State Universities Retirement System of Illinois

2018 Experience Review for the Years June 30, 2014, to June 30, 2017

GRS

February 26, 2018

Board of Trustees
State Universities Retirement System of Illinois
1901 Fox Drive
Champaign, Illinois 61820

Subject: Experience Review for the Years June 30, 2014, to June 30, 2017

Dear Members of the Board:

At your request, we have performed a review of the actuarial assumptions used in the annual actuarial valuation of the State Universities Retirement System of Illinois ("SURS"). The primary purpose of the study is to determine the continued appropriateness of the current actuarial assumptions by comparing actual experience to expected experience. Our study was based on census information for the period from June 30, 2014, to June 30, 2017, as provided by SURS Staff.

Our study includes a review of the experience associated with the following actuarial assumptions:

- Salary Increases
- Mortality
- Disability
- Withdrawal
- Retirement
- Price Inflation
- Investment Return
- Wage Inflation (based on uncapped pay)
- Effective Rate of Interest

The results of this analysis are set forth in Section II of this report. Section III contains the cost impact on the Statutory contribution and funded status of the plan as a result of the assumption modifications. Finally, Section IV contains a summary of all proposed rates.

Amy Williams and Lance Weiss are Members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

The signing actuaries are independent of the plan sponsor.

This report should not be relied on for any purpose other than the purpose stated. This report may be provided to parties other than SURS only in its entirety and only with the permission of SURS. GRS is not responsible for unauthorized use of this report.
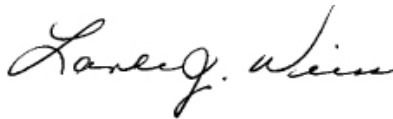
This report is based upon information, furnished to us by SURS, concerning retirement and ancillary benefits, active members, deferred vested members, retirees and beneficiaries, and financial data. If your understanding of this information is different, please let us know. This information was checked for internal consistency, but it was not audited.

The results of the experience study and recommended assumptions set forth in this report are based on the data and actuarial techniques and methods described above, and upon the provisions of SURS as of the most recent valuation date, June 30, 2017. To the best of our knowledge the information contained in this report is accurate and fairly presents the experience of members participating in the SURS defined benefit plans for the period June 30, 2014, through June 30, 2017. All calculations have been made in conformity with generally accepted actuarial principles and practices, and with the Actuarial Standards of Practice issued by the Actuarial Standards Board.

Sincerely,

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Consultant

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Senior Consultant

Alex Rivera, FSA, EA, MAAA
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SECTION I

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Experience Review Summary

Background

For any pension plan, actuarial assumptions are selected that are intended to provide reasonable estimates of future expected events, such as System investment returns, interest crediting, and patterns of retirement, turnover and mortality. These assumptions, along with an actuarial cost method, the employee census data and the plan's provisions are used to determine the actuarial liabilities and overall actuarially determined funding requirements for the plan. The true cost to the plan over time will be the actual benefit payments and expenses required by the plan's provisions for the participant group under the plan. To the extent the actual experience deviates from the assumptions, experience gains and losses will occur. These gains (losses) then serve to reduce (increase) future actuarially determined contributions and increase (reduce) the funded ratio. The actuarial assumptions should be individually reasonable and consistent in the aggregate. They should also be reviewed periodically to ensure that they remain appropriate. The actuarial cost method, for plan sponsors that use actuarially based funding policies, automatically adjusts contributions over time for differences between what is assumed and the actual experience under the plan.

Actuarial Standards of Practice ("ASOPs")

The Actuarial Standards Board ("ASB") provides guidance on measuring the costs of financing a retirement program through the following Actuarial Standards of Practices ("ASOPs"):

(1) ASOP No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*;
(2) ASOP No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*;
(3) ASOP No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*; and
(4) ASOP No. 44, *Selection and Use of Asset Valuation Methods for Pension Valuations*.

The recommendations provided in this report are consistent with the preceding actuarial standards of practice.

The ASB recently adopted Actuarial Standard of Practice (ASOP) No. 51, Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions. ASOP No. 51 will be effective for any actuarial work product with a measurement date on or after November 1, 2018.

Assumptions Reviewed

The actuarial assumptions are usually divided into two categories:

(1) Economic assumptions, which include:

- Assumed rate of price inflation (as measured by the change in the Consumer Price Index for all urban consumers)
    - Underlies all other economic assumptions
    - Basis for cost-of-living increases for members hired on or after January 1, 2011
- Assumed long-term rate of return on investments (prescribed rate as defined in statute)

- ▪ Rate at which projected benefits are reduced to present value
- ▪ Basis for money purchase annuity factors
- Assumed effective rate of interest (rate at which member contributions are accumulated to generate benefits under the Money Purchase Benefit formula – Rule 2)
- General wage increases
  - ▪ Reflects inflationary forces on increases in pay for all members
- Rate of payroll growth
  - ▪ Reflects expectation of growth in total payroll and affects level percent of pay statutory contribution

The economic assumptions are generally chosen on the basis of the actuary's expectations as to the effect of future economic conditions on the operation of the plan, with input from Staff, the Board and other investment advisors.

