Wyoming Retirement System

Actuarial Experience Study
As of December 31, 2016

January 10, 2018

Board of Trustees
Wyoming Retirement System
6101 Yellowstone Road
Cheyenne, Wyoming 82002

Subject: **Results of 2017 Actuarial Experience Study**

Members of the Board:

We are pleased to present our report on the results of the 2017 Actuarial Experience Study for the Wyoming Retirement System (WRS). These proposed assumption and method changes apply to all plans under WRS. Recommendations for the Volunteer Firefighter and Emergency Medical Technician Pension Fund are under separate cover. This report includes recommendations for new actuarial assumptions and methods to be effective for the January 1, 2018 actuarial valuation. The actuarial impacts shown in this report are presented as though the recommended new assumptions and methods had been effective for the January 1, 2017 actuarial valuation.

With the Board's approval of the recommendations in this report, the actuarial condition of WRS will be more accurately portrayed. The Board's decisions should be based on the appropriateness of each recommendation individually, not on their collective effect on the funding period or the unfunded liability.

This study was conducted in accordance with generally accepted actuarial principles and practices, and with the Actuarial Standards of Practice issued by the Actuarial Standards Board. The signing actuaries are independent of the plan sponsor. They are all Members of the American Academy of Actuaries, and meet the Qualification Standards of the American Academy of Actuaries. Finally, each of the undersigned is experienced in performing valuations for large public retirement systems. We wish to thank the WRS staff for their assistance in providing data for this study.

Respectfully submitted,
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SECTION A

EXECUTIVE SUMMARY

Summary of Recommendations-All Plans

Recommended changes to the current actuarial assumptions may be summarized as follows:

Economic Assumptions

1. **Inflation**: reduce the current assumption of 3.25% to a rate no higher than 2.50%. The average annual increase in the CPI-U over the last 20 years is lower than the assumption. Investment consultants assume between 2.00% and 2.50%.

2. **Real rate of return**: increase the current assumption from 4.50% to 4.75%. The average real rate of return predicted by a group of surveyed consultants is 4.76%.

3. **Nominal rate of return**: decrease the nominal investment return assumption (the sum of inflation and the real rate of return) from 7.75% to no more than 7.25%. If the Board would prefer to enhance the probability of achieving its expected return, they should consider a move to 7.00%.

4. **Wage inflation**: reduce the wage inflation assumption from 4.25% to at most 2.75%. The general wage inflation assumption should be 0.25% above the inflation assumption.

5. **Payroll growth**: reduce the assumed growth in total payroll from 4.25% to no more than 2.75%.

6. **Cost of living increases**: none are assumed (except for Fire A).

7. **Asset valuation method**: the current smoothing method smooths the realized and unrealized gains and losses and immediately recognizes interest and dividends. Recommend smoothing all elements of return.

8. **Administrative expenses**: recommend reducing the assumed annual increase in expenses from 6.5% per year to the payroll growth assumption rate.

Demographic Assumptions

9. **Post-retirement mortality**, **disabled lives mortality, active life mortality**: update to the RP2014 table, projected generationally using MP 2016. MP 2017 will be used with the January 1, 2018 valuation.

Specific Recommendations-by Plan

State of Wyoming Retirement System

10. **Salary increase**: observed experience shows salary increases lower than assumed. The recommendation is to decrease the assumed salary increases and to move from age-based merit and promotion increases to service-based merit and promotion increases.

11. **Retirement (unreduced retirement):** data shows members work past age 70 and after 70 rates drop. Increase the assumed final age of employment from 70 to 80. Experience also shows higher rates from age 67 to 70. Recommend making modifications to the retirement rates to reflect this experience.

12. **Early (reduced) retirement**: actual experience showed fewer early retirements, recommend decreasing rates at all ages to reflect this experience.

13. **Termination (withdrawal)**: experience shows that terminations are occurring at a higher rate than assumed, except for females in the first five years of employement. Recommend adjusting rates to reflect observed experience.

14. **Disability**: experience shows disabilities occurring at a lower rate than assumed. Recommend reducing rates to reflect observed experience.

Air Guard Firefighters Retirement System

15. **Salary increase**: observed experience shows salary increases lower than assumed. The recommendation is to decrease the assumed salary increases and to move from age-based merit and promotion increases to service-based merit and promotion increases (same assumption as the State plan).

16. **Retirement (unreduced retirement):** data shows members work past age 70. Increase the assumed final age of employment from 70 to 80. Experience also shows slightly higher retirement rates. Recommend making modifications to the retirement rates to reflect this experience.

17. **Early (reduced) retirement**: actual experience showed fewer early retirements, recommend decreasing rates at all ages to reflect this experience.

18. **Termination (withdrawal)**: experience shows that terminations are occurring at a higher rate than assumed for younger ages and lower than assumed for older ages. Recommend adjusting rates to reflect observed experience.

19. **Disability**: experience shows disabilities occurring at a lower rate than assumed. Recommend reducing rates to reflect observed experience.

Law Enforcement Plan

20. **Salary increase**: experience shows total increases were lower than expected, but pay increases in the early years of employment were higher than expected. Recommend decreasing the total assumed increases while increasing the merit/promotion assumption.

21. **Retirement (unreduced retirement):** data shows members work past age 65. Increase the assumed final age of employment from 65 to 70. Experience also shows slightly lower retirement rates. Recommend decreasing retirement rates to reflect this experience.

22. **Early (reduced) retirement**: actual experience shows fewer early retirements, recommend decreasing rates at all ages to reflect this experience.

23. **Termination (withdrawal)**: experience shows that terminations are occurring at a higher rate than assumed for males and lower rate for females. Additionally the ultimate rate is higher than expected. Recommend increasing rates to reflect observed experience.

24. **Disability**: Data indicated fewer disabilities than expected. Duty disabilities were lower than expected while non-duty disabilities were higher than expected. Recommend changes to reflect observed experience.

State Highway Patrol, Game & Fish Warden and Criminal Investigator Retirement Plan (Wardens)

25. **Salary increase**: experience shows the merit and promotion increases are lower than assumed. Recommend slightly decreasing the age-based salary increase rates for merit and promotion.

26. **Retirement (unreduced retirement):** Experience shows slightly lower retirement rates. Recommend decreasing retirement rates to reflect this experience.

27. **Termination (withdrawal)**: experience shows that terminations are occurring at a higher rate than assumed. Recommend increasing rates to reflect observed experience.

28. **Disability**: data does not indicate any change required.

Judicial Retirement System

29. **Salary increase**: experience shows the salary increases are higher than assumed. Recommend increasing salary increase rates to 1.50% above wage inflation (2.50%) for all years. The current salary increase assumption of 3.75% per year will increase to 4.00% per year.

30. **Retirement (unreduced retirement):** data does not indicate any change required.

31. **Early (reduced) retirement**: data does not indicate any change required.

32. **Termination (withdrawal)**: data does not indicate any change required.

33. **Disability**: data does not indicate any change required.

Paid Firemen's Retirement Fund Plan A

34. **Salary increase**: no change recommended.

35. **Retirement (unreduced retirement):** no change recommended.

36. **Early (reduced) retirement**: no change recommended.

37. **Termination (withdrawal)**: no change recommended.

38. **Disability**: data does not indicate any change required.

Paid Firemen's Retirement Fund Plan B

39. **Salary increase**: experience shows the merit and promotion increases are higher than assumed. Recommend slightly increasing the age-based salary increase rates for merit and promotion.

40. **Retirement (unreduced retirement):** Experience shows lower retirement rates. Recommend decreasing retirement rates to reflect this experience.

41. **Termination (withdrawal)**: experience shows that terminations are occurring at a higher rate than assumed. Recommend increasing rates to reflect observed experience.

42. **Disability**: experience shows a decrease in the rate of disability. Recommend decreasing rates to reflect observed experience.

Summary of Results

The following tables provide the summary of the key actuarial values for the current assumptions and the proposed assumptions.

Current Assumptions January 1, 2017 with 7.75% Assumed Return

	State	Law Enforcement	Wardens	Judges	Fire A	Fire B	Guard Firefighters
Actuarial accrued liability (AAL)	$9,039.30	$ 628.08	$ 169.25	$ 24.46	$205.95	$135.23	$ 7.80
Actuarial value of assets (AVA)	7,063.05	590.47	134.61	26.77	124.44	134.45	6.80
Market value of assets (MVA)	6,678.50	559.28	127.39	25.39	116.87	127.49	6.43
Unfunded actuarial accrued liability	$1,976.25	$ 37.62	$ 34.64	$ (2.31)	$ 81.52	$ 0.78	$ 1.00
Funded status							
- Actuarial value	78.14%	94.01%	79.53%	109.46%	60.42%	99.42%	87.21%
- Market value	73.88%	89.05%	75.26%	103.81%	56.74%	94.27%	82.51%

Proposed Assumptions January 1, 2017 with 7.25% Assumed Return

	State	Law Enforcement	Wardens	Judges	Fire A	Fire B	Guard Firefighters
Actuarial accrued liability (AAL)	$9,128.02	$ 662.36	$ 171.72	$ 26.17	$224.01	$140.75	$ 7.92
Actuarial value of assets (AVA)	7,063.05	590.47	134.61	26.77	124.44	134.45	6.80
Market value of assets (MVA)	6,678.50	559.28	127.39	25.39	116.87	127.49	6.43
Unfunded actuarial accrued liability	$2,064.97	$ 71.89	$ 37.11	$ (0.60)	$ 99.57	$ 6.30	$ 1.12
Funded status							
- Actuarial value	77.38%	89.15%	78.39%	102.30%	55.55%	95.53%	85.90%
- Market value	73.16%	84.44%	74.18%	97.02%	52.17%	90.58%	81.27%

Board Adopted Assumptions

Subsequent to the presentation of the results of this experience study, the Board adopted a 7.00% rate of return assumption with an inflation assumption of 2.25%. Throughout this report, the data and exhibits will be referred to the proposed rates above.

The following would show the impact of a 7.00% return, an inflation assumption of 2.25%. Assumed salary increase rates, wage inflation and payroll growth are decreased 0.25% from the above 7.25% scenario.

	State	Law Enforcement	Wardens	Judges	Fire A	Fire B	Guard Firefighters
Actuarial accrued liability (AAL)	$9,330.11	$ 679.51	$ 176.04	$ 26.72	$ 230.00	$ 144.43	$ 8.11
Actuarial value of assets (AVA)	7,063.05	590.47	134.61	26.77	124.44	134.45	6.80
Market value of assets (MVA)	6,678.50	559.28	127.39	25.39	116.87	127.49	6.43
Unfunded actuarial accrued liability	$2,267.05	$ 89.04	$ 41.43	$ (0.06)	$ 105.57	$ 9.98	$ 1.31
Funded status							
- Actuarial value	75.70%	86.90%	76.46%	100.21%	54.10%	93.09%	83.86%
- Market value	71.58%	82.31%	72.36%	95.04%	50.81%	88.27%	79.34%

The experience study illustrations focused on a 7.25% rate of return assumption with a 2.50% inflation assumption. The experience study recommendation is that the assumed rate of return be no more than 7.25% and that the assumed rate of inflation be no more than 2.50%. The Board's decision to move to a 7.00% return with a 2.25% inflation assumption is also reasonable and conservative. The assumption adopted by the Board will increase the likelihood of achieving the actuarially assumed rate of return.

State Plan Adopted Assumption Summary		
Assumption	Current	Adopted
Investment Return/Discount Rate	7.75%	7.00%
Inflation	3.25%	2.25%
Real Rate of Return	4.50%	4.75%
Wage Inflation	4.25%	2.50%
Productivity	1.00%	0.25%
Payroll Growth	4.25%	2.50%
Amortization Period for ADC*	30 Year Open	30 Year Closed Layered
Actuarial Value of Assets	5 year smoothing, with immediate recognition of interest and dividends	5 year smoothing of entire return
Mortality	RP-2000	RP-2014
Mortality Projection	Scale BB	Scale MP-2016**
Retirement	Age-based	Age-based modified
Termination	Age-based	Age-based modified
Salary	Age-based	Service-based
Disability	Age-based	Age-based modified
Expense Growth Rate	6.50%	2.50%

  *The Actuarially Determined Contribution
  **MP-2017 when available

Impacts on the contribution rate will be determined at the completion of the January 1, 2018 valuation. At that time, the 30 year projections will be produced which will indicate the contribution requirements under the Board's current policy for making contribution recommendations to the Joint Appropriations Committee.

Coordination with the 2016 actuarial audit

The WRS actuarial experience studies were audited, with findings presented in the report dated February 6, 2017. Certain recommendations for consideration were included in that report for this experience study. Those recommendations and their disposition are:

"Add more documentation on the development of the merit increase component of salary scale"
> This has been included in the section on salary scale

"Mortality- Use a benefit-weighted method"
> The assumption was studied and recommendations made based on the benefit-weighted amount

"Judges- eliminate the termination assumption"
> We kept the assumption as is, recognizing that although there are few terminations, there remains a possibility for that event.

We appreciate the comments made in the audit and have enhanced our own explanations in this experience study.

