus an individual productivity and merit component and finally a promotion component that is based on the service of an individual. The current schedule ranges from 5.25% for new members to 3.00% for members with 25 or more years of service.

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

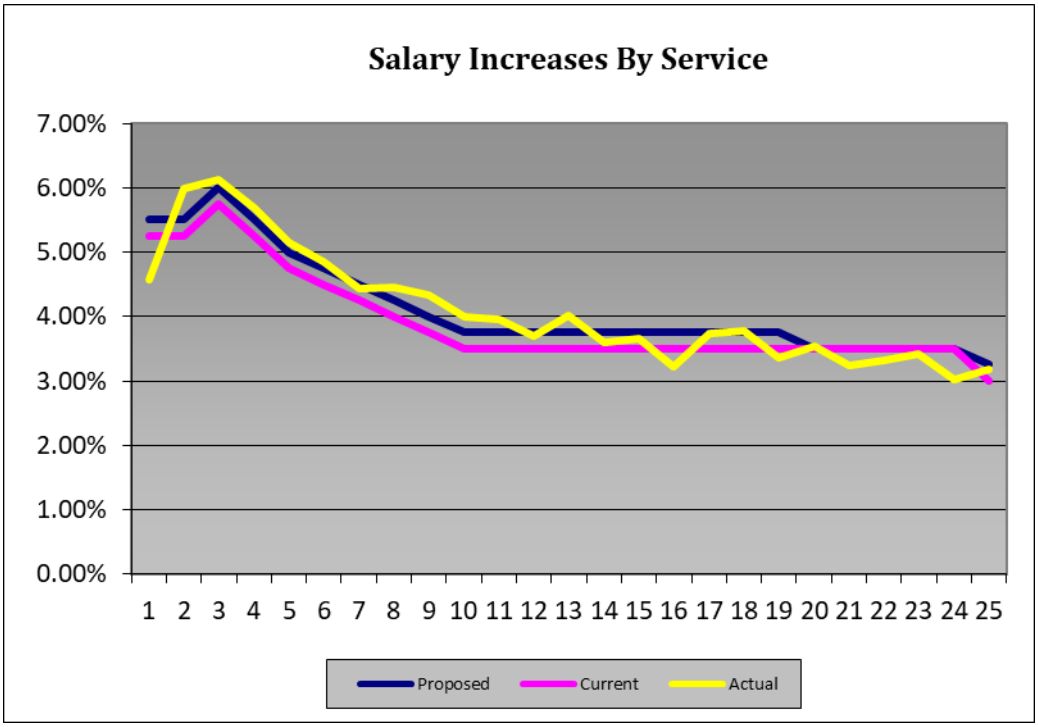
To separate the steps, or promotional component of the schedule, we segregated out members with 25 years of service or more. Most of these members should be past the promotional and step portions of their careers and therefore, only receive the general increases granted plus perhaps some individual merit. The following table provides the data for each year.

Period	Overall Increase for Long Service Members	Inflation	Increase Above Inflation
FY 2010 to FY 2011	3.62%	3.56%	0.07%
FY 2011 to FY 2012	2.92%	1.66%	1.26%
FY 2012 to FY 2013	1.23%	1.75%	-0.52%
FY 2013 to FY 2014	3.52%	2.07%	1.45%
FY 2014 to FY 2015	2.30%	0.12%	2.17%
FY 2015 to FY 2016	6.41%	1.00%	5.42%
FY 2016 to FY 2017	2.98%	1.63%	1.35%
FY 2017 to FY 2018	2.27%	2.87%	-0.61%
FY 2018 to FY 2019	3.90%	1.65%	2.25%
FY 2019 to FY 2020	2.69%	0.65%	2.05%
Average	3.18%	1.69%	1.48%
Current Assumption	3.00%	2.25%	0.75%
Proposed Assumption	3.25%	2.25%	1.00%

The actual increase above inflation during the ten-year period was 1.48%, higher than the assumed 0.75%. However, wages tend to be sticky on a nominal basis over the short to medium term, meaning salary increases are negotiated based on expected inflation or previous patterns as much as actual inflation at the time. Also, this was during a time when inflation was very low. Thus, the 1.48% is likely overstated. However, it is clear the actual nominal experience over the last decade was higher than the current 3.00%

assumption. Given that was during a time of low inflation, it suggests the assumption needs to be increased.

Based on this trend, we are recommending an increase from 3.00% to 3.25% for the nominal salary increase for long service members. The segments of this assumption would be 2.25% price inflation plus 0.50% general productivity plus 0.50% for individual productivity and merit.



Finally, we examined the pattern by service. The above exhibit models the current assumptions, the actual experience, and a set of new proposed assumptions on a nominal basis. You can see that the actual increases (yellow) were slightly higher than the current assumption (pink). However, this appears to be more across the board than at any specific service. It also tends to not be true for service of 20-24 years. The addition of the 0.25% individual merit component in the previous discussion appears to bring the proposed assumption in line with the experience across the full spectrum. We are recommending decreasing the step increases by 0.25% for years of service 20-24, but otherwise are making no changes to the step component of the schedule.

Based on the new schedule, the cumulative salary increases for the first 25 years of service are approximately 4% higher, meaning for a new member, the projected salary at the end of 25 years is expected to be 4% higher under the new assumptions. On its own, this would create an increase in the normal cost and unfunded liability.

Payroll Growth Rate

The salary increase patterns discussed above are assumptions applied to individuals. They are used in projecting future benefits. We also use a separate payroll growth assumption, which is currently 2.75% per year, in determining the contribution needed to amortize the unfunded actuarial accrued liability. The amortization payments are calculated to be a level percentage of payroll. Therefore, as payroll increases over time, so do the amortization payments. The amortization percentage is dependent on the rate at which payroll is assumed to increase.

Overall payroll often grows at a rate different from the average pay increases for individual members. There are various reasons for this, but the main one is that when older, longer-service members leave employment they are generally replaced with new members who are starting with a lower salary. Because of this, in most populations that are not growing in size, the growth in total payroll will be smaller than the average pay increase for members. On the other hand, payroll can grow due to an increase in the size of the group.

In theory, payroll growth in the absence of membership growth should approximate the general wage inflation assumption (currently 2.75%). However, we may make adjustments based on the demographics of the individual population. For example, if a population is disproportioned to older ages based on hiring and staffing patterns over the last decade we would anticipate slower growth over the next fifteen to twenty years and use an assumption lower than the GWI assumption.

Over the last ten years, the overall payroll for HMEPS has grown on average 1.8% per year. The population has declined on average 1.1% per year, meaning the net average annual change in average salary has been 2.90%, very close to the 2.75% assumption. This trend in a declining population could provide rationale for lowering the 2.75% in case the population does not stabilize, but it does appear to already have done so. The total active population has remained basically unchanged since 2012.

Most of the UAAL is currently being amortized as part of the Legacy Liability, which already has a set payment schedule. Thus, this assumption has a very minor impact on the annual costs of the plan. We are recommending no change to the current assumption of 2.75%.

Post-Retirement Benefit Increases

Eligible retired members of HMEPS receive increases to their annuity post-retirement based on a formula tied to the performance of the investments of the System. The amount of the increase is equal to half the average net investment return during the prior five fiscal years in excess of 5.0%, with the result not more than 2.0% nor less than 0.0%, not compounded. We currently assume this will equate to a 1.0% annual COLA over time based on the 7.00% return assumption less 5.00%, divided by 2. We recommend no change to this assumption.

DROP Interest Crediting Rate

Interest is credited to a member's DROP Account at an annual effective interest rate equal to half of the average net five-year investment return, but not less than 2.5% and not greater than 7.5%. Currently, the assumed DROP Credit interest is 4.0% per year. Half of the 7.00% return assumption would be 3.5% per year, but the floor of 2.50% does have a value when stochastically modeled over time. We recommend no change to this assumption.

Demographic Assumptions

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

Post-Retirement Mortality Rates

The most critical demographic assumption used in pension valuations is post-retirement mortality. Rates of mortality affect our estimate of how long each individual is expected to live and consequently how long each individual is expected to receive a pension. Life expectancy in turn has a direct impact on pension plan liabilities.

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

The relevant ASOP, ASOP 35, and published practice notes require pension actuaries to make and disclose an assumption as to expected mortality improvement after the valuation date. To meet this standard, the best practice actuarial model is to use mortality tables that explicitly incorporate projected mortality improvements over time. This type of table (or series of tables) is called "generational mortality." Specifically, mortality rates are assumed to decline each year in the future so that life expectancies for each annual cohort of retirees will be slightly higher than the previous year's. 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 2025, and their life expectancy will not be as long as someone reaching 60 in 2040, etc.

By utilizing generational mortality, the improvement over time is built into the contributions for individual members while they are employed. Below is a table with the projected life expectancy (including future improvement) for a retired member who attains age 65 based on the current assumptions.

Current Mortality Assumption – Projected Life Expectancy for an Age 65 Retiree in Years					
Group	**Year of Retirement**				
	2020	**2025**	**2030**	**2035**	**2040**
Male	18.6	19.2	19.8	20.3	20.9
Female	21.9	22.3	22.8	23.3	23.7

The mortality table currently being used for non-disabled retirees and for beneficiaries receiving benefits is the Gender-distinct RP2000 Combined Healthy Mortality Tables with Blue Collar Adjustment. Male rates are multiplied by 125% and female rates are multiplied by 112%. The rates are projected on a fully generational basis by scale BB to account for future mortality improvements. Our strategy is to update this table with each experience study to ensure that our Base tables are as current as possible, while leaving the projected improvement unchanged. This strategy allows for making minor, frequent adjustments instead of a large adjustment every decade or so and minimizes the volatility that can come from changing mortality assumptions.

Approach and Data

We have utilized nine years of experience to increase the credibility of the analysis and minimize any variance created by timing of data collection from year to year. During this time, mortality improvement may have occurred and thus a general procedure is to adjust the actual experience for mortality improvements during the study period to the central year, in this case 2015. Thus, for purposes of this study, proposed mortality rates shown in the tables have been adjusted to the central year 2015 using the proposed projection scales. The analysis uses only the retirees, not the beneficiaries, joint annuitants, or

survivors as the vast majority of the liability is based on this group of members and data from the beneficiaries can often have a survivorship bias which would skew the results. We will use a liability-weighted analysis by weighting members by the amount of their annuity. There are two reasons for using a liability-weighted approach. First, mortality experience across the U.S. has been shown to vary depending on income level. Liability-weighting considers differing benefit levels. Second, selecting an assumption based on headcount-weighting is consistent with estimating expected deaths, but selecting an assumption based on liability-weighting is consistent with minimizing the actuarial gains and losses associated with expected deaths. By weighting the data by annuity amounts, we are giving more weight to members who have larger annuities (and thus have larger liabilities).

Credibility

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

We first measured the credibility of the dataset to determine whether standard, unadjusted tables should be used or if client specific data was warranted. We apply a credibility procedure in accordance with ASOP No. 25, Credibility Procedures to determine partial credibility based on the limited fluctuation method to determine appropriate adjustments to the base table to be applied to each gender within each member classification. We utilized approaches described in this paper https://www.soa.org/globalassets/assets/files/static-pages/sections/retirement/credibility-resource-pension.pdf for this analysis. The paper shows that to be +/-5% with 90% confidence requires 1,082 deaths per gender. However, when using a benefit weighted approach to the analysis, even more deaths are required as the variance in the benefit amounts decreases the overall credibility.

HMEPS had 1,661 male and 735 female observed deaths during the period analyzed. This suggests very high credibility for male and modestly high for females. The following table provides the detail of these calculations based on p=90% and r=5%.

Group	Other Employees	
	Male	Female
Actual Deaths	1,661	735
Deaths needed for full credibility		
Based on Count	1,082	1,082
Based on Annuity Amount	1,850	1,891
Z Factor		
Based on Count	100.0%	82.4%
Based on Annuity Amount	94.8%	62.3%

Summary of Experience

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

The following is a summary of the data, all weighted by the amount of the annuity.