(2) Demographic assumptions, which include the following rates:

- Mortality
- Retirement
- Disablement
- Withdrawal (other termination of employment)

Demographic assumptions are generally based on the plan's own experience, taking into account emerging trends. Rates of salary increase due to promotion and longevity are also related to the plan's experience.

The accuracy and extent of the data is an important consideration in assessing demographic experience. The accuracy of the data for this study was generally good, but a very large amount of data is required to develop a credible mortality table. The approach we have taken to recommending a mortality assumption for the SURS actuarial valuation is based on the RPEC 2014 model described by the Society of Actuaries (SOA). In effect, we select a base mortality table from the RP-2014 mortality tables (consisting of blue collar, white collar and total gender-specific base mortality tables for actives, retireds and disabled plan members) and a mortality improvement scale based on the 2-dimensional MP-2017 mortality improvement scales projected from the base year of 2006 after adjusting for MP-2014 improvements. We then use what is termed "the limited fluctuation credibility procedure" to determine the appropriate scaling factor of the base mortality tables for each gender and each member classification.

(3) Other methods and assumptions including the following:
  a. Cost method
  b. Amortization method
  c. Asset smoothing method
  d. Dependent assumptions
  e. Assumptions on reciprocal service and service purchases
  f. Assumptions on refund of contributions vs. deferred annuity
  g. Pay increase and decrement timing assumptions
  h. Plan election assumptions (Traditional/Portable vs. Self-Managed Plan)

Experience Review Summary

Key Findings and Recommendations

Gabriel, Roeder, Smith & Company ("GRS") has performed an experience study of the State Universities Retirement System of Illinois ("SURS") for the period from June 30, 2014, to June 30, 2017. The primary purpose of the study was to compare the SURS plan experience and future expectations for experience against the actuarial assumptions used in the actuarial valuation. Our study was based on the information used to perform the annual actuarial valuations for the period from June 30, 2014, to June 30, 2017.

Following is a summary of the key findings and recommendations:

- **Price inflation**: We recommend decreasing the rate of assumed price inflation from 2.75 percent to 2.25 percent.

- **Investment return**: We recommend decreasing the investment return assumption from 7.25 percent to 6.75 percent. This reflects maintaining an assumed real rate of return of 4.50 percent and decreasing the underlying assumed price inflation from 2.75 percent to 2.25 percent. We recommend monitoring the assumption for continued reasonableness in the future.

- **Payroll growth assumption**: We recommend decreasing the general payroll growth assumption from 3.75 percent to 3.25 percent. This reflects maintaining the assumed rate for productivity increases of 1.00 percent and decreasing the underlying assumed price inflation from 2.75 percent to 2.25 percent.

- **Effective rate of interest assumption:** We recommend the long-term assumption for the ERI for crediting the money purchase accounts be reduced, from 7.00 percent per year to 6.75 percent per year.

- **Salary increase**: We recommend decreasing the overall assumed salary increase rates. This reflects decreasing the underlying assumed price inflation from 2.75 percent to 2.25 percent and increasing the assumed real rates of salary increase for certain years of service based on the observed experience.

- **Normal retirement rates:** We recommend decreasing the assumed rates for certain ages based on the observed experience which showed lower rates than under our current assumptions.

- **Early retirement rates:** We recommend decreasing the assumed rates for certain ages based on the observed experience which showed lower rates than under our current assumptions.

- **Turnover rates:** Overall the observed experience showed that fewer members terminated employment than expected. We recommend modifications to the current service-based rates. The proposed rates produce lower expected turnover for members with less than 10 years of service and higher turnover for members with more than 10 years of service than the currently assumed rates. In total, the proposed turnover rates produce fewer expected number of terminations than the current turnover rates.

- **Mortality rates:** We recommend:

  - Maintaining the RP-2014 mortality tables with projected generational mortality improvement

  - Updating the projection scale from the MP-2014 to the MP-2017 scale

  - Maintaining the MP-2017 projection scale until the assumptions are studied with the next experience study.

- Applying certain scaling factors to the base tables based on the actual experience and the credibility that can be applied to that experience.

The specific mortality table recommendations and a more detailed description of the new mortality tables can be found in Section II.

- **Disability rates:** We recommend decreasing the current disability rates to reflect that certain members who receive disability benefits do not receive the benefits on a long-term basis. We recommend including a small load on projected benefit payments to reflect the disability benefits expected to be paid to members who do not receive benefits on a long-term basis.

- **Money purchase conversion factor assumptions**: By statute, the money purchase conversion factors are to be updated when the investment return assumption and/or the mortality assumption are updated. Therefore, the recommended changes will result in updates to the money purchase conversion factors.

- **Cost Method**: The actuarial cost method is Projected Unit Credit, which is required to be used by State Statute.

