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## OKLAHOMA PUBLIC EMPLOYEES RETIREMENT SYSTEM

**Experience Study** 

For the Three-Year Period

Ending June 30, 2019



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May 13, 2020

Board of Trustees Oklahoma Public Employees Retirement System 5400 N Grand Boulevard, Suite 400 P.O. Box 53007 Oklahoma City, OK 73112-5625

Dear Members of the Board:

We are pleased to submit the results of a study of the economic and demographic experience for the Oklahoma Public Employees Retirement System (OPERS) and the Uniform Retirement System for Justices and Judges (URSJJ). The purpose of this investigation is to assess the reasonability of the actuarial assumptions for each of the Plans. This investigation covers the three-year period from July 1, 2016 to June 30, 2019. As a result of the investigation, it is recommended that revised assumptions be adopted by the Board for future use.

The recommended decrement tables are shown in Appendix D of this report for OPERS and Appendix E for URSJJ. In the actuary's judgment, the recommended rates are suitable for use until further experience indicates that modifications are needed.

Actuarial assumptions are used to measure 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 statutory contribution rates.

We hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices which are consistent with the principles prescribed by the Actuarial Standards Board (ASB) and the Code of Professional Conduct and Qualification Standards for Public Statements of Actuarial Opinion of the American Academy of Actuaries.

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In particular, we have prepared the assumptions developed in this report in keeping with our understanding of Actuarial Standards of Practice No. 27 (Selection of Economic Assumptions for Measuring Pension Obligations) and No. 35 (Selection of Demographic and Other Non-economic Assumptions for Measuring Pension Obligations).

As this report was being completed, a world-wide pandemic broke out. At this time, we do not believe that any of our proposed assumptions will be fundamentally changed over the long term. We will, of course, continue to monitor the experience of OPERS and URSJJ along with broader groups and propose alternative assumptions if they are warranted in our professional judgment.

We would like to acknowledge the help in the preparation of the data for this investigation given by the OPERS staff.

We, Alisa Bennett and Brent Banister, are Members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Respectfully submitted,

Alia Brand

Alisa Bennett, FSA, EA, FCA, MAAA President

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## **Section I: Summary of Results**

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

#### **Recommended Economic Assumption Changes**

The table below lists the three key economic assumptions used in the actuarial valuation and their current and proposed rates. We are recommending a decrease in the price inflation assumption from 2.75% to 2.50% and, also a decrease in the assumed real investment return assumption from 4.25% to 4.00%, for a nominal investment return assumption of 6.50%. We recommend retaining the real wage growth assumption of 0.75%.

Item	Current	Proposed
Price Inflation	2.75%	2.50%
Investment Return	7.00%	6.50%
Real Wage Growth	0.75%	0.75%

#### **Recommended Demographic Assumption Changes**

The table below lists the demographic assumptions that we recommend be changed based on the experience of the last three years.

Assumption Changes			
OPERS			
Adjust rates of mortality			
Increase the rate of withdrawal in the first year			
Decrease rates of disability retirements			
<ul> <li>Adjust rates of retirement</li> </ul>			
URSJJ			
Adjust rates of mortality			
Set salary scale to general wage growth			

#### **Recommended Method Changes**

We do not recommend any changes in the actuarial methods at this time. We do, however, encourage the Board begin a discussion regarding alternative amortization approaches in anticipation of our recommending a change in this method prior to or as part of the next experience study.



#### Financial Impact

The tables below highlight the impact on the Oklahoma Public Employees Retirement System (OPERS) and the Uniform Retirement System for Justices and Judges (URSJJ) if the proposed assumptions are adopted. The tables show the change in the unfunded actuarial accrued liability (UAAL), funded ratio and employer contribution rate for both Plans of the System as of July 1, 2019. The actual changes, which will first be reflected in the July 1, 2020 valuations, will be different, but should be similar.

Unfunded Actuarial Accrued Liability	OPERS	URSJJ
Before Changes	\$137,690,273	(\$36,620,576)
Change discount rate to 6.5%	666,330,129	(23,082,147)
After all changes	682,520,846	(25,153,631)

	Before Assumption Changes	After Assumption Changes
OPERS		
Unfunded Actuarial Accrued Liability	\$137,690,273	\$682,520,846
Funded Ratio	98.6%	93.6%
Employer Contribution Rate	7.51%	12.63%
URSJJ		
Unfunded Actuarial Accrued Liability	(\$36,620,576)	(\$25,153,631)
Funded Ratio	111.9%	107.9%
Employer Contribution Rate	2.27%	8.75%



## **Section II: Economic Assumptions**

There are three economic assumptions used in performing the actuarial valuation for the Oklahoma Public Employees Retirement System (OPERS) and the Uniform Retirement System for Justices and Judges (URSJJ). 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 general wage increase assumptions are selected on the basis of expectations in an inflation-free environment and then increased by the long-term expectation for inflation, called the "building block" approach.

Sources of data considered in the analysis and selection of the economic assumptions included:

- The 2019 Social Security Trustees Report
- Future expectations of OPERS investment consultant, Verus
- Future expectations of other investment consultants (2019 Horizon Survey)
- U.S. Department of the Treasury bond rates
- 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.



## **Section II: Economic Assumptions**

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 discusses a "range of reasonable assumptions" which in part states "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.

The remaining section of this 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.

	Current Assumptions	Proposed Assumptions
Price Inflation	2.75%	2.50%
Investment Return	7.00%	6.50%
Real Wage Growth	0.75%	0.75%
Payroll Growth	3.50%	3.25%

The following table summarizes the current and proposed economic assumptions:



#### 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, general wage growth (which then impacts individual salary increases), and payroll growth.

Inflation also has a direct impact on the valuation results. The long-term relationship between price inflation and investment return has long been recognized by economists. The basic principle is that 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 are expected to result in lower expected investment returns, at least in the long run.

The current assumption for price inflation is 2.75% per year which was recommended and adopted in the last experience study.

#### 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. More complete data is shown in Appendix A.

Period	Number of Years	Annualized Rate of Inflation	Annual Standard Deviation
1926 - 2019	93	2.92%	3.98%
1959 - 2019	60	3.68	2.85
1969 – 2019	50	3.91	2.97
1979 - 2019	40	3.07	2.16
1989 - 2019	30	2.40	1.11
1999 - 2019	20	2.14	0.97
2009 - 2019	10	1.75	0.65



## **Section II: Economic Assumptions**

The following graph illustrates the historical annual change in price inflation, measured as of December 31 for each of the last 70 years, as well as the thirty-year rolling average through that date.



Over more recent periods, measured from December 31, 2019, the average annual rate of increase in the CPI-U has been below the current assumption of 2.75%. The period of high inflation from 1973 to 1982 has a significant impact on the averages over periods which include these rates. It is difficult to ignore the steady decline in inflation shown in the data above.

#### 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 December 2019 suggest that investors expect inflation to be around 1.8 to 1.9% over the next 30 years. The bond market expectations may be heavily influenced by the low interest rate environment created by the Federal Reserve Bank's manipulation of the bond market. Whether inflation returns to the higher rates observed historically remains to be seen.

OPERS' investment consultant, Verus, also has an inflation forecast in their capital market assumptions. Their short-term assumption (10 years) is 1.9%. Horizon Actuarial Services surveys a significant portion of the major investment advisors and publishes their assumptions. For the 2019 study, the long-term inflation assumption was 2.29%



#### Social Security Projections

Although many economists forecast lower inflation than the assumptions used by retirement systems, they 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 (April 2019), the projected average annual increase in the CPI over the next 75 years was estimated to be 2.6%, under the intermediate (best estimate) cost assumption. The range of price inflation used in the Social Security 75-year modeling, which includes a low and high cost scenario, in addition to the intermediate cost projection, was 2.0% to 3.2%.

#### 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. Based on the Public Plan Database (a survey of over 125+ 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 governmental plans has been steadily declining. Based on the current data, both the average and median inflation assumption is 2.75%. This data is largely based on actuarial valuations prepared with measurement dates in 2018. Based on our experience, we believe that further declines in the inflation assumption have occurred for some systems over the last year. The following chart shows the public plan median inflation assumption compared with the difference of 10-year Treasuries and TIPS as reported by the St. Louis Federal Reserve.





#### Recommendation

The current inflation assumption is 2.75%. While actuarial standards caution against assigning too much weight to recent experience, multiple factors lead us to believe the current inflation assumption should be reduced. Actual inflation for the last 30 years has been 2.40%. The bond markets reflect an expectation of inflation well below 3.0%, the inflation assumption used by the Chief Actuary of the Social Security Administration in their 75-year projections is 2.6%, Verus's 10-year inflation assumption is 1.9%, and the median long-term inflation assumption in the Horizon Actuarial Survey is 2.29%. We believe that many of these opinions are influenced by the short-term outlook, while we are focused on the longer term. However, based on all of this information, we recommend a reduction in the price inflation assumption from 2.75% to 2.50%.

Price Inflation	
Current Assumption	2.75%
Recommended Assumption	2.50%



#### **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 7.00% per year, net of all investment-related and administrative expenses. This investment assumption was set in our last experience study. The 7.00% rate of return is referred to as the nominal rate of return and is composed 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 4.25% (7.00% 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., the 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 35 years, to age 60, and live another 30 years, to age 90. The retirement system would receive contributions for the first 35 years and then pay out benefits for the next 30 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.



#### **OPERS** Historical Perspective

One of the inherent problems with analyzing historical data is that the results can look significantly different depending on the timeframe used, especially if the year-to-year results vary widely. In addition, asset allocation can also impact the returns so comparing results over long periods when different asset allocations were in place may not be meaningful. The recent experience for the retirement funds over the last twenty-one years is shown in the table below.

Year Ending 6/30	Market Value (\$ million)	Market Value Rate of Return (Net of fees)
1999	\$ 4,831	9.2%
2000	5,246	9.9
2001	4,815	(6.0)
2002	4,486	(5.3)
2003	4,619	5.4
2004	5,126	14.0
2005	5,504	10.3
2006	5,817	7.9
2007	6,640	16.3
2008	6,255	(4.2)
2009	5,174	(15.4)
2010	5,774	13.9
2011	6,841	21.5
2012	6,821	2.2
2013	7,442	12.0
2014	8,570	18.0
2015	8,636	3.1
2016	8,436	0.2
2017	9,230	12.6
2018	9,702	8.4
2019	9,958	6.0



Clearly there is a significant amount of variation year to year. By considering compound returns over time, we can get some additional sense of the expected return. The following table shows the effective rate of return over various time periods through June 30, 2019.

Period	Rate of Return (net of investment fees)
5 years	5.97%
10 years	9.59
20 years	6.14

#### 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 Verus, 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. OPERS' current target asset allocation, along with their investment consultant's (Verus) long-term capital market assumptions, are shown in the following table (more detail is shown in Appendix B):

Asset Class	Target Allocation	Ten Year Return Forecast*	Standard Deviation Forecast
US Large Cap Equity	34.0%	6.6%	15.4%
US Small Cap Equity	6.0%	7.7%	21.1%
Int'l Developed Equity	23.0%	8.4%	17.5%
Emerging Market Equity	5.0%	10.4%	25.6%
Core Fixed Income	25.0%	2.4%	6.3%
Long Term Treasuries	3.5%	1.9%	6.7%
US TIPS	3.5%	2.2%	5.4%
Total	100.0%		

#### **OPERS** Target Asset Allocation and Verus Assumptions

\*Arithmetic mean, assumes 1.90% inflation.



## **Section II: Economic Assumptions**

Verus does not provide long-term capital market assumptions, which would be expected to be higher. Based on their 2019 capital market assumptions, Verus' expected one-year arithmetic mean return is 5.9%. Because of the nature of compounding returns, however, the arithmetic mean is of limited value. A more important measure is the geometric mean, which is the expected long-term compound rate of return. Mathematically, the geometric return will be less than the arithmetic return. Under the Verus assumptions, the geometric mean is 5.4%. If our inflation assumption were used instead of the Verus inflation assumption, the geometric mean would be 6.0%

It should be noted that there is currently a fair amount of variation in expectations among investment professionals. Therefore, it can be beneficial to consider other advisors' expectations when setting the investment return assumption. Horizon Actuarial Services prepares an annual study in which they survey various investment advisors and provide ranges of results as well as averages. The 2019 Survey included a total of 34 investment advisors who provided their capital market assumptions of which 16 provided both short-term and long-term assumptions. It is worth noting that this Survey has historically been prepared for the multiemployer (Taft-Hartley) plan community and initially included assumptions only from investment advisors serving those plans, but now includes assumptions from investment advisors outside of the Taft-Hartley community including consultants such as Aon Hewitt, NEPC, Callan Associates, Willis Towers Watson, JP Morgan, RVK, SEI, UBS, Blackrock and Verus who work with public plans.