	Male	Female
Actual Deaths ($000 Annuities)	$36,659	$13,520
Expected Deaths based on Current Assumptions	$32,588	$11,816
A/E Ratio	112.5%	114.4%
Actual Deaths Static Life Expectancy for 65-Year Old	16.9	19.9
Expected Static Life Expectancy for 65-Year Old	16.7	20.0
A/E Ratio	101.2%	99.5%

The actual experience came in much higher than expected across the entire group, but much of the higher experience came in very low ages or very high ages. For example, males from ages 65-85 showed an A/E of 97% versus the 112.5% above. Using A/E ratios across the entire spectrum can overstate the deviation if the population is not similar to the populations used in developing the published tables. The static life expectancy came within 0.1-0.2 of the expectation, which is the more meaningful statistic for the valuation.

This is close enough that it would be reasonable to leave the assumption unchanged. However, it is also close enough that any adjustments towards the actual data would not make a meaningful difference to the liabilities or contribution requirements. It is preferable to keep the assumption as current as possible and to follow the process that has been established, which is to update the full assumption with each experience study, and so we are recommending a new base table. In addition, there are new published tables in the actuarial community that should be given preference over the older tables currently being used.

Pub-2010 Public Retirement Plans Mortality Tables

In January 2019, the Society of Actuaries (SOA) issued the final version of Pub-2010 Public Retirement Plans Mortality Tables. This is the first set of mortality rates published based on U.S. public sector experience. In this study, the SOA examined mortality for Teachers, Public Safety, and General employment categories. The SOA also studied mortality rates by gender, income (in total and separated into above and below median), and status (active employees, retirees, disabled retirees, and contingent survivors). As a consequence, there are over 90 Pub-2010 tables to select from.

In August 2018, the Society of Actuaries (SOA) reviewed the comprehensive annual financial reports of the majority of large public sector employees' retirement systems for a review of their mortality assumptions. The SOA report included analysis of certain annuity values under current assumptions and the new Pub-2010 tables. As can be seen in the charts, the majority of public sector plans would have higher annuity values (i.e., plan costs) under Pub-2010.

Public Plan Mortality Assumption Comparison

Figure 1

2018 AGE 55 ANNUITY FACTORS WITH PUB-2010 AND RP-2006

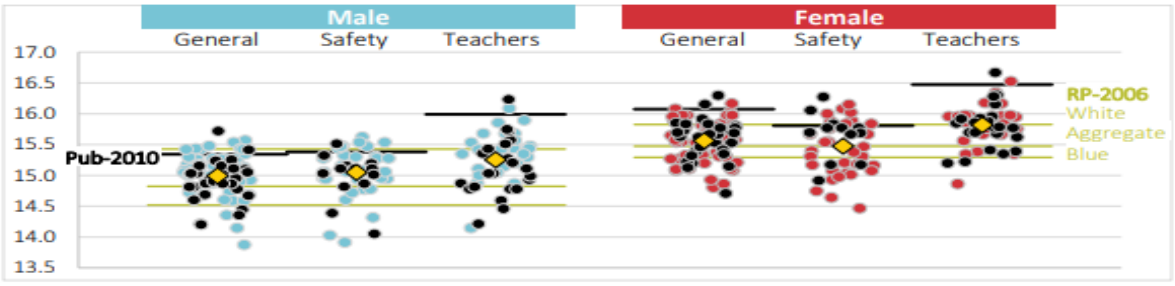


Figure 2

2018 AGE 65 ANNUITY FACTORS WITH PUB-2010 AND RP-2006

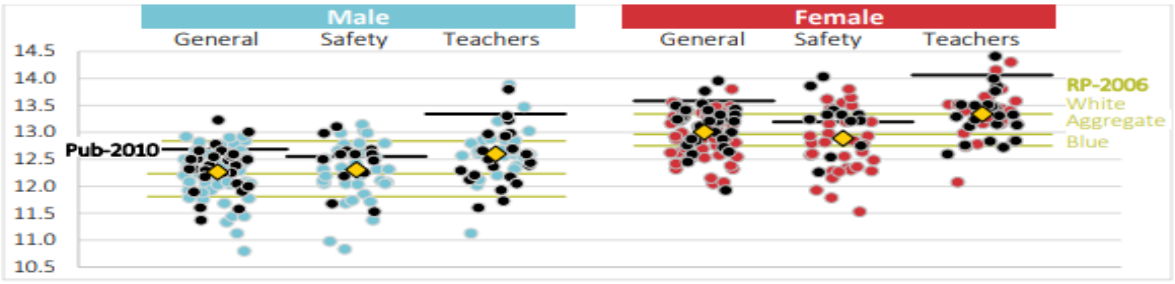
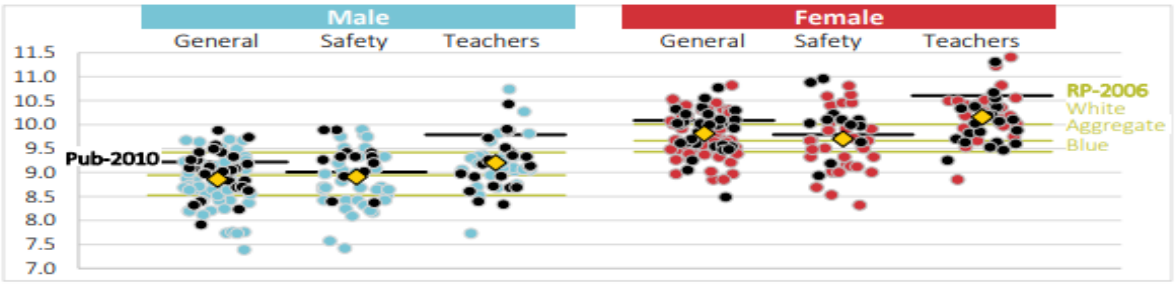


Figure 3

2018 AGE 75 ANNUITY FACTORS WITH PUB-2010 AND RP-2006



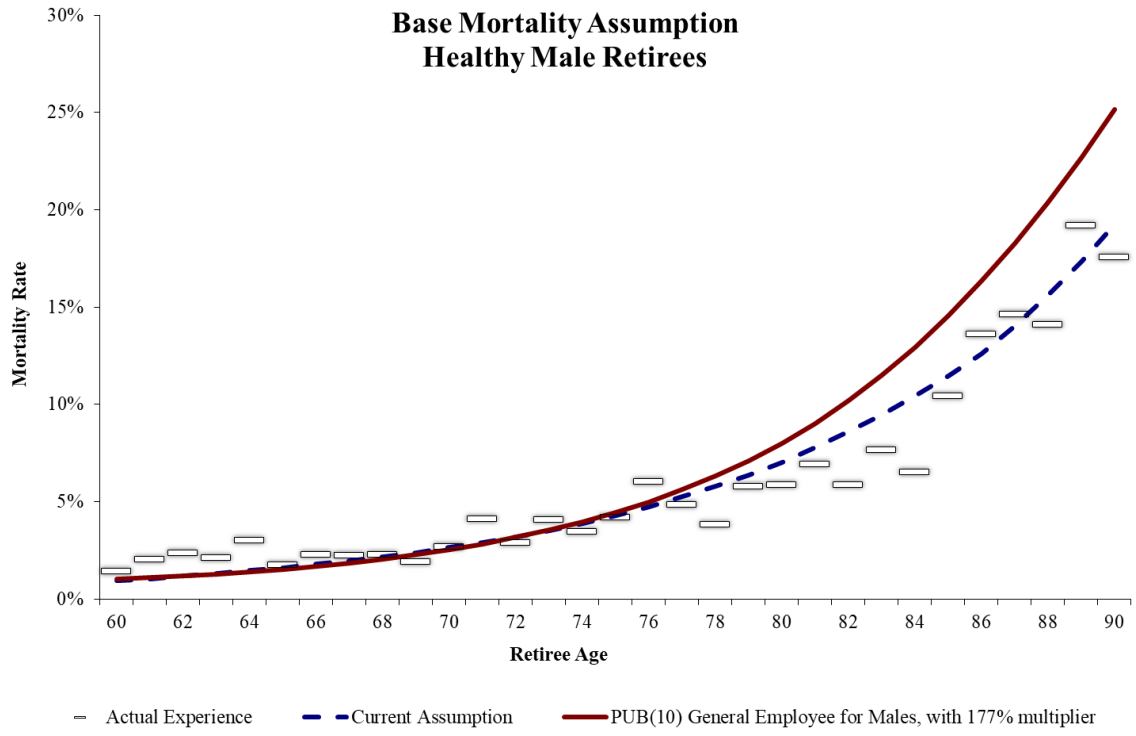
Legend	
Black dots	Plans that use RP-2006 or RP-2014 mortality rates (possibly adjusted) in the base table
Blue/red dots	Plans that use neither RP-2006 nor RP-2014 mortality rates (adjusted or otherwise) in the base table
Yellow diamonds	Average of all plans in the job category, weighted one per plan
Black lines	Pub-2010 Mortality Tables (amount-weighted) generationally projected with Scale MP-2017
Green lines	RP-2006 Mortality Tables (amount-weighted) generationally projected with Scale MP-2017: white collar (top), aggregate (middle) and blue collar (bottom)
Assumptions	Monthly single life annuities beginning in 2018, computed at 7% interest with 2% annual benefit increases

However, another observation is the wide range of outcomes across the datasets included in the analysis. Thus, occupation is not the only factor for variance in life expectancy. The report published alongside the Pub-2010 tables states that income was generally the most significant explanatory variable, even excluding job category. For this reason, Above Median and Below Median versions of the tables were also published. However, even the range between these versions of the tables is quite wide, especially for general employee males. Other factors could be duration of retirement, geographic region, access to health insurance, and definitions of disability. Some of these factors can be analyzed by trying to match these characteristics of the group to the baseline table, but if the dataset is large enough, this process can be analyzed through statistical techniques to scale the table to the experience.

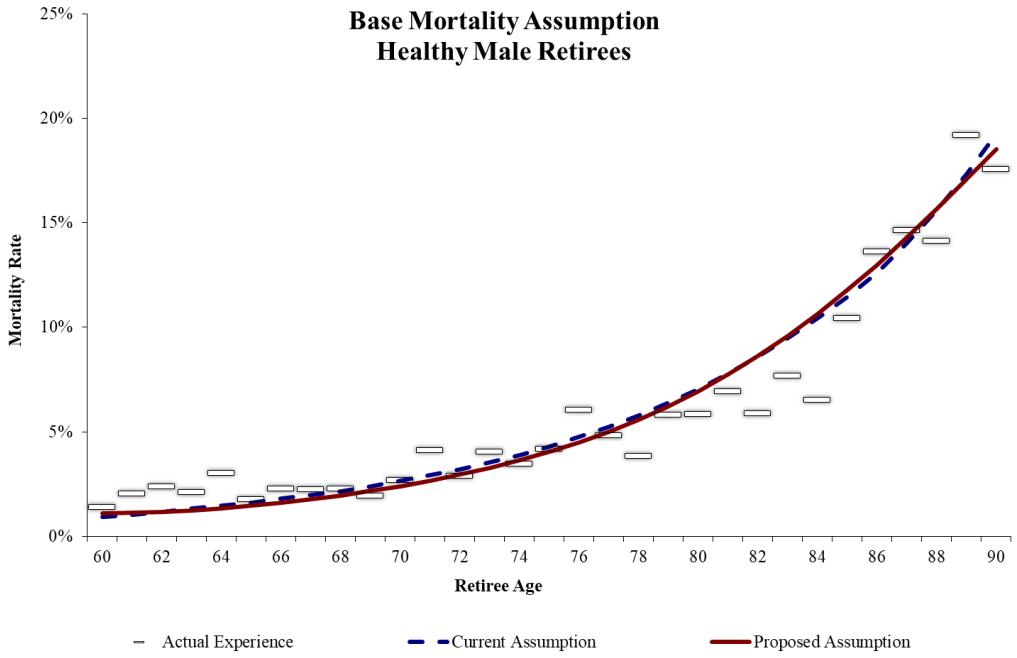
Recommended Base Mortality Assumption

While there is no requirement to adopt the new tables, the new tables are based specifically on public sector data and auditors will be expecting the new tables to be utilized. Thus, we have compared the data from the study period to variants of the newer PUB(10) mortality tables. We compared the ratio of the actual deaths to the expected deaths—the A/E ratio—to tell us whether the assumptions are reasonable.

We attempted to use the limited fluctuation credibility procedure to determine the appropriate scaling factor of the base mortality tables for each gender and each member classification on a benefits weighted basis. We first compared to the midline version of the tables. However, especially for males, the mortality experience of HMEPS retirees differed widely from the standard table. A 177% multiplier of the base table would be needed to produce mortality rates in line with the actual experience. The following shows the result of standard limited fluctuation procedures compared to the median tables for males. As shown, the shape is not optimal.