SECTION B

INTRODUCTION

Introduction

A periodic review and selection of the actuarial assumptions is one of many important components of understanding and managing the financial aspects of the Wyoming Retirement System (WRS). Use of outdated or inappropriate assumptions can result in understated costs which will lead to higher future contribution requirements or perhaps an inability to pay benefits when due; or, on the other hand, produce overstated costs which place an unnecessarily large burden on the current generation of members, employers, and taxpayers.

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

The economic impact from various outcomes and the ability to adjust from experience deviating from the assumption are not symmetric. Due to compounding economic forces, legal limitations, and other obligations, outcomes from underestimating future liabilities are much more difficult to manage than outcomes of overestimates. It is easier to decrease a contribution requirement than it is to increase the contribution requirement. That asymmetric risk should be considered when the assumption set, investment policy and funding policy are created. The assumption set used in the valuation process represents the best estimate of the future experience of the System and may even Provide a margin against adverse experience.

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

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

Summary of Process

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

- Retirement rates
- Mortality rates
- Turnover rates
- Disability rates
- Investment return rate
- Salary increase rates
- Inflation rate

For some of these assumptions, such as the mortality rates, past experience provides important evidence about the future. For others, such as the investment return assumption, the link between past

and future results is much weaker. In either case, actuaries should review the plan's assumptions periodically and determine whether these assumptions are consistent with actual past experience and with anticipated future experience.

The last such actuarial experience investigation was performed as of December 31, 2011 and the recommendations were adopted February 22, 2013 effective with the January 1, 2014 actuarial valuation. For this experience study, we have reviewed WRS' experience for the five-year period from January 1, 2012 through December 31, 2016. The new assumptions will be effective with the January 1, 2018, actuarial valuation.

In conducting experience studies, actuaries generally use data over a period of several years. This is necessary in order to gather enough data so that the results are statistically significant. In addition, if the study period is too short, the impact of the current economic conditions may lead to misleading results. It is known, for example, that the health of the general economy can affect salary increase rates and withdrawal rates. Using results gathered during a short-term boom or bust will not be representative of the long-term trends in these assumptions. In addition, the adoption of legislation, such as plan improvements or changes in salary schedules, will sometimes cause a short-term distortion in the experience. For example, if an early retirement window were opened during the study period, we would usually see a short-term spike in the number of retirements followed by a dearth of retirements for the following two-to-four years. Using a longer period prevents giving too much weight to such short-term effects. On the other hand, using a much longer period could water down real changes that may be occurring, such as mortality improvement or a change in the ages at which members retire.

In an experience study, the first step is to determine the number of deaths, retirements, etc. that occurred during the period. The next step is to use the assumptions in order to determine the number expected to occur. The number of "expected" decrements (death, termination, retirement, disability) is determined by multiplying the probability of the occurrence at the given age, by the "exposures" at that same age. An "exposure" is a member who is susceptible to the given decrement.

For example, consider a rate of retirement of 15% at age 55. The number of exposures can only be those members who are age 55 and eligible for retirement at that time. Thus, they are considered "exposed" to that assumption. Finally, the A/E ratio is calculated, where "A" is the actual number (of retirements, for example) and "E" is the expected number. If the current assumptions were "perfect", the A/E ratio would be 100%. Variance from this calculation is an indication that new assumptions may be needed. (However, in some cases the assumptions may be set to produce an A/E ratio a little above or below 100%, in order to introduce some conservatism.) Assumptions are reviewed in the aggregate and also by how well they fit the actual results by gender, by age, and by service.

If the data leads the actuary to conclude that new tables are needed, the actuary may "graduate" or smooth the results, since the raw results can be quite uneven from age to age or from service to service.

While the recommended assumption set represent a best estimate, there are other reasonable assumptions that could be supported. Some reasonable assumption sets would show higher or lower liabilities or costs.

SECTION C

ANALYSIS OF EXPERIENCE AND RECOMMENDATIONS

Analysis of Experience and Recommendations

This section begins by discussing the economic assumptions and recommendations that apply to all WRS plans. These assumptions are the inflation rate, the real rate of return, the investment return rate and the assumed rate of growth in payroll.

Actuarial Standards

Actuarial Standards of Practice (ASOP) No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, provides guidance to actuaries on giving advice on selecting economic assumptions for measuring obligations for defined benefit plans. ASOP No. 27 was revised and adopted by the Actuarial Standards Board (ASB) in September 2013.

As no one knows what the future holds, it is necessary for an actuary to estimate possible future economic outcomes. Recognizing that there is not one right answer, the current standard calls for an actuary to develop a reasonable economic assumption. A reasonable assumption is one that is:

1. appropriate for the purpose of the measurement,
2. reflects the actuary's professional judgment,
3. takes into account historical and current economic data that is relevant as of the measurement date,
4. is an estimate of future experience; an observation of market data; or a combination thereof;
5. and has no significant bias.

The standard explicitly advises an actuary not to give undue weight to recent experience.

Each economic assumption should individually satisfy this standard. Each economic assumption should be consistent with every other economic assumption over the measurement period.

Inflation Assumption

By "inflation," this analysis is referring to price inflation, as measured by annual increases in the Consumer Price Index (CPI). This inflation assumption underlies most of the other economic assumptions. It impacts investment return, salary increases, and overall payroll growth. The current annual inflation assumption is 3.25%. A history of the changes in the inflation assumption for WRS is shown in the following table:

Valuation Date : January 1,	Inflation Assumption
1990	4.50%
1998	4.00%
2003	3.00%
2009	3.50%
2014	3.25%

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

Average Annual Inflation
CPI-U, Five-Year Averages
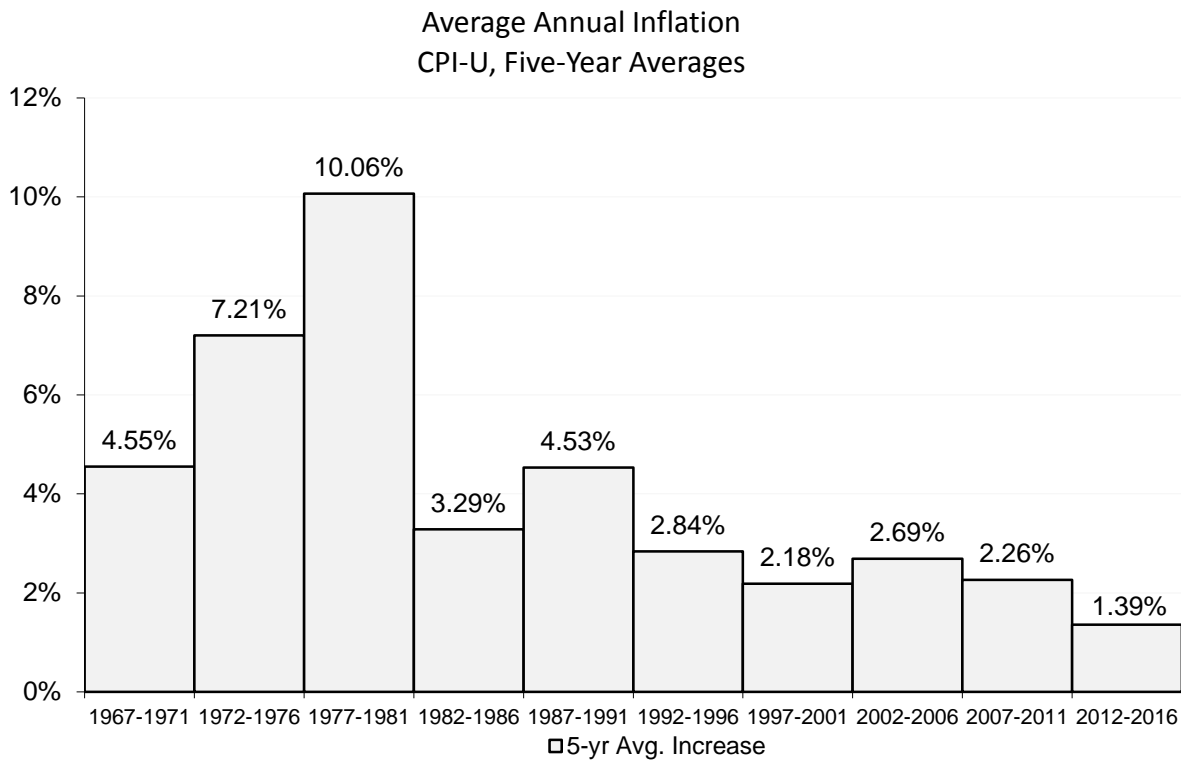
Source: Bureau of Labor Statistics, CPI-U, all items, not seasonally adjusted, Calendar Years

The table below shows the average inflation over various periods, ending December 2016.

Periods Ending Dec. 2016	Average Annual Increase in CPI-U
Last five (5) years	1.39%
Last ten (10) years	1.68%
Last twenty (20) years	2.15%
Last thirty (30) years	2.66%
Since 1913 (first available year)	3.14%

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

Inflation has been relatively low over the last thirty years, and historically so over the past 10 years.

This CPI-U measurement is based on the national CPI-U. The measurement is relevant to assessing the long term growth on assets. Inflation is also a component for salary increases and the payroll growth assumption. It is interesting to review the inflation that has occurred in the State of Wyoming. While the Wyoming rate of inflation is not used directly in setting assumptions, it may be useful in understanding some of the impacts on salary and population growth.

	Annual Rates of Inflation	
Quarter:	**US CPI**	**State of Wyoming CPI**
2Q12	1.7%	2.4%
4Q12	1.7%	2.1%
2Q13	1.8%	3.1%
4Q13	1.5%	2.9%
2Q14	2.1%	2.7%
4Q14	0.8%	1.1%
2Q15	0.1%	0.9%
4Q15	0.7%	0.5%
2Q16	1.0%	-0.6%
4Q16	2.1%	0.6%
Mean	**1.1%**	**0.6%**

*Source: Wyoming Department of Administration & Information, Economic Analysis Division, April 12, 2017; **Wyoming Cost of Living Index for the Fourth Quarter of 2016**, Table 3-Annual Inflation Rates by Region.*

Forecasts from the Investment Consultant

WRS has retained the investment consulting services of Meketa. Meketa is using 2.50% as their inflation assumption over the next 20 years. Meketa uses 2.00% over the next 10 years, then a higher rate over the following 10 years in order to produce an average 20-year rate of 2.50%.

Forecasts from Other Investment Consulting Firms

The 2017 capital market assumption sets for eight investment-consulting firms showed the average assumption for inflation was 2.27%, with a range of 2.00% to 2.50%.

Expectations Implied in the Bond Market

Another source of information about future inflation is the market for US Treasury bonds. The difference in yield between non-indexed and indexed (TIPS) treasury bonds should be a reasonable estimate of what the bond market expects on a forward-looking basis for inflation. Conventional Treasury securities compensate its holders by providing a nominal yield with two components; the real rate of interest and inflation. Since the TIPS (Treasury Inflation-Protected Securities) already adjust for inflation, the yield only includes the real rate of interest. Therefore, the difference roughly reflects the inflation expectation for that maturity horizon.

As of the end of April, the difference for 20-year bonds implies that inflation over the next twenty years would average 2.06%. The difference in yield for 30-year bonds implies 2.23% inflation over the next 30 years. The chart below shows the historical market implied inflation from January 1, 2003 through April 30, 2017.
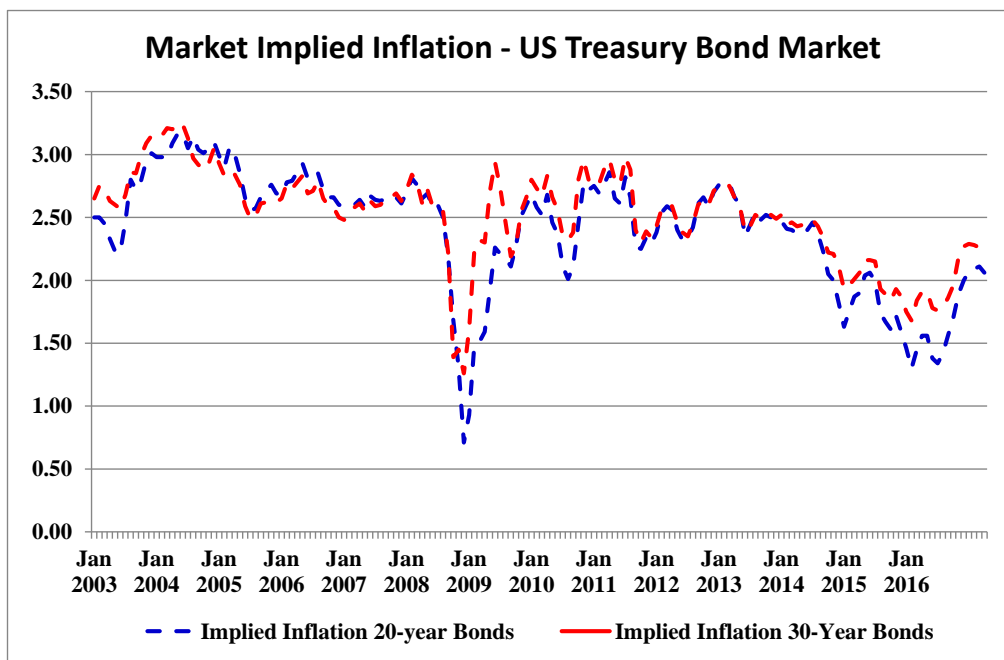
However, this analysis is known to be imperfect as it ignores the inflation risk premium that buyers of US Treasury bonds often demand as well as possible differences in liquidity between US Treasury bonds and TIPS.