It is important to reemphasize that the assumptions used by most investment consultants are usually intended to assist the Board with determining asset allocations, and thus may be more short-term in nature (10 years) and reflective of the current market conditions more than the investment return assumption developed by the actuary for funding the benefits and measuring liabilities. Although this has always been the case, the significant difference that currently exists in expected returns over the short term versus the long term causes more of a challenge in setting the investment return assumption.

This is evident for the 16 consultants included in the Horizon Survey who provided both shortterm (10 years) and long-term (20 years) assumptions. The long-term assumptions from the Horizon Survey provide an additional perspective on the magnitude of the potential difference in expected return over a longer timeframe. The following table provides a sample of the differences in the 10-year and 20-year horizon assumptions for the advisors who provided both short-term and long-term assumption sets in the Survey:

	10-Year	20-Year	
Asset Class	Horizon	Horizon	Difference
US Equity – Large Cap	7.26%	8.34%	1.08%
US Equity – Small/Mid Cap	8.45%	9.52%	1.07%
Non-US Equity – Developed	8.40%	9.30%	0.90%
Non-US Equity - Emerging	10.62%	11.67%	1.05%
US Corporate Bonds – Core	3.74%	4.46%	0.72%
US Treasuries	2.71%	3.07%	0.36%
TIPS	3.29%	3.69%	0.40%
Inflation:	2.22%	2.29%	0.07%

#### Average Expected Arithmetic Returns: Short-Term vs. Long-Term



## **Section II: Economic Assumptions**

Using the longer term assumptions, the median return for the OPERS portfolio based on the input of the 16 investment consultants in the Horizon Survey who provided long-term assumptions is 7.10%, when reflecting our 2.50% inflation assumption.

It must be noted that one-year expected returns come with high standard deviations, nearly 12%, and therefore high volatility. It is helpful to look at expected returns over a longer time horizon as shown in the tables on the following page. The returns shown are real returns (excluding inflation) so that a long term inflation assumption can be incorporated. The first table uses the Verus 10-year assumptions and the second table uses the Horizon 20-year assumptions.

Time Span In	Verus 10-year Assumptions Real Returns by Percentile						
Years	95 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>	25 <sup>th</sup>	5 <sup>th</sup>		
1	22.89%	11.02%	3.44%	-3.63%	-12.98%		
5	11.73%	6.77%	3.44%	0.22%	-4.25%		
10	9.24%	5.78%	3.44%	1.15%	-2.06%		
20	7.51%	5.09%	3.44%	1.82%	-0.48%		
30	6.75%	4.79%	3.44%	2.11%	0.23%		
50	6.00%	4.48%	3.44%	2.41%	0.95%		
75	5.52%	4.29%	3.44%	2.60%	1.40%		

Time Span In	Horizon 20-Year Assumptions Real Returns by Percentile						
Years	95 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>	25 <sup>th</sup>	5 <sup>th</sup>		
1	25.36%	12.67%	4.60%	-2.91%	-12.79%		
5	13.43%	8.13%	4.60%	1.17%	-3.56%		
10	10.77%	7.09%	4.60%	2.16%	-1.24%		
20	8.93%	6.35%	4.60%	2.87%	0.44%		
30	8.12%	6.03%	4.60%	3.19%	1.19%		
50	7.31%	5.70%	4.60%	3.50%	1.95%		
75	6.81%	5.50%	4.60%	3.70%	2.43%		

The charts above shows the percentile rankings for expected returns. Thus for the 20-year time span and using Verus's assumptions, 5% of the resulting real rates of return are expected to be below -0.48% and 95% expected to be above that. As the time span increases, the results begin to merge. Over a 75-year time span, the results indicate there is a 25% chance that the real return will be below 2.60% and a 25% chance it will be above 4.29% using Verus's assumptions. In other words there is a 50% chance the real returns will be between 2.60% and 4.29% using Verus's assumptions. Using the Horizon 20-year assumptions, there is a 50% chance the real returns will be between 3.70% and 5.50%.



#### 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 graph below shows the change in the distribution of the investment return assumption from fiscal year 2001 through 2019 for the 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 two decades, likely heavily impacted by a corresponding decrease in the underlying inflation assumption from 4.0% to 3.0% over the same period. It is worth noting that the median investment return assumption in fiscal year 2011 dropped from 8.00% to 7.75% and has declined further to 7.25% in 2019. We believe we will continue to see more systems move to a lower assumption.





#### Administrative and Investment Expenses

Budgeted administrative expenses are directly reflected as a separate component in the calculation of the contribution rate, and so no assumption is required. 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

Using the building block approach of ASOP No. 27 and the projection results outlined above, we can develop a range for the investment return assumption of the 25<sup>th</sup> to 75<sup>th</sup> percentile real returns over the 75-year time span plus the recommended inflation assumption. The following tables details the ranges using Verus's 10-year assumptions and Horizon's 20-year assumptions.

verus 10-1 ear Assumptions							
Itom	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>				
Item	Percentile	Percentile	Percentile				
Real Rate of Return	2.60%	3.44%	4.29%				
Inflation	2.50	<u>2.50</u>	<u>2.50</u>				
Net Investment Return	5.10%	5.94%	6.79%				

## Verus 10-Year Assumptions

11011		mprions	
Item	25 <sup>th</sup> Percentile	50 <sup>th</sup> Percentile	75 <sup>th</sup> Percentile
Real Rate of Return	3.70%	4.60%	5.50%
Inflation	2.50	2.50	2.50
Net Investment Return	6.20%	7.10%	8.00%

#### Horizon 20-Year Assumptions

As has been mentioned, shorter-term forecasts are typically lower than longer-term forecasts, if for no other reason than the current low interest rate term structure. While retirement plans like OPERS are long-term investors, it is important to consider that because the System pays out more in benefits than it receives in contributions (as should be the case of mature plans), the effective long-term earning rate will be lower than the capital market assumptions would indicate.

One additional consideration for OPERS is that the plan is partially closed. Over a fairly long period of time, this is anticipated to result in benefit payments being increasingly larger than the contributions from members and employers. This requires the gradual reduction of the investment pool, but is not a cause for concern – this is the very reason the investment pool exists. This drawdown may require some change in asset allocation, however, which could affect the net investment returns shown above. We have discussed this long-term drawdown with OPERS



## **Section II: Economic Assumptions**

investment staff and believe some degree of caution is in order, although the ultimate impact cannot yet be fully quantified. While the URSJJ portfolio is not subject to these same concerns, the fact that the large OPERS portfolio and the much smaller URSJJ portfolio are invested together argues for a common investment return assumption for the time being.

Considering the different sources discussed above (OPERS experience, historical markets, Verus's short term expectations, Horizon's 20-year expectations), we believe that 6.50% would be a reasonable assumption. This reflects a reduction due to lower inflation (now 2.50%) and a reduction of the expected real return (now 4.00%).

Investment Return	1 Assumption
Current	7.00%
Recommended	6.50%



#### **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. The excess of 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 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 when the demographic assumptions are studied. Currently, the 2.75% inflation assumption combined with the 0.75% real wage growth assumption leads to an a general wage growth assumption of 3.5%

#### 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. OPERS 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 OPERS members. In the shorter term, however, the wage growth of OPERS and the nation may be less directly correlated.

The excess of wage inflation over price inflation represents the real wage inflation rate. Although real wage inflation has been very low in recent years, likely due to the slow recovery from the 2008 financial crisis, our focus must remain on the long term. The following tables show the compounded wage growth over various periods, along with the comparable price inflation rate for the same period. The differences represent the real wage inflation rate. The table on the left shows the real wage inflation over different 10-year periods while the table on the right shows the real wage inflation over increasing periods of 10 to 60 years.



## **Section II: Economic Assumptions**

Decade	General Wage Inflation	CPI Incr.	Real Wage Inflation
2008-2018	2.4%	1.6%	0.8%
1998-2008	3.7%	2.8%	0.9%
1988-1998	4.1%	3.3%	0.8%
978-1988	6.2%	6.1%	0.1%
968-1978	6.6%	6.5%	0.1%
958-1968	4.3%	1.9%	2.4%

Similar information over rolling thirty year periods is shown in the following graph:



#### 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 April, 2019 Trustees Report, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.81%, 1.21% higher than the Social Security intermediate inflation assumption of 2.60% per year. The range of the assumed real wage inflation in the 2019 Trustees Report was 0.60% to 1.84% per year.



#### Public Sector Compensation and Wages

The Bureau of Labor Statistics publishes the Employment Cost Index, including detail for real (net of inflation) total compensation and wages and salaries. Further, this index is also broken down for state and local government workers. From 2001 through 2019, real compensation grew by at an annualized rate of 0.78%, while wages and salaries grew at a rate of 0.17%. This difference is a reflection that state and local government workers have had much of their compensation increase delivered through benefits rather than wages and salaries. While it is certainly reasonable to anticipate that total compensation will continue to increase faster than wages and salaries, it is also reasonable to anticipate that the difference between the two will moderate over time.

#### Recommendation

Over the last 30 years, the actual experience on a national basis has been close to the current assumption. However, this is based on SSA data which uses the average wages of all US workers. As mentioned earlier, the median real wage increase has been significantly lower. We believe that wages will continue to grow at a greater rate than prices over the long term, although not at the level projected by Social Security. We also expect wage growth for governmental employees to be lower than the national average, at least in the short term, due to budget challenges still being experienced by both state and local governmental employers.

Based on the available data and our professional judgment, we recommend that the long-term assumed real wage growth be kept at 0.75% per year. When coupled with the reduction in the price inflation assumption to 2.50%, the resulting general wage growth assumption decreases from 3.50% to 3.25%.



#### PAYROLL GROWTH ASSUMPTION

Senate Bill 2120 and House Bill 2630, in combination, have begun to significantly reduce the number of new members entering the plan after November 1, 2015. While this has had an impact on the valuation results as of July 1, 2016 and will have an impact going forward, the impact is small since it only concerns employees hired after November 1, 2015. However, there are potential ramifications of this legislation that will affect on-going plan funding. In particular, the current amortization of the UAAL is based on the assumption of increasing payroll. The current provision of the new legislation should provide the difference between the defined contribution plan match and the statutory rate for the System. This is expected to provide at least as much toward the UAAL as would have been expected otherwise, so we are comfortable with continuing the methodology of amortizing as a level percentage of payroll. We would encourage the Board to study the long-term impact of this legislation.

Therefore, the valuation requires an assumption regarding future annual increases in covered payroll. The wage growth assumption is typically used for this purpose. The current payroll growth assumption for OPERS is 3.50%, the same as the current wage growth assumption.

# Based on the recommended wage growth assumption of 3.25%, we recommend the payroll growth assumption also be set at 3.25%.

#### **SUMMARY OF ECONOMIC CHANGES**

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%	2.50%
Investment Return	7.00%	6.50%
General Wage Growth	3.50%	3.25%
Payroll Growth	3.50%	3.25%



There are several demographic assumptions used in the actuarial valuations performed for the Oklahoma Public Employees Retirement System (OPERS) and the Uniform Retirement System for Justices and Judges (URSJJ). They are:

- Rates of Mortality
- Rates of Service Retirement
- Rates of Disability Retirement
- Rates of Withdrawal
- Probability of Electing a Vested Benefit
- Rates of 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, 2016 through June 30, 2019) with what was expected to happen based on the assumptions used in the most recent actuarial valuations.

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, 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. Comparing the actual to expected results provides an indication of the reasonableness of the assumption. This actual to expected ratio, or A/E ratio, is not the only indicator, however, since an assumption that is too high for part of the group and too low for another part might still have an A/E ratio near 100%. Consequently, we also consider graphical displays of the results as another aid in assessing the results of a study period.

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 windows, need to be taken into account in determining the weight to give to recent experience.

Because a major purpose of an actuarial valuation is to determine the liability, it is often preferable to measure the events that occurred by the proportion of liability that experience the change rather than simply the proportion of individuals who experienced the change. This "liability weighting" reflects that if certain events are connected with the salary or service level of individuals, then we should give 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 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.

Following the 2008 turmoil in the financial markets, we were cautious in making significant changes, recognizing that some behavior observed in that time period may have been influenced by these events. At this point, we believe that the temporary behavior changes in response to these events have largely disappeared and that we are now observing during the study period what are likely to be long-term patterns.

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 F and G.

#### **Rates of Mortality**

Mortality tables are a fundamental assumption in actuarial valuations. Because benefits are typically paid over a retiree's lifetime, it is important to appropriately reflect what a typical lifetime looks like. 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.