We then compared to the below median income versions of the tables, which have been adjusted for groups in the lowest quartile of income/mortality factors. This produced a much closer fit, and would have been an appropriate approach, but the shape of the curve was still not optimal. Limited fluctuation theory really only holds when the two items being compared are just factors of each other. When one has a different shape, the process is not as meaningful. We finally compared both males and females to the below median income versions of the tables, but with a 2-year set forward. This means that a HMEPS retiree who is age 70 will be valued as if they are age 72. This produced a better match in the life expectancies at the most important ages (65-80). The following shows the experience for males compared to the current assumption and the proposed assumption. Notice the higher level of mortality for early ages. Again, this is a group that statistically is 95% credible.



Overall, the A/E ratios in total (across all ages) for males and females are still high. However, a better way to examine the table is to compare the life expectancies created at various ages. The following table provides the life expectancies calculated from the given age based on the actual data, the current assumption, and the recommended tables.

Static Life Expectancy, in years – with Central Year 2015						
	Males			Females		
Retiree Age	Actual in Data	Current Assumption	Proposed Table	Actual in Data	Current Assumption	Proposed Table
60	20.0	20.6	21.0	24.1	24.3	24.7
65	16.9	16.7	17.1	19.9	20.0	20.4
70	13.6	13.2	13.5	16.1	16.1	16.3
75	10.7	10.1	10.2	12.6	12.7	12.6
80	8.0	7.5	7.5	9.5	9.7	9.3

As shown, the proposed base tables produce slightly higher life expectancies than the current tables. However, the change in projection scale below will more than offset this impact. More detail is shown on the tables in Section VII.

Recommended Mortality Improvement Assumption

We use a fully generational approach to this assumption. Because of this strategy of building in continuous improvement, life expectancies for today's younger active members are expected to be materially longer than those of today's retirees, and this provides substantial stability and dependability on costs and liabilities. We currently use Scale BB, published by the Society of Actuaries in 2012, which is about a 1.5% improvement assumption per year across most ages.

There is an annual report published by the Retirement Plans Experience Committee of the Society of Actuaries to provide commentary on national trends in mortality experience and provide updated projection scales. The initial report was in 2014, with annual updates every year since. In every update, rates of projection were materially decreased, meaning the original MP-2014 table was found to be too

conservative. In addition, the amount of change from year to year has been significant. The amount of volatility produced by changing annually to each "most recent" table has been on a similar order as the actual investment performance. Thus, we find that the use of the full version of these tables produce an overly complex, volatile pattern of results that has actually had minimal, if any, predictive power.

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

In the 2020 report the ultimate mortality improvement rates were modified to be higher at some ages and more precise across different age groups based on historical trends. Specifically, the pattern is 1.35% rate for ages 62 and younger, decreasing linearly to 1.10% at age 80, further decreasing linearly to 0.40% at age 95, and then decreasing linearly to 0.00% at age 115 (and thereafter). In general, the net change in overall liabilities if a retirement system was using the ultimate rates of the MP-2019 table to the ultimate rates of the MP-2020 version is minimal. Basically, the rates at individual ages were changed but the overall pattern over a lifetime is not much different. However, both of these newer tables are lower than the current 1.5% being used for HMEPS.

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

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

Proposed Mortality Assumption – Projected Life Expectancy for an Age 65 Retiree in Years					
Group	**Year of Retirement**				
	2020	**2025**	**2030**	**2035**	**2040**
Male	18.4	18.8	19.3	19.7	20.1
Female	21.8	22.1	22.5	22.9	23.2

The net overall impact of updating both the base tables and the projection scales will be slightly lower liability and contribution requirements.

Disabled Mortality Rates

HMEPS does not have a heavily utilized disability provision and thus the members that are disabled are significantly impaired.

There were 134 deaths among the male disabled retirees, and 58 deaths among the female disabled retirees during the 9 years. The sample size of this group makes the A/E ratios unreliable as an analytical tool. We instead recommend a change in this assumption to a methodology commonly used for disabled mortality which is to set the healthy mortality rates forward to reflect impairment. We currently use a 5-year set-forward for use in the HMEPS valuation. This means a 70-year old disabled member will have the same mortality rate as a 75-year old healthy member.

Combining with the change to the healthy tables above means the disabled tables will have a 7-year set-forward to the base table. In addition, we will continue to apply a minimum 4% mortality rate for males and a 3% mortality rate for females to reflect material impairment at earlier ages.

Active Mortality Rates

Mortality across employee groups is generally lower than the mortality rates in the post-retirement mortality tables. It should be noted that this is probably the least material of all of the assumptions.

We are recommending updating to the PUB(10), below median income tables for general employees. We are recommending the same 2-year set forward to be consistent with the post-retirement adjustments.

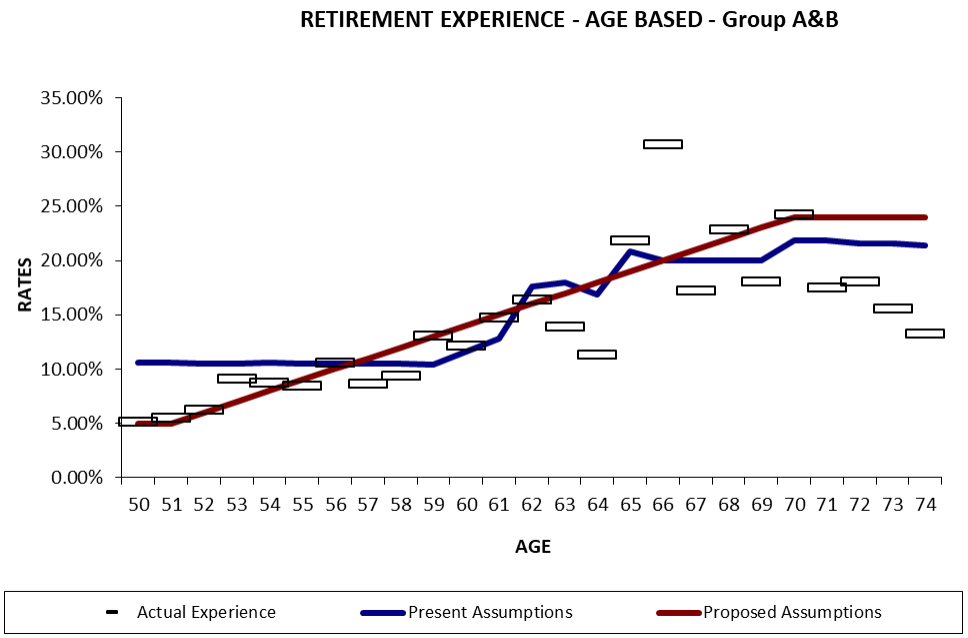
Disability Rates

There were 4.5 new disability retirements per year during the study period compared to approximately 7.5 expected. While the assumption appears to overstate expected rates of disability, most members that currently become disabled are also eligible to immediately commence retirement benefits, and the majority of the members becoming disabled elect to retire rather than apply for disability. Once Group D members reach those same ages, they will not be eligible for retirement and thus there will likely be more disability retirements. We recommend no changes to the current assumption.

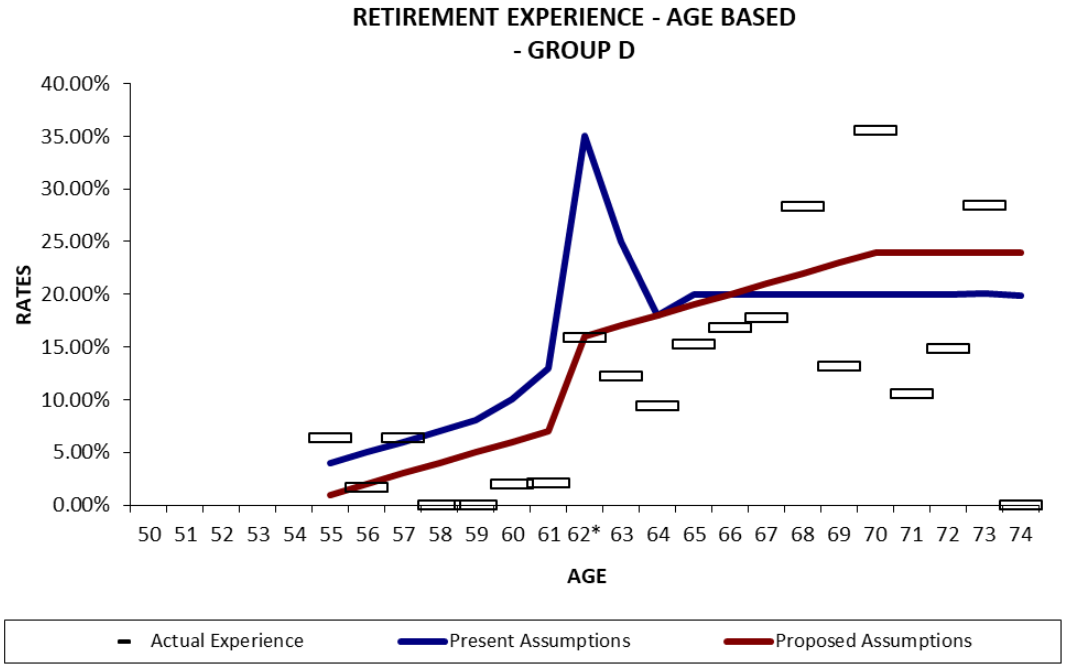
Retirement Rates

The current patterns of retirement are based on age, gender, and Group. The analysis weights members by their present value of future benefits. Selecting an assumption based on liability-weighting is consistent with minimizing the actuarial gains and losses associated with expected retirement patterns. By weighting the data by the potential liability of people that could retire versus the number of people that could retire, we are giving more weight to members who have larger liabilities. This analysis utilized five years of data. A/E ratios of less than 100% are conservative, and therefore the newly recommended retirement rates will continue to have an A/E ratio that is less than 100% when compared to prior experience.

For Group A and B members, the actual retirements were 94% of expected, which is in the ideal range. It would be appropriate to leave the expected patterns unchanged. However, the current patterns for Group D members appear to overestimate the number of retirements. Also, it appears unnecessary to have separate tables for males and females once weighted by liability. We have simplified the assumption into one base pattern that could be used for all groups and genders. This is illustrated in the following chart.



The proposed table produces an A/E ratio of 95%, very similar to the current pattern. However, it does give a better base pattern to work from for Group D. This is the first study with retirement experience for Group D, although it is only for members with smaller amounts of service. We have started with the same new proposed table and left it unchanged for ages after 62. For ages before 62, which are eligible for a reduced benefit, we will subtract 8% from the base pattern. At age 62, if the member has more than 20 years of service, we will add a 10% bump. The following chart illustrates the new pattern for Group D.



The net impact will be slightly lower liability and contribution requirements.

Termination Rates

Termination rates reflect members who leave for any reason other than death, disability or service retirement. They apply whether the termination is voluntary or involuntary, and whether the member takes a refund or keeps his/her contributions on deposit in the System. The current termination rates reflect the member's age, service and sex, and we want to continue this practice.

For this analysis, we used 10 years' worth of data to capture a longer economic cycle and also weighted the data by the present value of benefits for the member. For members with 10 years of service or less, the current assumptions produce an A/E ratio for males of 107% and an A/E ratio for females of 99%. This shows the assumptions to closely match the experience. However, there was no change to this assumption in the last experience study and re-graduating the patterns based on the data in this analysis does produce a better fit at various age and service combinations. The proposed patterns for members with 10 years of service or less produce A/E ratios of 103% for both males and females. For this assumption, slightly higher than 100% is optimal to allow some margin for rehires after an initial termination.

For members with more than 10 years of service, the pattern is based on age and gender and the current assumptions produce an A/E ratio for males of 101% and an A/E ratio for females of 77%. We recommend a small change to the male pattern mostly to get a better fit to the data by age but a more meaningful change to females. The proposed patterns for members with more than 10 years of service produce A/E ratios of 102% for both males and females.

Furthermore, experience continues to exhibit a pattern that suggests utilization of a ten-year select and ultimate withdrawal assumption will more appropriately reflect past (and anticipated future) experience. This means that the member moves through a select period based on age and service and then reaches an "ultimate" period in which all members follow the same pattern, based on age.

