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**State of Oklahoma
Police Pension and
Retirement System**

**Experience Study
for the Five-Year Period
Ending June 30, 2022**

TABLE OF CONTENTS

April 13, 2023

Board of Trustees
Oklahoma Police Pension and Retirement System
1001 N.W. 63rd Street, Suite 305
Oklahoma City, OK 73116-7335

Members of the Board:

We are pleased to submit the results of a study of the economic and demographic experience for the Oklahoma Police Pension and Retirement System (OPPRS). The purpose of this investigation is to assess the reasonability of the current actuarial assumptions for the System and provide a basis for revising assumptions, if appropriate. This investigation covers the five-year period from July 1, 2017 to June 30, 2022. As a result of the investigation, we recommend that revised assumptions be adopted by the Board for use in the July 1, 2023 actuarial valuation.

The set of recommended assumptions is shown in Appendix C of this report. In the actuary's judgment, these recommendations are suitable for use to measure the actuarial liability and budget future costs. Changing assumptions will not change the actual cost of future benefits. Once the assumptions have been adopted, the actuarial valuation measures the adequacy of the expected contributions to fund the benefits.

The experience study was performed by, and under the supervision of, independent actuaries who are members of the American Academy of Actuaries with experience in performing valuations for public retirement systems. The undersigned meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Respectfully submitted,

Brent A. Banister, PhD, FSA, FCA, EA, MAAA
Chief Actuary

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Summary of Results

The following summarizes the findings and recommendations with regard to the assumptions utilized by the Oklahoma Police Pension and Retirement System. Explanations for the recommendations are found in the sections that follow.

Recommended Economic Assumption Changes

As the table indicates, our only recommended change is to reduce the assumed investment return assumption from 7.50% to 7.25%.

Item	Current	Proposed
Price Inflation	2.75%	2.75%
Investment Return	7.50%	7.25%
Interest Credit on DOP Balances	11.00%	11.00%
Real Wage Growth	0.75%	0.75%
COLA basis (Baker group)	3.50%	3.50%

Recommended Demographic Assumption Changes

We recommend several changes to the demographic assumptions based on the experience of the last five years. Termination rates did not change, but mortality rates, retirement rates and the probability of disability were revised. There were also revisions to the total salary scale. The following is a brief summary of the proposed demographic assumption changes:

1. Mortality Rates: Move to the Pub-2010 Safety below-median mortality tables, with rates set forward two years and future mortality improvements projected generationally using SOA Scale MP-2021.
2. Retirement Rates: Move to an age-based retirement assumption for members with 100% retirement at age 67 or 35 years of service.
3. Disability Rates: Increase rates across the board by 10%.
4. Salary Scale: Small changes for the period between 11 and 16 years of service.

Recommended Actuarial Method Changes

We are not recommending any changes to the set of actuarial methods.

Financial Impact

The table below highlights the financial impact of the proposed assumptions, including the change in the unfunded actuarial accrued liability (UAAL), funded ratio and components of the actuarial contribution rate, based on the July 1, 2022 actuarial valuation. If adopted, the new set of assumptions will first be used in the July 1, 2023 actuarial valuation. While the impact of the new assumptions is expected to be similar as a percentage of the Actuarial Accrued Liability, the dollar amounts will be different.

	July 1, 2022 Valuation	Demographic Assumptions Only	All Assumption Changes
Actuarial Accrued Liability	$2,928,775,000	$2,873,108,000	$2,944,414,000
Actuarial Value of Assets	3,087,329,000	3,087,329,000	3,087,329,000
Unfunded Actuarial Accrued Liability	$(158,554,000)	$(214,221,000)	$(142,915,000)
Funded Ratio	105.4%	107.5%	104.9%
Normal Cost Rate	20.5%	20.6%	21.6%
Amortization Rate	(3.6%)	(4.8%)	(3.1%)
Budgeted Expense Rate	0.7%	0.7%	0.7%
Total Actuarial Contribution Rate	17.6%	16.5%	19.2%

In order to prepare these measurements of the impact on liabilities in this report, we have utilized actuarial models that we developed to measure liabilities and develop actuarial costs. These models include tools that we have produced and tested, along with commercially available valuation software that we have reviewed to confirm the appropriateness and accuracy of the output. In utilizing these models, we develop and use input parameters and assumptions about future contingent events along with recognized actuarial approaches to develop the needed results.

Economic Assumptions

There are three core economic assumptions used in performing the actuarial valuation for the Oklahoma Police Pension and Retirement System (OPPRS) from which other economic assumptions are derived. The assumptions are:

- Price Inflation
- Investment Return
- Wage Inflation

Unlike demographic assumptions, economic assumptions do not lend themselves to analysis largely on the basis of internal historical patterns because economic assumptions are impacted by external forces in the economy. The investment return and wage inflation assumptions are selected on the basis of expectations in an inflation-free environment and then increased by the long-term expectation for inflation, using the "building block" approach.

Sources of data considered in the analysis and selection of the economic assumptions included:
- The 2022 Social Security Trustees Report
- Future expectations of OPPRS' investment consultant, Asset Consulting Group (ACG)
- U.S. Department of the Treasury bond rates
- Expectations of the Survey of Professional Forecasters and other investment consultants
- Assumptions used by other large public retirement systems, based on the Public Fund Survey, published by the National Association of State Retirement Administrators (NASRA)
- Historical observations of price and wage growth statistics and investment returns

Actuarial Standard of Practice Number 27

Guidance regarding the selection of economic assumptions for measuring pension obligations is provided by Actuarial Standard of Practice (ASOP) No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*. Because no one knows what the future holds, the best an actuary can do is to use professional judgment to estimate possible future economic outcomes. These estimates are based on a mixture of past experience, future expectations, and professional judgment.

ASOP 27 requires the actuary to select a "reasonable" assumption. For this purpose, an assumption is reasonable if it has the following characteristics:

a. it is appropriate for the purpose of the measurement;

b. it reflects the actuary's professional judgment;

c. it takes into account historical and current economic data that is relevant as of the measurement date;

    d. it reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and

    e. it has no significant bias (i.e., it is neither significantly optimistic nor pessimistic) except when provisions for adverse deviation or plan provisions that are difficult to measure are included.

With respect to relevant data, the standard recommends the actuary review appropriate recent and long-term historical economic data but advises the actuary not to give undue weight to recent experience. Furthermore, it advises the actuary to consider that some historical economic data may not be appropriate for use in developing assumptions for future periods due to changes in the underlying environment. In addition, with respect to any particular valuation, each economic assumption should be consistent with all other economic assumptions over the measurement period.

ASOP 27 recognizes that economic data and analyses are available from a variety of sources, including representatives of the plan sponsor, investment advisors, economists, and other professionals. The actuary is permitted to incorporate the views of experts, but the selection or advice must reflect the actuary's professional judgment.

The standard also acknowledges that there is not a single right assumption, noting "the actuary should also recognize that different actuaries will apply professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop both for an individual actuary and across actuarial practice."

This section of the report will address the relevant types of economic assumptions used in the actuarial valuation to determine the obligations of the System. In our opinion, the economic assumptions proposed in this report have been developed in accordance with ASOP No. 27.

The following table summarizes the current and proposed major economic assumptions:

|	Current Assumptions	Proposed Assumptions
Price Inflation	2.75%	2.75%
Investment Return	7.50%	7.25%
Wage Inflation	0.75%	0.75%

Price Inflation

Use in the Valuation: Future price inflation has an indirect impact on the results of the actuarial valuation through the development of the assumptions for investment return and wage inflation (which then impacts individual salary increases).

The long-term relationship between price inflation and investment return has long been recognized by economists. The basic principle is that in exchange for taking risk, the investor demands a more or less level "real return" – the excess of actual investment return over price inflation. If inflation rates are expected to be high, investment return rates are also expected to be high, while low inflation rates lead to lower expected investment returns, at least in the long run. Likewise, wages are expected, over the long haul, to increase with the prices of goods and services (price inflation) along with some increase to reflect general increases in productivity in the workplace.

Past Experience: Although economic activities, in general, and inflation in particular, do not lend themselves to prediction solely on the basis of historical analysis, historical patterns and long-term trends are factors to be considered in developing the inflation assumption. The Consumer Price Index, US City Average, All Urban Consumers, CPI-U, has been used as the basis for reviewing historical levels of price inflation. The following table provides historical annualized rates and annual standard deviations of the CPI-U over periods ending December 31st.

Period	Number of Years	Annualized Rate of Inflation	Annual Standard Deviation
1927 – 2022	95	3.04%	3.96%
1962 – 2022	60	3.87	2.88
1972 – 2022	50	3.96	3.07
1982 – 2022	40	2.82	1.52
1992 – 2022	30	2.49	1.45
2002 – 2022	20	2.51	1.74
2012 - 2022	10	2.60	2.24

The following graph illustrates the historical annual change in price inflation, measured as of December 31 for each year for the past 80 years, as well as the thirty-year rolling average.

Historical Inflation
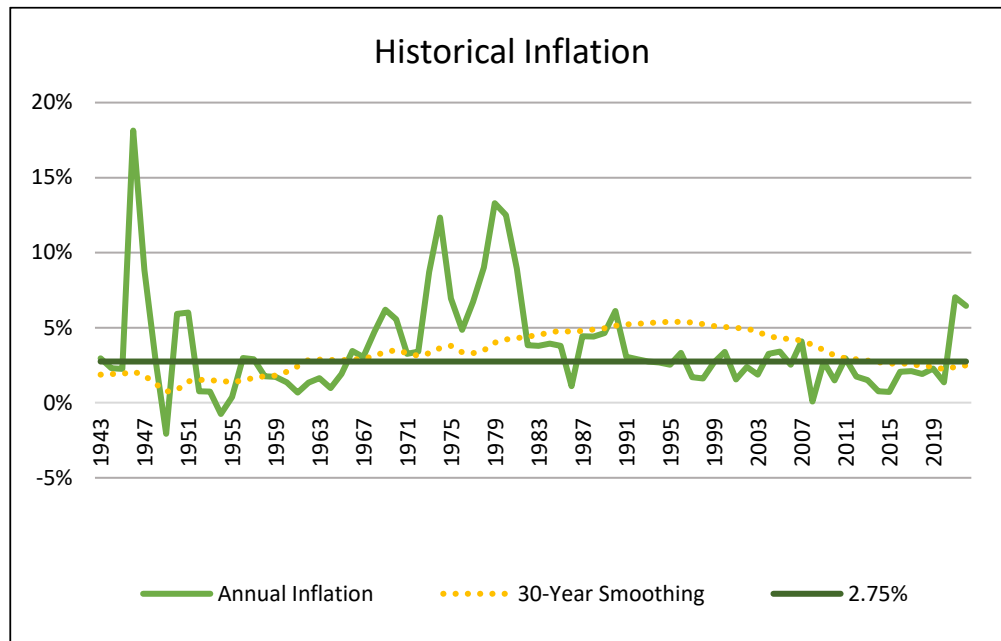
As is evident from history, inflation is often low, but there have been periods in which high inflation has occurred, sometimes briefly and sometimes for extend periods. For the most part, the last 30-40 years has been a period of low inflation, although 2021 and 2022 have been a sharp contrast.

Forecasts of Inflation

Additional information to consider in formulating this assumption is obtained from measuring the spread on Treasury Inflation Protected Securities (TIPS) and from the prevailing economic forecasts. The spread between the nominal yield on treasury securities (bonds) and the inflation indexed yield on TIPS of the same maturity is referred to as the "breakeven rate of inflation" and represents the bond market's expectation of inflation over the period to maturity. Current market prices as of February 2023 suggest that investors expect inflation to be around 2.3% over the next 30 years, although there has been a fair amount of volatility recently. Of course, the bond markets in 2019 did not predict the observed inflation patterns in 2020 through 2022 that occurred at least partly as a result of the Covid-19 pandemic and the U.S. federal government actions that followed.

We also note that ACG estimates that inflation will be 2.38% in the near term, increasing to 2.75% over time. A survey of 40 financial advisors conducted by Horizon Actuarial in early 2022 indicated a near-term assumption of 2.46%, with a longer-range forecast of 2.44%. The 4th quarter 2022 survey by the Philadelphia Federal Reserve Bank Survey of Professional Forecasters suggested an expectation over the next 10 years of 2.95%. The variation across those estimating is wider than normal, reflecting that the current economic situation is somewhat unusual and changing rapidly.