#### **Retiree Mortality:**

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

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. While the direct projection – also called generational mortality – may better predict future payouts, it is not an appropriate approach for OPERS. Because the guiding statutes require that actuarial factors for optional form of payments, etc. be the same as the assumptions used in the valuation, the generational approach cannot be used. (It would require a new set of factors each year, something which is not desirable from a member planning perspective and which would be a burdensome administrative challenge.) Consequently, we propose that the selected table reflect some degree of future improvement now, thereby providing a margin for improvement. The current table is the RP-2014 Blue Collar Annuitants table with the base rates projected to 2025 using projection scale MP-2016 (a set of mortality improvement factors recently issued by the Society of Actuaries), with scaling factors of 95% for males under age 70 and 105% over age 70, and 90% and 115%, respectively, for females.

Graphs showing actual versus expected post-retirement mortality rates for OPERS members are shown in Appendix F in Table F-1 for males and F-2 for females, and Appendix G Tables G-1 and G-2 have the corresponding numerical data. The analysis of the actual post-retirement mortality



experience over the three-year experience study period yields actual/expected ratios of 111% and 114% respectively for males and females on a liability basis, however. These margins, are adequate, but have declined from three years ago as would be anticipated with expected mortality improvements.

In 2019, the Society of Actuaries published a new family of mortality tables based on public sector data. The Pub-2010 family of tables is split by membership type (general, teachers, and safety) and also has tables that include only above or below median benefits. Because optional form factors will be changing anyway as a result of the economic assumption changes, we recommend updating the mortality tables at this time to the new tables. We recommend using the PubG-2010(B) table, the table for below median amounts for general membership, with a two-year age set forward for females (treating a 65-year old like a 67-year old) and no age adjustment for males, projected to 2030 using scale MP-2019. The resulting mortality rates are similar to the current tables with slightly more margin (113% and 117% for males and females) which should reduce the likelihood of needing to change tables in the next experience study. As may be noted, there are fewer adjustments made to fit the tables to OPERS, which is our preference and likely a reflection of the underlying tables being based on public plan data.

Because of the small URSJJ retiree population, we cannot obtain credible analysis of retiree mortality experience. Drawing upon general background on factors affecting mortality, we do anticipate that this group will have better mortality (i.e. live longer) than the broader OPERS membership. This has been recognized by setting the OPERS table back one year, so a 65-year old URSJJ retiree is treated as having the same mortality as a 64-year old OPERS member. We recommend continuing with this approach.

#### **Beneficiary Mortality:**

For benefits payable with a joint and survivor option, an assumption is needed regarding the beneficiary's lifetime. Because many members take a lifetime only benefit, there is less data available for beneficiaries. 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. We recommend that for both OPERS and URSJJ that the same table used for retirees also be used for beneficiaries.

#### **Disabled Retiree Mortality:**

Members who retire under the disability retirement provisions are generally expected to be less healthy than the overall population. Currently, the assumption for this group is the same as the regular members with a 12-year age set forward. With the new mortality table being recommended for healthy mortality, we believe a 12-year age set forward remains an appropriate adjustment. There is admittedly not a lot of data to draw from, but the disability incidence is also low enough that this assumption is not significant.

#### **Active Member Mortality:**

For active members, the mortality assumption is less significant since it is represents only a small portion of cases where employment ends and benefits begin. Further, there is less of a concern compared to retirees with margin for future improvements. We had the following experience over the study period for active members ages 20 to 62:



	Actual Deaths	Expected Deaths	A/E Ratio
Males	127	125	102%
Females	83	75	111%

Because we are recommending a change to the mortality tables for retirees and beneficiaries, we believe it is reasonable to make the corresponding adjustment for actives and use the PubG-2010(B) table, the table for below median amounts for general membership, with a two-year age setback for females and no age adjustment for males, projected to 2030 using scale MP-2019. For hazardous duty members, the current assumption is that the death rates should be 10% higher to reflect an increased risk of death in the line of duty. With the very limited data available, we cannot assess the adequacy of this assumption, but we find it reasonable and recommend its continued use.

#### **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.

The System provides for two types of retirements based on different eligibility requirements. The first one is for an unreduced retirement benefit. The second one is for an early retirement benefit which is reduced. Separate assumptions have been developed for each type of retirement benefit.

#### **Regular OPERS Members**

OPERS provides for a normal, unreduced retirement benefit upon the earlier of (a) age 62 and six years of service or (b) "Rule of 80" (if hired prior to July 1, 1992) or "Rule of 90" (if hired on or after July 1, 1992). Members hired after October 31, 2011 must be 65 rather than 62 or reach age 60 with "Rule of 90". OPERS also provides for an early, reduced retirement benefit upon reaching age 55 and completing ten years of participating service. Under the provisions for early retirement, the benefit is reduced 1/15<sup>th</sup> for each of the first five years and 1/30<sup>th</sup> per year for the next two years.

Because the Rule of 90 came in just less than 30 years ago, there are very few individuals hired after July 1, 1992 who are now eligible for retirement before age 62. Members hired before that date, in contrast, are largely eligible for unreduced retirement already. Very few of those hired since 2011 have reached age 65, and fewer still have reached eligibility for early retirement because of the 10-year service requirement. We do see similar retirement patterns for between the pre-2011 groups at ages above 62, and so we are believe it reasonable to anticipate that retirement patterns among eligible employees who will eventually meet Rule of 90 before age 62 are not unlike the patterns of those who now meet Rule of 80 at those ages. Over the next 2-3 experience studies, we will begin to be able to test the validity of that belief. For now, the practical result of the groups and eligibility requirements is that we use a uniform retirement assumption for those eligible to retire.



Graphs and detailed tables showing actual versus expected retirement rates are shown in Appendices F-3, F-4, G-3, and G-4. The analysis of the actual retirement experience over the three-year period yields an actual/expected ratio of 81% for early retirement and 78% for normal retirements.

The early retirement rates were unchanged in the last study and exhibit similar patterns in this study. We believe that increasing the rate at age 55 while lowering rates from 58 through 61 will improve the overall fit. For normal (unreduced) retirement, the rates under age 70 are a decent fit and the A/E ratio would be 94%. Observed retirement rates for ages 70 and above are similar to those for members in their late 60's. We propose a partial reflection of this by adopting retirement rates of 50% for ages 70 to 74. This general trend of delaying retirement is a pattern we are observing in many retirement systems, so we are not surprised to observe it in OPERS as well. If the pattern persists, we may make further adjustments in the future.

Retirement rates for members hired after October 31, 2011 are based upon professional judgment rather than actual experience because no meaningful experience yet exists, especially for early retirement. Experience will be limited for many years. We will continue to base the rates on professional judgment and will monitor actual experience as it becomes available.

## **Elected Officials**

Elected officials may retire with a normal, unreduced retirement benefit upon the earlier of (a) age 60 and six years of elected service or (b) "Rule of 80". They may also retire with an early, reduced retirement benefit upon reaching age 55 and completing ten years of creditable service. Under the provisions for early retirement, the benefit is reduced 6% per year before age 60. (For those hired after October 31, 2011, the retirement age is 65 with 8 years of service or 62 with 10 years.)

Graphs and detailed tables showing actual versus expected retirement rates are shown in Appendices F-5, F-6, G-5, and G-6. The analysis of the actual retirement experience over the three-year period yields an actual/expected ratio of 83% for early retirement and 96% for unreduced.

In the last study, early retirement rates were reduced for elected officials. While there is some indication on a weighted basis for more reduction, fewer than 10 early retirements were expected, limiting the credibility of the experience. If the usage remains low, we are likely to reduce these rates in the next study. With the unreduced A/E ratio being fairly close to 100%, we suggest leaving those rates unchanged.

Retirement rates for members hired after October 31, 2011 are based upon professional judgment rather than actual experience because no such experience yet exists. These members will begin to become retirement eligible in the next experience study period, but this experience will still be limited. We will continue to base the rates on professional judgment and will monitor actual experience as it becomes available.



#### <u>Hazardous Duty</u>

Hazardous Duty members may retire with a normal, unreduced retirement benefit upon the earlier of (a) 20 years of hazardous duty service, (b) age 62 with 6 years of service, or (c) "Rule of 80" (if hired prior to July 1, 1992) or "Rule of 90" (if hired on or after July 1, 1992). They may also retire with an early, reduced retirement benefit upon reaching age 55 and completing ten years of creditable service. Under the provisions for early retirement, the benefit is reduced 1/15<sup>th</sup> for each of the first five years before age 62 and 1/30<sup>th</sup> per year for the next two years. New rules affect those hired after October 31, 2011.

Graphs and detailed tables showing actual versus expected retirement rates are shown in Appendices F-7 to F-9 and G-7 to G-9. Note that unreduced retirement has an assumption that is split into a service based component (for those eligible for the 20 years of service) and an age based component (for those eligible due to age, but with less than 20 years of service). Early retirement had an actual to expected ratio of 152% and the service-based unreduced component had a ratio of 80%, while the age-based unreduced retirement had a ratio of 126%.

The two studies prior to this study have been somewhat volatile in terms of retirement utilization. Because of the relatively limited number of exposures, we are not proposing any changes in the assumptions at this time.

Retirement rates for members hired after October 31, 2011 are based upon professional judgment rather than actual experience because no such experience yet exists. These members will begin to become retirement eligible in the next experience study period, but this experience will still be limited. We will continue to base the rates on professional judgment and will monitor actual experience as it becomes available.

#### <u>URSJJ</u>

URSJJ members may retire with a normal, unreduced retirement benefit upon the earlier of (a) 65 with eight years of service, (b) age 60 with ten years of service or (c) "Rule of 80". For judges taking office after January 1, 2012, retirement age is sixty-seven (67) with eight (8) years of service or age sixty-two (62) with ten (10) years of service. No early retirement option is available for judges.

Detailed tables showing actual versus expected retirement rates are shown in Appendices F-10 and G-10. The analysis of the actual retirement experience over the three-year period yields an actual/expected ratio of 116%.

In the last experience study we reduced retirement rates because of persistent A/E ratios of under 100%. While this study is over 100%, we prefer not to undo the changes from last time, until and unless the higher retirement rates become a pattern. In addition, we recommend using a single set of retirement rates for all judges, whether hired before or after January 1, 2012, since we do not have any reason to anticipate different behavior.



#### **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. In order to qualify for disability benefits, the member must have at least eight years of service and qualify for Social Security or Railroad Retirement Board disability benefits.

Graphs and detailed tables showing actual versus expected disability rates are shown in Appendices F-11 to F-12 and G-11 to G-12.

In the prior experience study, we proposed two sets of unisex rates for the OPERS, one for Regular and Elected members and one for Hazardous Duty members. Judges are not assumed to have any disability retirements. While liability-weighted results are typically used in analyzing decrements, we use counts for analyzing the disability assumption in order to better reflect situations in which a member has had reduced earnings in the year ahead of disability.

As has been the case in recent studies, observed disabilities remain well below the expected rates. As a result, we propose some reduction for both Regular/Elected and Hazardous Duty members. We prefer not to fully reflect the observed experience since the low number of actual disablements means that these results can be volatile.

#### **Rates of Withdrawal**

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

The current URSJJ termination rates are 2% for all years of service. Termination from employment for reasons other than death, disability or retirement is uncommon in Judges' systems across the country. Actual experience was close to this over this period, with an observed termination rate of 1.8%, but is based on limited data. We recommend this assumption be maintained.

The OPERS assumption is based on years of service and uses unisex rates. We believe the current rates are doing an appropriate job, although we do recommend changing the duration 0 rate to better fit experience. The complete tables of recommended withdrawal rates are shown in Appendices F-13 and G-13.

#### **Probability of Electing a Vested Benefit**

When a vested member terminates employment, the member (eventually) chooses to either take a deferred retirement benefit or to receive a refund of member contributions in lieu of the deferred benefit. An assumption for the frequency of this election is used for OPERS regular members. Because of the benefit structure, retirement eligibility, and demographic make-up of elected



officials, hazardous duty members, and URSJJ members, these members are not expected to take a refund.

In the last study, we adopted probabilities based on duration. We believe the current assumption remains a good predictor of behavior and recommend continuing with this assumption. Appendices F-14 and G-14 show the analysis of the last three years' experience.

#### **Rates of Salary Increase for Merit and Promotion**

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 inflation and productivity components are combined to produce the assumed rates of wage inflation. The rate represents the "across the board" average annual increase in salaries shown in the experience data. The merit component includes the additional increases in salary due to performance, seniority, promotions, etc.

During this study period, OPERS salary increases were generally below expectation. Since price inflation was less than expected during this period, we are not surprised to see actual results less than expected. However, we are also aware that there has been some pressure on wages to catch up for the prior years. As a result, we want to be somewhat cautious in making any adjustments. Because the general "shape" of the increases is largely in line with what we observed, and because recent studies have shown larger increases for ages under 30, we are proposing to leave the merit scale unchanged. Because of the change in wage growth resulting from the lower inflation assumption, the total salary scale will decrease by 0.25% for all ages. Detailed salary increase rates at all ages are shown in Appendices F-14 and G-14.