Vested Terminating Members Benefit Election Assumption

Currently it is assumed that all terminated vested contributing members will select the most valuable benefit available to them (either refund of member contributions or a deferred annuity). Additionally, it is assumed members with deferred annuities will commence their retirement benefit at the age they are first eligible for unreduced retirement. We believe these assumptions are still reasonable and are recommending no change.

DROP Election Rates

The current assumption is that 65% of members eligible for DROP will participate at first eligibility for retirement. The current DROP provisions are not as generous as previous versions and thus it is not as advantageous for all members to utilize DROP. In fact, if a member reaches age 60 before becoming eligible to retire, it is likely in their best interest to not use the DROP once they attain retirement eligibility and instead continue to earn service. We have segmented the data based on the age the member reaches eligibility for unreduced retirement and found that 95% of members who reach eligibility prior to age 60 utilize DROP within three years of reaching retirement eligibility. Based on this, we are simplifying the assumption so that 100% of members who reach retirement eligibility prior to age 60 will utilize the DROP program, while 0% of members who reach retirement eligibility at age 60 or above will do so.

This change is about simplification and the two patterns produce approximately the same liabilities and costs.

Retiree DROP Payout Duration

When a member participates in DROP, they accumulate a DROP account while they continue to work. When they leave employment, they have the option of leaving their DROP account monies with HMEPS and to continue to receive interest credits on their DROP accounts. HMEPS credits 50% of the average five-year net investment return with a minimum crediting rate of 2.50% and a maximum crediting rate of 7.50%. Based on the expected rate of return and the expected volatility of the portfolio, it is beneficial to HMEPS' funding status for these monies to be left in the System. Currently we assume that future retirees will receive the balance of their DROP accounts in equal installments over an eight-year period from their retirement date. We analyzed the data from year to year in the balances left on account and found that members tend to leave their accounts for even longer than eight years. We recommend no change.

Percent Married and Assumed Age Difference

This assumption is used to reflect the cost of the automatic Joint & 80% Survivor benefit provided to married members upon commencement of retirement benefits as well as to estimate how many current retirees have beneficiaries that would continue to receive benefits if the retiree died. The current assumption is 70% and this is supported by national statistics. We are recommending no change at this time. Additionally, we continue to assume males are three years older than their female spouses.

Actuarial Methods

The statute requires the Ultimate Normal Cost variant of the Entry Age Normal cost method (EAN). The Entry Age Normal method will generally produce relatively level contribution amounts as a percentage of payroll from year to year, and allocates costs among various generations of taxpayers in a reasonable manner. It is by far the most commonly used actuarial cost method for large public retirement systems. In addition, the Ultimate Normal Cost variant of EAN produces a funding requirement as a percentage of payroll that is the most stable and predictable over time compared to all other funding methods and variants. We continue to believe that this is the method of choice for this plan, since this method usually does the best job of keeping costs level as a percentage of payroll for plans with more than one benefit tier. We are recommending no change to the cost method.

In the actuarial valuation we do not use the market value of assets directly. Instead, we use a smoothed market asset value referred to as the actuarial value of assets. The method for determining the actuarial value of assets is to recognize the difference between expected earnings and actual earnings over a period of not more than five years. We are recommending no change to this method. Please see page 34 for a more detailed discussion of this method.

Other Assumptions

We have thoroughly reviewed all of these ancillary assumptions, and believe they are generally appropriate and reasonable. Therefore, we recommend no changes to these other assumptions. A listing of all of these assumptions is in Section VI.

SECTION IV

ILLUSTRATED ACTUARIAL IMPACT OF RECOMMENDATIONS

Illustrated Actuarial Impact of Recommendations

For illustrative purposes, shown below is a table that compares key statistics from the July 1, 2020 actuarial valuation report before and after taking into account the recommended new assumptions.

Recommended Assumptions based on 7.00% Investment Return Assumption				
	Valuation Results as of July 1, 2020		Change	
Item	Current Assumptions	Recommended Assumptions	Amount	Percent
(1)	(2)	(3)	(4)	(5)
1. Total normal cost %	11.44%	11.20%	-0.24%	-2.1%
2. Actuarial accrued liability	$5,196	$5,159	-$37	-0.7%
3. Actuarial value of assets	$3,074	$3,074	$0	0.0%
4. Unfunded actuarial accrued liability	$2,122	$2,085	-$37	-1.7%
5. Funded ratio	59.2%	59.6%	0.40%	0.7%
6. Calculated Contribution Rate	7.89%	7.30%	-0.59%	-7.5%
7. City Contribution Rate	8.41%	8.41%	0.00%	0.0%

All dollar amounts in $ millions

SECTION V

SUMMARY OF ASSUMPTIONS AND METHODS, INCORPORATING RECOMMENDED ASSUMPTIONS

Summary of Assumptions and Methods, Incorporating Recommended Assumptions

The following methods and assumptions will be used in preparing the July 1, 2021, actuarial valuation.

1. Valuation Date

   The valuation date is July 1st of each plan year. This is the date as of which the actuarial present value of future benefits and the actuarial value of assets are determined.

2. Actuarial Cost Method (Prescribed Method under Actuarial Standards of Practice)

   The actuarial valuation uses the Entry Age Normal actuarial cost method. Under this method, the employer contribution rate is the sum of (i) the employer normal cost rate, and (ii) a rate that will amortize the unfunded actuarial accrued liability.

   a. The valuation is prepared on the projected benefit basis, under which the present value, at the investment return rate assumed to be earned in the future, of each participant's expected benefit payable at retirement or death is determined, based on his/her age, service, sex and compensation. The calculations take into account the probability of a participant's death or termination of employment prior to becoming eligible for a benefit, as well as the possibility of his/her terminating with a service, disability, or survivor's benefit. Future salary increases are also anticipated. The present value of the expected benefits payable on account of the active participants is added to the present value of the expected future payments to retired participants and beneficiaries to obtain the present value of all expected benefits payable from the Plan on account of the present group of participants and beneficiaries.

   b. The employer contributions required to support the benefits of the Plan are determined using a level funding approach, and consist of a normal cost contribution and an accrued liability contribution.

   c. The normal contribution is determined using the "entry age normal" method. Under this cost method, a calculation is made to determine the average uniform and constant percentage rate of employer contribution which, if applied to the compensation of each participant during the entire period of his/her anticipated covered service, would be required to meet the cost of all benefits payable on his behalf based on the benefits provisions for new employees hired on or after the valuation date.

   d. The actuarial accrued liability (AAL) for each member is the difference between their present value of future benefits (PVFB), based on the tier of benefits that apply to the member, and their present value of future normal costs determined using the normal cost rate described in item c above. For inactive and retired members their AAL is equal to their PVFB.

   e. The Legacy Liability payments were established in the Initial RSVS valuation. In each subsequent valuation, a liability (gain)/loss layer is established that is the difference between the sum of (i) the remaining Legacy Liability and (ii) the remaining liability (gain)/loss layers, and the unfunded accrued liability. The amortization payment for each liability (gain)/loss layer is determined by amortizing the layer over 30 years with the first payment made one year after the valuation in which the layer was established.

The contribution rate determined by this valuation will not be effective until one year later and the determination of the rate reflects this deferral. It is assumed that there will be no change in the employer normal cost rate due to the deferral, and it is assumed that payments are made uniformly throughout the year.

3. Actuarial Value of Assets

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

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

The actuarial value of assets was marked to market value as of July 1, 2016 by recognizing all deferred investment shortfalls on that date. The method described above began again with the 2017 valuation.

4. Economic Assumptions

a. Investment return: 7.00% per year, compounded annually, composed of an assumed 2.25% inflation rate and a 4.75% net real rate of return. This rate represents the assumed return, net of all investment expenses.

b. Salary increase rate: A 2.25% inflation component, plus a 1.00% general increase, plus a service-related component as follows:

Years of Service	Service-related Component	Total Annual Rate of Increase Including 2.25% Inflation Component and 1.00% General Increase Rate
(1)	(2)	(3)
1	2.25%	5.50%
2	2.25	5.50
3	2.75	6.00
4	2.25	5.50
5	1.75	5.00
6	1.50	4.75
7	1.25	4.50
8	1.00	4.25
9	0.75	4.00
10-19	0.50	3.75
20-24	0.25	3.50
25+	0.00	3.25

c. Payroll growth rate: In the amortization of the unfunded actuarial accrued liability, payroll is assumed to increase 2.75% per year. This increase rate is solely due to the effect of inflation on salaries, with no allowance for future membership growth.

The investment return assumption is established in statute at 7.0% and therefore is considered a prescribed assumption under the Actuarial Standards of Practice.

5. Demographic Assumptions

a. Retirement Rates

	Expected Retirements per 100 Lives		
	Group A & B Members	Group D Members	
Age	All	Service <20	Service >= 20
(1)	(2)	(3)	(4)
45-51	5		
52	6		
53	7		
54	8		
55	9	1	1
56	10	2	2
57	11	3	3
58	12	4	4
59	13	5	5
60	14	6	6
61	15	7	7
62	16	16	26
63	17	17	17
64	18	18	18
65	19	19	19
66	20	20	20
67	21	21	21
68	22	22	22
69	23	23	23
70-74	24	24	24
75+	100	100	100

b. DROP Participation

100% of eligible members who reach eligibility for normal retirement prior to age 60 are assumed to enter DROP. 0% of eligible members who reach eligibility for normal retirement at or after age 60 are assumed to enter DROP.

c. DROP Entry Date

Those active members (not already in DROP) are assumed to enter DROP when first eligible. For members who have already entered DROP, the actual DROP entry date supplied in the data is used.

d. DROP Interest Credit

Interest is credited as 50% of the average five-year net investment return, with a minimum of 2.5% and a maximum of 7.5%. The credit rate is assumed to be 4.00% per year.

e. Mortality rates (active members)

Based on the Pub-2010, Amount-Weighted, Below-Median Income, General, Employee Male and Female tables, with a 2-year set forward. The rates are projected on a fully generational basis by the long-term rates of scale MP 2020 to account for future mortality improvements. 90% of the rates are assumed to be for non-service related deaths and 10% for service related deaths.

f. Mortality rates (retired members and beneficiaries):

Healthy Retirees and beneficiaries: Gender-distinct Pub-2010, Amount-Weighted, Below-Median Income, General, Healthy Retiree tables with a 2-year set-forward. The rates are projected on a fully generational basis by the long-term rates of scale MP 2020 to account for future mortality improvements. Life Expectancies are shown in the table below:

Life Expectancy of 65 year old retiree in years (with projection)						
Calendar Year	2020	2025	2030	2035	2040	2045
Male	18.4	18.8	19.3	19.7	20.1	20.4
Female	21.8	22.1	22.5	22.9	23.2	23.5

Disabled Retirees: Gender-distinct Pub-2010, Amount-Weighted, Below-Median Income, General, Healthy Retiree tables with a 7-year set-forward. The rates are projected on a fully generational basis by the long-term rates of scale MP 2020 to account for future mortality improvements. A minimum rate of 0.04 is applied to male and 0.03 to female.

g. Termination Rates and Disability Rates

Termination rates (for causes other than death, disability or retirement):

Termination rates are a function of the member's age and service. Termination rates are not applied after a member becomes eligible for a retirement benefit. Rates at selected ages are shown below.