Social Security Projections

The economists and investment consultants who make the inflation predictions just discussed are generally looking at a shorter time horizon (10 years) than is appropriate for a pension valuation. To consider a longer, similar time frame, we looked at the expected increase in the CPI by the Office of the Chief Actuary for the Social Security Administration. In the most recent report (July 2022), the projected average annual increase in the CPI over the next 75 years was estimated to be 2.4%, under the intermediate (best estimate) cost assumption. The range of price inflation used in the Social Security 75-year modeling, which includes low and high cost scenarios in addition to the intermediate cost projection, was 1.8% to 3.0%.

Peer System Comparison

While we do not recommend the selection of any assumption based on what other systems use, it does provide another set of relevant information to consider. According to the Public Plan Database (a survey of over 150 state and local retirement systems maintained by a collaboration between the Center for Retirement Research at Boston College, the Center for State and Local Government Excellence, and the National Association of State Retirement Administrators) the average inflation assumption for statewide systems has been steadily declining. As of the most recent study, the median and the most common assumption is 2.5%, which is lower than OPPRS' current assumption. There has been a consistent downward shift over the past several years as systems have been lowering this assumption – the typical system was using 3% just five years ago when the last experience study was performed.

Conclusion: The current inflation assumption is 2.75%. While actuarial standards caution against assigning too much weight to recent experience, inflation has been higher than it was for many years. Actual inflation for the last 30 years has been about 2.5%. The bond markets reflect an expectation of inflation of about 2.3% and the inflation assumption used by the Chief Actuary of the Social Security Administration in their 75-year projections is 2.4%. Some of the lower expectations are considering shorter periods of time than the timeframe we need to consider as public pension actuaries, so we are careful not to give those estimates as much weight. We also want to be measured in our changes so that we don't have to reverse a change in the next experience study. Based on this information, **we recommend a leaving the inflation assumption at 2.75%.**

Consumer Price Inflation	
Current Assumption	2.75%
Recommended Assumption	2.75%

INVESTMENT RETURN

Use in the Valuation: The investment return assumption reflects anticipated returns on the current and future assets. It is one of the primary determinants in the calculation of the expected cost of the System's benefits, providing a discount of the estimated future benefit payments to reflect the time value of money. This assumption has a direct impact on the calculation of liabilities, normal costs, and contribution rates. Generally, the investment return assumption should be set with consideration of the asset allocation policy, expected long term real rates of return on the specific asset classes, the underlying inflation rate, and any investment expenses, but is also impacted by the dynamics of the system along with the risk tolerance and preferences of the Board.

The current investment return assumption is 7.50% per year, net of all investment-related expenses. The 7.50% rate of return is referred to as the nominal rate of return and is comprised of two components. The first component is price inflation (previously discussed). Any excess return over price inflation is referred to as the real rate of return. The real rate of return, based on the current set of assumptions, is 4.75% (7.50% nominal return less 2.75% inflation).

ASOP 27 provides guidance to actuaries on the selection of economic assumptions used for measuring pension obligations. Our findings and analysis, following that ASOP, are discussed below.

Long Term Perspective

Because the economy is constantly changing, assumptions about what may occur in the near term are volatile. Asset managers and investment consultants usually focus on this near-term horizon so as to make prudent choices regarding how to invest the trust funds, i.e., asset allocation. For actuarial calculations, we typically consider very long periods of time as some current employees will still be receiving benefit payments more than 80 years from now. For example, a newly hired employee who is 25 years old may work for 30 years, to age 55, and live another 35 years, to age 90. The retirement system would receive contributions for the first 30 years and then pay out benefits for the next 35 years. During the entire 65-year period, the system is investing assets on behalf of the member. For such a typical career employee, more than one-half of the investment income earned on assets accumulated to pay benefits is received <u>after</u> the employee retires. This difference in time horizon is frequently a source of debate and confusion when setting economic assumptions.

Forward Looking Analysis

We believe the most appropriate analysis to consider in setting the investment return assumption is to model the expected returns given the system's target asset allocation and forward-looking capital market assumptions. However, we are trained as actuaries and not as investment professionals. As such, we rely heavily on professional investment consultants such as ACG, who is OPPRS' investment consultant, to provide investment expertise including capital market assumptions.

In performing our analysis, we use the building block approach so the real rate of return of the portfolio is modeled, based on the target asset allocation, and then the expected return is added to the price inflation assumption. Therefore, our analysis focuses on the real rate of return while the analysis of the investment consultants more typically focuses on the nominal return in their asset allocation consulting. OPPRS' current target asset allocation, along with their investment consultant's (ACG) long-term capital market assumptions, are shown in the following table (more detail is shown in Appendix A):

OPPRS Target Asset Allocation and ACG Assumptions

Asset Class	Target Allocation	Arithmetic Nominal Return	Standard Deviation
Core Bonds	7.5%	5.33%	4.58%
Multi-Sector Bonds	7.5%	6.29%	5.69%
Absolute Return	5.0%	6.00%	6.29%
U.S. Large Cap Equity	15.0%	9.92%	17.99%
U.S. Small Cap Equity	10.0%	11.36%	20.77%
International Developed Equity	10.0%	10.81%	19.70%
Emerging Market Equity	5.0%	12.08%	28.56%
Long/Short Equity	10.0%	8.52%	11.94%
Private Equity	15.0%	13.30%	18.39%
Core Real Estate	10.0%	9.29%	10.39%
Opportunistic Real Estate	5.0%	12.29%	18.26%
Total	100.0%		

While arithmetic means are straightforward to calculate, because of the nature of compounding returns, the arithmetic mean is of limited value. A more relevant measure is the geometric mean, which is the expected long-term compound rate of return. Mathematically, the geometric return will always be less than the arithmetic return due to the impact of the volatility of returns. Under the ACG long-term capital market assumptions, the geometric mean is 8.97%. It is important to note that this rate of return is their expectation for what the average compounded return will be over the next 30 years, reflecting a lower return for the first 10 years and a higher return for years 11 to 30.

It should be noted that there is currently a fair amount of variation in expectations among investment professionals. We have examined the ACG assumptions compared to a survey of 35 investment advisors conducted by Horizon Actuarial Services as well as other individual advisors who consult with some of our other clients. Generally, ACG's intermediate-term assumptions are in line with those of other firms and reflect the interest rate changes in recent months along with the corresponding equity declines. For the long-term assumptions, direct comparisons are complicated due to methodology and inflation differences, but after accounting for those, we do not believe that ACG's assumptions for the future are unreasonable. We note that investment consultants periodically update assumptions, and that these changes have been more pronounced over the past year as interest rates have increased.

Peer System Comparison

Public retirement systems have historically compared their investment performance to their peer group. While we believe there is some merit in assessing the movement in the assumed rate of return for other systems, this is not an appropriate basis for setting this assumption in our opinion. For example, different plans have different plan dynamics which will impact their choice of the assumed investment return. This peer group information merely provides another set of relevant data to consider as long as we recognize that asset allocation varies from system to system.

The following graph shows the change in the distribution of the investment return assumption from fiscal year 2001 through November 2022 for more than 120 large public retirement systems included in the NASRA Public Fund Survey. As it indicates, the investment return assumptions used by public plans have decreased over the last twenty years, partly as a result of a corresponding decrease in the underlying inflation assumption from 4.0% to 2.5% over the same period. At this point, only 8 of 131 plans use a return that is 7.5% or higher.

Distribution of Investment Return Assumptions, FY 01 to present
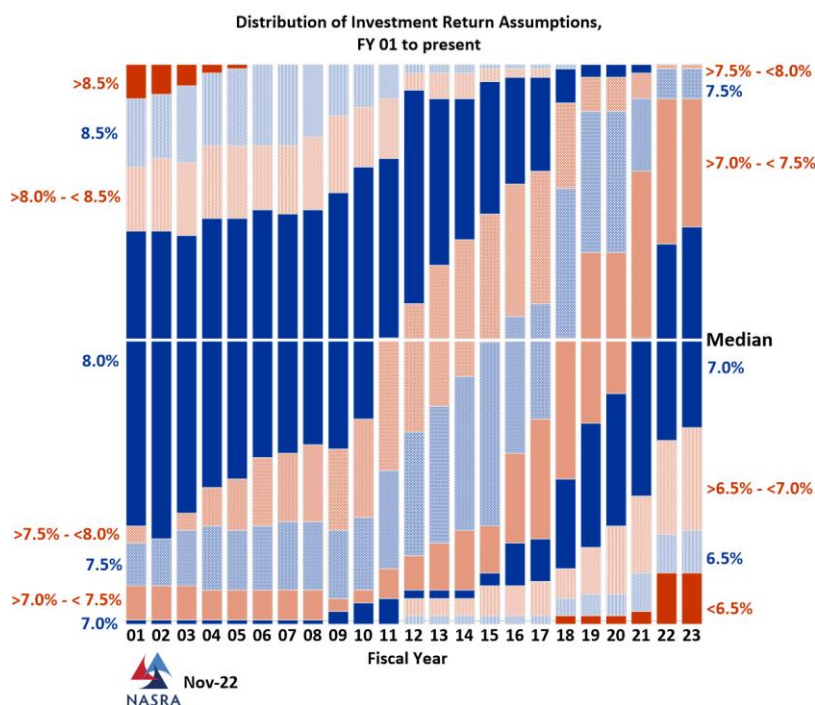
Administrative and Investment Expenses: Budgeted administrative expenses are directly accounted for as a separate component of the actuarial contribution rate so no adjustment to the investment return assumption is necessary. Generally, capital market assumptions are reflective of passive investment strategies where there are minimal investment expenses. Where active management is utilized, it is assumed that the additional return from active management is at least as great as the additional expense, and so no investment expense adjustment is required.

Recommendation: Investment advisors typically focus on the shorter term in order to appropriately make asset allocation decisions. We have seen many advisors increase their expectations over the last year following interest rate increases and equity market drops, partly in anticipation of a market rebound. Pensions, however, must focus on a much longer time frame, and so we are inclined to give more consideration to those advisors who are making longer term projections. Considering the capital market assumptions produced by ACG, the trends among similar funds, we believe that 7.50% is a plausible assumption. However, as the system matures, the risk of funding challenges from poor returns increases, making it desirable to have some conservatism in this assumption. This helps prevent shortfalls that result in sudden changes in the actuarial contribution rate. Consequently, **our suggestion would be for the Board to adopt a 7.25% assumed rate.**

Investment Return Assumption	
Current	7.50%
Recommended	7.25%

Interest Credited to DOP Accounts

Members who participate in the Deferred Option Program (DOP) receive an annual interest credit to their account balance. The benefit provisions (reflecting anticipated legislation) provide for an interest credit equal to the greater of (i) 7.5% or (ii) the actual investment return, less 2%. Based on a median return of 7.25% (the proposed investment return assumption) and the portfolio's standard deviation of 11.38%, we estimate the effective DOP interest crediting rate to be 11.0%. The effective rate is well above the investment return assumption, because when the return on the portfolio is less than 9.50%, the DOP account is credited with 7.50% interest. Given the portfolio's standard deviation, this means a higher rate than 7.50% is credited about 42% of the time, and the credited rate exceeds 11% (so a portfolio return over 13%) more than 30% of the time. Based on our analysis, **we recommend that the assumed interest crediting rate for DOP accounts be kept at 11.0%.** We reflect this assumption only for active members who are assumed to elect a retroactive DOP at some point in the future. Applying this assumption to current DOP members would be a complex process and have only a minor, immaterial impact on liabilities.

GENERAL WAGE GROWTH

Background: General wage growth, thought of as the "across the board" rate of salary increases, is composed of the price inflation assumption and an assumption for the real rate of wage increases real wage growth in excess of inflation. The excess of general wage growth over price inflation represents the increase in the standard of living, also called productivity growth.

In constructing the salary increase assumption used to project future salary increases for individual members, the general wage growth assumption is combined with an assumption for service-based salary increases (called a merit scale). The service-based salary increase assumption will be addressed with the demographic assumptions.

Historical Perspective: Wage statistics are found in the Social Security System database on the National Average Wage data. This information goes back to 1955 and is the most comprehensive database available. Because the National Average Wage is based on all wage earners in the country who are covered by Social Security, it can be influenced by the mix of jobs (full-time vs. part-time, manufacturing vs. service, etc.) as well as by changes in some segments of the workforce that are not seen in all segments (e.g., regional changes or growth in computer technology). Furthermore, if compensation is shifted between wages and benefits, the wage index would not accurately reflect increases in total compensation. OPPRS membership is composed exclusively of governmental employees working in Oklahoma, whose wages and benefits are somewhat linked as a result of state and local tax revenues, funding allocations, and governing policies. Because the competition for workers can, in the long term, extend across industries and geography, the broad national earnings growth will have some impact on OPPRS members. In the shorter term, however, the wage growth of OPPRS and the nation may be less directly correlated.