For URSJJ, a flat 3.75% assumption was used. In general, there is little merit component in judges pay, with all judges at the same level usually receiving the same pay rate, and very little promotion to higher courts. While this would normally argue for an assumption of pay increases equal to the wage growth assumption, there have been very few pay increases over the past decade, and so there may be some catch up over time. Therefore, we recommend lowering this assumption to 3.50%, a rate slightly above our assumed wage inflation.

#### **Miscellaneous Assumptions**

**Percent Married:** Currently 85% of members are assumed to be married with the husband four years older than the wife. This is a common and reasonable assumption and we recommend maintaining this assumption.

**Missing Data:** In preparing the valuation data, certain data items are missing, unavailable, or unreasonable. In such cases, we have developed assumptions for what the data element should be. These assumptions are described in Appendices D and E. We recommend keeping these assumptions.



## **Section IV: Actuarial Methods**

Actuarial valuations utilize methods to determine the liabilities, assets, and costs. While these are not like other 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 20% of the difference between the market value of assets and the expected actuarial value of assets, based on the assumed rate of return. 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:** The unfunded actuarial accrued liability is amortized using a level percentage of payroll method over the amortization period. The period is a fixed 20 year period, starting July 1, 2007. The payroll growth assumption is used to determine the percentage of payroll required over the remaining amortization period to fully amortize the unfunded liability.

Because the amortization period is now down to 7 years as of the upcoming July 1, 2020 valuation, there will be increasing volatility in the amortization rate each year as gains or losses must be recognized over an ever-shortening period. While contributions are not affected by the amortization rate and so the amortization method does not affect the funding of the plans, the calculated contribution rate is published as one measure of the funding progress of the Systems. Volatility in this measure that arises simply from a short amortization period may cause confusion and could eventually even become misleading. We believe that this method should be changed prior to, or with, the next experience study, allowing the Board to consider what an appropriate method would be. We especially suggest consideration of a layered amortization method in which the gain or loss and other changes each year is amortized over its own appropriate time period.

**COLA Reserve:** Nine years ago, we removed the use of an explicit COLA assumption and the reserve following legislation that would require a COLA to be funded. While there have been recent considerations of COLAs, we recommend continuing the practice of not valuing of any future COLA contingency. However, this recommendation could change if COLAs or stipends are funded from the plan with any regularity.



#### **Historical CPI-U Index**

December of:	Index	Increase	December of:	Index	Increase
1928	17.1		1974	51.9	12.3%
1929	17.2	0.6 %	1975	55.5	6.9
1930	16.1	-6.4	1976	58.2	4.9
1931	14.6	-9.3	1977	62.1	6.7
1932	13.1	-10.3	1978	67.7	9.0
1933	13.2	0.8	1979	76.7	13.3
1934	13.4	1.5	1980	86.3	12.5
1935	13.8	3.0	1981	94.0	8.9
1936	14.0	1.4	1982	97.6	3.8
1937	14.4	2.9	1983	101.3	3.8
1938	14.0	-2.8	1984	105.3	3.9
1939	14.0	0.0	1985	109.3	3.8
1940	14.1	0.7	1986	110.5	1.1
1941	15.5	9.9	1987	115.4	4.4
1942	16.9	9.0	1988	120.5	4.4
1943	17.4	3.0	1989	126.1	4.6
1944	17.8	2.3	1990	133.8	6.1
1945	18.2	2.2	1991	137.9	3.1
1946	21.5	18.1	1992	141.9	2.9
1947	23.4	8.8	1993	145.8	2.7
1948	24.1	3.0	1994	149.7	2.7
1949	23.6	-2.1	1995	153.5	2.5
1950	25.0	5.9	1996	158.6	3.3
1951	26.5	6.0	1997	161.3	1.7
1952	26.7	0.8	1998	163.9	1.6
1953	26.9	0.7	1999	168.3	2.7
1954	26.7	-0.7	2000	174.0	3.4
1955	26.8	0.4	2001	176.7	1.6
1956	27.6	3.0	2002	180.9	2.4
1957	28.4	2.9	2003	184.3	1.9
1958	28.9	1.8	2004	190.3	3.3
1959	29.4	1.7	2005	196.8	3.4
1960	29.8	1.4	2006	201.8	2.5
1961	30.0	0.7	2007	210.0	4.1
1962	30.4	1.3	2008	210.2	0.1
1963	30.9	1.6	2009	215.9	2.7
1964	31.2	1.0	2010	219.2	1.5
1965	31.8	1.9	2011	225.7	3.0
1966	32.9	3.5	2012	229.6	1.7
1967	33.9 25.5	5.0	2013	233.0	1.5
1968	55.5 27.7	4./	2014	234.8	0.8
1969	5/./ 20.9	0.2	2015	230.5	0.8
1970	39.8 41.1	5.0	2016	241.4 246.5	2.1
1971	41.1	3.3 2.4	2017	240.3 251.2	2.1
1972	42.5	5.4 9.7	2018	251.2	1.9
19/3	40.2	δ./	2019	257.0	2.3



## Capital Market Assumptions and Asset Allocation

Asset Class	Target Allocation	Ten Year Return Forecast*	Standard Deviation Forecast
US Large Cap Equity	34.0%	6.6%	15.4%
US Small Cap Equity	6.0%	7.7%	21.1%
Int'l Developed Equity	23.0%	8.4%	17.5%
Emerging Market Equity	5.0%	10.4%	25.6%
Core Fixed Income	25.0%	2.4%	6.3%
Long Term Treasuries	3.5%	1.9%	6.7%
US TIPS	3.5%	2.2%	5.4%
Total	100.0%		

### Target Allocation, Rates of Return, and Standard Deviation by Asset Class

#### Asset Class Correlation Coefficients

	1				-		
	US	US Small	Int Dev	Emg	Core	Treas	TIPS
	Large			Mkť			
US Large	1.00	0.90	0.90	0.70	-0.20	-0.40	0.00
US Small	0.90	1.00	0.70	0.60	-0.30	-0.50	-0.10
Int'l Dev	0.90	0.70	1.00	0.80	-0.10	-0.30	0.10
Emerg Mkt	0.70	0.60	0.80	1.00	0.00	-0.20	0.20
Core	-0.20	-0.30	-0.10	0.00	1.00	0.90	0.80
Long Treas	-0.40	-0.50	-0.30	-0.20	0.90	1.00	0.70
TIPS	0.00	-0.10	0.10	0.20	0.80	0.70	1.00



## National Average Wage Index

	Index	Increase		Index	Increase
1927	\$1,159.14		1973	\$ 7,580.16	6.3%
1928	1,162.53	0.3%	1974	8,030.76	5.9
1929	1,196.88	3.0	1975	8,630.92	7.5
1930	1,164.95	-2.7	1976	9,226.48	6.9
1931	1,086.09	-6.8	1977	9,779.44	6.0
1932	954.02	-12.2	1978	10,556.03	7.9
1933	892.58	-6.4	1979	11,479.46	8.7
1934	929.34	4.1	1980	12,513.46	9.0
1935	968.53	4.2	1981	13,773.10	10.1
1936	1,008.20	4.1	1982	14,531.34	5.5
1937	1,071.58	6.3	1983	15,239.24	4.9
1938	1,047.39	-2.3	1984	16,135.07	5.9
1939	1,076.41	2.8	1985	16,822.51	4.3
1940	1,106.41	2.8	1986	17,321.82	3.0
1941	1,228.81	11.1	1987	18,426.51	6.4
1942	1,455.70	18.5	1988	19,334.04	4.9
1943	1,661.79	14.2	1989	20,099.55	4.0
1944	1,796.28	8.1	1990	21,027.98	4.6
1945	1,865.46	3.9	1991	21,811.60	3.7
1946	2,009.14	7.7	1992	22,935.42	5.2
1947	2,205.08	9.8	1993	23,132.67	0.9
1948	2,370.53	7.5	1994	23,753.53	2.7
1949	2,430.52	2.5	1995	24,705.66	4.0
1950	2,570.33	5.8	1996	25,913.90	4.9
1951	2,799.16	8.9	1997	27,426.00	5.8
1952	2,973.32	6.2	1998	28,861.44	5.2
1953	3,139.44	5.6	1999	30,469.84	5.6
1954	3,155.64	0.5	2000	32,154.82	5.5
1955	3,301.44	4.6	2001	32,921.92	2.4
1956	3,532.36	7.0	2002	33,252.09	1.0
1957	3,641.72	3.1	2003	34,064.95	2.4
1958	3,673.80	0.9	2004	35,648.55	4.6
1959	3,855.80	5.0	2005	36,952.94	3.7
1960	4,007.12	3.9	2006	38,651.41	4.6
1961	4,086.76	2.0	2007	40,405.48	4.5
1962	4,291.40	5.0	2008	41,334.97	2.3
1963	4,396.64	2.5	2009	40,711.61	-1.5
1964	4,576.32	4.1	2010	41,673.83	2.4
1965	4,658.72	1.8	2011	42,979.61	3.1
1966	4,938.36	6.0	2012	44,321.67	3.1
1967	5,213.44	5.6	2013	44,888.16	1.3
1968	5,5/1./6	6.9	2014	46,481.52	3.5
1969	5,893.76	5.8	2015	48,098.63	3.5
1970	6,186.24	5.0	2016	48,642.52	1.1
1971	6,497.08	5.0	2017	50,321.89	3.5
1972	/,133.80	9.8	2018	52,145.80	3.6
## **Oklahoma Public Employees Retirement System**

#### **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 if it then 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 <u>plus</u> 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.



## **Oklahoma Public Employees Retirement System**

#### **Amortization Method**

Effective July 1, 2008, the unfunded actuarial accrued liability is amortized as a level percent of payroll over a 20-year closed period commencing July 1, 2007. For the defined contribution members, the employer sends to OPERS the difference between the OPERS statutorily required rate (16.5% for state members) and the amount required for the employer match in the defined contribution plan. These extra contributions to OPERS allow the use of the level percent of payroll amortization method since they are expected to produce a payment stream that is constant, if not increasing, as a percent of covered payroll.

#### **Valuation Procedures**

The actuarial accrued liability held for nonvested, inactive members who have a break in service, or for nonvested members who have quit or been terminated, even if a break in service has not occurred as of the valuation date, is equal to the amount of the individual's unclaimed contributions.

The wages used in the projection of benefits and liabilities are considered earnings for the year ending on the June 30 prior to the valuation date, increased by the salary scale to develop expected earnings for the current valuation year.

Earnings are annualized for members with less than twelve months of reported earnings.

In computing accrued benefits, average earnings are determined using actual pay history provided for valuation purposes.

The calculations for the required employer contribution are determined as of mid-year. This is a reasonable estimate since contributions are made on a monthly basis throughout the year.

We do not value the 415 limit for active participants. The impact was assumed to be *de minimus*.

The compensation limitation under IRC Section 401(a)(17) is considered in this valuation.

Liability is included for members who appear to be deferred vested, but who are not in the vested data provided. An estimated benefit was calculated based on pay and service from prior valuations. A corrected benefit and status will be provided by the System when the actual benefit and status have been finalized.

Members who are contributing to the System, but have not yet filled out an enrollment application, are included as active members. Service for this group was provided by the System.



#### SUMMARY OF ACTUARIALL ASSUMPTIONS

#### **Economic Assumptions**

**Price Inflation:** 

**Investment Return:** 

**Salary Increases:** 

2.5% per annum, compounded annually

6.5% net of investment expenses per annum, compounded annually

Sample rates below (midpoint of range shown):

<u>Nearest Age</u>	% Increase
20 - 24	9.25
25 - 29	7.55
30 - 34	6.05
35 - 39	5.25
40 - 44	4.95
45 - 49	4.55
50 - 54	4.25
55 - 59	4.05
60 - 64	3.55
65+	3.25

#### Wage and Payroll Growth:

3.25% per year

#### Ad hoc benefit increase assumptions

Monthly benefits	No increases assumed
Medical Supplement	No increases assumed

#### Projection of 401(a)(17) compensation limit:

Projected with inflation at 2.5%



.