Probability of Decrement Due to Withdrawal – Male Members

Age	Years of Service 0	1	2	3	4	5	6	7	8	9	10+
20	0.2528	0.2156	0.1864	0.1670	0.1513	0.1379	0.1160	0.0982	0.0828	0.0724	0.0675
30	0.2175	0.1642	0.1345	0.1204	0.1160	0.1141	0.1039	0.0859	0.0738	0.0675	0.0555
40	0.1925	0.1397	0.1080	0.0942	0.0911	0.0910	0.0823	0.0644	0.0511	0.0451	0.0375
50	0.1708	0.1270	0.0910	0.0760	0.0716	0.0703	0.0622	0.0523	0.0426	0.0400	0.0253
60	0.1321	0.1140	0.0959	0.0821	0.0705	0.0619	0.0525	0.0394	0.0295	0.0269	0.0171

Probability of Decrement Due to Withdrawal – Female Members

Age	Years of Service 0	1	2	3	4	5	6	7	8	9	10+
20	0.1903	0.2026	0.1911	0.1577	0.1170	0.0786	0.1036	0.1224	0.1373	0.1248	0.0441
30	0.1947	0.1743	0.1508	0.1252	0.1073	0.1030	0.1000	0.0885	0.0812	0.0857	0.0441
40	0.1892	0.1495	0.1260	0.1055	0.0928	0.0893	0.0810	0.0607	0.0459	0.0464	0.0318
50	0.1619	0.1297	0.1069	0.0874	0.0781	0.0704	0.0625	0.0473	0.0408	0.0288	0.0253
60	0.0960	0.0762	0.0638	0.0603	0.0645	0.0586	0.0479	0.0502	0.0446	0.0326	0.0223

Rates of Decrement Due to Disability

Age	Males	Females	Service-related Males	Service-related Females
20	0.000004	0.000006	0.000000	0.000001
25	0.000009	0.000013	0.000001	0.000002
30	0.000073	0.000065	0.000005	0.000008
35	0.000318	0.000102	0.000022	0.000013
40	0.000650	0.000234	0.000045	0.000029
45	0.001259	0.000528	0.000087	0.000066
50	0.002195	0.001256	0.000151	0.000157
55	0.003171	0.002021	0.000219	0.000253
60	0.004188	0.002436	0.000289	0.000305

Rates of disability are reduced to zero once a member becomes eligible for retirement.

6. Other Assumptions

a. Projected payroll for contribution purposes: The aggregate projected payroll for the fiscal year following the valuation date is calculated by increasing the actual payroll paid during the previous fiscal year to all members (actives, terminated and retired) by the payroll growth rate.

b. Percent married: 70% of employees are assumed to be married. (No beneficiaries other than the spouse assumed). The 70% assumption is intended to provide sufficient margin to cover the costs of any surviving children benefits.

c. Age difference: Male members are assumed to be three years older than their spouses, and female members are assumed to be three years younger than their spouses.

d. Percent electing annuity on death (when eligible): All of the spouses of vested, married participants are assumed to elect an annuity.

e. Percent electing deferred termination benefit: Vested terminating members are assumed to elect a refund or a deferred benefit, whichever is more valuable at the time of termination.

f. There will be no recoveries once disabled.

g. No surviving spouse will remarry.

h. Assumed age for commencement of deferred benefits: Members electing to receive a deferred benefit are assumed to commence receipt at the first age at which unreduced benefits are available.

i. Administrative expenses: The administrative expenses of the plan are added into the employer contribution rate as a percentage of payroll at a rate of 1.25%.

j. Pay increase timing: Beginning of (fiscal) year. This is equivalent to assuming that reported pays represent amounts paid to members during the year ended on the valuation date.

k. Decrement timing: Decrements of all types are assumed to occur mid-year.

l. Eligibility testing: Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur.

m. Decrement relativity: Decrement rates are used directly from the experience study, without adjustment for multiple decrement table effects.

n. Incidence of Contributions: Contributions are assumed to be received continuously throughout the year based upon the computed percent of payroll shown in this report, and the actual payroll payable at the time contributions are made.

o. Benefit Service: All members are assumed to accrue 1 year of service each year. Fractional service is used to determine the amount of benefit payable.

p. Retiree DROP Balances Payout Duration: It is assumed that retirees will receive their DROP balances in equal installments over the eight years following retirement.

q. COLA is assumed to be 1.00% per year for almost all members effective 7/1/2017. Group D members who terminated prior to 7/1/2017, the effective date of the 2017 legislation, are not eligible for a COLA.

7. Participant Data

Participant data was supplied on electronic files. There were separate files for (i) active members, (ii) inactive members, and (ii) members and beneficiaries receiving benefits.

The data for active members included birth date, sex, most recent hire date, salary paid during last fiscal year, hours worked by the employee, and employee contribution amounts. For retired members and beneficiaries, the data included date of birth, sex, amount of monthly benefit, and date of retirement. Also included was the member's Group and for members participating in DROP, their account balances and monthly DROP income.

For Groups A and B, most healthy and disabled retirees are assumed to have an 80% joint and survivor form of payment (a small group of retirees is only eligible for a 50% joint and survivor annuity), prorated by the 70% marriage assumption and reflecting the 3-year spousal age differential. All non-children beneficiaries are assumed to have life only benefits and all children beneficiaries' annuities are assumed to stop at age 21.

Salary for the prior fiscal year as well as an annualized rate of pay is provided in the data. The annualized rate increased by one-year's salary increase is the rate of pay the member is assumed to earn in the upcoming fiscal year.

Except as noted below, assumptions were made to correct for missing or inconsistent data. These had no material impact on the results presented.

We received some salary information on City of Houston employees employed by HFC, HFF, and CCSI. Where we had additional information because of previous HMEPS service, we added the salary information and treated the records as active employees. For the 170 records where we had no additional information, we valued these members as average Group D members with regards to demographics (age, gender, etc.) but using the reported pay.

8. Group Transfers

We assume no current Group B members will transfer to Group A.

SECTION VI

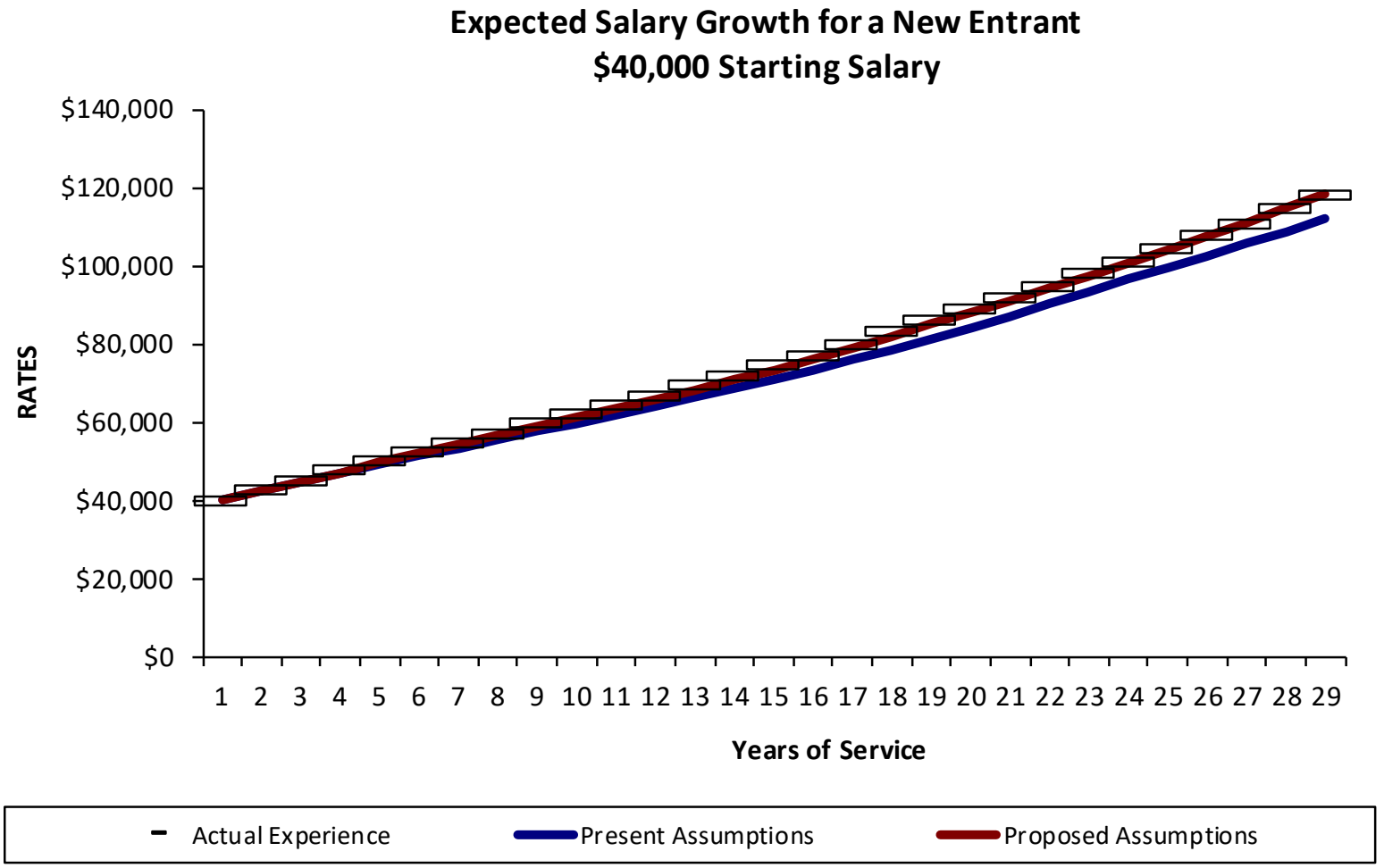
SUMMARY OF DATA AND EXPERIENCE

Salary Increase Analysis

Years of Service	Current Salary Scale		Fiscal Years 2010 - 2020 Experience			Proposed Salary Scale	
	Total	Step Rate/ Promotional	Total	Above Inflation	Step Rate/ Promotional	Total	Step Rate/ Promotional
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	5.25%	2.25%	4.57%	2.88%	1.40%	5.50%	2.25%
2	5.25%	2.25%	5.98%	4.29%	2.80%	5.50%	2.25%
3	5.75%	2.75%	6.13%	4.44%	2.95%	6.00%	2.75%
4	5.25%	2.25%	5.68%	3.99%	2.50%	5.50%	2.25%
5	4.75%	1.75%	5.16%	3.47%	1.98%	5.00%	1.75%
6	4.50%	1.50%	4.85%	3.16%	1.68%	4.75%	1.50%
7	4.25%	1.25%	4.43%	2.74%	1.25%	4.50%	1.25%
8	4.00%	1.00%	4.46%	2.76%	1.28%	4.25%	1.00%
9	3.75%	0.75%	4.33%	2.64%	1.16%	4.00%	0.75%
10	3.50%	0.50%	4.00%	2.31%	0.83%	3.75%	0.50%
11	3.50%	0.50%	3.95%	2.26%	0.78%	3.75%	0.50%
12	3.50%	0.50%	3.69%	2.00%	0.51%	3.75%	0.50%
13	3.50%	0.50%	4.03%	2.33%	0.85%	3.75%	0.50%
14	3.50%	0.50%	3.59%	1.90%	0.42%	3.75%	0.50%
15	3.50%	0.50%	3.65%	1.96%	0.47%	3.75%	0.50%
16	3.50%	0.50%	3.22%	1.53%	0.04%	3.75%	0.50%
17	3.50%	0.50%	3.74%	2.05%	0.56%	3.75%	0.50%
18	3.50%	0.50%	3.78%	2.09%	0.61%	3.75%	0.50%
19	3.50%	0.50%	3.36%	1.67%	0.19%	3.75%	0.50%
20	3.50%	0.50%	3.54%	1.85%	0.36%	3.50%	0.25%
21	3.50%	0.50%	3.23%	1.54%	0.06%	3.50%	0.25%
22	3.50%	0.50%	3.33%	1.64%	0.15%	3.50%	0.25%
23	3.50%	0.50%	3.43%	1.74%	0.25%	3.50%	0.25%
24	3.50%	0.50%	3.03%	1.34%	-0.15%	3.50%	0.25%
25+	3.00%	0.00%	3.18%	1.48%	0.00%	3.25%	0.00%

Current Inflation Assumption	2.25%	Proposed Inflation Assumption	2.25%
Current Productivity Component	0.75%	Proposed Productivity Component	1.00%
Actual CPI-U Inflation for Jun/10 - Jun/20	1.69%		
Apparent Productivity Component	1.48%		

Salary Increase Analysis



NON-DISABLED RETIREES
POST-RETIREMENT MORTALITY - MALES
Weighted by Annual Benefits in $000s

Age	Actual Deaths	Total Count	Actual Rate	Assumed Rate		Expected Deaths		Actual / Expected	
				Current	Proposed	Current	Proposed	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
55-59	$ 2,703	$ 119,546	0.0226	0.0066	0.0098	$ 792	$ 1,168	341%	231%
60-64	4,873	217,814	0.0224	0.0118	0.0117	2,561	2,550	190%	191%
65-69	5,463	261,748	0.0209	0.0198	0.0177	5,175	4,633	106%	118%
70-74	6,969	204,257	0.0341	0.0321	0.0295	6,552	6,025	106%	116%
75-79	5,589	114,070	0.0490	0.0525	0.0501	5,987	5,715	93%	98%
80-84	3,989	61,426	0.0649	0.0861	0.0863	5,286	5,300	75%	75%
85-89	3,996	29,017	0.1377	0.1403	0.1430	4,070	4,149	98%	96%
90-94	1,974	8,426	0.2343	0.2310	0.2149	1,946	1,811	101%	109%
95-99	406	1,201	0.3383	0.3529	0.3008	424	361	96%	112%
Totals	$ 35,962	$ 1,017,505				$ 32,794	$ 31,713	110%	113%
Male + Females	$ 49,385	$ 1,652,248				$ 44,552	$ 42,788	111%	115%