The excess of wage growth over price inflation represents the real wage growth rate. The following table shows the compounded wage growth over various periods, along with the comparable price inflation rate for the same period. The differences represent the real wage growth rate.

Years	Period	General Wage Growth	CPI Increase	Real Wage Growth
2011-2021	10	3.5%	2.1%	1.4%
2001-2021	20	3.1%	2.3%	0.8%
1991-2021	30	3.5%	2.4%	1.1%
1981-2021	40	3.8%	2.8%	1.0%
1971-2021	50	4.6%	3.9%	0.7%
1961-2021	60	4.6%	3.8%	0.8%

Similar information over rolling 30-year periods is shown in the following graph:
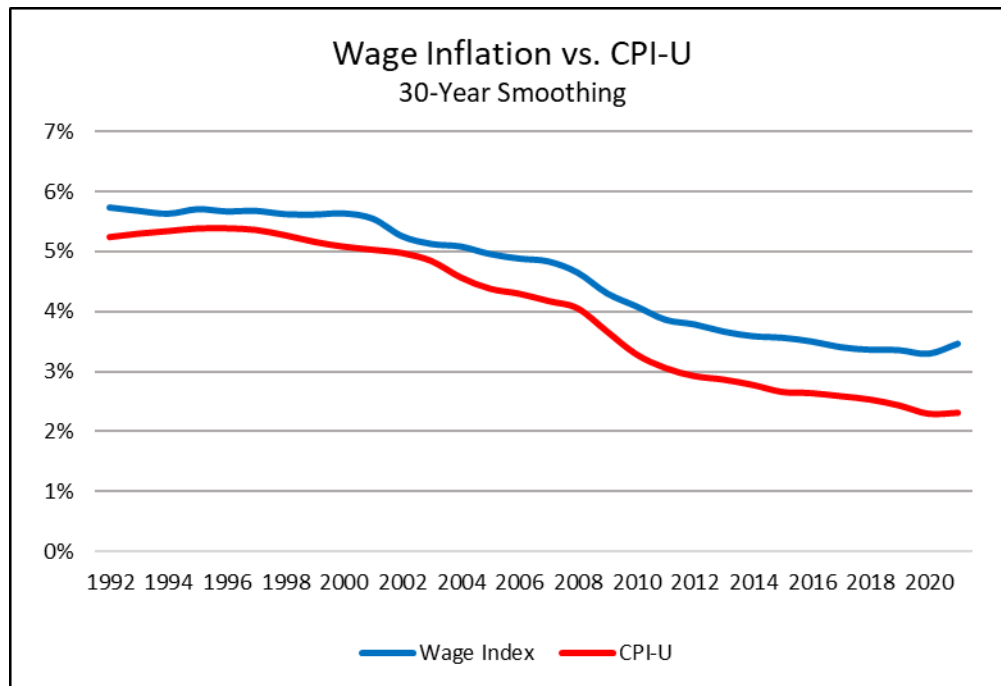
Over the last 30 years, the real wage increase, as measured by the increase in the National Average Wage Index, has been 1.09% per year on average. A somewhat similar, but slightly different set of data is available from the Bureau of Labor Statistics, which reports the average hourly wage for government employees. From 2004 through 2022, this amount has had an average increase of 2.21% per year, which lags inflation. Employment costs, which include benefits, have increased by 2.78% (more than inflation) indicating a shift in the proportion of compensation delivered as benefits vs. wages.

Forecasts of Future Wages: The wage index used for the historical analysis is projected forward by the Office of the Chief Actuary of the Social Security Administration in their 75-year projections. In the June, 2022 Trustees Report, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.6%, 1.2% higher than the Social Security Administration's intermediate inflation assumption of 2.4% per year. The range of the assumed real wage growth in the 2022 Trustees report was 0.5% to 1.8% per year.

Analysis and Conclusion: The various measures analyzed support a real wage growth assumption between 0.5% and 1.0%. **We recommend maintaining the current real wage assumption of 0.75%, so the total general salary growth assumption (price inflation plus real wage growth) will remain 3.50%.**

SUMMARY

The following table summarizes the current set of economic assumptions along with the recommended set of economic assumptions:

	Current Assumptions	Recommended Assumptions
Price Inflation	2.75%	2.75%
Investment Return	7.50%	7.25%
Interest Credited on DOP Balances	11.00%	11.00%
Real Wage Growth	0.75%	0.75%
General Wage Growth	3.50%	3.50%
COLA basis (Baker group)	3.50%	3.50%

Demographic Assumptions

There are several demographic assumptions used in the actuarial valuations performed for the Oklahoma Police Pension and Retirement System (OPPRS), including:

- Mortality
- Service Retirement
- Disability Retirement
- Termination of Employment
- Salary Increase for Merit and Promotions

The Actuarial Standards Board has issued Actuarial Standard of Practice (ASOP) No. 35, *"Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations"*, which provides guidance to actuaries in selecting demographic assumptions for measuring obligations under defined benefit plans. In our opinion, the demographic assumptions recommended in this report have been developed in accordance with ASOP No. 35.

The purpose of a study of demographic experience is to compare what actually happened to the membership during the study period (July 1, 2017 through June 30, 2022) with what was expected to happen, based on the assumptions used in the most recent actuarial valuation.

Detailed tabulations by age, service and/or gender are performed over the entire study period. These tabulations look at all active and retired members during the period as well as separately identifying those who experience a demographic event, also referred to as a decrement. In addition, the tabulation of all members together with the current assumptions permits the calculation of the number of expected decrements during the study period. We then compare the ratio of Actual to Expected decrements, called the A/E ratio as a measure of the adequacy of the assumption.

If the actual experience differs significantly from the overall expected results, or if the pattern of actual decrements by age, gender, or service does not follow the expected pattern, new assumptions are recommended. Recommended changes usually do not follow the exact actual experience during the observation period. Judgment is required to extrapolate future experience from past trends and current member behavior. In addition, non-recurring events, such as early retirement incentives, need to be taken into account in determining the weight to give to recent experience (called "credibility").

Because a major purpose of an actuarial valuation is to determine the liability for future benefit payments, it is often preferable to measure the events that occurred by the proportion of liability changing rather than simply the proportion of individuals change. This approach, called "liability weighting", helps reflect that if certain events are connected with the salary or service of

individuals, then we should reflect that by giving more weight to those with greater liability. In some cases, there may be a noticeable difference in the results based upon whether we look at the analysis on a count or liability-weighted basis. In these cases, we may select an assumption somewhere in between the two and move over time as the credibility of the liability-weighted results increases. For the most part, the relatively homogenous nature of OPPRS membership means that this analysis adds little value to our analysis. However, we did perform and consider this analysis, anticipating that it might better reflect the mix of larger and smaller employers participating in OPPRS.

The remainder of this section presents the results of the demographic study. We have prepared graphs and tables that show a comparison of the actual and expected decrements and the overall ratio of actual to expected results under the current assumptions. If a change is being proposed, the revised actual to expected ratios are shown as well. These tables are presented in Appendices D and E.

Mortality Tables

Mortality tables are a fundamental demographic assumption in actuarial valuations. Because pension benefits are typically paid over a retiree's lifetime, it is important to appropriately reflect the timeframe for a typical life. In addition, deaths before retirement may also result in the payout of benefits to a spouse or survivor. For valuation purposes, we must consider mortality tables for retirees, beneficiaries of retirees, disabled retirees, and active members. However, the post-retirement mortality assumption has a greater impact on the system's funding than the pre-retirement mortality assumption.

Due to the substantial amount of data required to construct a mortality table, actuaries normally rely on standard tables published by the Society of Actuaries (SOA). Actuaries may incorporate reasonable adjustments to these standard tables in order to better match the observed experience for a specific plan. These adjustments include common practices such as applying a scaling factor to the mortality rates or using age adjustments (an age set forward will increase mortality rates while an age set back will decrease mortality rates).

In addition to adjusting the current mortality rates within the standard mortality tables, actuaries must also consider how to appropriately reflect changes to the mortality rates over time. Rates of mortality declined throughout the 20th century and have continued to decline over the past 20 years through the appearance of Covid-19. This means that, in general, mortality people are living longer than they did in the past. It is now widespread practice in the actuarial profession to reflect future mortality improvements, but it is an issue that the profession continues to study and monitor. There

are two widely used methods for reflecting future mortality improvements: (i) incorporating a "margin" to the base rates and (ii) reflecting generational mortality improvement.

To incorporate a "margin" actuaries will adjust the rates in a static mortality table so that the actual/expected ratio is intentionally targeted to be over 100% (i.e., lowering the rates so that the number of expected deaths is lower). The other approach is to reflect generational mortality improvement, which is the current method used by OPPRS. This method directly anticipates future mortality improvements by calculating a different set of mortality rates based on a member's year of birth, with the rates for participants born in later years generally being lower. The varying mortality rates by year of birth create a series of mortality tables with rates that decrease over time. This creates the necessity for a second component of the mortality assumption. In addition to choosing what are known as the "base" mortality rates (i.e., the starting point), the actuary must now also come up with a reasonable assumption for how the base rates will change over time. When using generational mortality, the actual/expected ratios for observed experience are targeted to be near 100% as future mortality improvement will be directly accounted for under the assumption. The generational approach is our preferred method for recognizing future mortality improvements in the valuation process because it is more direct.

Retiree Mortality:

The post-retirement mortality rates used in the actuarial valuation estimate the percentage of retirees who are expected to die in a given future year. Of all the demographic assumptions, the mortality assumption typically has the most significant impact on liability projections.

Based upon the long-term trend of mortality improvement, actuaries seek to account for future improvements in longevity, either by directly projecting future improvements or by maintaining a sufficient margin in expected rates of mortality to allow for future improvement. The most direct approach is a projection of mortality improvements – also called generational mortality – starting with a base table and then estimating mortality rates for each year in the future based on expected improvements in mortality at each age over time. The current assumption is the RP-2000 Blue Collar Mortality Table, projected generationally with SOA Scale AA.

In early 2019, the Society of Actuaries published a new family of mortality tables based solely on mortality experience of public retirement plans in the United States. This Pub-2010 family of mortality tables provide separate assumptions for General, Public Safety and Teacher members. Assumptions are further broken down for members who earn above, below and at the median income level for each group.

Graphs showing actual versus expected post-retirement mortality rates for OPPRS male retirees are shown in Appendix D-1, while Appendix E-1 has the corresponding numerical data. Female

retirees are shown in Appendices D-2 and E-2. Under the current assumptions, the analysis of the actual post-retirement mortality experience over the five-year experience study period yields an actual/expected ratio of 134% for males and 133% for females (more deaths than expected). (Under the liability weighting discussed earlier, the A/E ratios are 107% and 95%, respectively). It should be noted that the overall number of retirees in OPPRS is relatively small for purposes of analyzing mortality experience, and the number of female retirees is especially limited, leading us to be cautious regarding drawing strong conclusions from it.