## **Oklahoma Public Employees Retirement System**

## **Demographic Assumptions**

Annual	Rates of Retirement	Per 100 Eligible Re	egular Non-Elected	Members
	Hired Prior to	11/1/2011	Hired on or Aft	er 11/1/2011
	Those Eligible	Those Eligible	Those Eligible	Those Eligible
	For Unreduced	For Reduced	For Unreduced	For Reduced
Age	Retirement	<u>Retirement</u>	<u>Retirement</u>	<u>Retirement</u>
50	15	N/A	N/A	N/A
51	15	N/A	N/A	N/A
52	15	N/A	N/A	N/A
53	15	N/A	N/A	N/A
54	15	N/A	N/A	N/A
55	10	4	N/A	N/A
56	10	4	N/A	N/A
57	11	4	N/A	N/A
58	12	4	N/A	N/A
59	13	5	N/A	N/A
60	14	6	30/15*	5
61	20	13	30/15*	6
62	25	N/A	30/15*	6
63	15	N/A	30/15*	6
64	15	N/A	30/15*	13
65	30	N/A	30/15*	N/A
66	25	N/A	25	N/A
67	25	N/A	25	N/A
68	25	N/A	25	N/A
69	25	N/A	25	N/A
70	50	N/A	50	N/A
71	50	N/A	50	N/A
72	50	N/A	50	N/A
73	50	N/A	50	N/A
74	50	N/A	50	N/A
75	100	N/A	100	N/A
		*3	0 when first eligibl	e to retire and
		15	thereafter	



# Oklahoma Public Employees Retirement System

# **Demographic Assumptions (continued)**

	1 mildul Huleb of Heeli			015
	Elected Prior to	11/1/2011	Elected on or Af	ter 11/1/2011
	Those Eligible	Those Eligible	Those Eligible	Those Eligible
	For Unreduced	For Reduced	For Unreduced	For Reduced
Age	<u>Retirement</u>	<u>Retirement</u>	<u>Retirement</u>	<u>Retirement</u>
50	25	N/A	N/A	N/A
51	25	N/A	N/A	N/A
52	25	N/A	N/A	N/A
53	25	N/A	N/A	N/A
54	25	N/A	N/A	N/A
55	20	7.0	N/A	N/A
56	20	7.0	N/A	N/A
57	20	7.0	N/A	N/A
58	20	7.0	N/A	N/A
59	20	7.0	N/A	N/A
60	20	N/A	N/A	10
61	20	N/A	N/A	10
62	20	N/A	20	N/A
63	20	N/A	20	N/A
64	20	N/A	20	N/A
65	20	N/A	20	N/A
66	20	N/A	20	N/A
67	35	N/A	35	N/A
68	35	N/A	35	N/A
69-74	35	N/A	35	N/A
75	100	N/A	100	N/A

#### Annual Rates of Retirement Per 100 Eligible Elected Members



# **Demographic Assumptions (continued)**

	Annual Rates	s of Retirem	ent Per 100	Eligible	Hazardous D	uty Member	<u>s</u>
	Hired Prior	r to 11/1/201	1		Hired on or	After 11/1/20	)11
Les	ss Than 20	At Le	east 20	Less	Than 20	At L	east 20
Year	rs of Service	Years of	f Service	Years	of Service	Years of	of Service
Age		Service		Age		Service	
50	N/A	20	25	50	N/A	20	25
51	N/A	21	25	51	N/A	21	25
52	N/A	22	20	52	N/A	22	20
53	N/A	23-24	15	53	N/A	23-34	15
54	N/A	25-29	23	54	N/A	25-29	23
55	4	30-34	25	55	N/A	30-34	25
56	5	35+	100	56	N/A	35+	100
57	5			57	N/A		
58	5			58	N/A		
59	5			59	N/A		
60	5			60	7		
61	20			61	20		
62	40			62	20		
63	22			63	20		
64	25			64	20		
65	40			65	40		
66	25			66	25		
67	25			67	23		
68	25			68	22		
69	25			69	21		
70	100			70	100		



# Oklahoma Public Employees Retirement System

# **Demographic Assumptions (continued)**

#### **Mortality Rates**

Active participants and nondisabled pensioners	Pub-2010 Below Median, General Membership Active/Retiree Healthy Mortality Table with base rates projected to 2030 using Scale MP-2019. Male rates are unadjusted and female rates are set forward two years.
Disabled pensioners	Nondisabled retiree mortality set forward 12 years for disabled experience.
Hazardous Duty members	For Department of Corrections officers, we assumed the mortality rate is 10% higher than the above table while the participant is active. This 10% is assumed to be in-line-of-duty.

**Disability Rates:** 

## Graduated rates

Disabled rates per 100 members

Nearest		Hazardous
Age	Regular/Elected	Duty
20	0.009	0.009
30	0.009	0.022
40	0.022	0.058
50	0.139	0.180
60	0.200	0.400



# Demographic Assumptions (continued)

Withdrawal Rates:

Service	Rate
0	26.0%
1	22.0%
2	18.0%
3	14.0%
4	12.0%
5	10.5%
6	9.0%
7	8.0%
8	7.0%
9	6.5%
10	6.0%
11	5.5%
12	5.0%
13	4.8%
14	4.5%
15	4.3%
16	4.0%
17	3.8%
18	3.5%
19	3.3%
20	3.0%
21	2.8%
22	2.5%
23	2.3%
24	2.0%
25	1.8%
26	1.5%
27	1.3%
28+	1.0%



#### **Demographic Assumptions (continued)**

# **Probability of Electing Vested Benefit:**

Regular Members Only		
Duration	Rate	
8	80%	
13	85%	
18	90%	
23	95%	
28	100%	

#### Marital Status:

Percentage Married	85%
Age difference	Males assumed to be four years older than spouses.
Children:	Special death benefits are provided upon the in-line- of-duty death of Department of Corrections' employees who have young children. We have assumed the average age of the youngest child of such employees is nine and that 50% of such children will attend an institution of higher education to age 22.
Form of Payment:	Participants are assumed to elect a life-only form of payment.



# Demographic Assumptions (continued)

Assumed age for commencement	
of deferred benefits:	Currently active members assumed to terminate in the future prior to retirement eligibility are assumed to commence benefits at age 62 (non-elected members) or age 60 (elected members).
	Currently active members hired on or after 11/1/2011 assumed to terminate in the future prior to retirement eligibility are assumed to commence benefits at age 65.
	Currently inactive members with deferred benefits are assumed to commence benefits on a date provided by OPERS.
Provision for expenses:	Administrative expenses, as budgeted by the Oklahoma Public Employees Retirement System.

# **Appendix E**

## Uniform Retirement System of Justices & Judges

#### Entry Age Actuarial Cost Method

Liabilities and contributions shown in this report are computed using the individual Entry Age Level Percent of Pay actuarial cost. 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 if it then 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 actually on hand 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 <u>plus</u> 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 fiscal 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.



#### State of Oklahoma Uniform Retirement System of Justices & Judges

#### **Amortization Method**

The Unfunded Actuarial Accrued Liability is amortized as a level percentage of payroll over a 20year period commencing July 1, 2007. Given a stable active workforce, this amortization method is expected to produce a payment stream that remains level as a percent of covered payroll.

#### **Valuation Procedures**

The actuarial accrued liability held for nonvested, inactive members who have a break in service, or for nonvested members who have quit or been terminated, even if a break in service has not occurred as of the valuation date, is equal to the amount of the individual's unclaimed contributions.

The wages used in the projection of benefits and liabilities are considered earnings for the year ending on the June 30 prior to the valuation date, increased by the salary scale to develop expected earnings for the current valuation year.

In computing accrued benefits, average earnings are determined using actual pay history provided for valuation purposes.

The calculations for the required employer contribution are determined as of mid-year. This is a reasonable estimate since contributions are made on a monthly basis throughout the year.

We do not value the 415 limit for active participants. The impact was assumed to be *de minimus*.

The compensation limitation under IRC Section 401(a)(17) is considered in this valuation.

Liability is included for members who appear to be deferred vested, but who are not in the vested data provided. An estimated benefit was calculated based on pay and service reported for prior valuations. A corrected benefit and status will be provided by the System when the actual benefit and status have been finalized.

Members who are contributing to the System, but have not yet filled out an enrollment application, are included as active members. Where data elements are missing, reasonable estimates are used. Service is estimated based on hours worked. Age is based on average entry age for other members. Gender is assigned in proportion to the overall group.



## **Appendix E**

#### State of Oklahoma Uniform Retirement System of Justices & Judges

Economic Assumptions	
Price Inflation:	2.5% per annum, compounded annually
Investment Return:	6.5% net of investment expenses per annum, compounded annually
Salary Increases:	3.50% per year
Wage and Payroll Growth:	3.25% per year
Ad hoc benefit increase assumption: Monthly benefits Medical supplement	No increases assumed No increases assumed
Projection of 410(a)(17) compensation limit	Projected with inflation at 2.75%

#### **Demographic Assumptions**

#### **Retirement age:**

	Annual Rates of Retirement
Attained Age	Per 100 Eligible Members
Below 59	7
59-61	10
62 - 66	15
67 - 68	20
69 - 74	25
75+	100

#### Deferred vested members

Participants with deferred benefits are assumed to commence benefits on a date provided by URSJJ. Actives expected to terminate with a vested benefit are expected to commence benefits at age 60.



## State of Oklahoma Uniform Retirement System of Justices & Judges

Mortality Rates:	
nondisabled pensioners	Pub-2010 Below Median, General Membership Active/Retiree Healthy Mortality Table with base rates projected to 2030 using Scale MP-2019. Male rates are set back one year and female rates are set forward one yeas.
Disabled pensioners	Nondisabled retiree mortality set forward 12 years for disabled experience.
Separation Rates:	
Separation for all reasons other than death	2% for all years of service.
Disability Rates:	0%
Marital Status:	
Age difference Percentage married	Males are assumed to be four years older than spouses. 85%
Other Assumptions:	
Provisions for expenses	Administrative expenses, as budgeted for the Oklahoma Uniform Retirement System for Justices and Judges.
Form of payment	Active members who were contributing 8% of pay as of August 31, 2005, are assumed to retire with an unreduced benefit payable as a 50% Joint and Survivor annuity. All other members are assumed to retire with a single life annuity.



## Experience Study 2016-2019 Appendix F-1 Probability of Death - Healthy Retirees OPERS -Males



		Expected - Current	Expected - Proposed
	Actual	Assumptions	Assumptions
Weighted Count	1,948,458	1,750,716	1,717,919
Actual/Expected		111%	113%



## Experience Study 2016-2019 Appendix F-2 Probability of Death - Healthy Retirees OPERS - Females



		Expected - Current	Expected - Proposed
	Actual	Assumptions	Assumptions
Weighted Count	1,760,347	1,550,386	1,503,702
Actual/Expected		114%	117%



## Experience Study 2016-2019 Appendix F-3 Retirement Rates Regular - Early



		Expected -	Expected -
		Current	Proposed
	Actual	Assumptions	Assumptions
Weighted Count	323,917	401,874	375,437
Actual/Expected		81%	86%



## Experience Study 2016-2019 Appendix F-4 Retirement Rates Regular - Unreduced



		Expected -	Expected -
		Current	Proposed
	Actual	Assumptions	Assumptions
Weighted Count	3,336,868	4,274,851	3,801,600
Actual/Expected		78%	88%



## Experience Study 2016-2019 Appendix F-5 Retirement Rates Elected Officials - Early



		Expected -	Expected -
		Current	Proposed
	Actual	Assumptions	Assumptions
Weighted Count	5,361	6,424	6,424
Actual/Expected		83%	83%



## Experience Study 2016-2019 Appendix F-6 Retirement Rates Elected Officials - Unreduced



		Expected -	Expected -
		Current	Proposed
	Actual	Assumptions	Assumptions
Weighted Count	156,239	162,801	162,801
Actual/Expected		96%	96%



## Experience Study 2016-2019 Appendix F-7 Retirement Rates Hazardous Duty - Early



		Expected -	Expected -
		Current	Proposed
	Actual	Assumptions	Assumptions
Weighted Count	9,964	6,573	6,573
Actual/Expected		152%	152%



## Experience Study 2016-2019 Appendix F-8 Retirement Rates Hazardous Duty - Unreduced



		Expected - Current	Expected - Proposed
	Actual	Assumptions	Assumptions
Weighted Count	46,446.27	58,407	58,407
Actual/Expected		80%	80%



## Experience Study 2016-2019 Appendix F-9 Retirement Rates Hazardous Duty - Unreduced (Age)



		Expected -	Expected -
		Current	Proposed
	Actual	Assumptions	Assumptions
Weighted Count	28,112	22,289	22,289
Actual/Expected		126%	126%



### Experience Study 2016-2019 Appendix F-10 Retirement Rates URSJJ



		Expected -	Expected -
		Current	Proposed
	Actual	Assumptions	Assumptions
Weighted Count	143,020	123,615	123,615
Actual/Expected		116%	116%



## Experience Study 2016-2019 Exhibit F-11 Rate of Disability - Active Lives Regular and Elected Members



		Expected -	Expected -
	Current		Proposed
	Actual	Assumptions	Assumptions
Total Count	67	125	96
Actual/Expected		54%	70%