Forecasts from Social Security Administration

In the Social Security Administration's 2016 Trustees Report, the Office of the Chief Actuary is projecting a long-term average annual inflation rate of 2.6% under the intermediate cost assumption.

For the second year in a row, the Chief Actuary for the Social Security Administration reduced this assumption by 0.10% from the prior year and narrowed the assumptions under the low cost and high cost scenarios to 2.0% and 3.2%.

Survey of Professional Forecasters and Fed Policy

The Philadelphia Federal Reserve conducts a quarterly survey of the Society of Professional Forecasters. Their most recent forecast (second quarter of 2017) was for inflation over the next ten years (2017 to 2026) to average 2.30%. This value has increased 0.20% in the last six months.

The Federal Open Market committee (FOMC) targets a 2% Personal Consumption Expenditure (PCE) price index. Since 1992 the PCE averaged 1.8% while the CPI-U averaged 2.3%. The last 70 years saw a PCE of 3.1% and a CPI-U of 3.5%. Thus an inflation target of the PCE of 2% plus a margin to CPI-U of .5% would be in alignment with the historical differences of these metrics. Based on this data, by targeting a 2% PCE, the Fed is implicitly targeting an inflation rate of 2.5%.

Recommendation

The recommendation is to reduce the inflation rate from 3.25% to a rate no greater than 2.50%.

Investment Return Rate Assumption

The investment return assumption is one of the principal assumptions used in any actuarial valuation of a retirement plan. It is used to discount future expected benefit payments to the valuation date in order to determine the liabilities of the plans. Even a small change to this assumption can produce significant changes to the liabilities and contribution rates. Currently, it is assumed that future investment returns will average 7.75% per year, net of investment expenses.

The chart below shows the historical annualized history of WRS market returns through FY 2016.

Wyoming Retirement System
History of Market Value Returns
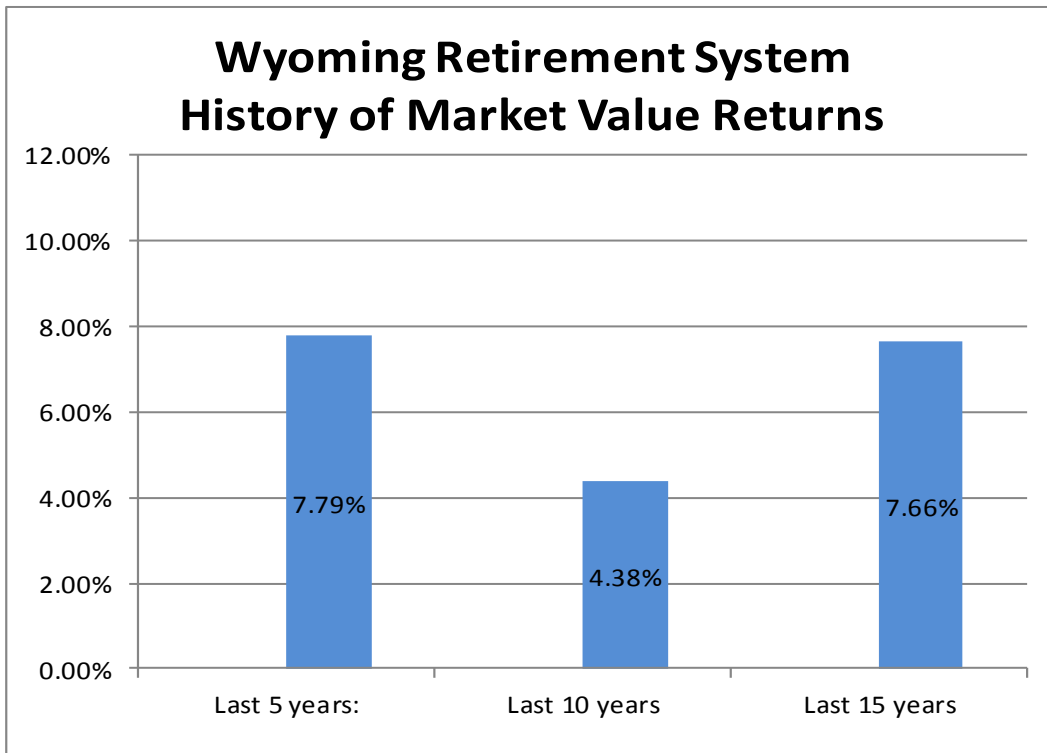
The returns in the chart above are market returns, gross of investment expenses, as reported in the actuarial valuations. WRS did exceed the expected 7.75% return assumption on a market value basis in seven of the last seventeen years.

Past performance, even averaged over a fifteen-year period, is not a reliable indicator of future performance.

More importantly, the real rates of return for many asset classes, especially equities, vary so dramatically from year to year that even a fifteen-year period is not long enough to provide reasonable guidance. There are strong reasons to believe the next fifteen years will be different from the last, in large part because current bond yields are significantly lower than they were 25 years ago.

Assumption Comparison to Peers

The chart below shows the distribution of the investment return assumptions in the Public Fund Data as of February 2017. Information from the 2011 survey is also included in order to show the national trends in this assumption. The median rate of return is 7.50% and the average is 7.54%. The chart also includes a subset of the current survey that only includes systems that have performed experience studies in the last 2 years:

Public Fund Data - Investment Return Assumption
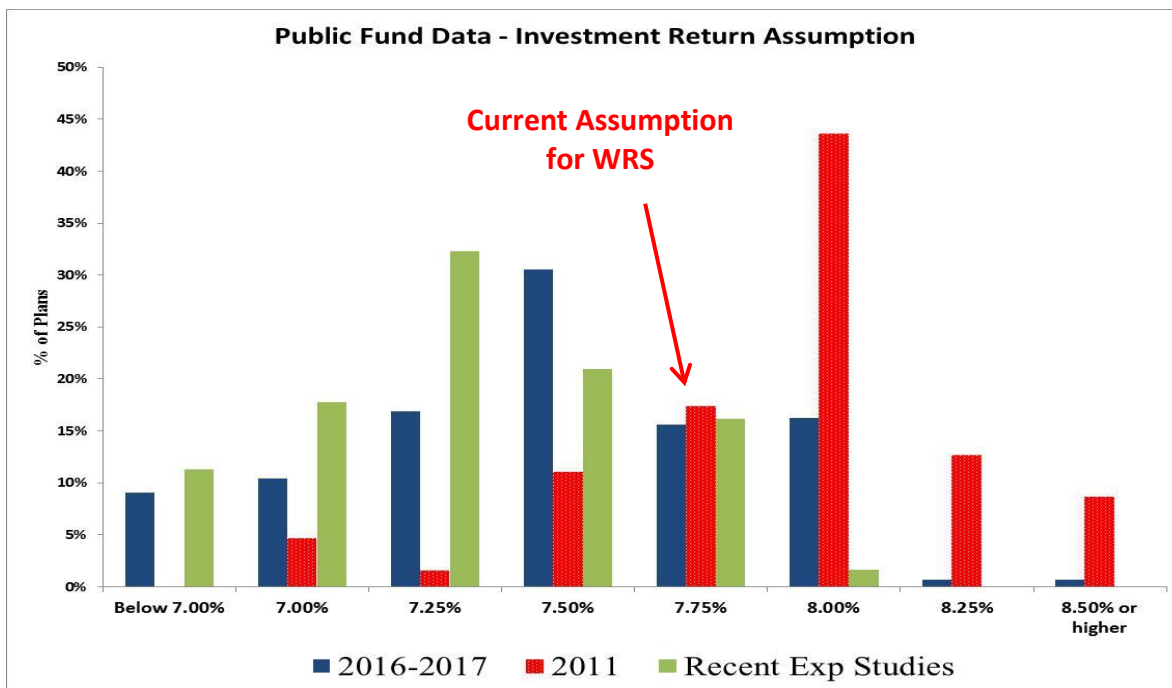
As shown, for recent experience studies, the median assumption has been 7.25%.

Asset Allocation

The most appropriate approach to selecting an investment return assumption identifies expected returns given the fund's asset allocation. Each asset class in the fund's asset allocation is mapped to capital market expectations.

WRS Asset Allocation	
Asset Classes	Percent
Cash	0.00%
US Stock - Large Cap	11.25%
US Stock - Small Cap	11.25%
International Equity	17.50%
Emerging Markets Equity	5.00%
US Corporate Bonds	7.50%
Government Bonds	10.00%
TIPS	0.00%
High Yield	2.50%
Real Estate	5.50%
Private Equity	9.00%
Hedge Funds	20.50%
Other Alternatives	0.00%
Total	100.00%

Investment Consultant	Investment Consultant Expected Nominal Return	Investment Consultant Inflation Assumption	Expected Real Return (2)–(3)	Actuary Inflation Assumption	Expected Nominal Return (4)+(5)	Expected Nominal Return Net of Expenses (6)-(7)+(8)
Wyoming Retirement System Experience Study						
(1)	(2)	(3)	(4)	(5)	(6)	(9)
1	5.97%	2.20%	3.77%	2.50%	6.27%	6.27%
2	6.45%	2.26%	4.19%	2.50%	6.69%	6.69%
3	6.19%	2.00%	4.19%	2.50%	6.69%	6.69%
4	7.01%	2.50%	4.51%	2.50%	7.01%	7.01%
5	7.03%	2.50%	4.53%	2.50%	7.03%	7.03%
6	7.60%	2.25%	5.35%	2.50%	7.85%	7.85%
7	7.73%	2.21%	5.51%	2.50%	8.01%	8.01%
8	8.25%	2.25%	6.00%	2.50%	8.50%	8.50%
Average	**7.03%**	**2.27%**	**4.76%**	**2.50%**	**7.26%**	**7.26%**

Each of the eight investment consultants surveyed submitted their capital market expectations. They submitted expected returns by asset class, as well as the expected correlation coefficients. Eight of the surveyed firms indicated that their expectations spanned a 5-10 year time horizon. These eight firms also showed an average expected inflation of 2.27%.

Four of the firms also presented a set of capital market expectations using a 20+ year time horizon. For those four data sets the average expectation for inflation was 2.29%.

As shown, based on the capital market assumptions used in the analysis, all eight portfolios are expected to return substantially less than the current 7.75% assumption. On average, the expected return for all eight surveyed firms is 7.26%.

Wyoming Retirement System Experience Study-Shorter Time Horizon						
Investment Consultant	Distribution of 20-Year Average Geometric Net			Probability of exceeding 7.75%	Probability of exceeding 7.50%	Probability of exceeding 7.25%
	40th	50th	60th			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	4.94%	5.61%	6.28%	21.11%	23.89%	26.87%
2	5.62%	6.20%	6.78%	24.95%	28.51%	32.30%
3	5.55%	6.16%	6.76%	25.32%	28.75%	32.38%
4	5.55%	6.26%	6.97%	29.92%	33.04%	36.29%
5	5.65%	6.33%	7.03%	30.26%	33.50%	36.88%
6	6.69%	7.30%	7.92%	42.67%	46.75%	50.87%
7	6.71%	7.37%	8.04%	44.29%	48.07%	51.87%
8	6.41%	7.31%	8.21%	45.05%	47.83%	50.62%
Average	5.89%	6.57%	7.25%	32.95%	36.29%	39.76%

The above chart looks at all eight surveyed firms and includes the impact of asset volatility on the returns. The expected compound return over the next 20 years is 6.57%, with a range from 5.89% to 7.25%. The surveyed firms have a short time horizon-much shorter than the life of the WRS plan. Next, the analysis looks at the four consultants who provided information based on a longer investment horizon.

Wyoming Retirement System Experience Study Longer Time Horizon						
Investment Consultant	Distribution of 20-Year Average Geometric Net			Probability of exceeding 7.75%	Probability of exceeding 7.50%	Probability of exceeding 7.25%
	40th	50th	60th			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	7.16%	7.82%	8.49%	51.08%	54.89%	58.65%
2	6.24%	6.95%	7.67%	38.95%	42.35%	45.81%
3	6.56%	7.24%	7.94%	42.65%	46.27%	49.92%
4	6.27%	6.91%	7.55%	36.96%	40.73%	44.60%
Average	6.56%	7.23%	7.91%	42.41%	46.06%	49.75%

For this group the expected compound return over the next 20 years is 7.23% with a range of 6.56% to 7.91%. Furthermore, the probability for exceeding the 7.25% is nearly 50%-indicating an expected return of 7.25% is reasonable. Returns lower than 7.25% would have an even higher probability of achievement.

The 20 year return expectation by Meketa is 7.26%.

Recommendation

Based on this analysis we are recommending the Board reduce the investment return assumption to at least 7.25%. This would include a real return of 4.75%. The ultimate nominal rate will be dependent on the adopted rate of inflation.