While the actual/expected ratio is a measure of how well an assumption predicted the actual events, this ratio does not necessarily supply a complete picture. For example, if a set of mortality rates predicted too many deaths at younger ages and not enough at older ages, the actual/expected ratio could be near 100%, even though the assumption might not be a good fit. We examined the PubS-2010 below median mortality table with a two-year age set forward and found that it had an actual/expected count ratio for males of 113% for ages 50 to 90, much improved over the actual/expected ratio under the current assumption of 134%. While actual/expected ratio under the alternative table is still above 100%, this is not necessarily unreasonable considering the impact of the Covid-19 pandemic during this period. Due to this abnormal event, we are not comfortable granting complete creditability to observed experience. **Therefore, we believe that the retiree table for males should be changed to use the PubS-2010 Healthy Retiree (below median) mortality table with a two-year age set forward and generational mortality reflected using the SOA Scale MP-2021.**

For the female retirees, due to the limited amount of observable experience **we believe it is reasonable for the female retiree table to also be changed to use the PubS-2010 Healthy Retiree (below median) mortality table with a two-year age set forward and generational mortality reflected using the SOA Scale MP-2021.**

Beneficiary Mortality:

For benefits payable with a joint and survivor option (which is the automatic form for OPPRS benefits), an assumption is needed regarding the beneficiary's lifetime. Beneficiary data is often less precise because it is not needed prior to a retiree's death. Further, data tracking of beneficiaries is less precise during the years when the member is alive. Consequently, we do not find sufficiently credible data to analyze this group separately. Therefore, we believe it is reasonable to also use the same family of mortality tables, with the same adjustments, as was proposed for heathy retirees for their beneficiaries. Specifically, **we recommend using the Pub-2010 Contingent Survivor (below median) mortality table with a two-year age set forward and generational mortality reflected using the SOA Scale MP-2021.**

Disabled Retiree Mortality:

Members who retire under the disability retirement provisions are generally expected to be less healthy than the overall working population and, therefore, experience higher mortality rates. Currently, the assumption for this group is the same as the regular members, but with a four-year age set forward. The number of disabled retirees is small, and so the number of deaths in this group can be very volatile. Therefore, we believe it is reasonable to also use the same family of mortality tables as was proposed for heathy retirees and beneficiaries, but without reflecting future generational mortality improvements due to their disabled status. Specifically, **we recommend using the PubS-2010 Disabled Retiree mortality table with static rates projected to 2023 using the SOA Scale MP-2021.**

Active and Inactive Vested Member Mortality:

For active and inactive vested members, the mortality assumption is less significant since it represents only a small portion of cases where employment ends and benefits begin. Further, there is less of a concern with margin for future improvements compared to retirees. During this study period, there were 27 active member deaths compared with 10 for the 2012 to 2017 study and 14 for the 2007 to 2012 study. Limited data such as this makes studying the assumption in detail impossible.

In light of this, we believe it is reasonable to also use the same family of mortality tables, with the same adjustments, as was proposed for heathy retirees. Specifically, **we recommend using the PubS-2010 Employee (below median) mortality table with a two-year age set forward and generational mortality reflected using the SOA Scale MP-2021.** All active member deaths will be assumed to be duty-related for conservatism and simplicity.

Rates of Retirement

The service retirement rates used in the actuarial valuations project the percentage of employees who are expected to retire during a given year. This assumption does not include the retirement patterns of the individuals who terminated from active membership prior to their retirement.

OPPRS provides a normal (unreduced) retirement benefit at any age upon the completion of 20 years of service. The benefit multiplier is capped at 75% after 30 years of service so the amount of the retirement benefit grows only with salary increases after that point. Significantly affecting retirement decisions are two other retirement options provided by OPPRS.

The Deferred Option Plan (DOP) allows a member to be treated by the System as though he or she had retired but then continues in active employment for up to five years. Monthly benefits that

would normally be paid during the DOP period are accumulated in a nominal account with interest, along with half of the employer contributions made on the member's behalf (the member no longer contributes). Upon final termination of employment, the member receives the monthly payments prospectively along with payment of the DOP account balance in a lump sum. A second alternative upon retiring is to have benefits calculated as though the member elected the DOP option at a specified time in the past. For purposes of preparing the funding valuation and compliance with accounting standards, a member is treated as retiring upon entering DOP, electing a retroactive DOP, or simply retiring and commencing benefits.

The analysis of the actual retirement experience over the five-year period yields an actual/expected ratio of 70% when compared to the current service-based assumption, indicating utilization is substantially lower than expected. However, further analysis into the System's retirement experience indicates that a member's age is a stronger predictor of retirement behavior than the member's service, though the two variables are closely linked due to most members joining the System in their 20's. Because members often utilize the System's retroactive DOP, which has a maximum period of five years, and the benefit multiplier is capped at 75% after 30 years of service, we believe it is unreasonable to assume any members work beyond 35 years of service. **As a result, we propose that OPPRS adopt an age-based retirement assumption with 100% retirement after age 67 or upon reaching 35 years of service.** Graphs and detailed tables showing actual versus proposed retirement rates are shown in Appendices D-3 and E-3.

Currently, the assumption is that all retirees elect a DOP retroactive for five years (or the date of retirement eligibility if more recent). During this study period, we identified 721 members as retiring, but there is only 1 member in DOP as of the most recent valuation. This would suggest that a forward-looking DOP election is rare. Because the retroactive election (back to the earliest unreduced retirement age that may be elected) is generally going to be more valuable than not electing it, we believe that it is reasonable to assume that all retirees elect the retroactive DOP. OPPRS staff also confirmed that almost all members elect the retroactive DOP. **Therefore, we recommend retaining the current retroactive DOP assumption.**

Rates of Disability Retirement

The rates of disability used in the actuarial valuation project the percentage of employees who are expected to become disabled each year and begin to receive a disability retirement benefit. For the study period, there were 17 disability retirements in the core ages of 20 to 54, compared with 15 expected. A graph and detailed table showing actual versus expected disability rates are shown in Appendices D-4 and E-4.

In the prior experience study, there were also more disabilities than expected (12 actual vs 10 expected) but given the limited amount of data the disability rates remained unchanged. In this study period, actual disabilities are again somewhat higher than expected. **As a result, we recommend disability rates be increased by 10% across the board.**

We reviewed the 20 disability retirements granted between 2017 and 2022, some of which were outside the formal five-year study period. A summary of the award percentage is shown in the following table:

Award Level	Number of Awards
25%	4
50%	5
75%	3
100%	8
	20

The table above shows the average award percentage was 69%, and the current award percentage assumption is 50% to 75%. **However, due to recent legislation (SB 743) that went into effect November 1, 2022, future duty-related disabilities will be treated as full disabilities. As a result of this new legislation, we recommend assuming all disabled members receive the full disability benefit.**

Rates of Termination of Employment

The termination of employment rates are used to determine the expected number of separations from active service that will occur prior to members attaining the eligibility requirement for a retirement benefit as a result of resignation or dismissal.

The experience during the five-year study period was close to expected with an A/E ratio of 105%. The current assumptions are service-based rates, a common approach, and one well supported by the data. **We recommend maintaining the current assumption**. The complete tables of recommended termination of employment rates are shown in Appendices D-5 and E-5.

We also recommend that the current assumption that all vested members who terminate will elect to receive a future benefit, commencing at age 50, be retained.

Rates of Total Salary Increase

Under the "building block" approach recommended in ASOP 27, this assumption is composed of three components: inflation, productivity (real wage increases), and merit/promotion. The first two of these were developed in the economic assumptions section. The merit component includes the additional increases in salary due to performance, seniority, promotions, etc.

We frequently find that salary increases are correlated to a member's length of service. Typically, new employees receive larger increases as certain milestones are met, while mid-career employees tend to have smaller increases, some of which reflect promotion to supervisory or management positions. Longer-term employees generally receive only general wage increases. In light of the current assumption for general wage growth of 3.50%, the total salary increase assumption (general wage increase plus merit) is expected to be 3.50% at longer service durations.

Detailed salary increase rates at all durations are shown in Appendices D-6 and E-6. **We recommend some changes be made for members with 11 to 16 years of service to better fit the observed data**.

Miscellaneous Assumptions

Marriage and Family Assumptions: Currently 85% of members are assumed to be married with the husband three years older than the wife. In addition, we assume that there are no eligible dependent children upon the death of an active member. These are common and reasonable assumptions which have minimal impact on the valuation results and so **we recommend maintaining them.**

Administrative Expenses: Currently, the System provides a budgeted estimate of administrative expenses for the upcoming year that is included as a separate component of the actuarial contribution rate. **We recommend this approach be continued.** Note that the impact of any investment expenses is reflected in the net investment return assumption.

Missing Data: In preparing the valuation data, certain data items are missing, unavailable, or unreasonable. In such cases, assumptions have been developed for those data elements. These assumptions are described in Appendix C. **We recommend retaining these assumptions.**

Actuarial Methods

Actuarial valuations utilize methods to determine the liabilities, assets, and costs. The selection of these methods constitute the system's funding policy. While these are not like assumptions that may change over time, an experience study is still a good opportunity to review these methods to see if they are still appropriate for systematically funding the promised benefits. Significant methods are described below.

Actuarial Cost Method: The cost method is used to allocate the present value of benefits between past service (actuarial accrued liability) and future service (normal cost). Currently the valuation uses the entry age normal cost method. This is the most widely used cost method of large public sector plans and has demonstrated the highest degree of stability as compared to alternative methods. We recommend no change in the use of this method.

Actuarial Value of Assets: The purpose of the asset smoothing is to dampen the impact that market volatility has on valuation results by spreading the unexpected market gains and losses over several years. Currently the System uses a smoothing method that recognizes each year's difference between the expected return on the market value of assets and the actual return on the market value of assets (based on the assumed rate of return) over a closed five-year period. The actuarial value of assets cannot be less than 80% or more than 120% of market value. We recommend no change in the use of this method.

Amortization Method: If the System has an unfunded actuarial accrued liability it is amortized using a level dollar method over an open five-year period. Essentially, this has the effect of attempting to move about a quarter of the way from the current funded position towards 100% funding. (Because the actual contributions are not based on the UAAL amortization contribution rate, actual results are not directly affected.) Compared to other retirement systems, this would be considered to be an aggressive attempt to reach 100% funding. If there is an asset surplus (i.e., actuarial assets are greater than the actuarial liability) it is amortized as a level dollar amount over an open 30-year period. We recommend no change to the use of this method.

Capital Market Assumptions and Asset Allocation

Rates of Return and Standard Deviation by Asset Class

Asset Class	Target Allocation	Arithmetic Nominal Return	Standard Deviation
Core Bonds	7.5%	5.33%	4.58%
Multi-Sector Bonds	7.5%	6.29%	5.69%
Absolute Return	5.0%	6.00%	6.29%
U.S. Large Cap Equity	15.0%	9.92%	17.99%
U.S. Small Cap Equity	10.0%	11.36%	20.77%
International Developed Equity	10.0%	10.81%	19.70%
Emerging Market Equity	5.0%	12.08%	28.56%
Long/Short Equity	10.0%	8.52%	11.94%
Private Equity	15.0%	13.30%	18.39%
Core Real Estate	10.0%	9.29%	10.39%
Opportunistic Real Estate	5.0%	12.29%	18.26%
Total	100.0%		

Asset Class Correlation Coefficients

Asset Class	Core Bonds	Multi Sector	Absolute Return	US Large	US Small	Int'l Develop	Emerg. Market	Long/ Short	Private Equity	Real Estate	Opportune Real Estate
Core Bonds	1.00	0.70	0.39	-0.15	-0.21	-0.22	-0.15	-0.08	-0.35	-0.16	-0.09
Multi-Sector		1.00	0.78	0.28	0.23	0.32	0.35	0.25	-0.06	-0.18	0.02
Absolute Return			1.00	0.62	0.64	0.65	0.67	0.59	0.21	-0.08	0.17
U.S. Large Cap				1.00	0.78	0.81	0.56	0.68	0.54	0.28	0.41
U.S. Small Cap					1.00	0.77	0.62	0.73	0.42	0.18	0.31
Int'l Developed						1.00	0.79	0.72	0.61	0.23	0.44
Emerging Market							1.00	0.69	0.48	0.01	0.27
Long/Short Equity								1.00	0.68	0.28	0.45
Private Equity									1.00	0.39	0.44
Core Real Estate										1.00	0.83
Opportunistic RE											1.00

Current Assumptions and Methods

Actuarial Cost Method

Liabilities and contributions shown in this report are computed using the Individual Entry Age method of funding. Sometimes called the "funding method," this is a particular technique used by actuaries for establishing the amount of the annual actuarial cost of pension benefits, or normal cost, and the related unfunded actuarial accrued liability. Ordinarily the annual contribution to the System is comprised of (1) the normal cost; and (2) an amortization payment on the unfunded actuarial accrued liability.

Under the Entry Age Actuarial Cost Method, the **Normal Cost** is computed as the level percentage of pay which, if paid from the earliest time each member would have been eligible to join the System had it existed (thus entry age) until his retirement or termination, would accumulate with interest at the rate assumed in the valuation to a fund sufficient to pay all benefits under the System.

The **Actuarial Accrued Liability** under this method, at any point in time, is the theoretical amount of the fund that would have accumulated had annual contributions equal to the normal cost been made in prior years (it does not represent the liability for benefits accrued to the valuation date). The **Unfunded Actuarial Accrued Liability** is the excess of the actuarial accrued liability over the actuarial value of System assets on the valuation date.