## Experience Study 2016-2019 Exhibit F-12 Rate of Disability - Active Lives Hazardous Duty Members



		Expected -	Expected -
		Current	
	Actual	Assumptions	Assumptions
Total Count	4	7	6
Actual/Expected		57%	67%



## Experience Study 2016-2019 Appendix F-13 Rate of Termination of Employment OPERS



		Expected -	Expected -
		Current	Proposed
	Actual	Assumptions	Assumptions
Weighted Count	168,245	154,872	154,872
Actual/Expected		109%	109%



## Experience Study 2016-2019 Appendix F-14 Probability of Contributions Remaining with the System OPERS - Regular



		Expected -	Expected -
		Current	Proposed
	Actual	Assumptions	Assumptions
Total Count	101,302	100,379	100,379
Actual/Expected		101%	101%



### Experience Study 2016-2019 Appendix F-15 Total Salary Scale OPERS



		Expected -	Expected -
	Current		Proposed
	Actual	Assumptions	Assumptions
Average Increase	3.69%	5.01%	4.76%
Actual/Expected		74%	78%



Appendix G-1
Probability of Death - Healthy Retirees
<b>OPERS</b> - Males

		Actual	Actual	Current	Current	Proposed	Proposed
Age	Exposure	Deaths	Rate	Expected	Rate	Expected	Rate
55	741,065	6,697	0.9%	3,862.2	0.5%	6,165.7	0.8%
56	907,394	6,865	0.8%	5,097.1	0.6%	7,924.3	0.9%
57	1,006,959	18,059	1.8%	6,096.5	0.6%	9,222.7	0.9%
58	1,059,635	13,577	1.3%	6,923.8	0.7%	10,168.3	1.0%
59	1,059,619	3,895	0.4%	7,489.4	0.7%	10,630.1	1.0%
60	1,255,355	14,467	1.2%	9,624.2	0.8%	13,129.8	1.0%
61	1,437,888	9,016	0.6%	11,989.3	0.8%	15,627.0	1.1%
62	1,736,762	23,127	1.3%	15,779.9	0.9%	19,536.8	1.1%
63	2,206,315	30,357	1.4%	21,873.9	1.0%	25,635.2	1.2%
64	2,426,408	30,583	1.3%	26,278.0	1.1%	29,065.9	1.2%
65	2,652,873	33,064	1.2%	31,356.7	1.2%	32,765.6	1.2%
66	2,753,123	26,911	1.0%	35,518.0	1.3%	36,481.6	1.3%
67	2,794,387	38,132	1.4%	39,283.8	1.4%	39,956.9	1.4%
68	2,939,738	45,546	1.5%	45,016.4	1.5%	45,518.9	1.5%
69	3,185,986	69,748	2.2%	54,510.7	1.7%	53,706.2	1.7%
70	3,163,097	49,309	1.6%	60,503.9	1.9%	58,169.4	1.8%
71	2,926,182	65,015	2.2%	62,613.3	2.1%	58,907.0	2.0%
72	2,567,684	54,102	2.1%	61,551.2	2.4%	56,704.7	2.2%
73	2,436,889	62,430	2.6%	63,960.6	2.6%	59,157.9	2.4%
74	2,252,035	91,232	4.1%	64,810.0	2.9%	60,253.2	2.7%
75	2,043,941	51,342	2.5%	64,635.2	3.2%	60,400.5	3.0%
76	1,893,778	63,440	3.3%	65,953.5	3.5%	61,947.4	3.3%
77	1,839,101	75,050	4.1%	70,599.4	3.8%	66,672.9	3.6%
78	1,666,370	73,030	4.4%	70,710.2	4.2%	67,088.1	4.0%
79	1,489,849	66,987	4.5%	69,907.3	4.7%	66,728.9	4.5%
80	1,303,723	80,840	6.2%	67,774.7	5.2%	65,053.2	5.0%
81	1,159,417	84,296	7.3%	66,832.1	5.8%	64,563.3	5.6%
82	1,021,240	79,113	7.7%	65,363.2	6.4%	63,484.3	6.2%
83	913,867	83,013	9.1%	64,944.9	7.1%	63,448.8	6.9%
84	821,008	76,391	9.3%	64,881.1	7.9%	63,595.3	7.7%
85	686,666	86,347	12.6%	60,339.7	8.8%	59,233.9	8.6%
86	604,035	65,117	10.8%	59,071.5	9.8%	57,956.5	9.6%
87	487,991	52,368	10.7%	53,126.2	10.9%	51,900.3	10.6%
88	395,643	56,265	14.2%	47,912.6	12.1%	46,523.2	11.8%
89	323,334	52,486	16.2%	43,530.8	13.5%	41,869.2	12.9%
90	273,992	58,456	21.3%	40,971.6	15.0%	38,948.0	14.2%
Total to 100	59,143,701	1,948,458	3.3%	1,750,716.0	3.0%	1,717,918.6	2.9%



## Appendix G-2 Probability of Death - Healthy Retirees OPERS - Females

		Actual	Actual	Current	Current	Proposed	Proposed
Age	Exposure	Deaths	Rate	Expected	Rate	Expected	Rate
55	690,933	8,165	1.2%	2,417.7	0.3%	3,374.5	0.5%
56	948,558	2,210	0.2%	3,606.9	0.4%	4,753.2	0.5%
57	1,171,598	3,994	0.3%	4,839.9	0.4%	6,038.4	0.5%
58	1,337,696	9,904	0.7%	5,994.3	0.4%	7,089.8	0.5%
59	1,540,674	5,330	0.3%	7,487.7	0.5%	8,425.9	0.5%
60	1,801,657	13,162	0.7%	9,477.6	0.5%	10,202.8	0.6%
61	2,133,940	15,109	0.7%	12,160.9	0.6%	12,543.3	0.6%
62	2,573,426	12,192	0.5%	15,869.8	0.6%	15,736.5	0.6%
63	3,114,617	27,419	0.9%	20,771.4	0.7%	19,849.5	0.6%
64	3,160,874	28,820	0.9%	22,818.0	0.7%	21,945.9	0.7%
65	3,235,182	36,787	1.1%	25,302.4	0.8%	24,545.3	0.8%
66	3,356,132	32,638	1.0%	28,474.4	0.8%	27,976.7	0.8%
67	3,474,351	30,363	0.9%	32,054.0	0.9%	31,918.9	0.9%
68	3,491,181	31,907	0.9%	35,084.3	1.0%	35,491.3	1.0%
69	3,444,666	45,590	1.3%	40,179.7	1.2%	38,886.8	1.1%
70	3,186,310	48,859	1.5%	43,236.3	1.4%	40,016.9	1.3%
71	2,789,382	42,422	1.5%	44,164.5	1.6%	39,084.8	1.4%
72	2,532,261	47,550	1.9%	46,849.9	1.9%	39,652.7	1.6%
73	2,496,176	72,210	2.9%	50,884.3	2.0%	43,728.0	1.8%
74	2,343,355	58,498	2.5%	52,727.6	2.3%	46,014.1	2.0%
75	2,163,915	58,363	2.7%	53,841.2	2.5%	47,675.4	2.2%
76	1,890,784	53,929	2.9%	52,120.4	2.8%	46,836.6	2.5%
77	1,714,060	56,864	3.3%	52,419.3	3.1%	47,794.8	2.8%
78	1,544,761	77,345	5.0%	52,537.5	3.4%	48,601.3	3.1%
79	1,338,892	59,266	4.4%	50,738.6	3.8%	47,615.0	3.6%
80	1,187,663	49,057	4.1%	50,208.6	4.2%	47,782.1	4.0%
81	1,112,535	66,269	6.0%	52,590.3	4.7%	50,729.4	4.6%
82	1,011,955	66,118	6.5%	53,520.8	5.3%	52,326.2	5.2%
83	928,424	57,520	6.2%	55,012.6	5.9%	54,479.0	5.9%
84	845,741	62,543	7.4%	56,180.4	6.6%	56,368.7	6.7%
85	741,156	45,636	6.2%	55,184.9	7.4%	56,074.4	7.6%
86	653,293	69,460	10.6%	54,506.6	8.3%	56,016.6	8.6%
87	584,202	55,291	9.5%	54,590.4	9.3%	56,564.2	9.7%
88	505,821	49,613	9.8%	52,842.3	10.4%	55,071.8	10.9%
89	443,996	59,951	13.5%	51,765.2	11.7%	53,892.7	12.1%
90	350,905	44,882	12.8%	45,597.7	13.0%	47,035.0	13.4%
Total to 100	66,944,917	1,760,347	2.6%	1,550,386.2	2.3%	1,503,702.3	2.2%



# Appendix G-3 Retirement Rates Regular - Early

		Actual	Actual	Current	Current	Proposed	Proposed
Age	Exposure	Retirements	Rate	Expected	Rate	Expected	Rate
55	1,035,300	45,581	4.4%	31,059.0	3.0%	41,412.0	4.0%
56	936,240	34,907	3.7%	37,449.6	4.0%	37,449.6	4.0%
57	951,587	35,181	3.7%	38,063.5	4.0%	38,063.5	4.0%
58	934,544	32,847	3.5%	46,727.2	5.0%	37,381.8	4.0%
59	953,233	45,974	4.8%	57,194.0	6.0%	47,661.6	5.0%
60	950,577	49,197	5.2%	57,034.6	6.0%	57,034.6	6.0%
61	895,643	80,231	9.0%	134,346.5	15.0%	116,433.6	13.0%
	6,657,123	323,917	4.9%	401,874.3	6.0%	375,436.7	5.6%



# Appendix G-4 Retirement Rates Regular - Unreduced

		Actual	Actual	Current	Current	Proposed	Proposed
Age	Exposure	Retirements	Rate	Expected	Rate	Expected	Rate
50	62,022	12,759	20.6%	9,303.3	15.0%	9,303.3	15.0%
51	187,624	26,878	14.3%	28,143.6	15.0%	28,143.6	15.0%
52	432,757	64,108	14.8%	64,913.6	15.0%	64,913.6	15.0%
53	693,943	79,582	11.5%	104,091.4	15.0%	104,091.4	15.0%
54	944,765	106,418	11.3%	141,714.8	15.0%	141,714.8	15.0%
55	1,159,952	140,306	12.1%	115,995.2	10.0%	115,995.2	10.0%
56	1,160,034	138,315	11.9%	116,003.4	10.0%	116,003.4	10.0%
57	1,204,892	134,933	11.2%	132,538.1	11.0%	132,538.1	11.0%
58	1,224,407	101,739	8.3%	146,928.8	12.0%	146,928.8	12.0%
59	1,254,546	162,910	13.0%	163,090.9	13.0%	163,090.9	13.0%
60	1,157,223	128,473	11.1%	162,011.3	14.0%	162,011.3	14.0%
61	1,091,480	173,654	15.9%	218,295.9	20.0%	218,295.9	20.0%
62	1,888,420	414,344	21.9%	472,105.0	25.0%	472,105.0	25.0%
63	1,553,974	216,006	13.9%	233,096.1	15.0%	233,096.1	15.0%
64	1,482,374	279,784	18.9%	222,356.1	15.0%	222,356.1	15.0%
65	1,241,787	332,460	26.8%	372,536.2	30.0%	372,536.2	30.0%
66	893,875	255,489	28.6%	223,468.7	25.0%	223,468.7	25.0%
67	652,829	133,919	20.5%	163,207.2	25.0%	163,207.2	25.0%
68	499,795	100,732	20.2%	124,948.8	25.0%	124,948.8	25.0%
69	454,404	111,353	24.5%	113,601.0	25.0%	113,601.0	25.0%
70	322,756	77,718	24.1%	322,756.4	100.0%	161,378.2	50.0%
71	252,090	56,330	22.3%	252,090.2	100.0%	126,045.1	50.0%
72	164,010	35,162	21.4%	164,010.2	100.0%	82,005.1	50.0%
73	110,952	27,281	24.6%	110,952.1	100.0%	55,476.0	50.0%
74	96,693	26,216	27.1%	96,693.0	100.0%	48,346.5	50.0%
	20,187,605	3,336,868	16.5%	4,274,851.4	21.2%	3,801,600.4	18.8%



# Appendix G-5 Retirement Rates Elected Officials - Early

		Actual	Actual	Current	Current	Proposed	Proposed
Age	Exposure	Retirements	Rate	Expected	Rate	Expected	Rate
55	17,366	-	0.0%	1,215.6	7.0%	1,215.6	7.0%
56	22,032	810	3.7%	1,542.3	7.0%	1,542.3	7.0%
57	22,669	3,660	16.1%	1,586.8	7.0%	1,586.8	7.0%
58	17,520	-	0.0%	1,226.4	7.0%	1,226.4	7.0%
59	12,187	891	7.3%	853.1	7.0%	853.1	7.0%
	91,774	5,361	5.8%	6,424.2	7.0%	6,424.2	7.0%