If the Board would like to increase the probability of achieving the long-term rate of return, it may wish to consider adopting a 7.00% return assumption.

Salary Increase Rates

The current salary increase rates assumed for the valuation vary by age, with the exception of the Fire A plan and the Judges plan. The Fire A plan assumes a constant salary increase rate of 5.00% per year. The Judges plan assumes a constant salary increase rate of 4.50% per year.

Wage Inflation

The salary increase assumption consists of the sum of the wage inflation assumption and a "merit and promotion" assumption. The merit and promotion increases are assumed only to apply in the earlier years of a member's career.

Historically wage inflation usually exceeds price inflation. The amount of wage inflation in excess of price inflation is referred to as the "productivity" component of the salary increase. This productivity component is a reflection of economic gains occurring to the organization and being passed on to the members through increases in their compensation.

For the last ten years wage inflation has outpaced price inflation by about .61%. Since 1951, wage inflation has been about 1.00% per year larger than price inflation.

Wage inflation is currently assumed 4.25%. This wage inflation assumption is comprised of a core inflation assumption component of 3.25% and a productivity assumption component of 1.00%. Individual merit and promotion assumptions are age based ranging from 4.00% in the younger years to 0.00% in later years.

Productivity in the pay raises is defined as the amount of the pay raise above inflation that is generally given to all members. As discussed previously, inflation for the study period was 1.39%. In order to determine the productivity component that occurred over the study period the pay raises for the members at the older service periods is examined. Pay raises for this group generally do not include merit and promotion amounts. The pay raises for these longer-service members includes inflation and productivity. The average pay raise for this group was 1.64% for the study period. Inflation, at 1.39%, is then subtracted, leaving a productivity component of the pay raises of .25%.

Over the five-year experience period, actual core inflation was 1.39% (versus the assumed rate of 3.25%). Over this same five-year period, the productivity component has been .25% (rather than the assumed 1.00%). The recommendation for all plans (except Fire A, Judges and the Volunteer plans) is to decrease the wage inflation assumption from 4.25% to 2.50%. The new wage inflation assumption

will be comprised of a 2.25% inflation assumption and a .25% productivity assumption. The recommendation for the merit and promotion assumption on the State plan is to correlate those increases to years of service rather than age.

Merit and promotion is the final piece of the assumed salary increase assumption. In order to determine the merit and promotion increases that occurred during the study period the total increases are prepared (by service group) and then the inflation (1.39%) and productivity (.25%) are subtracted.

The following exhibits illustrate the expected versus actual merit and promotion increases as well as the total salary increase rates to be assumed.

Wyoming Retirement System Experience Study							
State Plan		Merit/Promotion % Increase			Total % Increase		
Service			Expected			Expected	
Index	Number	Actual[1]	Old	New	Actual	Old	New[2]
1	9,316	2.79 %	1.35 %	4.00 %	4.43 %	5.60 %	6.50 %
2	14,630	5.90 %	1.33 %	4.00 %	7.54 %	5.58 %	6.50 %
3	11,575	3.93 %	1.31 %	4.00 %	5.57 %	5.56 %	6.50 %
4	10,079	3.30 %	1.28 %	3.50 %	4.94 %	5.53 %	6.00 %
5	9,083	2.76 %	1.24 %	2.75 %	4.40 %	5.49 %	5.25 %
6	8,555	2.35 %	1.21 %	2.25 %	3.99 %	5.46 %	4.75 %
7	8,113	1.69 %	1.18 %	1.75 %	3.33 %	5.43 %	4.25 %
8	7,611	1.36 %	1.14 %	1.50 %	3.00 %	5.39 %	4.00 %
9	6,985	1.54 %	1.12 %	1.50 %	3.18 %	5.37 %	4.00 %
10	6,322	1.55 %	1.09 %	1.50 %	3.19 %	5.34 %	4.00 %
11	5,704	1.07 %	1.08 %	1.25 %	2.71 %	5.33 %	3.75 %
12	5,204	1.15 %	1.06 %	1.00 %	2.79 %	5.31 %	3.50 %
13	4,844	0.95 %	1.04 %	1.00 %	2.59 %	5.29 %	3.50 %
14	4,544	1.17 %	1.02 %	1.00 %	2.81 %	5.27 %	3.50 %
15	4,264	0.73 %	1.00 %	0.75 %	2.37 %	5.25 %	3.25 %
16	3,862	0.83 %	0.98 %	0.75 %	2.47 %	5.23 %	3.25 %
17	3,516	0.53 %	0.97 %	0.75 %	2.17 %	5.22 %	3.25 %
18	3,210	0.64 %	0.95 %	0.75 %	2.28 %	5.20 %	3.25 %
19	2,961	0.47 %	0.92 %	0.50 %	2.11 %	5.17 %	3.00 %
20	2,772	0.42 %	0.91 %	0.50 %	2.06 %	5.16 %	3.00 %
21	2,680	0.50 %	0.88 %	0.25 %	2.14 %	5.13 %	2.75 %
22	2,538	0.25 %	0.87 %	0.25 %	1.89 %	5.12 %	2.75 %
23	2,432	0.19 %	0.85 %	0.25 %	1.83 %	5.10 %	2.75 %
24	2,308	0.08 %	0.85 %	0.25 %	1.72 %	5.10 %	2.75 %
25+	17,529	(0.04)%	0.66 %	0.00 %	1.60 %	4.91 %	2.50 %

1. *The Actual Merit/Promotion rate increase is determined by taking the total salary increase, subtracting inflation (1.39%), and productivity (.25%) for the same period.*

2. *The new Total % increase is the recommended total assumed salary increase, which is the sum of the inflation assumption of 2.25%, productivity of .25% and the relevant merit/promotion% increase.*

Wyoming Retirement System Experience Study							
		Merit/Promotion % Increase			Total % Increase		
			Expected			Expected	
Law Enforcement	Number	Actual	Old	New	Actual	Old	New
<25	606	4.59%	3.75%	4.50%	6.23%	8.00%	7.00%
25-29	1,918	4.07%	3.19%	4.00%	5.71%	7.44%	6.50%
30-34	2,111	2.42%	2.20%	2.50%	4.06%	6.45%	5.00%
35-39	1,959	1.65%	1.56%	1.75%	3.29%	5.81%	4.25%
40-44	1,826	1.72%	1.05%	1.75%	3.36%	5.30%	4.25%
45-49	1,511	1.33%	0.75%	1.50%	2.97%	5.00%	4.00%
50-54	1,100	1.11%	0.47%	1.00%	2.75%	4.72%	3.50%
55-59	802	0.85%	0.00%	0.75%	2.49%	4.25%	3.25%
60-64	345	0.69%	0.00%	0.50%	2.33%	4.25%	3.00%
65+	85	-0.64%	0.00%	0.00%	1.00%	4.25%	2.50%

Wyoming Retirement System Experience Study							
		Merit/Promotion % Increase			Total % Increase		
			Expected			Expected	
Fire B	Number	Actual	Old	New	Actual	Old	New
<25	39	-1.46%	2.75%	5.00%	0.18%	7.00%	7.50%
25-29	199	4.05%	2.75%	4.50%	5.69%	7.00%	7.00%
30-34	335	4.91%	2.52%	4.50%	6.55%	6.77%	7.00%
35-39	352	3.88%	1.90%	4.00%	5.52%	6.15%	6.50%
40-44	315	2.72%	1.25%	3.00%	4.36%	5.50%	5.50%
45-49	242	2.63%	1.25%	2.50%	4.27%	5.50%	5.00%
50-54	130	2.61%	0.75%	2.50%	4.25%	5.00%	5.00%
55-59	66	2.21%	0.20%	2.25%	3.85%	4.45%	4.75%
60-64	10	2.90%	0.00%	2.00%	4.54%	4.25%	4.50%
65+	3	3.26%	0.00%	2.00%	4.90%	4.25%	4.50%

Wyoming Retirement System Experience Study

Wardens	Number	Merit/Promotion % Increase			Total % Increase		
		Actual	Expected		Actual	Expected	
			Old	New		Old	New
<25	2	13.39%	3.75%	6.00%	15.03%	8.00%	8.50%
25-29	62	5.47%	3.75%	5.50%	7.11%	8.00%	8.00%
30-34	183	1.52%	3.75%	3.25%	3.16%	8.00%	5.75%
35-39	351	0.34%	3.63%	1.50%	1.98%	7.88%	4.00%
40-44	524	0.34%	3.25%	0.50%	1.98%	7.50%	3.00%
45-49	640	0.37%	2.79%	0.50%	2.01%	7.04%	3.00%
50-54	603	-0.03%	1.81%	0.50%	1.61%	6.06%	3.00%
55-59	399	-0.25%	0.75%	0.00%	1.39%	5.00%	2.50%
60-64	56	-1.57%	0.38%	0.00%	0.07%	4.63%	2.50%
65+	-	0.00%	0.00%	0.00%	1.64%	4.25%	2.50%

Wyoming Retirement System Experience Study

Judges	Number	Merit/Promotion % Increase			Total % Increase		
		Actual	Expected		Actual	Expected	
			Old	New		Old	New
<25	-	0.00%	0.00%	1.50%	0.00%	3.75%	4.00%
25-29	-	0.00%	0.00%	1.50%	0.00%	3.75%	4.00%
30-34	-	0.00%	0.00%	1.50%	0.00%	3.75%	4.00%
35-39	-	0.00%	0.00%	1.50%	0.00%	3.75%	4.00%
40-44	15	4.63%	0.00%	1.50%	6.27%	3.75%	4.00%
45-49	18	2.29%	0.00%	1.50%	3.93%	3.75%	4.00%
50-54	15	1.74%	0.00%	1.50%	3.38%	3.75%	4.00%
55-59	51	2.57%	0.00%	1.50%	4.21%	3.75%	4.00%
60-64	89	1.70%	0.00%	1.50%	3.34%	3.75%	4.00%
65+	21	0.93%	0.00%	1.50%	2.57%	3.75%	4.00%

➢ *Law Enforcement- decrease total assumed pay increases while increase the merit/promotion assumption.*
➢ *Fire B- Some changes to the total assumed pay increases while increasing the merit/promotion assumption.*
➢ *Wardens- decrease total assumed pay increases and decrease the merit/promotion assumption.*
➢ *Fire A- no change is recommended in the salary increase rates. The current assumed salary increase rate for the three active members is 4.25% per year.*
➢ *Judges- Increase the total assumed pay rate to 4.00%; add a merit/promotion component*
➢ *Guard Fire- There is not enough data for own assumption, there GuardFire was included in the analysis for the state plan.*

Payroll Growth Rate

The salary increase rates discussed above are assumptions applied to individuals. These assumed individual pay increases are used in projecting future benefits for each member of the system. There is also an overall payroll growth assumption, currently 4.25%, in projecting aggregate payroll. This separate payroll growth assumption is used in determining the annual amortization payment needed to pay off the unfunded actuarial accrued liability for six plans: State, Law Enforcement, Fire B, Wardens, Judges and Guard Firefighters (the Fire A plan calculates its amortization payment as a flat dollar amount). The amortization payments are calculated to be a level percentage of payroll. As total payroll increases over time, these charges also increase. The annual amortization payment is dependent on the rate as which payroll is assumed to increase. Higher payroll total growth means a lower payment can be made today since more dollars will be contributed in the future. A decrease in the payroll growth assumption will increase the required amortization payment.

Wyoming Retirement System Experience Study											
	Annual Payroll Increase						Population Adjusted[1] Annual Payroll Increase				
Valuation Year	State	Law Enforcemen	Wardens	Fire B	Judges	Guard FireFighters	State	Law Enforcemen	Wardens	Fire B	Judges	Guard FireFighters
2002	7.41%		17.35%	17.35%	17.97%		3.09%		10.15%	7.10%	-2.37%	
2003	2.49%		6.42%	6.42%	0.55%		8.01%		7.19%	0.70%	0.55%	
2004	4.47%	6.34%	4.47%	4.47%	29.79%		3.27%	3.36%	-0.59%	-4.95%	17.62%	
2005	5.28%	6.06%	2.84%	2.84%	-0.23%		3.18%	2.81%	2.48%	-1.96%	-0.23%	
2006	6.41%	9.76%	6.01%	6.01%	14.18%		3.87%	4.18%	1.46%	4.51%	4.40%	
2007	11.13%	10.48%	11.24%	11.79%	2.78%		7.00%	6.15%	8.04%	7.24%	2.78%	
2008	13.80%	9.98%	16.09%	9.93%	14.79%		12.84%	10.20%	12.84%	8.82%	5.72%	
2009	8.43%	11.36%	14.02%	9.22%	6.79%		6.76%	8.19%	11.24%	3.33%	4.05%	
2010	7.13%	12.64%	2.31%	6.57%	5.95%		5.41%	3.19%	5.19%	1.42%	5.95%	
2011	1.74%	3.46%	1.50%	1.38%	4.35%		1.07%	0.66%	0.87%	2.62%	1.74%	
2012	1.64%	0.54%	2.72%	0.72%	-0.10%	1.60%	0.96%	1.67%	4.01%	0.41%	-0.10%	1.60%
2013	1.44%	1.47%	0.14%	6.76%	11.29%	22.52%	0.39%	1.93%	-1.10%	-1.64%	8.58%	-5.14%
2014	0.00%	-2.34%	-6.88%	5.72%	14.84%	-3.27%	0.25%	-1.44%	-1.04%	2.27%	7.01%	-3.27%
2015	2.02%	1.77%	1.74%	5.84%	6.24%	22.71%	1.64%	3.72%	1.40%	5.55%	1.62%	0.11%
2016	2.23%	2.91%	6.49%	1.55%	0.33%	1.26%	1.99%	2.69%	2.12%	0.74%	0.33%	6.89%
2017	-0.37%	-0.80%	0.02%	6.90%	0.02%	-8.16%	1.54%	0.74%	0.66%	7.18%	0.02%	-5.53%
Five year average	1.06%	0.58%	0.21%	5.34%	6.38%	6.23%	1.16%	1.51%	0.40%	2.77%	3.45%	-1.49%
Ten year average	3.72%	3.98%	3.62%	5.41%	6.32%	NA	3.22%	3.10%	3.52%	3.02%	3.45%	NA
All years average	4.70%	5.26%	5.40%	6.47%	8.10%	4.65%	3.83%	3.43%	4.06%	2.71%	3.61%	-0.84%

1. *The annual increase in payroll growth is adjusted to smooth out the effects of large swings in the population.*

Based on the payroll growth data and the prior analysis on salary increases and price inflation, it is recommended that the payroll growth assumption be reduced from 4.25% to 2.50%. For the Judges plan, a flat salary growth assumption in all years (4.00%) also leads to a recommended payroll growth assumption of the 4.00% per year.