Under this method, experience gains or losses, i.e. decreases or increases in actuarial accrued liabilities attributable to deviations in experience from the actuarial assumptions, adjust the unfunded actuarial accrued liability.

Asset Valuation Method

The actuarial value of assets is based on a five-year moving average of expected and actual market values determined as follows:

- at the beginning of each fiscal year, a preliminary expected actuarial asset value is calculated as the sum of the previous year's actuarial value increased with a year's interest at the System valuation rate plus net cash flow adjusted for interest (at the same rate) to the end of the previous fiscal year;

- the expected actuarial asset value is set equal to the preliminary expected actuarial value plus the unrecognized investment gains and losses as of the beginning of the previous fiscal year;

- the difference between the expected actuarial asset value and the market value is the investment gain or loss for the previous year;

- the (final) actuarial asset value is the preliminary value plus 20% of the investment gains and losses for each of the five previous fiscal years, but in no case more than 120% of the market value or less than 80% of the market value.

Amortization Method

The unfunded actuarial accrued liability is amortized as a level dollar amount over a 5-year open period. Surplus, if any, is amortized as a level dollar amount over a 30-year open period.

Valuation Procedures

The wages used in the projection of benefits and liabilities are pay for the year ending June 30 (including longevity bonuses). These amounts were projected into the valuation year using the valuation salary scale.

In computing accrued benefits, average earnings were determined using the valuation salary scale. Historical earnings for the past five years have been retained.

Retired members were assumed to be married according to the probability of marriage assumption. For those in the Baker group, the assumption is 100% married.

The impact from compensation limit under IRC Section 401(a)(17) and from the dollar limitation required by the Internal Revenue Code Section 415 for governmental plans were considered in this valuation and was determined to be *de minimis*.

The calculations for the required state contribution are determined as of mid-year. Since the agency contributions, member contributions and State insurance premium tax allocations are made on a monthly basis throughout the year, a mid-year determination date represents an average weighting of the contributions.

Economic Assumptions

1. Inflation   2.75%, per annum, compound annually.

2. Investment Return   7.50%, net of investment expenses, per annum, compounded annually.

3. Salary Scale

Attained Service	Inflation %	Merit %	Increase %
0	3.50	8.50	12.00
1	3.50	6.50	10.00
2	3.50	5.50	9.00
3	3.50	4.50	8.00
4-6	3.50	4.00	7.50
7	3.50	3.75	7.25
8	3.50	3.50	7.00
9	3.50	3.25	6.75
10-12	3.50	3.00	6.50
13	3.50	2.00	5.50
14	3.50	1.25	4.75
15	3.50	0.75	4.25
16-25	3.50	0.25	3.75
26+	3.50	0.00	3.50

Demographic Assumptions

1. Retirement Rates   Sample rates are shown below:

Attained Service	Annual Rates of Retirement
20	15%
21	8
22	8
23	8
24	8
25	20
26	10
27	10
28	10
29	15
30	20
31	30
32	40
33	50
34	75
35	100

2. Mortality Rates

(a) Active participants	RP-2000 Combined Blue Collar Healthy Employees (generational using Scale AA) with age set back four years
(b) Active participants (post-retirement) and nondisabled pensioners	RP-2000 Combined Blue Collar Healthy Employees (generational using Scale AA)
(c) Disabled pensioners	RP-2000 Combined Blue Collar Healthy Employees with age set forward four years (no generational improvement)

3. Disability Rates   Sample rates are shown below:

Age	Rate
20-24	0.02%
25-29	0.02
30-34	0.04
35-39	0.06
40-44	0.08
45-49	0.10
50-54	0.12
Over 55	0.14

No disabilities are assumed after a member attains retirement eligibility. 100% of disabilities are assumed to be duty-related.

4. Withdrawal Rates   Sample rates are shown below:

Service Range	Rate
0	15.0%
1	12.0
2	10.0
3	8.0
4	7.0
5	6.0
6	5.0
7	4.5
8	4.0
9	3.5
10	3.0
11	2.5
12	2.0
13	1.5
14-20	1.0
Over 20	0.0

5. Marital Status

(a) Percentage married: Males: 85%; Females: 85%

(b) Age difference: Males are assumed to be three (3) years older than females.

<u>Other Assumptions:</u>

1. Deferred Benefits Begin at: Age 50, or the date at which the participant would have achieved 20 years of service, if later.

2. Provision for Expenses: Administrative Expenses, as budgeted by the Oklahoma Police Pension and Retirement System.

3. Percentage of Disability: Members becoming disabled have a 50%-74% impairment.

4. Duty-Related Death: All pre-retirement deaths are duty-related.

5. Cost-of-Living Allowance: Police officers eligible to receive increased benefits according to repealed Section 50-120 of Title 11 of the Oklahoma Statutes pursuant to a court order receive an adjustment of 1/3 to 1/2 of the increase or decrease of any adjustment to the base salary of a regular police officer, based on an increase in base salary of 3.5% (wage inflation).

6. Deferred Option Plan: Members currently participating in the Deferred Option Plan (DOP) are assumed to remain in the DOP for the maximum of five years. Active members leaving active service are assumed to retroactively elect to join the DOP for the maximum allowable period. DOP account balances are assumed to accumulate at 11% (to reflect the interest rate guarantee prior to retirement) for future BackDOP elections and members are assumed to elect a lump sum at retirement. All balances held in Deferred Option payout accounts are assumed to be paid immediately upon the end of employment.

Proposed Assumptions and Methods

Actuarial Cost Method

Liabilities and contributions shown in this report are computed using the Individual Entry Age method of funding. Sometimes called the "funding method," this is a particular technique used by actuaries for establishing the amount of the annual actuarial cost of pension benefits, or normal cost, and the related unfunded actuarial accrued liability. Ordinarily the annual contribution to the System is comprised of (1) the normal cost; and (2) an amortization payment on the unfunded actuarial accrued liability.

Under the Entry Age Actuarial Cost Method, the **Normal Cost** is computed as the level percentage of pay which, if paid from the earliest time each member would have been eligible to join the System had it existed (thus entry age) until his retirement or termination, would accumulate with interest at the rate assumed in the valuation to a fund sufficient to pay all benefits under the System.

The **Actuarial Accrued Liability** under this method, at any point in time, is the theoretical amount of the fund that would have accumulated had annual contributions equal to the normal cost been made in prior years (it does not represent the liability for benefits accrued to the valuation date). The **Unfunded Actuarial Accrued Liability** is the excess of the actuarial accrued liability over the actuarial value of System assets on the valuation date.

Under this method, experience gains or losses, i.e. decreases or increases in actuarial accrued liabilities attributable to deviations in experience from the actuarial assumptions, adjust the unfunded actuarial accrued liability.

Asset Valuation Method

The actuarial value of assets is based on a five-year smoothing method and is determined by spreading the effect of each year's investment return in excess of or below the expected return. The Market Value of assets as of the valuation date is reduced by the sum of the following:

    i.   80% of the return to be spread during the first year preceding the valuation date,
    ii.   60% of the return to be spread during the second year preceding the valuation date,
    iii.   40% of the return to be spread during the third year preceding the valuation date, and
    iv.   20% of the return to be spread during the fourth year preceding the valuation date.

The return to be spread is the difference between (1) the actual investment return on Market Value and (2) the expected return on Market Value. The final actuarial asset value cannot be more than 120% or less than 80% of the market value.

Amortization Method

The unfunded actuarial accrued liability is amortized as a level dollar amount over a 5-year open period. Surplus, if any, is amortized as a level dollar amount over a 30-year open period.

Valuation Procedures

The wages used in the projection of benefits and liabilities are pay for the year ending June 30 (including longevity bonuses). These amounts were projected into the valuation year using the valuation salary scale.

In computing accrued benefits, average earnings were determined using the valuation salary scale. Historical earnings for the past five years have been retained.

Retired members were assumed to be married according to the probability of marriage assumption. For those in the Baker group, the assumption is 100% married.

The impact from compensation limit under IRC Section 401(a)(17) and from the dollar limitation required by the Internal Revenue Code Section 415 for governmental plans were considered in this valuation and was determined to be *de minimis*.

The calculations for the required state contribution are determined as of mid-year. Since the agency contributions, member contributions and State insurance premium tax allocations are made on a monthly basis throughout the year, a mid-year determination date represents an average weighting of the contributions.

Economic Assumptions

1. Inflation   2.75%, per annum, compound annually

2. Investment Return   7.25%, net of investment expenses, per annum, compounded annually.

3. Salary Scale   Sample rates are shown below:

Attained Service	Wage Inflation %	Merit %	Increase %
0	3.50	8.50	12.00
1	3.50	6.50	10.00
2	3.50	5.50	9.00
3	3.50	4.50	8.00
4-6	3.50	4.00	7.50
7	3.50	3.75	7.25
8	3.50	3.50	7.00
9	3.50	3.25	6.75
10	3.50	3.00	6.50
11	3.50	2.75	6.25
12	3.50	2.50	6.00
13	3.50	2.00	5.50
14	3.50	1.50	5.00
15	3.50	1.00	4.50
16	3.50	0.50	4.00
17-25	3.50	0.25	3.75
26+	3.50	0.00	3.50

Demographic Assumptions

1. Retirement Rates   Rates are shown below:

Age	Annual Rates of Retirement
40-45	5%
46-55	10%
56	15%
57-58	20%
59-60	25%
61-63	30%
64-66	40%
67+	100%

100% retirement with 35 or more years of service.

2. Mortality Rates

(a) Active and Inactive Vested Members

PubS-2010 Employee (Below Median) Mortality Table with rates set forward two years and projected generationally using SOA Scale MP-2021.

(b) Healthy Retirees

PubS-2010 Healthy Retiree (Below Median) Mortality Table with rates set forward two years and projected generationally using SOA Scale MP-2021.

(c) Beneficiaries

Pub-2010 Contingent Survivor (Below Median) Mortality Table with rates set forward two years and projected generationally using SOA Scale MP-2021.

(c) Disabled Retirees

PubS-2010 Disabled Retiree Mortality Table with rates projected to 2023 using SOA Scale MP-2021.

3. Disability Rates

Sample rates are shown below:

Age	Rate
20-24	0.022%
25-29	0.022%
30-34	0.044%
35-39	0.066%
40-44	0.088%
45-49	0.110%
50-54	0.132%
55-59	0.154%

No disabilities are assumed after a member attains retirement eligibility. 100% of disabilities are assumed to be duty-related.

4. Withdrawal Rates   Sample rates are shown below:

Service Range	Rate
0	15.0%
1	12.0
2	10.0
3	8.0
4	7.0
5	6.0
6	5.0
7	4.5
8	4.0
9	3.5
10	3.0
11	2.5
12	2.0
13	1.5
14-20	1.0
Over 20	0.0

5. Marital Status

(a) Percentage married: Males: 85%; Females: 85%

(b) Age difference: Males are assumed to be three (3) years older than females.

(c) Eligible children   Deceased active members are not assumed to leave behind any eligible children.

Other Assumptions:

1. Deferred Benefits Begin at: Age 50, or the date at which the participant would have achieved 20 years of service, if later.

2. Provision for Expenses: Administrative Expenses, as budgeted by the Oklahoma Police Pension and Retirement System.

3. Percentage of Disability: Members becoming disabled have a 100% impairment.

4. Duty-Related Death: All pre-retirement deaths are duty-related.

5. Cost-of-Living Allowance: Police officers eligible to receive increased benefits according to repealed Section 50-120 of Title 11 of the Oklahoma Statutes pursuant to a court order receive an adjustment of 1/3 to 1/2 of the increase or decrease of any adjustment to the base salary of a regular police officer, based on an increase in base salary of 3.5% (wage inflation).

6. Deferred Option Plan: Members currently participating in the Deferred Option Plan (DOP) are assumed to remain in the DOP for the maximum of five years. Active members leaving active service are assumed to retroactively elect to join the DOP for the maximum allowable period. DOP account balances are assumed to accumulate at 11% (to reflect the interest rate guarantee prior to retirement) for future BackDOP elections and members are assumed to elect a lump sum at retirement. All balances held in Deferred Option payout accounts are assumed to be paid immediately upon the end of employment.