# Appendix G-6 Retirement Rates Elected Officials - Unreduced

		Actual	Actual	Current	Current	Proposed	Proposed
Age	Exposure	Retirements	Rate	Expected	Rate	Expected	Rate
50	3,430	-	0.0%	857.4	25.0%	857.4	25.0%
51	6,263	-	0.0%	1,565.8	25.0%	1,565.8	25.0%
52	13,465	1,820	13.5%	3,366.2	25.0%	3,366.2	25.0%
53	17,583	4,298	24.4%	4,395.7	25.0%	4,395.7	25.0%
54	23,032	8,631	37.5%	5,758.1	25.0%	5,758.1	25.0%
55	21,863	9,427	43.1%	4,372.7	20.0%	4,372.7	20.0%
56	23,087	5,967	25.8%	4,617.4	20.0%	4,617.4	20.0%
57	27,896	6,079	21.8%	5,579.2	20.0%	5,579.2	20.0%
58	24,612	4,664	19.0%	4,922.5	20.0%	4,922.5	20.0%
59	35,321	9,079	25.7%	7,064.1	20.0%	7,064.1	20.0%
60	50,649	7,647	15.1%	10,129.7	20.0%	10,129.7	20.0%
61	60,178	6,698	11.1%	12,035.5	20.0%	12,035.5	20.0%
62	67,303	16,194	24.1%	13,460.6	20.0%	13,460.6	20.0%
63	53,055	11,501	21.7%	10,611.0	20.0%	10,611.0	20.0%
64	50,164	14,532	29.0%	10,032.9	20.0%	10,032.9	20.0%
65	45,220	6,343	14.0%	9,044.1	20.0%	9,044.1	20.0%
66	30,767	9,356	30.4%	6,153.3	20.0%	6,153.3	20.0%
67	28,235	6,578	23.3%	9,882.1	35.0%	9,882.1	35.0%
68	22,177	2,379	10.7%	7,761.9	35.0%	7,761.9	35.0%
69	24,865	4,717	19.0%	8,702.7	35.0%	8,702.7	35.0%
70	11,187	4,254	38.0%	3,915.4	35.0%	3,915.4	35.0%
71	2,263	438	19.4%	792.0	35.0%	792.0	35.0%
72	4,116	1,621	39.4%	1,440.7	35.0%	1,440.7	35.0%
73	12,559	8,026	63.9%	4,395.6	35.0%	4,395.6	35.0%
74	7,760	2,073	26.7%	2,716.2	35.0%	2,716.2	35.0%
75	9,229	3,913	42.4%	9,228.5	100.0%	9,228.5	100.0%
	676,278	156,239	23.1%	162,801.2	24.1%	162,801.2	24.1%


## Appendix G-7 Retirement Rates Hazardous Duty - Early

		Actual	Actual	Current	Current	Proposed	Proposed
Age	Exposure	Retirements	Rate	Expected	Rate	Expected	Rate
55	16,977	381	2.2%	679.1	4.0%	679.1	4.0%
56	17,326	1,254	7.2%	866.3	5.0%	866.3	5.0%
57	14,244	747	5.2%	712.2	5.0%	712.2	5.0%
58	14,603	2,374	16.3%	730.1	5.0%	730.1	5.0%
59	10,667	1,546	14.5%	533.3	5.0%	533.3	5.0%
60	10,843	1,459	13.5%	542.1	5.0%	542.1	5.0%
61	12,547	2,202	17.6%	2,509.4	20.0%	2,509.4	20.0%
	97,207	9,964	10.3%	6,572.6	6.8%	6,572.6	6.8%



#### Appendix G-8 Retirement Rates Hazardous Duty - Unreduced

		Actual	Actual	Current	Current	Proposed	Proposed
Duration	Exposure	Retirements	Rate	Expected	Rate	Expected	Rate
20	50,777	14,276	28.1%	12,694.3	25.0%	12,694.3	25.0%
21	37,951	6,884	18.1%	9,487.9	25.0%	9,487.9	25.0%
22	24,862	2,783	11.2%	4,972.4	20.0%	4,972.4	20.0%
23	23,707	2,089	8.8%	3,556.0	15.0%	3,556.0	15.0%
24	26,197	5,651	21.6%	3,929.6	15.0%	3,929.6	15.0%
25	22,891	1,126	4.9%	5,264.8	23.0%	5,264.8	23.0%
26	24,848	4,002	16.1%	5,714.9	23.0%	5,714.9	23.0%
27	17,453	1,098	6.3%	4,014.1	23.0%	4,014.1	23.0%
28	14,599	4,031	27.6%	3,357.7	23.0%	3,357.7	23.0%
29	7,715	3,131	40.6%	1,774.4	23.0%	1,774.4	23.0%
30	3,023	-	0.0%	755.8	25.0%	755.8	25.0%
31	4,071	1,375	33.8%	1,017.7	25.0%	1,017.7	25.0%
32	2,945	-	0.0%	736.2	25.0%	736.2	25.0%
33	3,037	-	0.0%	759.2	25.0%	759.2	25.0%
34	1,486	-	0.0%	371.6	25.0%	371.6	25.0%
35	-	-	0.0%	-	100.0%	-	100.0%
	265,561	46,446	17.5%	58,406.8	22.0%	58,406.8	22.0%



### Appendix G-9 Retirement Rates Hazardous Duty - Unreduced (Age)

	Actual	Actual	Current	Current	Proposed	Proposed
Exposure	Retirements	Rate	Expected	Rate	Expected	Rate
24,871	11,623	46.7%	9,948.5	40.0%	9,948.5	40.0%
12,933	4,794	37.1%	2,845.3	22.0%	2,845.3	22.0%
8,541	2,113	24.7%	2,135.2	25.0%	2,135.2	25.0%
6,415	2,535	39.5%	2,566.1	40.0%	2,566.1	40.0%
4,929	2,109	42.8%	1,232.3	25.0%	1,232.3	25.0%
5,394	2,137	39.6%	1,348.5	25.0%	1,348.5	25.0%
4,750	1,558	32.8%	1,187.4	25.0%	1,187.4	25.0%
1,804	1,243	68.9%	451.1	25.0%	451.1	25.0%
574	-	0.0%	574.0	100.0%	574.0	100.0%
70,212	28,112	40.0%	22,288.6	31.7%	22,288.6	31.7%
	Exposure 24,871 12,933 8,541 6,415 4,929 5,394 4,750 1,804 574 70,212	ActualExposureRetirements24,87111,62312,9334,7948,5412,1136,4152,5354,9292,1095,3942,1374,7501,5581,8041,243574-70,21228,112	ActualActualExposureRetirementsRate24,87111,62346.7%12,9334,79437.1%8,5412,11324.7%6,4152,53539.5%4,9292,10942.8%5,3942,13739.6%4,7501,55832.8%1,8041,24368.9%574-0.0%70,21228,11240.0%	ActualActualCurrentExposureRetirementsRateExpected24,87111,62346.7%9,948.512,9334,79437.1%2,845.38,5412,11324.7%2,135.26,4152,53539.5%2,566.14,9292,10942.8%1,232.35,3942,13739.6%1,348.54,7501,55832.8%1,187.41,8041,24368.9%451.1574-0.0%574.070,21228,11240.0%22,288.6	ActualActualCurrentCurrentExposureRetirementsRateExpectedRate24,87111,62346.7%9,948.540.0%12,9334,79437.1%2,845.322.0%8,5412,11324.7%2,135.225.0%6,4152,53539.5%2,566.140.0%4,9292,10942.8%1,232.325.0%5,3942,13739.6%1,348.525.0%4,7501,55832.8%1,187.425.0%1,8041,24368.9%451.125.0%574-0.0%574.0100.0%70,21228,11240.0%22,288.631.7%	ActualActualCurrentCurrentProposedExposureRetirementsRateExpectedRateExpected24,87111,62346.7%9,948.540.0%9,948.512,9334,79437.1%2,845.322.0%2,845.38,5412,11324.7%2,135.225.0%2,135.26,4152,53539.5%2,566.140.0%2,566.14,9292,10942.8%1,232.325.0%1,232.35,3942,13739.6%1,348.525.0%1,348.54,7501,55832.8%1,187.425.0%1,187.41,8041,24368.9%451.125.0%451.1574-0.0%574.0100.0%574.070,21228,11240.0%22,288.631.7%22,288.6



#### Appendix G-10 Retirement Rates URSJJ

		Actual	Actual	Current	Current	Proposed	Proposed
Age	Exposure	Retirements	Rate	Expected	Rate	Expected	Rate
55	-	-	0.0%	-	5.0%	-	5.0%
56	2,675	2,675	100.0%	133.8	5.0%	133.8	5.0%
57	5,707	3,032	53.1%	285.4	5.0%	285.4	5.0%
58	15,939	-	0.0%	796.9	5.0%	796.9	5.0%
59	22,159	8,060	36.4%	2,215.9	10.0%	2,215.9	10.0%
60	41,754	2,673	6.4%	4,175.4	10.0%	4,175.4	10.0%
61	34,501	-	0.0%	3,450.1	10.0%	3,450.1	10.0%
62	49,698	17,151	34.5%	7,454.7	15.0%	7,454.7	15.0%
63	37,142	2,450	6.6%	5,571.3	15.0%	5,571.3	15.0%
64	48,068	5,951	12.4%	7,210.2	15.0%	7,210.2	15.0%
65	64,486	9,360	14.5%	9,672.8	15.0%	9,672.8	15.0%
66	68,454	7,689	11.2%	10,268.2	15.0%	10,268.2	15.0%
67	72,569	20,848	28.7%	14,513.7	20.0%	14,513.7	20.0%
68	47,522	21,708	45.7%	9,504.4	20.0%	9,504.4	20.0%
69	35,539	14,880	41.9%	8,884.8	25.0%	8,884.8	25.0%
70	37,840	9,659	25.5%	9,460.0	25.0%	9,460.0	25.0%
71	34,949	2,338	6.7%	8,737.3	25.0%	8,737.3	25.0%
72	30,812	5,610	18.2%	7,703.1	25.0%	7,703.1	25.0%
73	19,533	5,652	28.9%	4,883.2	25.0%	4,883.2	25.0%
74	10,328	779	7.5%	2,582.0	25.0%	2,582.0	25.0%
75	6,112	2,505	41.0%	6,111.8	100.0%	6,111.8	100.0%
	685,787	143,020	20.9%	123,614.9	18.0%	123,614.9	18.0%



#### Appendix G-11 Rate of Disability - Active Lives Regular and Elected Members

		Actual	Actual	Current	Current	Proposed	Proposed
Age	Exposure	Disabilities	Rate	Expected	Rate	Expected	Rate
20	254	-	0.000%	0.0	0.009%	0.0	0.009%
21	414	-	0.000%	0.0	0.009%	0.0	0.009%
22	602	-	0.000%	0.1	0.009%	0.1	0.009%
23	719	-	0.000%	0.1	0.009%	0.1	0.009%
24	911	-	0.000%	0.1	0.009%	0.1	0.009%
25	1,203	-	0.000%	0.1	0.009%	0.1	0.009%
26	1,517	-	0.000%	0.1	0.009%	0.1	0.009%
27	1,675	-	0.000%	0.2	0.009%	0.2	0.009%
28	1,810	-	0.000%	0.2	0.009%	0.2	0.009%
29	1,834	-	0.000%	0.2	0.009%	0.2	0.009%
30	1,876	-	0.000%	0.2	0.009%	0.2	0.009%
31	1,963	-	0.000%	0.2	0.009%	0.2	0.009%
32	2,078	1	0.048%	0.2	0.009%	0.2	0.009%
33	2,160	-	0.000%	0.2	0.009%	0.2	0.009%
34	2,255	-	0.000%	0.2	0.009%	0.2	0.009%
35	2,317	-	0.000%	0.2	0.009%	0.2	0.009%
36	2,479	-	0.000%	0.3	0.011%	0.3	0.011%
37	2,463	-	0.000%	0.3	0.013%	0.3	0.013%
38	2,409	1	0.042%	0.4	0.016%	0.4	0.016%
39	2,423	1	0.041%	0.5	0.019%	0.5	0.019%
40	2,343	-	0.000%	0.5	0.022%	0.5	0.022%
41	2,366	-	0.000%	0.6	0.027%	0.6	0.027%
42	2,368	-	0.000%	0.8	0.032%	0.8	0.032%
43	2,426	-	0.000%	0.9	0.039%	0.9	0.039%
44	2,451	2	0.082%	1.1	0.046%	1.1	0.046%
45	2,584	-	0.000%	1.4	0.056%	1.4	0.056%
46	2,861	-	0.000%	1.9	0.067%	1.9	0.067%
47	2,826	1	0.035%	2.3	0.080%	2.3	0.080%
48	2,802	2	0.071%	2.7	0.096%	2.7	0.096%
49	2,782	-	0.000%	3.2	0.116%	3.2	0.116%
50	2,728	3	0.110%	3.8	0.139%	3.8	0.139%
51	2,748	3	0.109%	4.6	0.166%	4.6	0.166%
52	2,835	1	0.035%	5.7	0.200%	5.7	0.200%
53	3,142	4	0.127%	7.5	0.240%	6.3	0.200%
54	3,291	6	0.182%	9.5	0.288%	6.6	0.200%
55	3,320	6	0.181%	10.0	0.300%	6.6	0.200%
56	3,244	6	0.185%	9.7	0.300%	6.5	0.200%
57	3,278	6	0.183%	9.8	0.300%	6.6	0.200%
58	3,246	6	0.185%	9.7	0.300%	6.5	0.200%
59	3,210	7	0.218%	9.6	0.300%	6.4	0.200%
60	3,108	7	0.225%	9.3	0.300%	6.2	0.200%
61	2,917	3	0.103%	8.8	0.300%	5.8	0.200%
62	2,662	1	0.038%	8.0	0.300%	5.3	0.200%
	98,900	67	0.068%	125.0	0.126%	95.9	0.097%