Static Life Expectancy (As of Central Year)

	Actual		Current		Proposed	
	Unsmoothed	Smoothed	Value	Margin	Value	Margin
50	24.8	27.5	29.4	6.9%	28.8	4.6%
55	22.6	23.6	24.9	5.1%	24.8	5.1%
60	19.9	20.0	20.6	3.3%	21.0	5.1%
65	16.9	16.9	16.7	-1.2%	17.1	1.0%
70	13.5	13.6	13.2	-3.0%	13.5	-1.1%
75	10.6	10.7	10.1	-5.6%	10.2	-4.4%
80	8.0	8.0	7.5	-7.0%	7.5	-6.5%
85	5.2	5.3	5.3	-0.3%	5.4	1.3%
90	3.4	3.4	3.6	4.4%	3.9	12.3%

POST-RETIREMENT MORTALITY - FEMALES
Weighted by Annual Benefits in $000s

Age	Actual Deaths	Total Count	Actual Rate	Assumed Rate		Expected Deaths		Actual / Expected	
				Current	Proposed	Current	Proposed	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
55-59	834	96,530	0.0086	0.0036	0.0049	347	473	240%	176%
60-64	1,874	159,933	0.0117	0.0066	0.0063	1,060	1,001	177%	187%
65-69	2,314	167,644	0.0138	0.0123	0.0100	2,064	1,679	112%	138%
70-74	2,160	106,954	0.0202	0.0211	0.0172	2,261	1,839	96%	117%
75-79	1,777	53,695	0.0331	0.0339	0.0302	1,822	1,622	98%	110%
80-84	1,720	27,078	0.0635	0.0552	0.0548	1,494	1,484	115%	116%
85-89	1,122	14,346	0.0782	0.0949	0.1034	1,362	1,483	82%	76%
90-94	1,304	7,455	0.1750	0.1496	0.1653	1,115	1,233	117%	106%
95-99	318	1,107	0.2878	0.2111	0.2374	234	263	136%	121%
Totals	13,423	634,743				11,758	11,076	114%	121%

Static Life Expectancy (As of Central Year)

	Actual		Current		Proposed	
	Unsmoothed	Smoothed	Value	Margin	Value	Margin
50	31.8	32.6	33.5	2.5%	33.4	2.2%
55	27.4	28.4	28.8	1.6%	29.1	2.4%
60	23.4	24.1	24.3	0.9%	24.7	2.5%
65	19.7	19.9	20.0	0.6%	20.4	2.6%
70	15.9	16.1	16.1	0.1%	16.3	1.3%
75	12.4	12.6	12.7	1.0%	12.6	0.2%
80	9.2	9.5	9.7	2.0%	9.3	-1.7%
85	6.9	7.1	7.1	0.0%	6.6	-6.9%
90	4.1	4.5	5.1	12.6%	4.6	2.1%

DISABLED RETIREES
POST-RETIREMENT MORTALITY - MALES
Weighted by Annual Benefits in $000s

Age	Actual Deaths	Total Count	Actual Rate	Assumed Rate		Expected Deaths		Actual / Expected	
				Current	Proposed	Current	Proposed	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
40-44	$ 33	155	0.2142	0.0400	0.0400	$ 6	$ 6	535%	535%
45-49	34	524	0.0646	0.0400	0.0400	21	21	161%	161%
50-54	59	1,606	0.0366	0.0400	0.0400	64	64	92%	92%
55-59	174	3,399	0.0512	0.0400	0.0400	136	136	128%	128%
60-64	326	4,282	0.0761	0.0400	0.0400	171	171	190%	190%
65-69	240	3,807	0.0630	0.0400	0.0400	152	152	158%	158%
70-74	247	3,562	0.0693	0.0527	0.0503	188	179	132%	138%
75-79	261	2,130	0.1226	0.0840	0.0837	179	178	146%	147%
80-84	58	887	0.0653	0.1329	0.1355	118	120	49%	48%
Totals	$ 1,432	20,352				$ 1,035	$ 1,028	138%	139%
Male + Females	1,834	31,738				1,435	1,427	128%	128%

DISABLED RETIREES
POST-RETIREMENT MORTALITY - FEMALES
Weighted by Annual Benefits in $000s

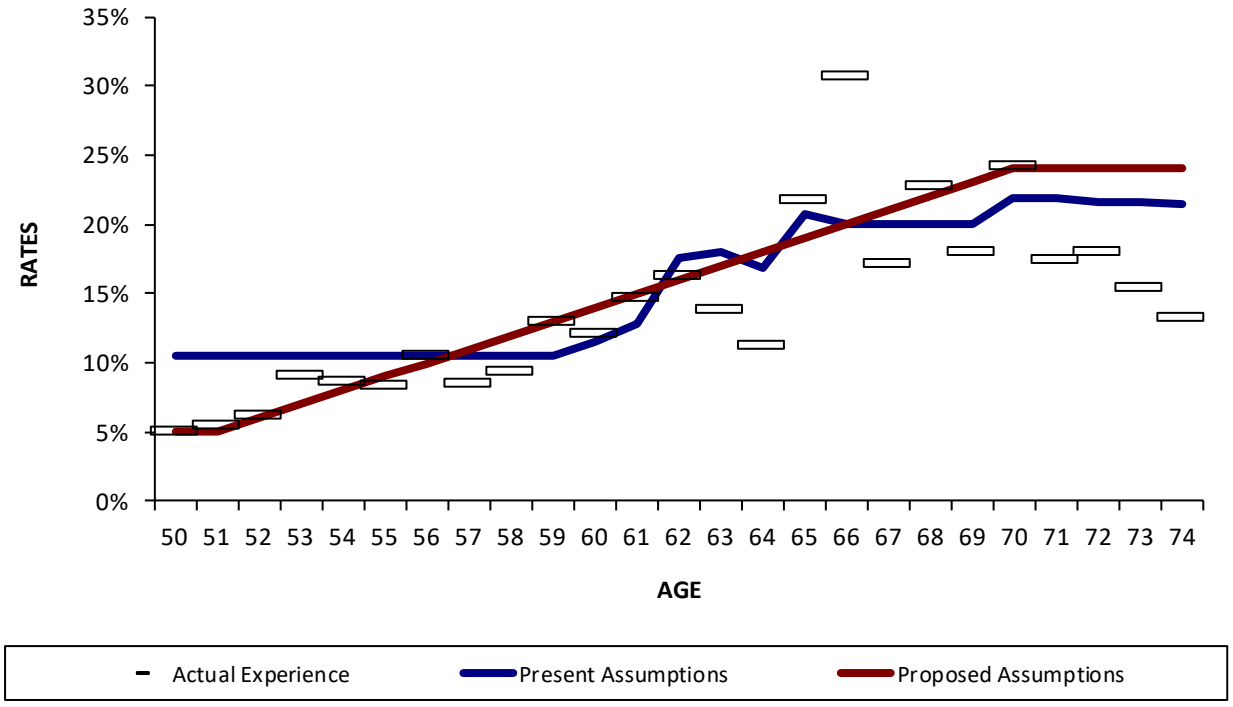
Age	Actual Deaths	Total Count	Actual Rate	Assumed Rate		Expected Deaths		Actual / Expected	
				Current	Proposed	Current	Proposed	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
40-44	$ 7	$ 89	0.0828	0.0300	0.0300	$ 3	$ 3	276%	276%
45-49	26	367	0.0702	0.0300	0.0300	11	11	234%	234%
50-54	34	1,600	0.0210	0.0300	0.0300	48	48	70%	70%
55-59	48	2,405	0.0199	0.0300	0.0300	72	72	66%	66%
60-64	102	2,536	0.0404	0.0300	0.0300	76	76	135%	135%
65-69	86	1,783	0.0485	0.0300	0.0300	53	53	162%	162%
70-74	71	1,177	0.0601	0.0347	0.0325	41	38	173%	185%
75-79	24	1,021	0.0231	0.0563	0.0557	57	57	41%	41%
80-84	5	409	0.0127	0.0920	0.0986	38	40	14%	13%
Totals	$ 403	$ 11,386				$ 399	$ 399	101%	101%

RETIREMENT EXPERIENCE - AGE BASED - GROUP A&B

Weighted by Liability in $000s

				Assumed Rate		Expected Retirement		Actual/Expected	
Age	Actual Retirement	Total Eligible	Actual Rate	Current (Blended)	Proposed	Current (3) * (5)	Proposed (3) * (6)	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
50	5,880	115,309	5.1%	10.6%	5.0%	12,178	5,765	48%	102%
51	9,440	171,763	5.5%	10.5%	5.0%	18,120	8,588	52%	110%
52	13,649	217,289	6.3%	10.5%	6.0%	22,868	13,037	60%	105%
53	24,524	270,230	9.1%	10.5%	7.0%	28,436	18,916	86%	130%
54	27,018	308,425	8.8%	10.5%	8.0%	32,518	24,674	83%	109%
55	28,599	337,022	8.5%	10.5%	9.0%	35,460	30,332	81%	94%
56	38,586	363,079	10.6%	10.5%	10.0%	38,113	36,308	101%	106%
57	33,382	388,015	8.6%	10.5%	11.0%	40,730	42,682	82%	78%
58	38,391	407,798	9.4%	10.5%	12.0%	42,790	48,936	90%	78%
59	52,728	402,324	13.1%	10.4%	13.0%	42,025	52,302	125%	101%
60	48,815	402,678	12.1%	11.6%	14.0%	46,544	56,375	105%	87%
61	56,283	380,964	14.8%	12.8%	15.0%	48,620	57,145	116%	98%
62	63,613	387,579	16.4%	17.6%	16.0%	68,116	62,013	93%	103%
63	46,899	336,348	13.9%	18.0%	17.0%	60,542	57,179	77%	82%
64	34,174	301,138	11.3%	16.8%	18.0%	50,717	54,205	67%	63%
65	53,225	243,494	21.9%	20.8%	19.0%	50,670	46,264	105%	115%
66	57,916	188,408	30.7%	20.0%	20.0%	37,681	37,682	154%	154%
67	22,570	130,639	17.3%	20.0%	21.0%	26,128	27,434	86%	82%
68	24,651	107,849	22.9%	20.0%	22.0%	21,569	23,727	114%	104%
69	14,854	82,320	18.0%	20.0%	23.0%	16,464	18,934	90%	78%
70	16,104	66,356	24.3%	21.8%	24.0%	14,491	15,926	111%	101%
71	8,169	46,552	17.5%	21.9%	24.0%	10,191	11,172	80%	73%
72	6,058	33,513	18.1%	21.6%	24.0%	7,229	8,043	84%	75%
73	3,951	25,409	15.5%	21.6%	24.0%	5,486	6,098	72%	65%
74	2,558	19,262	13.3%	21.4%	24.0%	4,124	4,623	62%	55%
Total	732,035	5,733,762	12.8%			781,810	768,359	94%	95%
< Age 62	377,295	3,764,895	10.0%	10.8%	10.5%	408,402	395,060	92%	96%
62-66	255,827	1,456,966	17.6%	18.4%	17.7%	267,726	257,342	96%	99%
67+	98,914	511,900	19.3%	20.6%	22.7%	105,682	115,957	94%	85%