Oklahoma Police Pension and Retirement System

Experience Study 2017-2022
Appendix D-1
Probability of Death - Healthy Retirees
Males
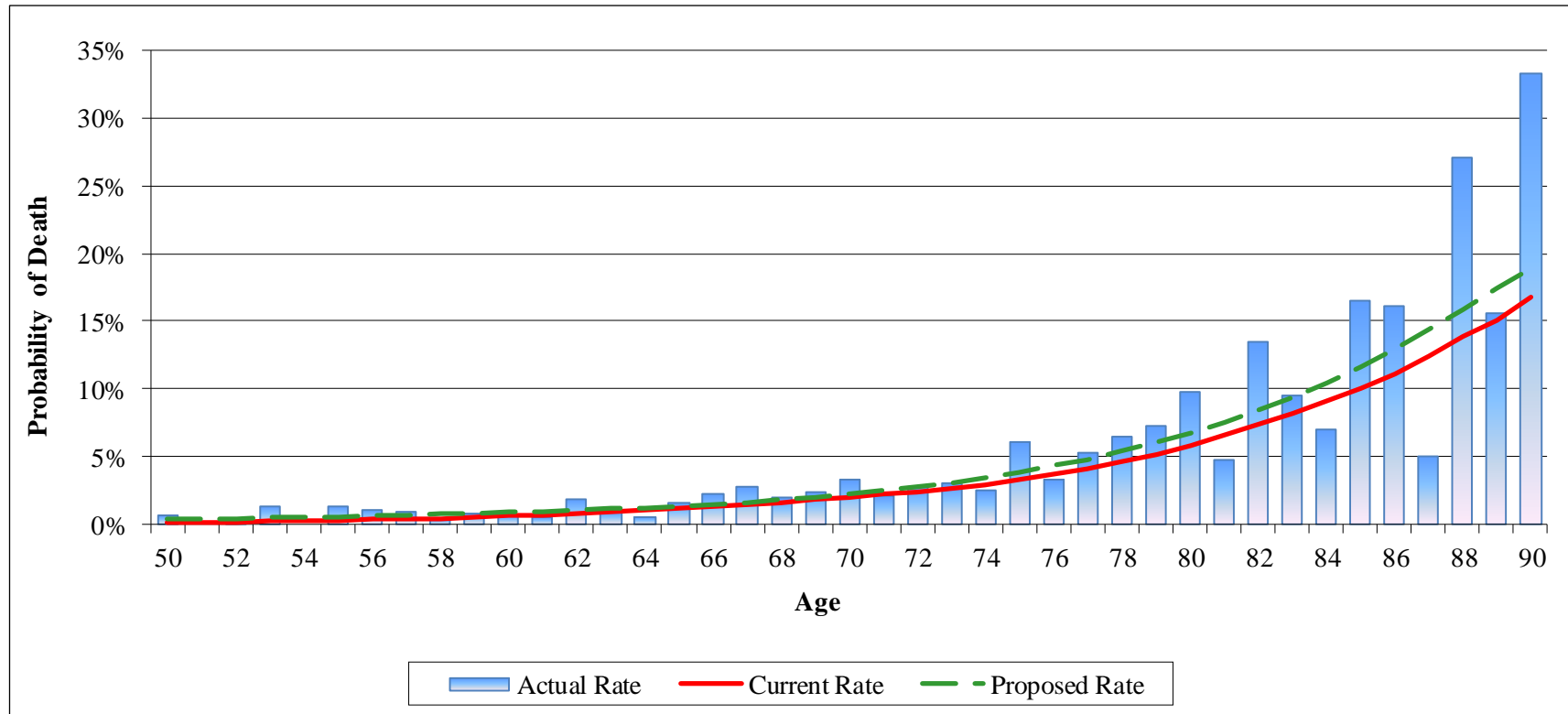
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Count	342	256	304
Actual/Expected		134%	113%

Oklahoma Police Pension and Retirement System
Experience Study 2017-2022
Appendix D-2
Probability of Death - Healthy Retirees
Females
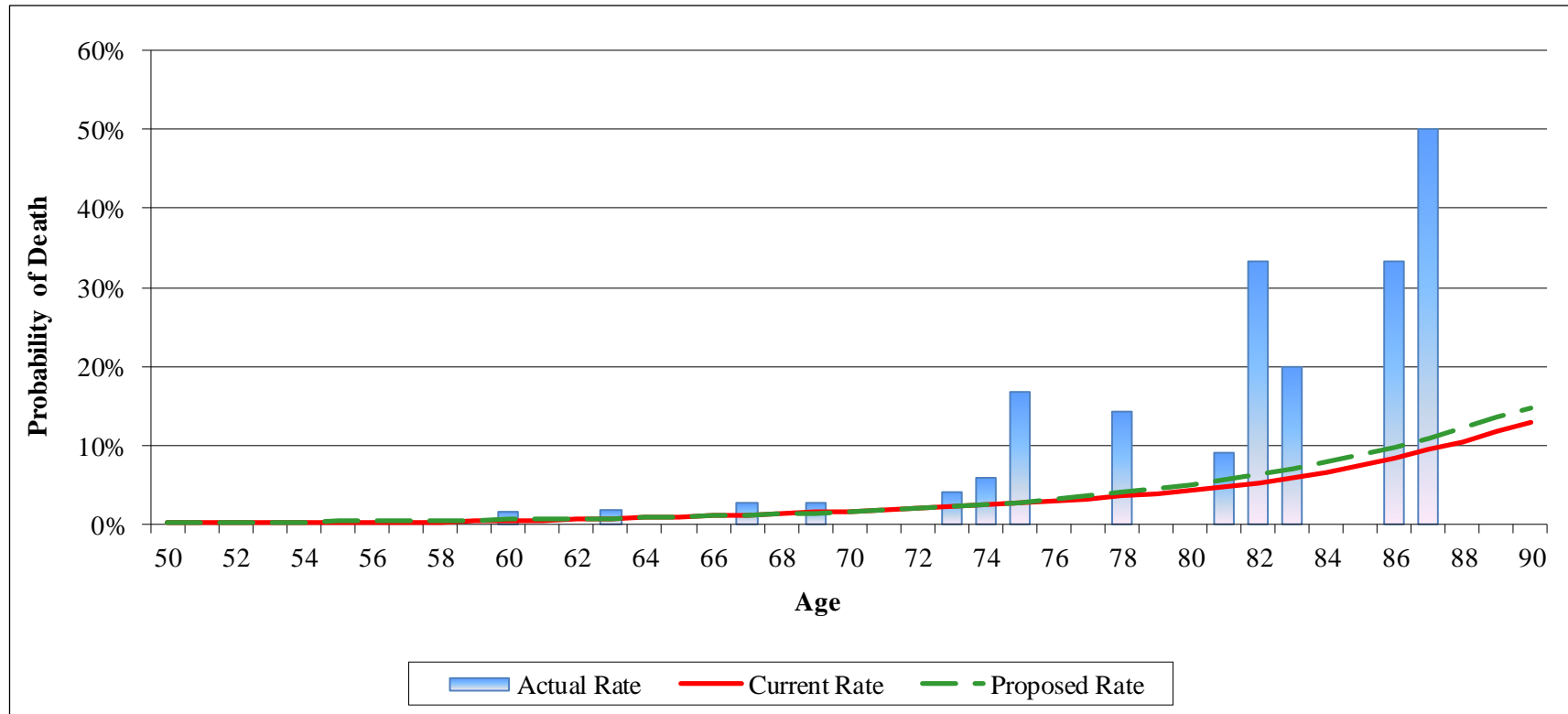
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Count	16	12	13
Actual/Expected		133%	123%

Oklahoma Police Pension and Retirement System

Experience Study 2017-2022
Appendix D-3
Retirement Rates
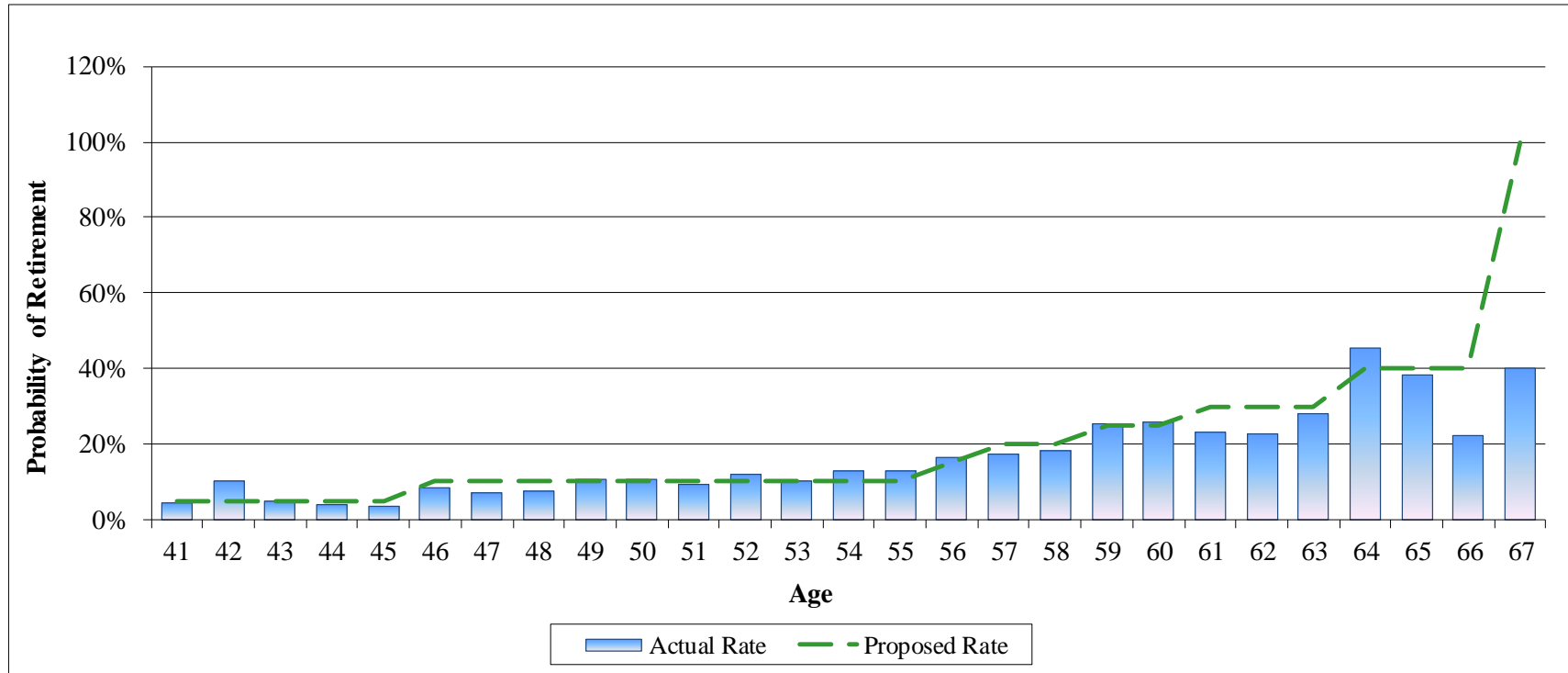
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	656	946	670
Actual/Expected		70%	98%