#### Appendix G-12 Rate of Disability - Active Lives Hazardous Duty Members

		Actual	Actual	Current	Current	Proposed	Propos	ed
Age	Exposure	Disabilities	Rate	Expected	Rate	Expected	Rate	
20	19	-	0.000%	0.0	0.009%	0.0	0.009%	20
21	118	-	0.000%	0.0	0.009%	0.0	0.009%	21
22	187	-	0.000%	0.0	0.009%	0.0	0.009%	22
23	209	-	0.000%	0.0	0.009%	0.0	0.009%	23
24	261	-	0.000%	0.0	0.009%	0.0	0.009%	24
25	263	-	0.000%	0.0	0.018%	0.0	0.014%	25
26	289	-	0.000%	0.1	0.018%	0.0	0.014%	26
27	235	-	0.000%	0.0	0.018%	0.0	0.014%	27
28	225	-	0.000%	0.0	0.018%	0.0	0.014%	28
29	217	-	0.000%	0.1	0.027%	0.0	0.022%	29
30	231	-	0.000%	0.1	0.027%	0.0	0.022%	30
31	245	-	0.000%	0.1	0.027%	0.1	0.022%	31
32	220	-	0.000%	0.1	0.027%	0.0	0.022%	32
33	204	-	0.000%	0.1	0.027%	0.0	0.022%	33
34	172	-	0.000%	0.1	0.036%	0.0	0.029%	34
35	180	-	0.000%	0.1	0.045%	0.1	0.036%	35
36	192	-	0.000%	0.1	0.045%	0.1	0.036%	36
37	178	-	0.000%	0.1	0.045%	0.1	0.036%	37
38	193	-	0.000%	0.1	0.054%	0.1	0.043%	38
39	198	1	0.505%	0.1	0.063%	0.1	0.050%	39
40	204	-	0.000%	0.1	0.072%	0.1	0.058%	40
41	184	-	0.000%	0.1	0.072%	0.1	0.058%	41
42	182	-	0.000%	0.1	0.081%	0.1	0.065%	42
43	174	1	0.575%	0.2	0.099%	0.1	0.079%	43
44	179	-	0.000%	0.2	0.108%	0.2	0.086%	44
45	158	-	0.000%	0.2	0.126%	0.2	0.101%	45
46	179	-	0.000%	0.2	0.135%	0.2	0.108%	46
47	168	-	0.000%	0.3	0.153%	0.2	0.122%	47
48	164	-	0.000%	0.3	0.180%	0.2	0.144%	48
49	134	-	0.000%	0.3	0.207%	0.2	0.166%	49
50	116	-	0.000%	0.3	0.225%	0.2	0.180%	50
51	102	1	0.980%	0.3	0.270%	0.2	0.216%	51
52	90	-	0.000%	0.3	0.315%	0.2	0.252%	52
53	99	-	0.000%	0.4	0.360%	0.3	0.288%	53
54	106	-	0.000%	0.5	0.428%	0.4	0.342%	54
55	83	-	0.000%	0.4	0.500%	0.3	0.400%	55
56	71	-	0.000%	0.4	0.500%	0.3	0.400%	56
57	64	-	0.000%	0.3	0.500%	0.3	0.400%	57
58	68	-	0.000%	0.3	0.500%	0.3	0.400%	58
59	55	-	0.000%	0.3	0.500%	0.2	0.400%	59
60	50	1	2.000%	0.3	0.500%	0.2	0.400%	60
61	52	-	0.000%	0.3	0.500%	0.2	0.400%	61
62	47/	-	0.000%	0.2	0.500%	0.2	0.400%	62
	6,765	4	0.059%	7.2	0.107%	5.8	0.086%	



#### Appendix G-13 Rate of Termination of Employment OPERS

		Actual	Actual	Current	Current	Proposed	Proposed
Duration	Exposure	Terminations	Rate	Expected	Rate	Expected	Rate
0	7,988	2,882	36.1%	1,917	24.0%	2,237	28.0%
1	27,846	5,719	20.5%	6,126	22.0%	6,126	22.0%
2	66,532	11,642	17.5%	11,976	18.0%	11,976	18.0%
3	102,041	13,813	13.5%	14,286	14.0%	14,286	14.0%
4	117,609	13,296	11.3%	14,113	12.0%	14,113	12.0%
5	120,624	12,152	10.1%	12,666	10.5%	12,666	10.5%
6	109,688	9,464	8.6%	9,872	9.0%	9,872	9.0%
7	120,571	10,792	9.0%	9,646	8.0%	9,646	8.0%
8	135,922	10,264	7.6%	9,515	7.0%	9,515	7.0%
9	143,355	11,220	7.8%	9,318	6.5%	9,318	6.5%
10	133,516	8,953	6.7%	8,011	6.0%	8,011	6.0%
11	135,686	8,826	6.5%	7,463	5.5%	7,463	5.5%
12	127,883	8,214	6.4%	6,394	5.0%	6,394	5.0%
13	110,987	7,367	6.6%	5,272	4.8%	5,272	4.8%
14	106,616	5,729	5.4%	4,798	4.5%	4,798	4.5%
15	111,005	5,583	5.0%	4,718	4.3%	4,718	4.3%
16	119,676	5,751	4.8%	4,787	4.0%	4,787	4.0%
17	126,343	6,167	4.9%	4,738	3.8%	4,738	3.8%
18	122,505	5,033	4.1%	4,288	3.5%	4,288	3.5%
19	117,689	5,155	4.4%	3,825	3.3%	3,825	3.3%
20	102,115	3,104	3.0%	3,063	3.0%	3,063	3.0%
	2,266,196	171,127	7.6%	156,790	6.9%	157,109	6.9%

Note: Counts are weighted, except for duration 0.

# Appendix G



#### Appendix G-14 Probability of Contributions Remaining with the System OPERS - Regular

		Actual	Actual	Proposed	Proposed
Duration	Exposure	Remaining	Rate	Expected	Rate
8	9,720	8,152	83.9%	7,776	80.0%
9	11,136	8,951	80.4%	9,020	81.0%
10	9,849	7,870	79.9%	8,076	82.0%
11	9,211	7,810	84.8%	7,645	83.0%
12	9,254	7,871	85.0%	7,774	84.0%
13	7,907	6,262	79.2%	6,721	85.0%
14	6,693	5,824	87.0%	5,756	86.0%
15	6,833	5,827	85.3%	5,944	87.0%
16	7,101	6,679	94.0%	6,249	88.0%
17	6,764	5,959	88.1%	6,020	89.0%
18	5,595	5,213	93.2%	5,035	90.0%
19	6,116	5,526	90.3%	5,566	91.0%
20	4,402	4,320	98.1%	4,050	92.0%
21	2,243	2,201	98.1%	2,086	93.0%
22	3,108	3,108	100.0%	2,921	94.0%
23	2,198	2,089	95.1%	2,088	95.0%
24	2,011	1,958	97.4%	1,931	96.0%
25	2,536	2,393	94.3%	2,460	97.0%
26	892	892	100.0%	874	98.0%
27	1,144	1,144	100.0%	1,133	99.0%
28	1,036	1,036	100.0%	1,036	100.0%
29	108	108	100.0%	108	100.0%
30	111	111	100.0%	111	100.0%
	115,967	101,302	87.4%	100,379	86.6%



#### Appendix G-15 Total Salary Scale OPERS

	Initial	Subsequent		Current		Proposed	
	Salary	Salary	Actual	Expected	Current	Expected	Proposed
Age	(\$ Millions)	(\$ Millions)	Rate	(\$ Millions)	Rate	(\$ Millions)	Rate
21	8.1	8.6	6.86%	8.8	9.50%	8.8	9.25%
22	13.0	14.0	7.53%	14.2	9.50%	14.2	9.25%
23	16.7	17.8	6.69%	18.2	9.20%	18.2	8.95%
24	23.5	25.1	6.72%	25.6	8.90%	25.6	8.65%
25	32.9	34.9	6.09%	35.7	8.60%	35.6	8.35%
26	43.2	45.7	5.96%	46.7	8.20%	46.6	7.95%
27	48.9	51.6	5.49%	52.7	7.80%	52.6	7.55%
28	55.6	58.8	5.78%	59.8	7.50%	59.6	7.25%
29	57.9	61.1	5.51%	62.1	7.20%	61.9	6.95%
30	61.6	65.2	5.88%	65.9	6.90%	65.7	6.65%
31	68.7	72.9	6.22%	73.2	6.60%	73.0	6.35%
32	73.6	77.6	5.38%	78.3	6.30%	78.1	6.05%
33	79.2	83.5	5.47%	84.0	6.10%	83.8	5.85%
34	83.3	87.6	5.12%	88.2	5.90%	88.0	5.65%
35	87.0	91.1	4.66%	92.1	5.80%	91.9	5.55%
36	93.8	98.4	4.92%	99.2	5.70%	98.9	5.45%
37	93.4	97.8	4.70%	98.5	5.50%	98.3	5.25%
38	94.7	99.6	5.24%	99.8	5.40%	99.5	5.15%
39	96.7	101.0	4.45%	101.9	5.40%	101.7	5.15%
40	94.4	98.8	4.68%	99.4	5.30%	99.2	5.05%
41	96.2	100.4	4.37%	101.3	5.30%	101.1	5.05%
42	97.2	100.8	3.74%	102.2	5.20%	102.0	4.95%
43	98.7	103.2	4.47%	103.8	5.10%	103.5	4.85%
44	102.0	105.5	3.45%	107.1	5.00%	106.8	4.75%
45	107.5	111.3	3.59%	112.9	5.00%	112.6	4.75%
46	117.4	121.7	3.59%	123.2	4.90%	122.9	4.65%
47	117.0	121.4	3.75%	122.7	4.80%	122.4	4.55%
48	118.6	121.9	2.76%	124.2	4.70%	123.9	4.45%
49	116.1	120.4	3.77%	121.5	4.70%	121.2	4.45%
50	115.4	119.4	3.40%	120.7	4.60%	120.4	4.35%
51	115.4	118.2	2.47%	120.7	4.60%	120.4	4.35%
52	117.6	121.3	3.15%	122.9	4.50%	122.6	4.25%
53	130.2	133.5	2.58%	136.0	4.50%	135.7	4.25%
54	136.2	139.6	2.50%	142.4	4.50%	142.0	4.25%
55	137.2	141.4	3.03%	143.4	4.50%	143.0	4.25%
56	133.5	137.7	3.12%	139.4	4.40%	139.0	4.15%
57	136.1	139.7	2.63%	142.0	4.30%	141.6	4.05%
58	136.1	139.5	2.50%	141.8	4.20%	141.5	3.95%
59	133.1	137.0	2.97%	138.5	4.10%	138.2	3.85%
60	126.9	130.1	2.54%	132.0	4.00%	131.7	3.75%
61	115.7	119.0	2.87%	120.2	3.90%	119.9	3.65%
62	96.6	99.1	2.63%	100.3	3.80%	100.0	3.55%
63	85.4	87.1	1.99%	88.5	3.70%	88.3	3.45%
64	74.3	75.9	2.23%	77.0	3.60%	76.8	3.35%
65	57.1	58.5	2.31%	59.1	3.50%	59.0	3.25%
	4,043.6	4,194.8	3.74%	4,247.9	5.05%	4,237.8	4.80%