RETIREMENT EXPERIENCE - AGE BASED - Group A&B



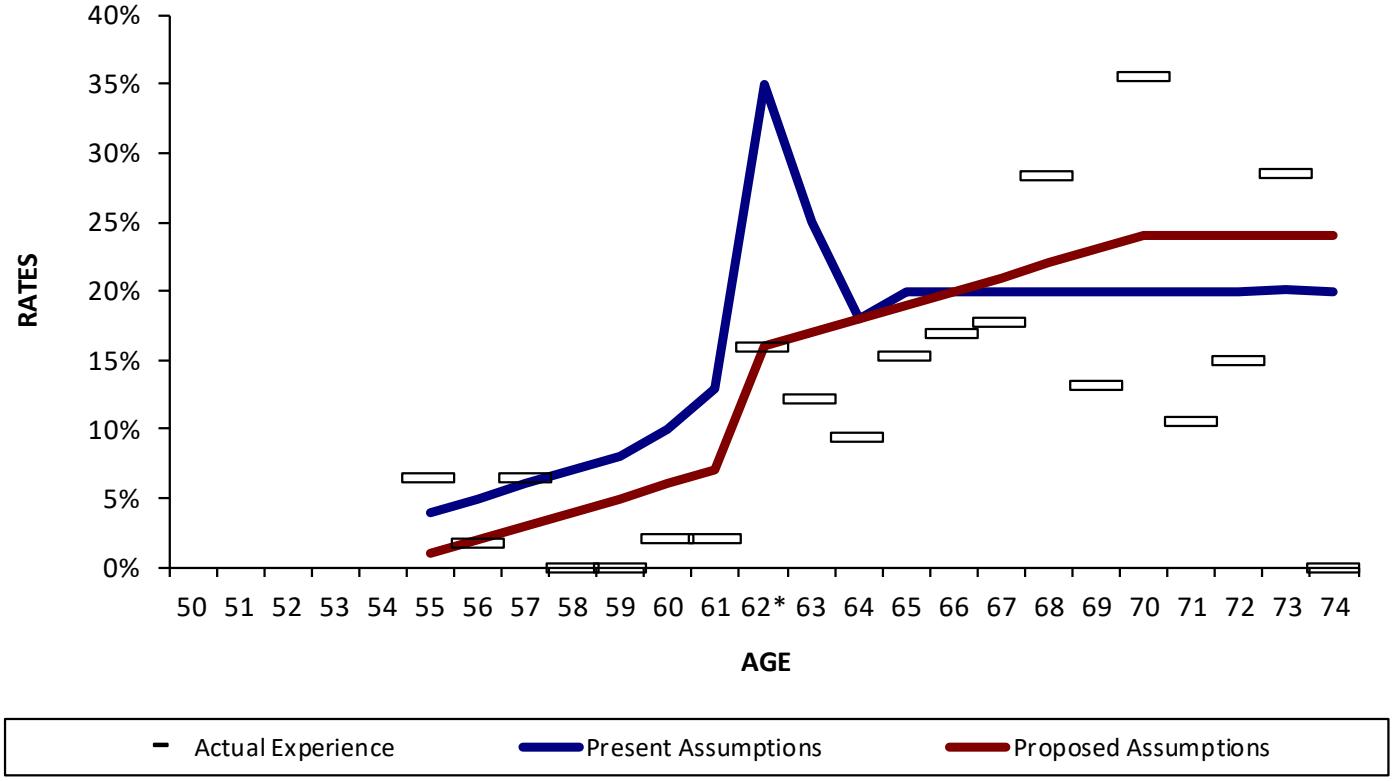
RETIREMENT EXPERIENCE - AGE BASED - GROUP D
Weighted by Liability in $000s

				Assumed Rate		Expected Retirement		Actual/Expected	
Age	Actual Retirement	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									
51									
52									
53									
54									
55	425	6,637	6.4%	4.0%	1.0%	265	66	160%	643%
56	128	7,418	1.7%	5.0%	2.0%	371	148	34%	86%
57	467	7,292	6.4%	6.0%	3.0%	438	219	107%	213%
58	-	6,598	0.0%	7.0%	4.0%	462	264	0%	0%
59	-	6,882	0.0%	8.0%	5.0%	551	344	0%	0%
60	140	6,909	2.0%	10.0%	6.0%	691	415	20%	34%
61	103	5,041	2.1%	13.0%	7.0%	655	353	16%	29%
62*	3,208	20,111	15.9%	35.0%	16.0%	7,039	3,218	46%	100%
63	2,191	17,888	12.2%	25.0%	17.0%	4,472	3,041	49%	72%
64	1,353	14,430	9.4%	18.0%	18.0%	2,597	2,597	52%	52%
65	1,954	12,813	15.3%	20.0%	19.0%	2,563	2,434	76%	80%
66	1,819	10,783	16.9%	20.0%	20.0%	2,157	2,157	84%	84%
67	1,482	8,351	17.8%	20.0%	21.0%	1,670	1,754	89%	85%
68	1,743	6,139	28.4%	20.0%	22.0%	1,228	1,350	142%	129%
69	665	5,026	13.2%	20.0%	23.0%	1,005	1,156	66%	58%
70	886	2,493	35.6%	20.0%	24.0%	499	598	178%	148%
71	167	1,584	10.5%	20.0%	24.0%	317	380	53%	44%
72	219	1,472	14.9%	20.0%	24.0%	294	353	75%	62%
73	317	1,113	28.5%	20.0%	24.0%	223	267	142%	119%
74	-	532	0.0%	19.9%	24.0%	106	128	0%	0%
Total	17,269	149,510	11.6%			27,603	21,242	63%	81%

Proposed: add 10% at age 62 if Service >= 20 years

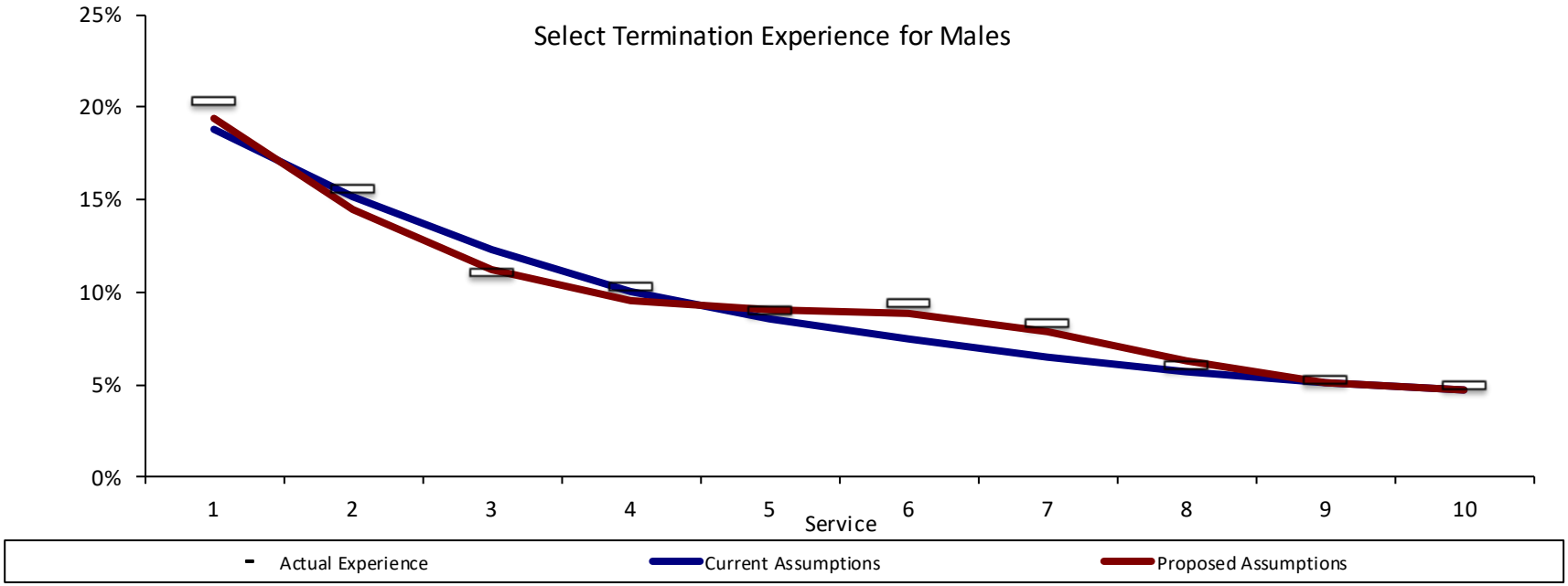
< Age 62	1,263	46,776	2.7%	7.3%	3.9%	3,433	1,809	37%	70%
62-66	10,525	76,025	13.8%	24.8%	17.7%	18,828	13,447	56%	78%
67+	5,480	26,709	20.5%	20.0%	22.4%	5,342	5,986	103%	92%

RETIREMENT EXPERIENCE - AGE BASED
- GROUP D



MALE EMPLOYEES
SELECT TERMINATION EXPERIENCE
WEIGHTED BY PRESENT VALUE OF BENEFITS (PVB) in $000s

Service	Terminations Weighted by PVB	Exposure Weighted by PVB	Crude Rates	Sample Rates		Expected Terminations Weighted by PVB		A/E	
				Current	Proposed	Current	Proposed	Current	Proposed
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	$ 13,257	$ 65,336	0.2029	0.1877	0.1938	$ 12,266	$ 12,665	108%	105%
2	21,663	138,492	0.1564	0.1519	0.1450	21,033	20,077	103%	108%
3	16,221	146,903	0.1104	0.1232	0.1119	18,093	16,443	90%	99%
4	17,092	165,961	0.1030	0.1006	0.0959	16,698	15,911	102%	107%
5	16,531	183,854	0.0899	0.0858	0.0909	15,780	16,705	105%	99%
6	19,231	205,001	0.0938	0.0744	0.0888	15,262	18,195	126%	106%
7	19,275	233,392	0.0826	0.0650	0.0786	15,171	18,351	127%	105%
8	15,897	261,708	0.0607	0.0567	0.0628	14,851	16,447	107%	97%
9	15,278	292,764	0.0522	0.0512	0.0515	14,997	15,074	102%	101%
10	15,283	308,188	0.0496	0.0469	0.0468	14,454	14,435	106%	106%
Totals	$ 169,727	$ 2,001,599	0.0848	0.0792	0.0821	$ 158,605	$ 164,302	107%	103%
1-5	$ 84,764	$ 700,546	0.1210	0.1197	0.1168	$ 83,871	$ 81,801	101%	104%
6-10	84,963	1,301,053	0.0653	0.0574	0.0634	74,734	82,502	114%	103%

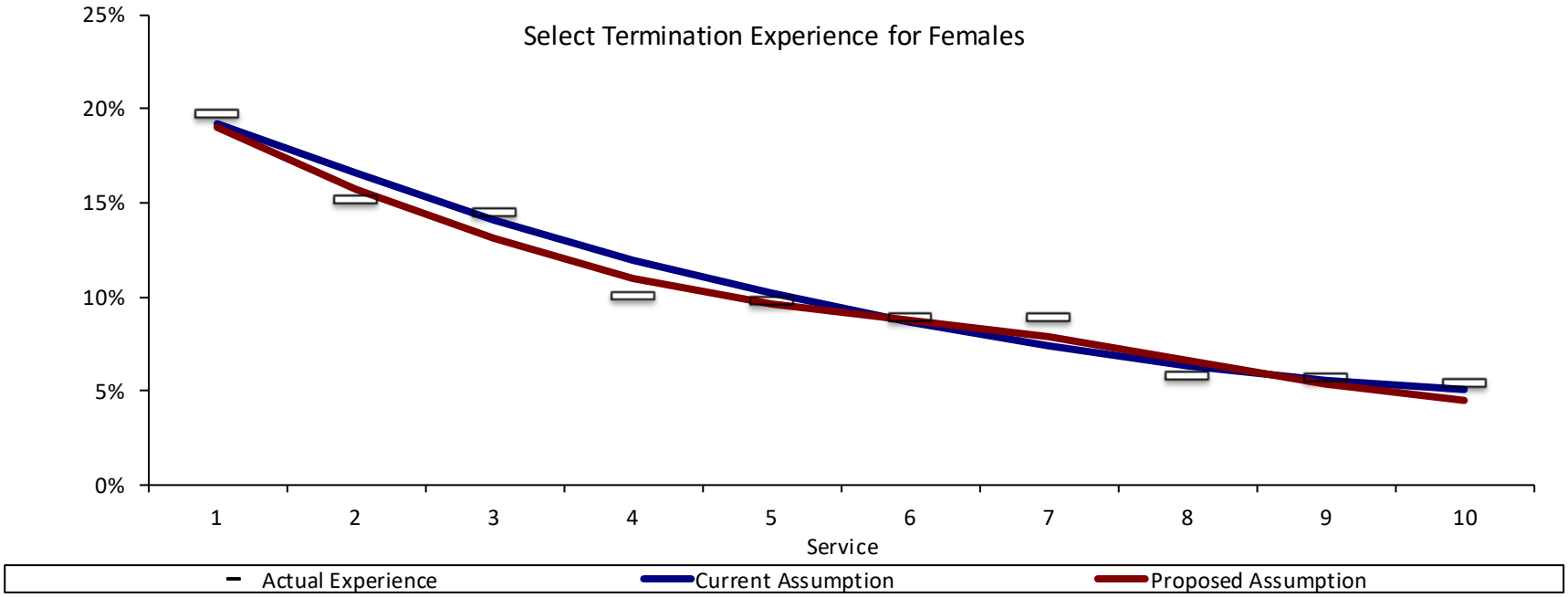

Select Termination Experience for Males
25%
20%
15%
10%
5%
0%
1
2
3
4
5
6
7
8
9
10
Service
Actual Experience
Current Assumptions
Proposed Assumptions