Oklahoma Public Employees Retirement System
Experience Study 2017-2022
Appendix D-4
Rate of Disability - Active Lives
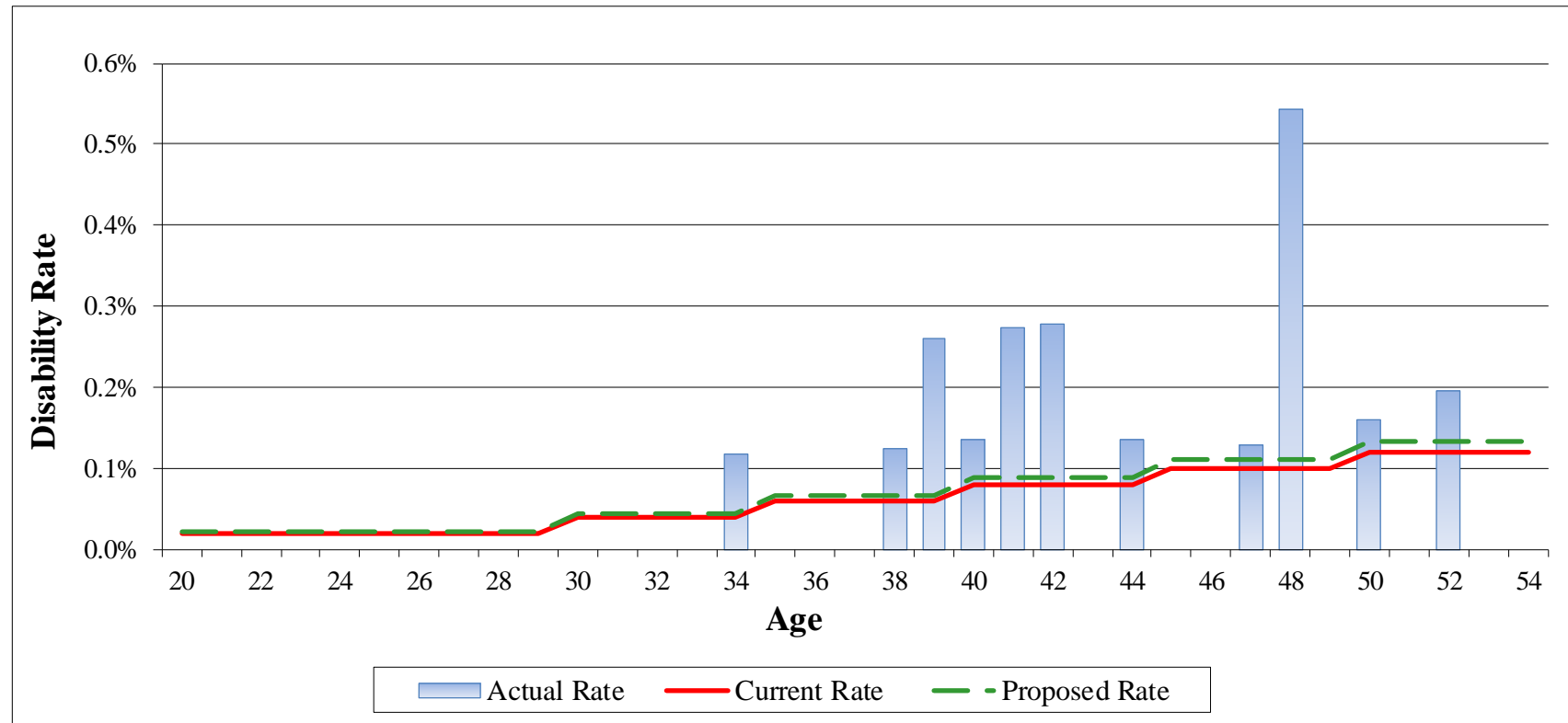
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	17	15	16
Actual/Expected		113%	106%

Oklahoma Police Pension and Retirement System
Experience Study 2017-2022
Appendix D-5
Rate of Termination of Employment
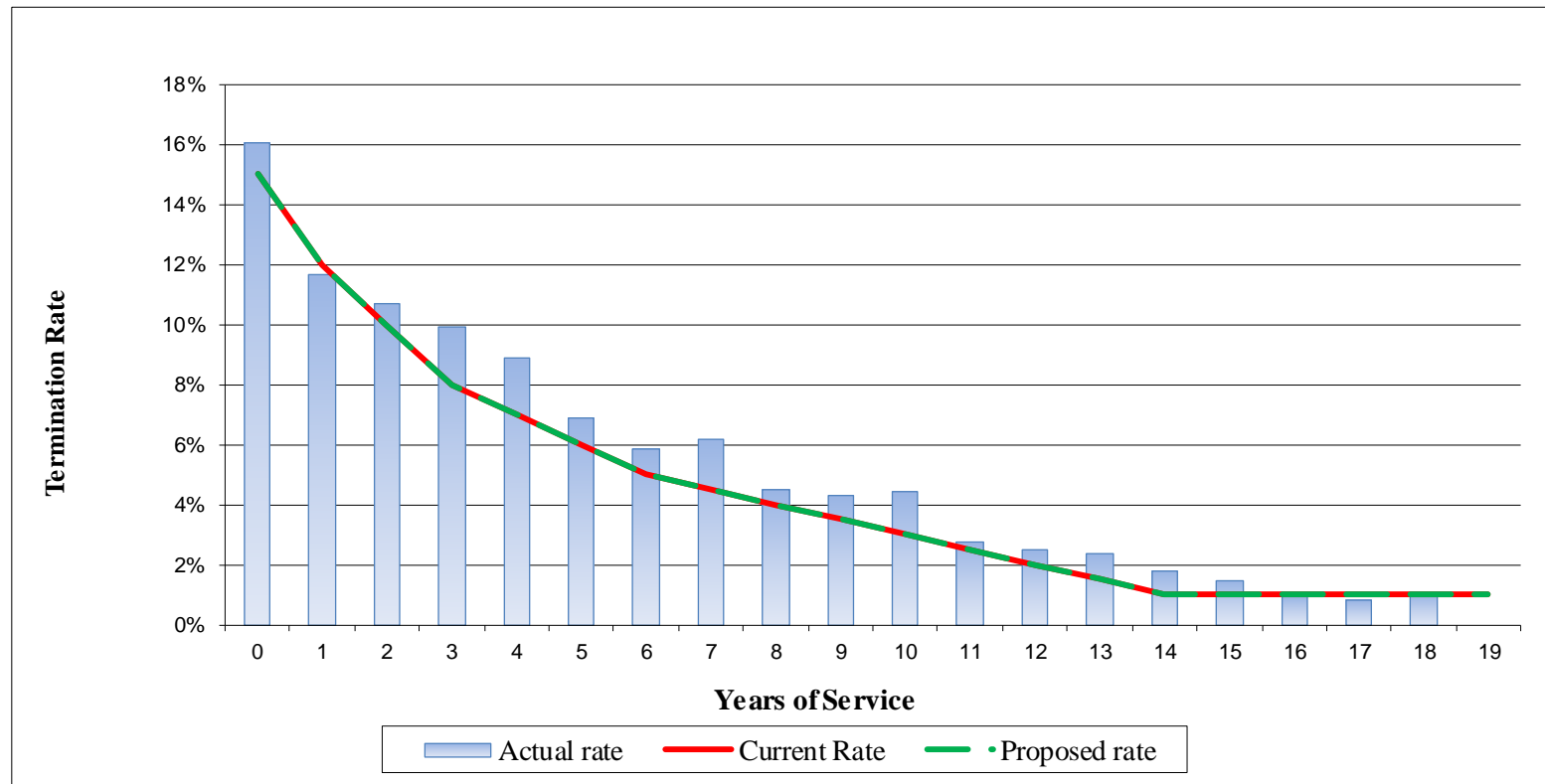
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	1,284	1,144	1,144
Actual/Expected		112%	112%

41

Oklahoma Police Pension and Retirement System
Experience Study 2017-2022
Appendix D-6
Total Salary Scale
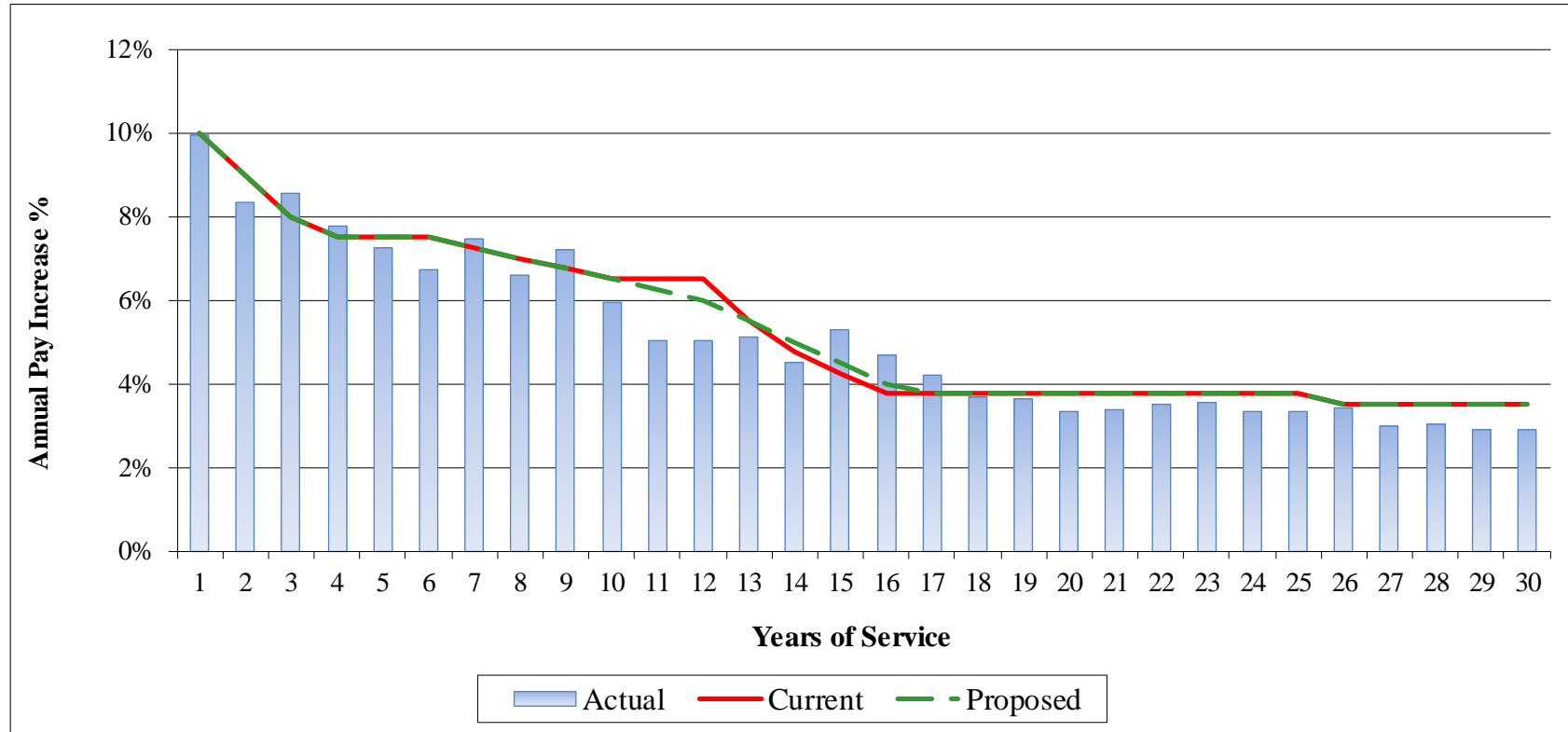
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Average Increase	5.47%	5.67%	5.79%
Actual/Expected		96%	94%

Appendix E-1
Probability of Death - Healthy Retirees
Males

Age	Exposure	Actual Deaths	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
50	162	1	0.6%	0.3	0.2%	0.6	0.4%
51	220	-	0.0%	0.4	0.2%	0.9	0.4%
52	238	1	0.4%	0.5	0.2%	1.1	0.4%
53	287	4	1.4%	0.6	0.2%	1.4	0.5%
54	324	-	0.0%	0.8	0.2%	1.7	0.5%
55	369	5	1.4%	1.1	0.3%	2.2	0.6%
56	379	4	1.1%	1.3	0.4%	2.4	0.6%
57	432	4	0.9%	1.8	0.4%	3.0	0.7%
58	458	2	0.4%	2.2	0.5%	3.5	0.8%
59	476	4	0.8%	2.5	0.5%	4.0	0.8%
60	483	3	0.6%	2.9	0.6%	4.4	0.9%
61	504	3	0.6%	3.6	0.7%	5.0	1.0%
62	487	9	1.8%	3.9	0.8%	5.2	1.1%
63	504	5	1.0%	4.7	0.9%	5.8	1.1%
64	527	3	0.6%	5.6	1.1%	6.6	1.3%
65	559	9	1.6%	6.6	1.2%	7.7	1.4%
66	542	12	2.2%	7.4	1.4%	8.2	1.5%
67	532	15	2.8%	8.1	1.5%	8.8	1.7%
68	515	10	1.9%	8.5	1.7%	9.4	1.8%
69	513	12	2.3%	9.4	1.8%	10.3	2.0%
70	485	16	3.3%	9.7	2.0%	10.8	2.2%
71	482	10	2.1%	10.6	2.2%	12.0	2.5%
72	459	13	2.8%	11.1	2.4%	12.7	2.8%
73	426	13	3.1%	11.3	2.7%	13.1	3.1%
74	359	9	2.5%	10.5	2.9%	12.4	3.4%
75	328	20	6.1%	10.8	3.3%	12.6	3.8%
76	269	9	3.3%	9.8	3.6%	11.6	4.3%
77	245	13	5.3%	10.1	4.1%	11.8	4.8%
78	216	14	6.5%	10.0	4.6%	11.7	5.4%
79	194	14	7.2%	10.1	5.2%	11.7	6.0%
80	163	16	9.8%	9.5	5.8%	11.0	6.8%
81	148	7	4.7%	9.7	6.6%	11.2	7.6%
82	133	18	13.5%	9.9	7.4%	11.2	8.5%
83	105	10	9.5%	8.6	8.2%	9.9	9.4%
84	86	6	7.0%	7.9	9.2%	9.0	10.5%
85	85	14	16.5%	8.6	10.1%	9.9	11.7%
86	56	9	16.1%	6.2	11.1%	7.3	13.0%
87	40	2	5.0%	4.9	12.4%	5.7	14.4%
88	37	10	27.0%	5.1	13.8%	5.9	15.9%
89	32	5	15.6%	4.8	15.1%	5.6	17.4%
90	24	8	33.3%	4.0	16.8%	4.5	18.9%
	12,883	342	2.7%	255.6	2.0%	304.0	2.4%