Demographic Assumptions

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

Post-Retirement Mortality Rates

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

The mortality table currently being used for non-disabled retirees and for beneficiaries receiving benefits is the RP-2000 combined mortality table, fully generational. Generational mortality improvements are projected for future generations using the Scale BB. The mortality tables were then calibrated with setbacks and multipliers to fit with the Wyoming data. Males are set back 5 years with a multiplier of 104% and females are set back 4 years with a multiplier of 90%.

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

The analysis of the mortality rate assumption begins by determining the expected number of deaths in each year at each age for males and females. The actual number of deaths is then compared to the expected number of deaths. The ratio of the actual deaths to the expected deaths (the A/E ratio) indicates the degree to which the assumption is predicting the outcome. When using a generational approach for mortality improvement, an A/E of 100% is targeted. However, we will also focus on the pattern across all ages and life expectancy created at individual ages when determining whether the assumption is appropriate. We will discuss this in two parts, the recommended base mortality assumption, and the recommended mortality improvement assumption.

Recommended Base Table Mortality Assumption

A ratio of actual deaths to expected deaths (A/E ratio) of 100% would be considered appropriate for a fully generation mortality table. Assumptions regarding mortality improvements for future generations will follow, through the use of a projection scale.

In analyzing the fit of the Base Table to the data, the deaths were "weighted" by the member's associated liability. In general, members with higher benefit amounts (higher liabilities) tend to live

longer than those with lower benefit amounts. [insert language on how this can be interpreted]. As can be seen below, the "fit", as measured by the A/E ratio, is good.

POST-RETIREMENT MORTALITY - MALE - ALL PLANS							
			Crude	Sample Rates		Expected Deaths	
Age	Deaths	Exposure	Rates	Old	New	Old	New
50-54	7	2,025	0.003565	0.002442	0.004709	5.7	10.0
55-59	53	9,464	0.005550	0.004188	0.006478	43.0	63.2
60-64	278	24,688	0.011271	0.007134	0.008854	186.7	223.7
65-69	333	29,535	0.011263	0.012477	0.012930	368.6	382.8
70-74	349	18,763	0.018620	0.020680	0.020141	387.8	374.3
75-79	328	10,302	0.031877	0.035492	0.032735	362.3	332.3
80-84	289	5,144	0.056266	0.060635	0.055526	308.9	280.7
85-89	207	2,131	0.097204	0.103354	0.097038	216.1	199.1
90+	110	580	0.189833	0.180490	0.167422	104.1	96.1
Other	3	611	0.004985	0.001636	0.002945	1.0	1.8
Totals	1,958	103,243	0.018965	0.019219	0.019023	1,984	1,964
Actual/Expected ratio						99%	100%

Both the Old and New tables provide a good fit to the mortality data.

The following is a chart that shows the actual mortality experience assumption for females.

POST-RETIREMENT MORTALITY - FEMALE - ALL PLANS							
			Crude	Sample Rates		Expected Deaths	
Age	Deaths	Exposure	Rates	Old	New	Old	New
50-54	4	822	0.005408	0.001741	0.002690	1.60	2.40
55-59	55	8,836	0.006260	0.002837	0.003633	27.40	33.80
60-64	140	27,642	0.005049	0.005060	0.005417	148.80	154.30
65-69	205	29,571	0.006935	0.009244	0.008518	271.60	250.50
70-74	171	15,756	0.010835	0.015706	0.013740	243.00	212.60
75-79	158	7,476	0.021109	0.025921	0.022488	191.30	165.50
80-84	161	3,786	0.042442	0.042786	0.038056	159.80	141.40
85-89	141	1,770	0.079643	0.073221	0.066891	126.90	115.50
90-94	131	713	0.183959	0.124991	0.117303	93.00	89.90
Other	2	108	0.017282	0.000928	0.000928	0.10	0.10
Totals	1,168	96,479	0.012103	0.013096	0.012086	1,264	1,166
Actual/Expected ratio						92%	100%

When reviewing the female tables, the New table provides a better fit. Thus the recommendation is to use the liability-weighted RP 2014 as the Base Table for all plans.

Recommended Mortality Improvement Assumption

In 2013, the Board adopted a fully generational mortality assumption. This strategy of building in continuous mortality improvement produces life expectancies of younger members that are materially longer than those of today's retirees. The lengthening of the future retiree's life has a significant impact on actuarial liabilities contribution requirements. Currently mortality is assumed to improve in accordance with Scale BB. Scale BB was issued in 2012 and is now considered to be an outdated improvement scale.

In 2015 and 2016, the RPEC issued updates to the mortality improvement assumption called Scale MP-2015 and Scale MP-2016. MP-2015 reflected an additional two years of mortality experience and MP-2016 reflected an additional three years of mortality experience. In both updates, rates of projection were materially decreased, meaning the original MP-2014 table was found to be too conservative. In addition, it has been stated that new projection scales are going to be published in October of each year. The recommendation and liability impacts in this report are based on MP-2016. The additional recommendation is to use MP 2017 if it is released in time for the January 1, 2018 actuarial valuation.

The mortality improvement scales provide for the rates of improvement in life expectancy that can be expected for each future generation. The tables have rates that vary for earlier generations, but the rates converge after a period of time to their "ultimate" improvement rate.

For the retiree population we recommend the use of the mortality improvement scale as designed , with the varying rates of improvement for earlier generations and the later convergence to an ultimate rate.

Active Mortality Rates

Active mortality is an assumption with a minimal impact on valuation results, since so few members die while in active service. Life expectancy is higher for members who are still engaged in active employment. Incidence of active deaths is very low in comparison to terminations and retirements. For active mortality rates, the recommendation is to use the RP-2014 mortality tables for healthy employees as the base table. The recommendation for the improvement assumption is to use the ultimate mortality improvement rates in the MP-2016/2017 tables. The use of the ultimate improvement rates for all future generations is intended to reflect the general longer life expectancy for those who are still employed.

MALE PRE-RETIREMENT MORTALITY EXPERIENCE - ALL PLANS			Crude Rates	Sample Rates*		Expected Deaths**	
Age	Deaths	Exposure		Old	New	Old	New
Under 25	-	50	0.0000	0.0004	0.0003	-	-
25-29	-	480	0.0000	0.0004	0.0004	0	0
30-34	-	930	0.0000	0.0006	0.0005	0	0
35-39	-	1,102	0.0000	0.0009	0.0006	1	1
40-44	-	1,242	0.0000	0.0013	0.0007	1	1
45-49	2	1,492	0.0013	0.0018	0.0012	2	2
50-54	-	1,654	0.0000	0.0028	0.0021	2	3
55-59	10	1,570	0.0064	0.0049	0.0034	3	5
60-64	4	1,002	0.0040	0.0091	0.0059	4	6
65-69	4	284	0.0141	0.0167	0.0102	1	3
Totals	20	9,806	0.0020	0.0015	0.0022	15	21
Actual/Expected Ratio						137%	94%

FEMALE PRE-RETIREMENT MORTALITY EXPERIENCE - ALL PLANS			Crude Rates	Sample Rates*		Expected Deaths**	
Age	Deaths	Exposure		Old	New	Old	New
Under 25	-	64	0.0000	0.0002	0.0002	-	-
25-29	-	776	0.0000	0.0002	0.0002	-	0
30-34	-	1,562	0.0000	0.0004	0.0002	0	0
35-39	-	1,570	0.0000	0.0005	0.0003	0	1
40-44	-	1,576	0.0000	0.0008	0.0005	0	1
45-49	-	2,058	0.0000	0.0013	0.0008	1	2
50-54	4	2,496	0.0016	0.0020	0.0013	1	4
55-59	2	2,644	0.0008	0.0035	0.0019	3	5
60-64	-	1,852	0.0000	0.0069	0.0029	3	5
65-69	-	464	0.0000	0.0121	0.0046	1	2
Totals	6	15,062	0.0004	0.0006	0.0013	10	20
Actual/Expected ratio						63%	30%

Disabled Retiree Mortality Rates

The rate of disability incidence is low for the WRS plans and the disabled mortality rates apply to a very small subsection of plan participants. The lack of data does not permit an in-depth study of this assumption. This is a minor assumption that has little impact on the liabilities of WRS. The RP-2014 Disabled Mortality base table with future mortality improvements modeled using the MP tables is recommended for the disabled lives mortality assumption. Use of the Disabled Mortality table will still reflect the impairment of life expectancy that occurs with disability and will also reflect some consistency with the general population by utilizing a similar basis as the retiree group.

Disability Rates

For the disability assumption, A/E ratios under 100% means there are few disabilities than expected. WRS experienced fewer disabilities than expected. The disability assumption is an assumption with a minor impact on the liabilities of the plan. Note the following:

- Law Enforcement is the only plan that separates duty from non-duty disability;
  - Non-duty disability requires 10 years of service for eligibility;
  - A breakdown by age is shown to provide insight into the age of members who receive disability benefits.
- Fire A and Guard Fire are not included since there is too little data to analyze.

Wyoming Retirement System Experience Study- Rates of Disability						
			Expected		A/E Ratio	
Plan	Actual	Exposure	Current	New	Current	New
State						
Males	18	19,009	28	22	64%	82%
Females	18	34,151	28	22	64%	82%
Total	36	53,160	56	44	64%	82%
Law Enforcement						
Non-duty	23	4613	11	23	209%	100%
<30	0	4	0	0	0%	0%
30-34	0	260	0	0	0%	0%
35-39	4	719	0	1	0%	736%
40-44	5	985	1	2	500%	288%
45-49	4	954	1	3	400%	122%
50-54	4	739	3	4	133%	92%
55-59	4	600	3	5	133%	74%
60-64	2	352	3	8	67%	27%
65+	0	0	0	0	0%	0%
Duty	5	11,075	34	16	15%	31%
<30	1	2,141	1	0	100%	0%
30-34	1	2,426	1	0	100%	0%
35-39	2	2,207	1	1	200%	200%
40-44	0	2,027	3	2	0%	0%
45-49	0	1,713	5	2	0%	0%
50-54	2	1,299	7	3	29%	67%
55-59	0	923	8	4	0%	0%
60-64	0	480	8	4	0%	0%
65+	0	0	0	0	0%	0%
Total	28	15,688	45	39	62%	72%
Fire B	2	1,298	4	3	50%	67%
Wardens	6	1,556	8	8	75%	75%
Guard Fire	1	76	0	0	0%	0%
Judges	0	84	0	0	0%	0%

> *State Plan- decrease assumed rates of disability*
> *Law Enforcement-decrease total assumed rates of disability while increasing non-duty rates and decreasing the duty rates*
> *Fire B- decrease assumed rates of disability*
> *Wardens- No change recommended*
> *Judges- No change recommended[there should be an expected number]*
> *Fire A- No change recommended*
> *Guard Fire- No change recommended*

Retirement Rates

This assumption includes only members who retired from active status. It excludes those who were inactive for over a year before retiring. For this assumption, A/E ratios under 100% are conservative (when there are fewer retirements than expected, the Plan usually experiences a gain). The results of this analysis are shown below for each plan independently.

Retirement eligibility for the State plan is age 60 with 4 years of service or any age such that age plus years of service totals at least 85. Eligibility for early retirement is age 50 with 4 years of service, or any age with at least 25 years of service. The State plan currently uses two retirement rate tables; one for early retirement eligibility and one for normal retirement eligibility. For reduced retirement benefits (early retirement) members are retiring less than expected. For unreduced retirement the experience is slightly higher than the current assumption at younger ages and at ages 67 to 70. Retirements rates are lower for members over the age of 70. Members are also working past age 70. Recommendations for this assumption include increasing the age at which a 100% probability of retirement is assumed (from age 70 to age 80) and make modifications to the other rates to reflect experience.