FEMALE EMPLOYEES

SELECT TERMINATION EXPERIENCE

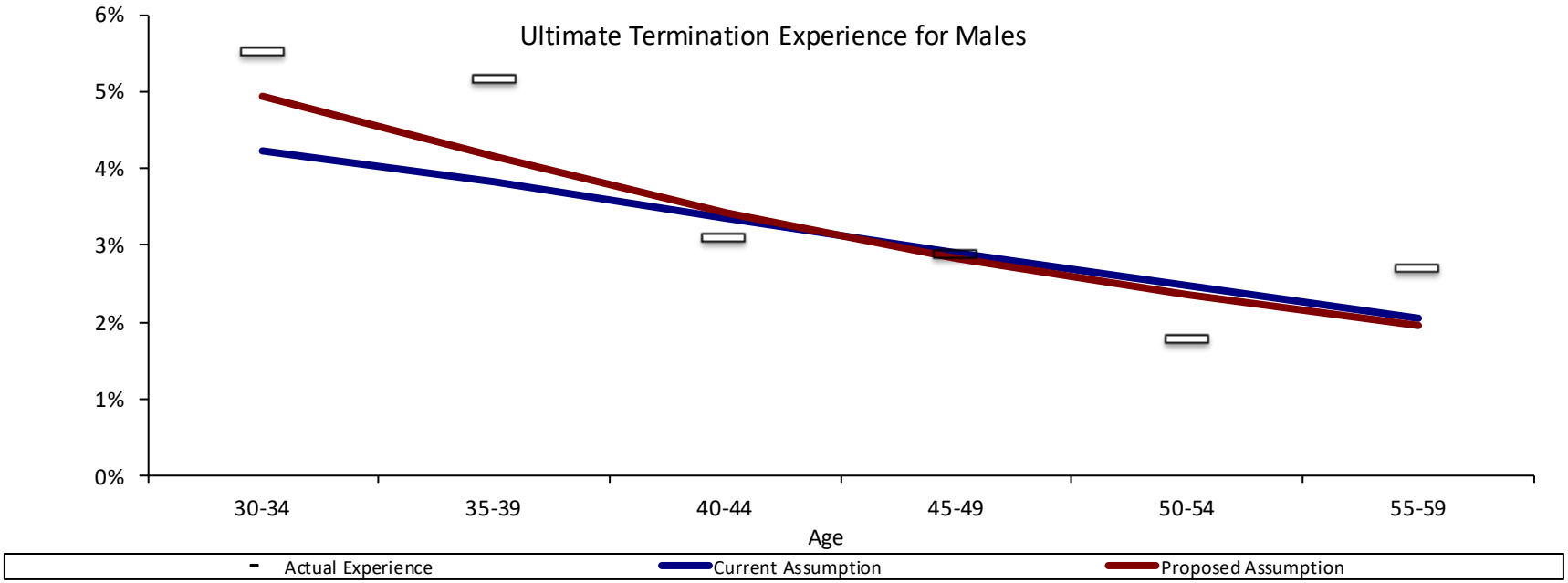
WEIGHTED BY PRESENT VALUE OF BENEFITS (PVB) in $000s

Service	Terminations Weighted by PVB	Exposure Weighted by PVB	Crude Rates	Sample Rates		Expected Terminations Weighted by PVB		A/E	
				Current	Proposed	Current	Proposed	Current	Proposed
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	$ 10,121	$ 51,158	0.1978	0.1923	0.1905	$ 9,839	$ 9,747	103%	104%
2	16,475	108,375	0.1520	0.1662	0.1572	18,015	17,033	91%	97%
3	17,206	118,441	0.1453	0.1411	0.1316	16,706	15,587	103%	110%
4	13,622	135,614	0.1004	0.1197	0.1100	16,226	14,915	84%	91%
5	15,158	154,406	0.0982	0.1019	0.0963	15,731	14,865	96%	102%
6	15,420	173,113	0.0891	0.0871	0.0880	15,080	15,228	102%	101%
7	16,812	187,748	0.0895	0.0739	0.0793	13,875	14,889	121%	113%
8	11,571	200,550	0.0577	0.0636	0.0659	12,746	13,225	91%	87%
9	12,898	226,568	0.0569	0.0559	0.0534	12,673	12,095	102%	107%
10	13,094	240,985	0.0543	0.0510	0.0451	12,288	10,870	107%	120%
Totals	$ 142,376	$ 1,596,958	0.0892	0.0897	0.0867	$ 143,178	$ 138,455	99%	103%
1-5	$ 72,582	$ 567,993	0.1278	0.1347	0.1270	$ 76,517	$ 72,147	95%	101%
6-10	69,794	1,028,965	0.0678	0.0648	0.0644	66,661	66,307	105%	105%


Select Termination Experience for Females
25%
20%
15%
10%
5%
0%
1
2
3
4
5
6
7
8
9
10
Service
Actual Experience
Current Assumption
Proposed Assumption

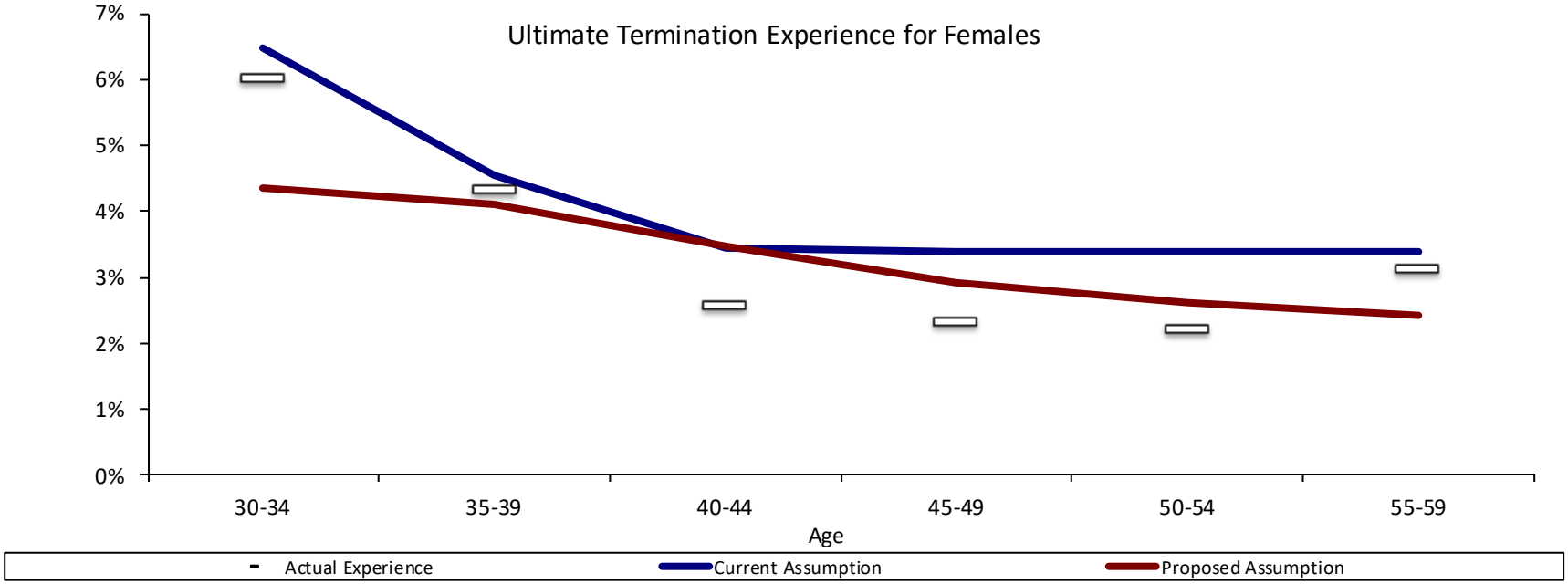
MALE EMPLOYEES
ULTIMATE TERMINATION EXPERIENCE (SERVCE > 10)
WEIGHTED BY PRESENT VALUE OF BENEFITS (PVB) in $000s

AGE	Terminations Weighted by PVB	Exposure Weighted by PVB	Crude Rates	Sample Rates		Expected Terminations Weighted by PVB		A/E	
				Current	Proposed	Current	Proposed	Current	Proposed
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
25-29	$ 75	$ 548	0.1375	0.0456	0.0584	$ 25	$ 32	301%	235%
30-34	2,857	51,818	0.0551	0.0422	0.0495	2,188	2,564	131%	111%
35-39	13,018	252,336	0.0516	0.0382	0.0417	9,638	10,517	135%	124%
40-44	17,991	577,702	0.0311	0.0337	0.0343	19,441	19,842	93%	91%
45-49	33,774	1,163,450	0.0290	0.0291	0.0283	33,868	32,928	100%	103%
50-54	17,985	1,014,894	0.0177	0.0248	0.0236	25,219	23,955	71%	75%
55-59	13,828	513,751	0.0269	0.0204	0.0196	10,502	10,050	132%	138%
60-64	3,587	93,374	0.0384	0.0170	0.0168	1,585	1,573	226%	228%
Totals	$ 103,114	$ 3,667,872	0.0281	0.0279	0.0277	$ 102,466	$ 101,461	101%	102%
<50	$ 67,715	$ 2,045,854	0.0331	0.0318	0.0322	$ 65,160	$ 65,883	104%	103%
>=50	35,399	1,622,019	0.0218	0.0230	0.0219	37,306	35,578	95%	99%


Ultimate Termination Experience for Males
6%
5%
4%
3%
2%
1%
0%
30-34
35-39
40-44
45-49
50-54
55-59
Age
Actual Experience
Current Assumption
Proposed Assumption

FEMALE EMPLOYEES
ULTIMATE TERMINATION EXPERIENCE (SERVCE > 10)
WEIGHTED BY PRESENT VALUE OF BENEFITS (PVB) in $000s

AGE	Terminations Weighted by PVB	Exposure Weighted by PVB	Crude Rates	Sample Rates		Expected Terminations Weighted by PVB		A/E	
				Current	Proposed	Current	Proposed	Current	Proposed
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
25-29	$ 122	$ 1,359	0.0899	0.0853	0.0434	$ 116	$ 59	105%	207%
30-34	3,802	62,989	0.0604	0.0648	0.0410	4,080	2,583	93%	147%
35-39	12,808	295,567	0.0433	0.0456	0.0347	13,471	10,243	95%	125%
40-44	15,392	594,944	0.0259	0.0344	0.0291	20,450	17,332	75%	89%
45-49	24,980	1,072,201	0.0233	0.0339	0.0261	36,397	27,933	69%	89%
50-54	18,126	817,517	0.0222	0.0339	0.0242	27,752	19,763	65%	92%
55-59	12,638	405,999	0.0311	0.0339	0.0227	13,782	9,227	92%	137%
60-64	2,423	56,233	0.0431	0.0339	0.0218	1,909	1,227	127%	197%
Totals	$ 90,292	$ 3,306,809	0.0273	0.0357	0.0267	$ 117,957	$ 88,367	77%	102%
<50	$ 57,105	$ 2,027,060	0.0282	0.0368	0.0287	$ 74,514	$ 58,150	77%	98%
>=50	33,187	1,279,749	0.0259	0.0339	0.0236	43,443	30,217	76%	110%


Ultimate Termination Experience for Females
7%
6%
5%
4%
3%
2%
1%
0%
30-34
35-39
40-44
45-49
50-54
55-59
Age
Actual Experience
Current Assumption
Proposed Assumption