Appendix E-2
Probability of Death - Healthy Retirees
Females

Age	Exposure	Actual Deaths	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
50	20	-	0.0%	0.0	0.1%	0.0	0.2%
51	30	-	0.0%	0.0	0.2%	0.1	0.2%
52	38	-	0.0%	0.1	0.2%	0.1	0.2%
53	49	-	0.0%	0.1	0.2%	0.1	0.3%
54	48	-	0.0%	0.1	0.2%	0.2	0.3%
55	50	-	0.0%	0.1	0.2%	0.2	0.4%
56	54	-	0.0%	0.1	0.3%	0.2	0.4%
57	57	-	0.0%	0.2	0.3%	0.3	0.5%
58	48	-	0.0%	0.2	0.3%	0.2	0.5%
59	56	-	0.0%	0.2	0.4%	0.3	0.6%
60	62	1	1.6%	0.3	0.4%	0.4	0.6%
61	64	-	0.0%	0.3	0.5%	0.4	0.7%
62	55	-	0.0%	0.3	0.6%	0.4	0.7%
63	52	1	1.9%	0.4	0.7%	0.4	0.8%
64	48	-	0.0%	0.4	0.8%	0.4	0.9%
65	40	-	0.0%	0.4	0.9%	0.4	0.9%
66	33	-	0.0%	0.4	1.1%	0.3	1.0%
67	38	1	2.6%	0.5	1.2%	0.4	1.2%
68	39	-	0.0%	0.5	1.3%	0.5	1.3%
69	37	1	2.7%	0.6	1.5%	0.5	1.4%
70	36	-	0.0%	0.6	1.7%	0.6	1.6%
71	29	-	0.0%	0.5	1.8%	0.5	1.8%
72	27	-	0.0%	0.6	2.1%	0.5	2.0%
73	24	1	4.2%	0.5	2.2%	0.5	2.2%
74	17	1	5.9%	0.4	2.5%	0.4	2.5%
75	12	2	16.7%	0.3	2.7%	0.3	2.8%
76	9	-	0.0%	0.3	2.9%	0.3	3.2%
77	7	-	0.0%	0.2	3.2%	0.2	3.6%
78	7	1	14.3%	0.2	3.5%	0.3	4.0%
79	9	-	0.0%	0.3	3.9%	0.4	4.5%
80	9	-	0.0%	0.4	4.3%	0.5	5.0%
81	11	1	9.1%	0.5	4.7%	0.6	5.6%
82	9	3	33.3%	0.5	5.3%	0.6	6.3%
83	5	1	20.0%	0.3	5.9%	0.4	7.0%
84	2	-	0.0%	0.1	6.5%	0.2	7.8%
85	1	-	0.0%	0.1	7.4%	0.1	8.8%
86	3	1	33.3%	0.3	8.4%	0.3	9.8%
87	2	1	50.0%	0.2	9.5%	0.2	10.9%
88	1	-	0.0%	0.1	10.5%	0.1	12.2%
89	2	-	0.0%	0.2	11.8%	0.3	13.5%
90	2	-	0.0%	0.3	12.9%	0.3	14.8%
Totals	1,142	16	1.4%	12.1	1.1%	13.5	1.2%

Appendix E-3
Retirement Rates

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
41	44	2	4.5%			2.2	5.0%
42	88	9	10.2%			4.4	5.0%
43	160	8	5.0%			8.0	5.0%
44	240	10	4.2%			12.0	5.0%
45	294	10	3.4%			14.7	5.0%
46	368	31	8.4%			36.8	10.0%
47	388	28	7.2%			38.8	10.0%
48	416	32	7.7%			41.6	10.0%
49	422	45	10.7%			42.2	10.0%
50	398	43	10.8%			39.8	10.0%
51	382	35	9.2%			38.2	10.0%
52	383	46	12.0%			38.3	10.0%
53	346	35	10.1%			34.6	10.0%
54	348	45	12.9%			34.8	10.0%
55	337	44	13.1%			33.7	10.0%
56	301	49	16.3%			45.2	15.0%
57	232	40	17.2%			46.4	20.0%
58	182	33	18.1%			36.4	20.0%
59	139	35	25.2%			34.8	25.0%
60	89	23	25.8%			22.3	25.0%
61	65	15	23.1%			19.5	30.0%
62	44	10	22.7%			13.2	30.0%
63	32	9	28.1%			9.6	30.0%
64	22	10	45.5%			8.8	40.0%
65	13	5	38.5%			5.2	40.0%
66	9	2	22.2%			3.6	40.0%
67	5	2	40.0%			5.0	100.0%
	5,747	656	11.4%			670.0	11.7%

Appendix E-4
Rate of Disability - Active Lives

Age	Exposure	Actual Disabilities	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
20	-	-	0.000%	-	0.020%	-	0.022%
21	18	-	0.000%	0.0	0.020%	0.0	0.022%
22	150	-	0.000%	0.0	0.020%	0.0	0.022%
23	286	-	0.000%	0.1	0.020%	0.1	0.022%
24	422	-	0.000%	0.1	0.020%	0.1	0.022%
25	562	-	0.000%	0.1	0.020%	0.1	0.022%
26	625	-	0.000%	0.1	0.020%	0.1	0.022%
27	690	-	0.000%	0.1	0.020%	0.2	0.022%
28	729	-	0.000%	0.1	0.020%	0.2	0.022%
29	744	-	0.000%	0.1	0.020%	0.2	0.022%
30	752	-	0.000%	0.3	0.040%	0.3	0.044%
31	786	-	0.000%	0.3	0.040%	0.3	0.044%
32	820	-	0.000%	0.3	0.040%	0.4	0.044%
33	821	-	0.000%	0.3	0.040%	0.4	0.044%
34	860	1	0.116%	0.3	0.040%	0.4	0.044%
35	863	-	0.000%	0.5	0.060%	0.6	0.066%
36	804	-	0.000%	0.5	0.060%	0.5	0.066%
37	805	-	0.000%	0.5	0.060%	0.5	0.066%
38	811	1	0.123%	0.5	0.060%	0.5	0.066%
39	768	2	0.260%	0.5	0.060%	0.5	0.066%
40	737	1	0.136%	0.6	0.080%	0.6	0.088%
41	733	2	0.273%	0.6	0.080%	0.6	0.088%
42	720	2	0.278%	0.6	0.080%	0.6	0.088%
43	759	-	0.000%	0.6	0.080%	0.7	0.088%
44	745	1	0.134%	0.6	0.080%	0.7	0.088%
45	780	-	0.000%	0.8	0.100%	0.9	0.110%
46	803	-	0.000%	0.8	0.100%	0.9	0.110%
47	777	1	0.129%	0.8	0.100%	0.9	0.110%
48	736	4	0.543%	0.7	0.100%	0.8	0.110%
49	700	-	0.000%	0.7	0.100%	0.8	0.110%
50	626	1	0.160%	0.8	0.120%	0.8	0.132%
51	557	-	0.000%	0.7	0.120%	0.7	0.132%
52	513	1	0.195%	0.6	0.120%	0.7	0.132%
53	454	-	0.000%	0.5	0.120%	0.6	0.132%
54	428	-	0.000%	0.5	0.120%	0.6	0.132%
Total	22,384	17	0.076%	14.7	0.066%	16.2	0.072%

Appendix E-5
Rate of Termination of Employment

Duration	Exposure	Actual Terminations	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
0	1,932	310	16.05%	290	15.00%	290	15.00%
1	1,753	204	11.64%	210	12.00%	210	12.00%
2	1,507	161	10.68%	151	10.00%	151	10.00%
3	1,324	131	9.89%	106	8.00%	106	8.00%
4	1,150	102	8.87%	81	7.00%	81	7.00%
5	1,103	76	6.89%	66	6.00%	66	6.00%
6	956	56	5.86%	48	5.00%	48	5.00%
7	826	51	6.17%	37	4.50%	37	4.50%
8	736	33	4.48%	29	4.00%	29	4.00%
9	745	32	4.30%	26	3.50%	26	3.50%
10	680	30	4.41%	20	3.00%	20	3.00%
11	734	20	2.72%	18	2.50%	18	2.50%
12	809	20	2.47%	16	2.00%	16	2.00%
13	769	18	2.34%	12	1.50%	12	1.50%
14	688	12	1.74%	7	1.00%	7	1.00%
15	696	10	1.44%	7	1.00%	7	1.00%
16	628	6	0.96%	6	1.00%	6	1.00%
17	638	5	0.78%	6	1.00%	6	1.00%
18	699	7	1.00%	7	1.00%	7	1.00%
19	2	-	0.00%	0	1.00%	0	1.00%
Total	18,375	1,284	6.99%	1,144	6.23%	1,144	6.23%

Appendix E-6
Total Salary Scale

Duration	Initial Salary (Millions)	Subsequent Salary (Millions)	Actual Rate	Current Expected (Millions)	Current Rate	Proposed Expected (Millions)	Proposed Rate
1	67.5	74.2	9.96%	74.2	10.00%	74.2	10.00%
2	62.9	68.2	8.33%	68.6	9.00%	68.6	9.00%
3	58.8	63.8	8.53%	63.5	8.00%	63.5	8.00%
4	54.9	59.1	7.74%	59.0	7.50%	59.0	7.50%
5	57.0	61.2	7.25%	61.3	7.50%	61.3	7.50%
6	51.9	55.4	6.74%	55.8	7.50%	55.8	7.50%
7	46.6	50.1	7.44%	50.0	7.25%	50.0	7.25%
8	43.4	46.2	6.61%	46.4	7.00%	46.4	7.00%
9	44.8	48.0	7.19%	47.8	6.75%	47.8	6.75%
10	41.9	44.4	5.94%	44.6	6.50%	44.6	6.50%
11	48.1	50.5	5.04%	51.2	6.50%	51.1	6.25%
12	55.3	58.0	5.01%	58.9	6.50%	58.6	6.00%
13	54.6	57.3	5.12%	57.6	5.50%	57.6	5.50%
14	50.3	52.6	4.51%	52.7	4.75%	52.8	5.00%
15	52.4	55.1	5.26%	54.6	4.25%	54.7	4.50%
16	48.4	50.6	4.69%	50.2	3.75%	50.3	4.00%
17	49.5	51.6	4.18%	51.4	3.75%	51.4	3.75%
18	55.6	57.7	3.67%	57.7	3.75%	57.7	3.75%
19	53.7	55.7	3.61%	55.7	3.75%	55.7	3.75%
20	53.0	54.8	3.31%	55.0	3.75%	55.0	3.75%
21	47.3	48.9	3.38%	49.1	3.75%	49.1	3.75%
22	42.0	43.5	3.50%	43.6	3.75%	43.6	3.75%
23	35.4	36.6	3.54%	36.7	3.75%	36.7	3.75%
24	30.1	31.2	3.35%	31.3	3.75%	31.3	3.75%
25	25.4	26.3	3.34%	26.4	3.75%	26.4	3.75%
26	26.5	27.4	3.42%	27.4	3.50%	27.4	3.50%
27	27.0	27.8	3.00%	28.0	3.50%	28.0	3.50%
28	26.0	26.8	3.03%	26.9	3.50%	26.9	3.50%
29	21.1	21.7	2.89%	21.8	3.50%	21.8	3.50%
30	18.0	18.6	2.90%	18.7	3.50%	18.7	3.50%
Total	1,349.5	1,423.3	5.47%	1,426.1	5.67%	1,426.1	5.67%