Wyoming Retirement System Experience Study- Rates of Retirement						
			Expected		A/E Ratio	
State - Tier 1	Actual	Exposure	Current	New	Current	New
Normal Retirement						
55	93	699	119	119	78%	78%
56	149	913	155	155	96%	96%
57	160	1,061	159	159	101%	101%
58	170	1,156	173	173	98%	98%
59	172	1,270	191	191	90%	90%
60	574	4,743	617	617	93%	93%
61	476	4,205	547	547	87%	87%
62	645	3,774	660	679	98%	95%
63	502	3,176	556	476	90%	105%
64	410	2,647	450	397	91%	103%
65	580	2,225	556	556	104%	104%
66	522	1,673	535	502	98%	104%
67	308	1,124	225	315	137%	98%
68	178	783	157	196	113%	91%
69	134	573	115	143	117%	94%
70	118	507	507	76	23%	155%
71	62	348	348	52	18%	119%
72	47	263	263	39	18%	119%
73	27	223	223	33	12%	81%
74	26	178	178	27	15%	97%
75	26	140	140	21	19%	124%
76	11	114	114	17	10%	64%
77	13	89	89	13	15%	97%
78	10	66	66	10	15%	101%
79	8	51	51	8	16%	105%
80+	18	104	104	104	17%	17%
Total	**5,439**	**32,105**	**7,298**	**5,626**	**75%**	**97%**
Early Retirement						
50	8	3792	171	19	5%	42%
51	12	4065	183	20	7%	59%
52	21	4325	195	22	11%	97%
53	21	4467	223	22	9%	94%
54	25	4476	224	22	11%	112%
55	35	4276	214	43	16%	82%
56	40	4180	209	42	19%	96%
57	45	3993	200	40	23%	113%
58	63	3796	209	38	30%	166%
59	86	3580	215	90	40%	96%
Total	**356**	**40,950**	**2,043**	**358**	**17%**	**100%**

1. There is not sufficient data to set a retirement assumption for tier 2 members. Therefore, it is recommended that the retirement rates for Tier 1 be used for Tier 2.

Retirement eligibility for the Law Enforcement plan is age 60 with 4 years of service or any age with 20 years of service. Eligibility for early retirement is age 50 with 4 years of service. Under the normal retirement assumption, younger members are retiring at a greater rate than assumed. In general, for the other ages, members are retiring at a lower rate than assumed. Early retirements are occurring at a lower rate than assumed. The recommendation is to change rates to reflect the experience.

Wyoming Retirement System Experience Study- Rates of Retirement						
			Expected		A/E Ratio	
Law Enforcement	Actual	Exposure	Current	New	Current	New
Normal Retirement						
< 45	17	53	5	5	340%	321%
45	6	39	4	4	150%	154%
46	12	44	5	4	240%	273%
47	5	47	5	5	100%	106%
48	4	47	5	5	80%	85%
49	7	55	6	6	117%	127%
50	7	56	12	11	58%	63%
51	8	53	10	7	80%	116%
52	4	59	11	8	36%	52%
53	16	72	13	9	123%	171%
54	12	61	11	8	109%	151%
55	6	54	8	8	75%	74%
56	10	61	9	9	111%	109%
57	9	49	7	7	129%	122%
58	14	59	9	12	156%	119%
59	11	51	7	10	157%	108%
60	13	131	19	26	68%	50%
61	16	102	26	17	62%	92%
62	16	96	25	16	64%	98%
63	16	67	7	13	229%	119%
64	7	58	15	12	47%	60%
65	14	51	51	26	27%	55%
66	14	34	34	17	41%	82%
67	5	21	21	11	24%	48%
68	6	16	16	8	38%	75%
69	3	9	9	5	33%	67%
70+	8	26	26	26	31%	31%
Total	266	1,471	376	295	71%	90%
Early Retirement						
50	0	193	15	15	0%	0%
51	1	175	11	11	9%	9%
52	0	164	10	10	0%	0%
53	1	148	13	13	8%	8%
54	4	137	12	12	33%	33%
55	2	115	14	14	14%	14%
56	3	121	10	10	30%	30%
57	0	116	9	9	0%	0%
58	3	112	9	9	33%	33%
59	2	89	13	13	15%	15%
Total	96	1,229	112	103	86%	93%

Retirement eligibility for the Fire B plan is age 50 with 4 years of service. Rate changes are recommended to align the table with experience.

Wyoming Retirement System Experience Study- Rates of Retirement						
			Expected		A/E Ratio	
Fire B	Actual	Exposure	Current	New	Current	New
50	5	26	5.0	5.2	100%	96%
51	3	25	3.0	2.5	100%	120%
52	2	22	3.0	2.2	67%	91%
53	1	24	5.0	2.4	20%	42%
54	2	26	5.0	2.6	40%	77%
55	5	26	8.0	5.2	63%	96%
56	5	18	5.0	4.5	100%	111%
57	3	15	5.0	3.8	60%	80%
58	2	12	4.0	1.8	50%	111%
59	1	10	3.0	1.5	33%	67%
60	1	8	4.0	2.0	25%	50%
61	2	6	3.0	3.0	67%	67%
62+	2	7	7.0	7.0	29%	29%
Total	34	225	60	44	57%	78%

Retirement eligibility for the Wardens plan is age 50 with 6 years of service. Members are retiring generally less than expected, and data is limited for this group, so recommended changes to fit the A/E ratios for each age are minor.

Wyoming Retirement System Experience Study- Rates of Retirement						
			Expected		A/E Ratio	
Wardens	Actual	Exposure	Current	New	Current	New
50	5	43	6	6.5	83%	78%
51	2	36	4	1.8	50%	111%
52	2	40	4	2.0	50%	100%
53	2	34	3	1.7	67%	118%
54	3	30	3	3.0	100%	100%
55	4	26	3	2.6	133%	154%
56	1	30	3	3.0	33%	33%
57	6	33	5	5.0	120%	121%
58	4	25	5	3.8	80%	107%
59	3	19	4	2.9	75%	105%
60	5	16	6	5.6	83%	89%
61	1	8	3	3.2	33%	31%
62+	5	8	8	8.0	63%	63%
Total	43	348	57	49	75%	88%

Retirement eligibility for the Judges plan is the earliest of: age 60 with 20 years of service, age 65 with 4 years of service, or age 70. Eligibility for early retirement is age 55 with 4 years of service.

Data is very limited for this group, so no changes are recommended.

Wyoming Retirement System Experience Study- Rates of Retirement						
			Expected		A/E Ratio	
Judges	Actual	Exposure	Current	New	Current	New
< 65	0	4	0.1	0.1	0%	0%
65	0	11	1.7	1.7	0%	0%
66	1	11	1.1	1.1	91%	91%
67	1	5	0.5	0.5	200%	200%
68	1	3	0.3	0.3	333%	333%
69	1	1	0.1	0.1	1000%	1000%
70+	0	1	0.2	0.2	0%	0%
Total	4	120	3.9	3.9	103%	103%

Termination Rates

Termination rates are used to estimate the number of members who leave for any reason other than death, disability or service retirement. Termination rates apply whether the termination is voluntary or involuntary, and whether the member takes a refund or keeps his/her account balance on deposit in the Pension Trust. For this assumption, A/E ratios over 100% are conservative (when there are more terminations than expected, the Plan usually experiences a gain).

Some plans incorporate both age and service in the "select and ultimate" assumption. This means that, for a five year select period, every employee will be assumed to terminate according to the rates in the select table, regardless of age. This assumption is employed in populations where the early years of employment experience higher rates of termination. This period of higher termination is known as the "select" period and the termination rates in this period are referred to as the "select" rates. After the select period termination rates tend to settle down. These rates are known as the "ultimate" rates. For WRS the recommendation is to use a five year select period. Upon earning five years of service, each employee will, from then on, be assumed to terminate according to the age-based rates in the ultimate table.

			Expected		A/E Ratio	
Wyoming Retirement System Experience Study- Rates of Termination						
State	**Actual**	**Exposure**	**Current**	**New**	**Current**	**New**
Male - Select						
1	858	4,008	890	882	96%	97%
2	1,167	6,249	1,138	1,125	103%	104%
3	623	4,752	629	665	99%	94%
4	444	3,351	373	436	119%	102%
5	361	2,449	270	318	134%	113%
Total	**3,453**	**20,809**	**3,300**	**3,426**	**105%**	**101%**
Male - Ultimate						
< 20	0	0	0	0	0%	0%
20-24	1	12	1	1	100%	83%
25-29	59	523	38	58	155%	103%
30-34	158	2546	104	153	152%	103%
35-39	188	4048	162	202	116%	93%
40-44	201	4747	182	190	110%	106%
45-49	219	5451	188	218	116%	100%
Total	**825**	**17,315**	**674**	**821**	**122%**	**101%**
Female - Select						
1	2,035	8,115	2,118	2,029	96%	100%
2	2,388	11,789	2,489	2,476	96%	96%
3	1,345	8,689	1,314	1,303	102%	103%
4	889	6,259	943	939	94%	95%
5	692	4,640	650	650	106%	107%
Total	**7,349**	**39,492**	**7,514**	**7,396**	**98%**	**99%**
Female - Ultimate						
< 20	0	0	0	0	0%	0%
20-24	5	13	1	1	500%	385%
25-29	106	1097	103	110	103%	97%
30-34	365	4719	311	378	117%	97%
35-39	373	6543	327	393	114%	95%
40-44	432	8234	412	412	105%	105%
45-49	486	9184	404	459	120%	106%
Total	**1,762**	**29,777**	**1,557**	**1,751**	**113%**	**101%**

The State plan currently employs a select and ultimate assumption with a five year select period.

In the five-year select period, males experienced a higher number of terminations than assumed. The actual termination count for males is 3,453 while the assumed number of terminations is 3,300. Females, during their first five years of employment, experienced fewer terminations than expected. For females, the actual number of terminations in their first five years of employment was 7,349 while the assumed number of terminations was 7,514. The recommendation is to increase the rates of termination for males in the select period, and to decrease the rates of termination for females in the select period.

After the first five years of employment, actual experience shows that terminations are occurring at a higher rate than assumed. The recommendation is to increase the rates for members past their first five years of employment.

Wyoming Retirement System Experience Study- Rates of Termination						
			Expected		A/E Ratio	
Law Enforcement	Actual	Exposure	Current	New	Current	New
Male - Select						
1	135	603	151	145	89%	93%
2	199	1,036	208	207	96%	96%
3	133	894	117	134	114%	99%
4	103	765	85	99	121%	104%
5+	95	699	77	84	123%	113%
Total	665	3,997	638	669	104%	99%
Female - Select						
1	62	247	79	62	78%	100%
2	91	410	90	90	101%	101%
3	59	311	62	59	95%	100%
4	43	247	37	44	116%	97%
5+	30	200	24	30	125%	100%
Total	285	1,415	292	286	98%	100%
Ultimate						
< 20	0	0	0	0	0%	0%
20-24	1	3	0	0	0%	0%
25-29	53	461	38	51	139%	105%
30-34	111	1299	92	110	121%	101%
35-39	100	1459	89	95	112%	105%
40-44	81	1437	76	79	107%	102%
45-49	64	1093	47	55	136%	117%
Total	409	5,749	342	390	120%	105%

The Law Enforcement plan currently employs a select and ultimate assumption with a five year select period.

In the first five years of employment (the "select" period), there were more male terminations than assumed (665 actual terminations compared to 638 assumed). For that same period there were fewer terminations than assumed for the female members.

After the select period there were more terminations than assumed (409 actual terminations compared to the 342 assumed).

The recommendation is overall to increase the rates of termination. The exception is for the females in their first five years of employment. For that select period the recommendation is to reduce overall the rates of termination.

Wyoming Retirement System Experience Study- Rates of Termination						
			Expected		A/E Ratio	
Fire B	Actual	Exposure	Current	New	Current	New
< 20	0	0	0	0	0%	0%
20-24	2	24	3	3	67%	69%
25-29	18	165	13	15	138%	121%
30-34	13	264	12	11	108%	123%
35-39	6	296	7	9	86%	68%
40-44	5	262	3	7	167%	76%
45-49	5	222	2	4	250%	113%
50-54	2	40	0	1	0%	250%
55-59	0	23	0	0	0%	0%
60-62	0	2	0	0	0%	0%
Total	51	1,298	40	49	128%	104%

The Fire B plan currently employs a termination assumption that is based solely on the member's age. There is no "select" period in the Fire B termination assumption. There were more terminations (51) than assumed (40). The recommendation is to slightly increase these age-based termination rates to reflect the higher than assumed termination experience.

Wyoming Retirement System Experience Study- Rates of Termination						
			Expected		A/E Ratio	
Wardens	Actual	Exposure	Current	New	Current	New
< 20	0	0	0	0	0%	0%
20-24	2	11	1	2	200%	100%
25-29	9	159	12	10	75%	90%
30-34	14	238	12	14	117%	100%
35-39	16	272	11	16	145%	100%
40-44	8	256	8	8	100%	100%
45-49	17	261	6	16	283%	106%
50-54	5	199	3	5	168%	100%
55-59	0	133	0	1	0%	0%
60-62	2	27	0	0	0%	0%
Total	73	1,556	53	72	138%	101%

The Wardens plan currently employs a termination assumption that is based solely on the member's age. There were more terminations (73) than assumed (50). The recommendation is to slightly increase these age-based termination rates to reflect the higher than assumed termination rates.

Wyoming Retirement System Experience Study- Rates of Termination						
			Expected		A/E Ratio	
Judges	Actual	Exposure	Current	New	Current	New
< 20	0	0	0.0	0.0		
20-24	0	0	0.0	0.0		
25-29	0	0	0.0	0.0		
30-34	0	0	0.0	0.0		
35-39	0	0	0.0	0.0		
40-44	0	17	0.2	0.2	0%	0%
45-49	0	28	0.2	0.2	0%	0%
50-54	0	24	0.1	0.1	0%	0%
55-59	0	51	0.1	0.1	0%	0%
60+	1	120	0.1	0.1	1000%	1000%
Total	**1**	**240**	**0.7**	**0.7**	**149%**	**149%**

The Judges plan currently employs a termination assumption that is based solely on the member's age. This methodology is recommended to remain the same. Data is very limited, and no change to these rates is recommended.

Other Assumptions and Refunds

There are other assumptions made in the course of a valuation, such as the percentage of members who are married, the age difference between husbands and wives, the likelihood that a terminating employee will take a refund, etc.

There are additional assumptions made that have a smaller role in determining liabilities.

Percent Married: Currently, the Fire A plan and the Judge's plan assume 100% of members are married at retirement and all other plans assume 85%. No change is recommended.

Spouse Age Difference: The current assumption is that males are three years older than their female spouse. There is no recommended change to this assumption.

Refund: There is no recommended change to this assumption.

Optional Forms of Payment

The optional forms of payment for Service Retirement benefits are all generally considered to be the same value (or "actuarial equivalent"). There is no additional assumption used in valuing optional forms of payment.

Administrative Expenses

The valuation assumes that administrative expenses will increase each year by 6.50% based on the

average adjusted expenses paid for the prior two years. This amount is explicitly calculated each year and added to the contribution requirement. The recommendation is to decrease the 6.50% to the payroll growth rate assumption of 2.50% per year.

Retirement Age for Terminated-Vested members

The following chart shows the assumed age for retirement for terminated vested members by plan:

**Assumed Retirement Age for Members
with Deferred Vested Benefits**

Plan	Age
Fire B	50
Guard Fire	60
Judges	65
LE	60
State	60 (65 for Tier 2)
Vol	60
Wardens	50

We recommend no change for the retirement age assumption for deferred vested members.

Actuarial Methods

Asset Valuation (Smoothing) Method

The purpose of asset smoothing is to reduce short-term volatility in actuarial valuation results which are intended for long-term decision making and funding. Periods of poor returns are often followed by some amount of recovery or vice versa, and a market value (unsmoothed) approach, may result in overreaction to short-term market volatility.

We are recommending a change to the asset valuation method. Currently, the actuarial value of assets smooths the realized gains and losses, but recognizes immediately the interest and dividends. To achieve the best results from using smoothing the method for smoothing the asset returns should smooth all elements of the investment return. The recommendation is to continue the five year smoothing of asset gains and losses, and change the period for smoothing the interest and dividends from one year (no smoothing) to five years.

Amortization Method for determining the Actuarially Determined Contribution

The State of Wyoming Retirement System has an Unfunded Accrued Liability (UAL) of $1.976 billion as of January 1, 2017. The amortization methodology is important because it establishes a systematic approach to paying off the UAL and determines how the Actuarially Determined Contribution is to be calculated for the valuation report.

The total required contribution to this System is calculated as the sum of the normal cost, administrative expenses and an amortization of the UAL based on a 30 year, open, level percent-of-pay basis.

The discussion in this section addresses the primarily the amortization policy for only one plan, the State of Wyoming Retirement System. However, WRS utilizes varying amortization approaches depending upon the unique characteristics of each plan in the System, as shown below, and the recommendations relate to these other plans as well:

Plan	Amortization length	Open or Closed	Type	Note
State of Wyoming Retirement System	30	Open	Level-percent of pay	
Law Enforcement Retirement Fund	30	Open	Level-percent of pay	
Paid Firemen's Retirement Fund A	10	Open	Level-dollar	Closed to new entrants
Paid Firemen's Retirement Fund B	30	Open	Level-percent of pay	
State Highway Patrol, Game & Fish Warden and Criminal Investigator Retirement Fund	30	Open	Level-percent of pay	
Judicial Retirement System	30	Open	Level-percent of pay	
Air Guard Firefighters Retirement Fund	30	Open	Level-percent of pay	

Funding policies and objectives set by the Retirement Board and Legislature provide guidance on how the UAL is to be paid off. WRS has adopted a Governance Policy regarding the funding and the actuarial condition of the plans. The Policy states the following objective:

"To collect contributions based on contribution rates that have been determined by a qualified actuary based on assumptions, which are reasonable in relation to long-term plan experience for each of the legislatively created retirement plans. The contribution rates so determined are intended to remain relatively level as a percent of payroll from generation to generation and comply with standards promulgated by the American Academy of Actuaries and Governmental Accounting Standards Board."

In practice, the Retirement Board looks at the 30 year projections for the plan and bases the recommendations for contribution rate increases on the rates necessary to achieve at least 100% funding within a 30 year period.

Thus, the funding policy "in practice" has been to use a 30 year closed method. The recommendation in this section is to move from a 30 year open to a 30 year closed amortization calculation for the actuarially determined contribution in the annual valuation report.

Amortization Considerations

One of the major components of the actuarially determined contribution requirement, in addition to the normal cost, is the cost for the amortization of the Unfunded Accrued Liability (UAL). Consequently, when setting the funding policy, the structure of the amortization payments and the length of the amortization period are important issues. It should also be noted that during the amortization period, interest accrues

on the outstanding UAL at a rate reflecting the long-term expected investment return. In setting up an amortization policy, the following decisions should be made:

• Should the amortization period be open or closed?
• Should the amortization be on a level-dollar basis or a level-percent-of-pay basis?
• What should be the length of the amortization period?

Closed Amortization vs. Open Amortization

If a closed amortization period is used, the UAL will be fully paid by the end of the period and contribution amounts will reflect those higher payments. By contrast, under an open amortization period, the period is reset each year. For example, under a 30-year open amortization period, the UAL is refinanced each year over a new 30-year period. Closed amortization periods pay down the UAL more rapidly and limit negative amortization, but produce more volatility in the contribution rate as the period gets shorter. An open period results in a more gradual decline of the UAL and helps to control volatility in the contribution rate, but never pays down the UAL. Moreover, an open amortization period is more likely to produce negative amortization, at least when the period is 15 to 20 years or longer and when combined with level percent of pay financing.

A key issue in setting the amortization policy, the extent to which principal is paid, is the possibility of negative amortization. Negative amortization occurs when the amortization payments are less than the interest accrued on the UAL during the year, and so the outstanding UAL increases rather than decreases. However, this depends on the length of the amortization period, as well as assumptions related to expected investment return and payroll growth. It is important to note that while the UAL increases when there is negative amortization, it is typically not expected to increase faster than the projected rate of payroll growth and is expected to be fully paid by the end of the period. However, an open amortization period which allows negative amortization may be inconsistent with reaching a funding target of 100% in a reasonable period of time.

Under the closed level-percent-of-pay approach the payments remain level until the UAL is fully paid off at the end of the 30 year period. However, under the open level-percent-of-pay approach, the amortization payments, and the UAL, extend beyond the 30-year period and continue to decline for decades thereafter. The rate at which the payment amounts decrease depends on a number of factors, including the expected investment return and payroll growth assumption. All of the WRS funds use the open amortization method.

A blend of these two methods, open and closed, is the "year-by-year layered" amortization method. Any unfunded that emerges in a given year is established and paid off over a closed period. Each base will have its own end date when it has been paid in full. This blended approach guarantees the unfunded will be paid off in a given period of time while still managing volatility through giving each base a full 30 years (or less) for payment.

Level-dollar and Level-percent-of-pay

Level-dollar amortization is similar to a fixed-rate home mortgage with a constant dollar payment. Level-percent-of-pay amortization initially has lower dollar payments, but these increase each year. The level-dollar amortization pays a greater portion of the UAL (compared to the level percent of pay method) in earlier years. When comparing the two, the level dollar method is considered more conservative due to its quicker payment of the UAL. However, level-percent-of pay-amortization may be more consistent with the budgeting process of most governmental entities. WRS uses level-percent-of pay-amortization for the plans that provide salary-related benefits and level-dollar for those plans that are closed to new entrants or provide benefit amounts independent of salary.

Amortization Period Length

Generally, for public pension plans, amortization periods range from 15 to 30 years, although some plans use shorter or longer periods. Shorter amortization periods result in the UAL being paid off sooner, but require higher and likely more volatile contributions. Longer amortization periods require lower contributions, but may shift some of the pension costs beyond the working careers of active employees and on to future generations. One way to achieve intergeneration equity is to amortize the UAL over a period of time that relates to a career employee's expected working lifetime. WRS uses a 30 year amortization period for all plans except for Paid Firemen's Retirement Fund A which uses 10 years.

A whitepaper published by the Conference of Consulting Actuaries titled "Actuarial Funding Policies and Practices for Public Pension Plans" recommends using a period that is shorter than 30 years.

Discussion and Recommendations

WRS makes recommendations for contribution rate changes based on looking at 30 year projections and using a contribution change which allows the Plan(s) to achieve a 100% funded ratio within the 30 year period. We are not making any recommended changes to this practice.

The changes recommended below affect the methods used in the valuation report (not the 30 year projections or its related contribution change practices).

WRS uses level percent-of-pay amortization methodology for the plans that provide salary-related benefits and level dollar amortization methodology for plans that are closed to new entrants or provide benefit amounts independent of salary. No changes are recommended to this approach.

Regarding the length of the amortization period, the only change recommended is for the Judges plan. The average age of the members in the Judges Plan is approximately 58 years, while the current amortization period is 30 years. Since the length of the amortization period should reflect the average future working lifetime of the members, it is recommended that the Judges' period be changed from 30 years to 15 years.

WRS has a goal of reaching a 100% funded ratio. Currently, the practice of using the projections and the valuation reports are not "in sync". This is because the valuation reports use an open (never pay-off) method to create the actuarially determined contribution. We recommend bringing the report and the practice into alignment by using year by year closed amortization to calculate the payments on the

unfunded accrued liability.

In summary, the following changes are recommended:

- Continue the practice of developing rates based on achieving full funding in 30 years or less;
- Sync the valuation report method through using a layered amortization approach. Set the initial UAL at a period not to exceed 30 years, and subsequent new unfunded liabilities to be closed and paid off over a period not to exceed 30 years.
- Decrease the length of the Judges Plan amortization period from 30 years to 15 years.

SECTION D

SUMMARY OF ASSUMPTIONS AND METHODS

Summary of Assumptions and Methods
Incorporating the Recommended Assumptions

Salary Increase Assumptions

% Increases in Salary - Proposed Assumptions	
Service	State
1	6.5000%
2	6.5000%
3	6.5000%
4	6.0000%
5	5.2500%
6	4.7500%
7	4.2500%
8	4.0000%
9	4.0000%
10	4.0000%
11	3.7500%
12	3.5000%
13	3.5000%
14	3.5000%
15	3.2500%
16	3.2500%
17	3.2500%
18	3.2500%
19	3.0000%
20	3.0000%
21	2.7500%
22	2.7500%
23	2.7500%
24	2.7500%
25	2.5000%

% Increases in Salary - Proposed Assumptions				
Age	Law Enf.	Fire B	Wardens	Judges
20	7.0000%	7.5000%	8.5000%	4.0000%
21	7.0000%	7.5000%	8.5000%	4.0000%
22	7.0000%	7.5000%	8.5000%	4.0000%
23	7.0000%	7.5000%	8.5000%	4.0000%
24	7.0000%	7.5000%	8.5000%	4.0000%
25	6.5000%	7.0000%	8.0000%	4.0000%
26	6.5000%	7.0000%	8.0000%	4.0000%
27	6.5000%	7.0000%	8.0000%	4.0000%
28	6.5000%	7.0000%	8.0000%	4.0000%
29	6.5000%	7.0000%	8.0000%	4.0000%
30	5.0000%	7.0000%	5.7500%	4.0000%
31	5.0000%	7.0000%	5.7500%	4.0000%
32	5.0000%	7.0000%	5.7500%	4.0000%
33	5.0000%	7.0000%	5.7500%	4.0000%
34	4.2500%	6.5000%	5.7500%	4.0000%
35	4.2500%	6.5000%	4.0000%	4.0000%
36	4.2500%	6.5000%	4.0000%	4.0000%
37	4.2500%	6.5000%	4.0000%	4.0000%
38	4.2500%	6.5000%	4.0000%	4.0000%
39	4.2500%	5.5000%	4.0000%	4.0000%
40	4.2500%	5.5000%	3.0000%	4.0000%
41	4.2500%	5.5000%	3.0000%	4.0000%
42	4.2500%	5.5000%	3.0000%	4.0000%
43	4.2500%	5.5000%	3.0000%	4.0000%
44	4.2500%	5.5000%	3.0000%	4.0000%
45	4.0000%	5.0000%	3.0000%	4.0000%
46	4.0000%	5.0000%	3.0000%	4.0000%
47	4.0000%	5.0000%	3.0000%	4.0000%
48	4.0000%	5.0000%	3.0000%	4.0000%
49	4.0000%	5.0000%	3.0000%	4.0000%
50	3.5000%	5.0000%	3.0000%	4.0000%
51	3.5000%	5.0000%	3.0000%	4.0000%
52	3.5000%	5.0000%	3.0000%	4.0000%
53	3.5000%	5.0000%	3.0000%	4.0000%
54	3.5000%	5.0000%	3.0000%	4.0000%
55	3.2500%	4.7500%	2.5000%	4.0000%
56	3.2500%	4.7500%	2.5000%	4.0000%
57	3.2500%	4.7500%	2.5000%	4.0000%
58	3.2500%	4.7500%	2.5000%	4.0000%
59	3.2500%	4.7500%	2.5000%	4.0000%
60+	3.0000%	4.5000%	2.5000%	4.0000%

Post Retirement Mortality Rates

	Base Table - All WRS Plans										
	% Dying Next Year			**% Dying Next Year**			**% Dying Next Year**			**% Dying Next Year**	
Age	**Male**	**Female**	**Age**	**Male**	**Female**	**Age**	**Male**	**Female**	**Age**	**Male**	**Female**
50	0.4064%	0.2436%	65	1.1013%	0.7082%	80	4.4722%	3.0663%	95	21.8559%	15.7550%
51	0.4384%	0.2556%	66	1.1916%	0.7762%	81	4.9795%	3.4129%	96	23.6535%	17.2395%
52	0.4709%	0.2690%	67	1.2930%	0.8518%	82	5.5526%	3.8056%	97	25.5059%	18.7937%
53	0.5042%	0.2838%	68	1.4067%	0.9357%	83	6.1996%	4.2508%	98	27.4170%	20.4152%
54	0.5384%	0.3003%	69	1.5342%	1.0289%	84	6.9290%	4.7548%	99	29.3848%	22.0988%
55	0.5735%	0.3187%	70	1.6769%	1.1324%	85	7.7497%	5.3244%	100	31.3988%	23.8355%
56	0.6099%	0.3395%	71	1.8363%	1.2470%	86	8.6712%	5.9665%	101	33.4365%	25.6115%
57	0.6478%	0.3633%	72	2.0141%	1.3740%	87	9.7038%	6.6891%	102	35.4599%	27.4071%
58	0.6877%	0.3904%	73	2.2127%	1.5145%	88	10.8591%	7.5002%	103	37.4524%	29.2072%
59	0.7305%	0.4214%	74	2.4345%	1.6700%	89	12.1499%	8.4095%	104	39.3982%	30.9964%
60	0.7771%	0.4568%	75	2.6826%	1.8425%	90	13.5908%	9.4271%	105	41.2831%	32.7600%
61	0.8284%	0.4968%	76	2.9608%	2.0344%	91	15.1322%	10.5375%	106	43.0946%	34.4837%
62	0.8854%	0.5417%	77	3.2735%	2.2488%	92	16.7422%	11.7303%	107	44.8227%	36.1547%
63	0.9492%	0.5916%	78	3.6258%	2.4893%	93	18.4030%	12.9994%	108	46.4592%	37.7619%
64	1.0209%	0.6470%	79	4.0232%	2.7602%	94	20.1074%	14.3414%	109	47.9987%	39.2959%
									110	100.00%	100.00%

Pre-Retirement Mortality Rates

	Base Table - Active - All Plans								
	% Dying Next Year			**% Dying Next Year**			**% Dying Next Year**	
Age	**Male**	**Female**	**Age**	**Male**	**Female**	**Age**	**Male**	**Female**
20	0.0406%	0.0162%	35	0.0523%	0.0286%	50	0.1686%	0.1102%
21	0.0449%	0.0162%	36	0.0536%	0.0300%	51	0.1871%	0.1206%
22	0.0488%	0.0162%	37	0.0551%	0.0318%	52	0.2072%	0.1315%
23	0.0509%	0.0166%	38	0.0570%	0.0339%	53	0.2289%	0.1429%
24	0.0516%	0.0169%	39	0.0595%	0.0365%	54	0.2527%	0.1548%
25	0.0484%	0.0173%	40	0.0628%	0.0396%	55	0.2788%	0.1673%
26	0.0462%	0.0179%	41	0.0671%	0.0433%	56	0.3079%	0.1805%
27	0.0449%	0.0187%	42	0.0725%	0.0477%	57	0.3407%	0.1946%
28	0.0444%	0.0196%	43	0.0793%	0.0529%	58	0.3779%	0.2097%
29	0.0446%	0.0206%	44	0.0876%	0.0589%	59	0.4204%	0.2261%
30	0.0452%	0.0218%	45	0.0973%	0.0657%	60	0.4688%	0.2442%
31	0.0463%	0.0231%	46	0.1087%	0.0733%	61	0.5240%	0.2642%
32	0.0477%	0.0244%	47	0.1215%	0.0816%	62	0.5867%	0.2864%
33	0.0492%	0.0258%	48	0.1358%	0.0906%	63	0.6577%	0.3113%
34	0.0508%	0.0272%	49	0.1515%	0.1001%	64	0.7377%	0.3389%
						65	0.8277%	0.3696%

Disabled Retirement Mortality Rates

	Base Table - Disabled - All Plans										
	% Dying Next Year			% Dying Next Year			% Dying Next Year			% Dying Next Year	
Age	Male	Female	Age	Male	Female	Age	Male	Female	Age	Male	Female
50	2.0395%	1.1907%	65	3.1685%	2.0860%	80	7.6616%	6.1036%	95	24.7169%	19.5880%
51	2.1016%	1.2450%	66	3.3081%	2.1976%	81	8.2562%	6.6074%	96	26.2610%	21.1049%
52	2.1621%	1.2979%	67	3.4633%	2.3250%	82	8.9136%	7.1506%	97	27.8276%	22.6923%
53	2.2210%	1.3494%	68	3.6353%	2.4702%	83	9.6405%	7.7357%	98	29.4176%	24.3443%
54	2.2791%	1.3992%	69	3.8253%	2.6348%	84	10.4436%	8.3652%	99	31.0320%	26.0551%
55	2.3369%	1.4479%	70	4.0346%	2.8203%	85	11.3303%	9.0420%	100	32.6717%	27.8189%
56	2.3953%	1.4958%	71	4.2647%	3.0280%	86	12.3081%	9.7694%	101	34.3376%	29.6297%
57	2.4557%	1.5439%	72	4.5170%	3.2591%	87	13.3850%	10.5510%	102	36.0308%	31.4819%
58	2.5190%	1.5931%	73	4.7935%	3.5148%	88	14.5697%	11.3909%	103	37.7522%	33.3694%
59	2.5868%	1.6447%	74	5.0965%	3.7962%	89	15.8714%	12.2939%	104	39.5026%	35.2865%
60	2.6604%	1.6999%	75	5.4287%	4.1045%	90	17.3005%	13.2652%	105	41.2831%	37.2273%
61	2.7414%	1.7603%	76	5.7934%	4.4413%	91	18.7464%	14.3420%	106	43.0946%	39.1860%
62	2.8312%	1.8273%	77	6.1945%	4.8078%	92	20.2100%	15.5186%	107	44.8227%	41.0849%
63	2.9314%	1.9028%	78	6.6363%	5.2059%	93	21.6924%	16.7890%	108	46.4592%	42.9112%
64	3.0433%	1.9884%	79	7.1235%	5.6372%	94	23.1944%	18.1474%	109	47.9987%	44.6544%
									110	100.00%	100.00%

Disability Rates

	% Disabled Next Year						
	State		Law Enforcement				
Age	Male	Female	Non-Duty	Duty	Fire B	Wardens	Judges
20	0.0100%	0.0100%	0.0231%	0.0429%	0.0300%	0.1040%	0.0100%
25	0.0100%	0.0100%	0.0231%	0.0429%	0.0300%	0.1040%	0.0100%
30	0.0100%	0.0100%	0.0231%	0.0429%	0.0300%	0.2340%	0.0100%
35	0.0100%	0.0100%	0.0273%	0.0507%	0.1900%	0.3900%	0.0100%
40	0.0100%	0.0100%	0.0630%	0.1170%	0.4200%	0.5720%	0.0100%
45	0.0300%	0.0300%	0.1344%	0.2496%	0.6500%	0.7280%	0.0100%
50	0.1500%	0.0600%	0.2331%	0.4329%	0.8200%	0.7540%	0.0300%
55	0.3000%	0.1500%	0.3990%	0.7410%	1.8100%	0.7540%	0.0500%
60	0.3000%	0.3000%	0.7770%	1.4430%	2.0000%	0.7540%	0.0700%
65	0.0000%	0.0000%	0.2520%	0.4680%	0.0000%	0.7540%	0.0900%
70	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.7540%	0.1100%
75	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.1300%

Retirement Rates

	% Retired Next Year						
	State		Law Enforcement				
Age	Normal	Early	Normal	Early	Fire B	Wardens	Judges
50	15.0000%	0.5000%	20.0000%	2.0000%	20.0000%	15.0000%	
51	15.0000%	0.5000%	13.0000%	2.0000%	10.0000%	5.0000%	
52	15.0000%	0.5000%	13.0000%	2.0000%	10.0000%	5.0000%	
53	15.0000%	0.5000%	13.0000%	2.0000%	10.0000%	5.0000%	
54	15.0000%	0.5000%	13.0000%	2.0000%	10.0000%	10.0000%	
55	17.0000%	1.0000%	15.0000%	2.0000%	20.0000%	10.0000%	2.0000%
56	17.0000%	1.0000%	15.0000%	2.0000%	25.0000%	10.0000%	2.0000%
57	15.0000%	1.0000%	15.0000%	2.0000%	25.0000%	15.0000%	2.0000%
58	15.0000%	1.0000%	20.0000%	2.0000%	15.0000%	15.0000%	2.0000%
59	15.0000%	2.5000%	20.0000%	2.0000%	15.0000%	15.0000%	2.0000%
60	13.0000%	2.5000%	20.0000%	2.0000%	25.0000%	35.0000%	2.0000%
61	13.0000%	2.5000%	17.0000%	2.0000%	50.0000%	40.0000%	2.0000%
62	18.0000%	2.5000%	17.0000%	2.0000%	100.0000%	100.0000%	2.0000%
63	15.0000%	2.5000%	20.0000%	2.0000%			2.0000%
64	15.0000%	2.5000%	20.0000%	2.0000%			2.0000%
65	25.0000%	2.5000%	50.0000%	2.0000%			15.0000%
66	30.0000%	2.5000%	50.0000%				10.0000%
67	28.0000%	2.5000%	50.0000%				10.0000%
68	25.0000%	2.5000%	50.0000%				10.0000%
69	25.0000%	2.5000%	50.0000%				10.0000%
70	15.0000%		100.0000%				15.0000%
71	15.0000%						15.0000%
72	15.0000%						100.0000%
73	15.0000%						
74	15.0000%						
75	15.0000%						
76	15.0000%						
77	15.0000%						
78	15.0000%						
79	15.0000%						
80	100.0000%						

Termination Rates

	State		Law Enforcement				
Service	**Male**	**Female**	**Male**	**Female**	**Fire B**	**Wardens**	**Judges**
1	22.00%	26.00%	25.00%	32.00%			
2	18.00%	21.00%	20.00%	22.00%			
3	13.00%	15.00%	13.00%	20.00%			
4	11.00%	15.00%	11.00%	15.00%			
5	11.00%	14.00%	11.00%	12.00%			

% Terminated Next Year (table heading)

	State					
Age	**Male**	**Female**	**Law Enforcement**	**Fire B**	**Wardens**	**Judges**
20	10.0000%	11.0000%	10.0000%	12.0000%	11.0000%	5.6000%
25	10.0000%	11.0000%	10.0000%	8.0000%	10.0000%	4.2000%
30	4.5000%	7.5000%	7.5000%	5.0000%	5.0000%	2.9000%
35	4.0000%	5.0000%	6.5000%	3.0000%	4.0000%	2.0000%
40	4.0000%	5.0000%	6.0000%	1.0000%	3.5000%	1.5000%
45	3.5000%	5.0000%	5.0000%	1.0000%	2.5000%	1.1000%
50	3.0000%	4.0000%	0.0000%	1.0000%	2.0000%	0.8000%
55	3.0000%	4.0000%	0.0000%	0.5000%	1.0000%	0.6000%
60	3.0000%	4.0000%	0.0000%	0.5000%	0.5000%	0.4000%
62	3.0000%	4.0000%	0.0000%	0.5000%	0.5000%	0.3000%

GRS Retirement Consulting