- **Amortization Method**: The State Statute requires that the plan be funded at a level such that the funded ratio reaches 90% in the year 2045. There is no separate amortization of the unfunded accrued liability that leads to a 100% funding of the accrued liability. This funding method does not comply with generally accepted actuarial principles for the funding of a retirement system because the funding method targets 90% instead of 100%.

- **Asset Smoothing Method**: The asset smoothing method is also defined by State Statute. Gains and losses (the difference between the actual investment return and the expected investment return) are smoothed in over a five-year period at a rate of 20 percent per year. There is currently no asset corridor. An asset corridor limits the amount that the actuarial (smoothed) value of assets can deviate from the market value of assets. Because the statutory funding policy defers contributions, we recommend that an asset corridor of 80 percent to 120 percent of market value of assets be implemented. However, our understanding is that this change could require legislative action.

- **Plan Election**: Because the Board voted not to implement the Optional Hybrid Plan until more information is available, we recommend changing the plan election assumptions that were first used in the actuarial valuation as of June 30, 2017 (60 percent of new members elect the Optional Hybrid Plan, 20 percent elect Tier 2 and 20 percent elect to participate in the Self-Managed Plan (SMP)) to the assumptions used in the actuarial valuation as of June 30, 2016 (70 percent elect Tier 2 and 30 percent elect to participate in SMP).

- **Load for reciprocal benefits, service purchases and refunds of excess contributions**: We recommend maintaining the liability load of 10 percent on the liabilities for service retirees whose benefits have not been finalized and a "best formula" benefit has not been provided and a 5 percent load if a "best formula" benefit has been provided.

- **Pay increases during the final rate of earnings period (used for 6% employer billing contributions)**: We recommend that no assumption be made for either the contributions received or the liability losses generated by members receiving pay increases in excess of 6.00 percent during the final average earnings period.

Experience Review Summary

Section III contains the cost impact on the Statutory contribution and funded status of the plan as a result of the assumption modifications. The recommended assumptions increase the actuarial liability and contribution requirements and decrease the funded ratio.

In order to maintain the fiscal health of SURS, and to comply with the Actuarial Standards of Practice (applicable to all actuaries who practice in the United States), it is important to (1) select actuarial assumptions that reflect realistic estimates of future investment returns and (2) not be unnecessarily swayed by alternative actuarial assumptions that result in the more favorable contribution levels and/or accounting disclosures.

One factor to keep in mind is that Public Act 100-0023 requires any change in an actuarial assumption that increases or decreases the required State contribution to be implemented in equal annual amounts over a five-year period beginning in the state fiscal year in which the change first applies to the required state contribution. For changes that first applied in FY 2014, FY 2015, FY 2016 or FY 2017, the impact is calculated based on a five-year period and the applicable portion is recognized during the remaining fiscal years in that five-year period. Any contribution increases attributable to changes in actuarial assumptions first effective in the June 30, 2018, actuarial valuation will be recognized over five years beginning with the fiscal year 2020 Statutory contribution.

SECTION II

EXPERIENCE ANALYSIS

Economic Assumptions

Economic assumptions reflect the effects of economic forces on the projections of retirement benefits payable from the plan and in the discounting of those benefits to present value.

These assumptions are based, at their core, on the assumed level of price inflation. Each economic assumption is then developed from expected spreads over price inflation. Since price inflation is relatively volatile and is subject to a number of influences not based on recent history, economic assumptions are less reliably based on recent past experience than are the demographic assumptions.

The key economic assumptions are:

1. Assumed Rate of Inflation – The rate of price inflation (as measured by the Consumer Price Index for all Urban consumers) which underlies the remainder of the economic assumptions.
2. Assumed Rate of Investment Return – The rate at which projected future benefits under the system are reduced to present value.
3. Rate of General Annual Pay Increases – This reflects inflationary forces on increases in pay for individual members.

Actuarial Standard of Practice No. 27

ASOP No. 27 provides guidance related to selecting economic assumptions, including the investment return, discount rate, inflation, postemployment benefit increases, compensation increases and any other related economic assumptions, such as the Effective Rate of Interest (ERI) assumption.

In developing specific actuarial assumptions, ASOP No. 27 requires the actuary to follow a general process of:

(1) Identifying the components of the assumption;
(2) Evaluating relevant data;
(3) Considering specific and general factors related to the measurement; and
(4) Selecting a reasonable assumption.

In evaluating relevant data, the actuary should include appropriate recent and long-term historic data, but not give undue weight to recent experience.
Further, under ASOP No. 27, an assumption is considered reasonable if:

- It is appropriate for the purpose of the measurement;
- It reflects the actuary's professional judgment;
- It takes into account historical and current economic data that is relevant as of the measurement date;
- It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and
- It has no significant bias (i.e., it is not significantly optimistic or pessimistic).

Also according to the ASOP No. 27, the actuary should recognize the uncertain nature of the items for which assumptions are selected and, as a result, may consider several different assumptions reasonable for a given measurement. The actuary should also recognize that different actuaries will apply different

professional judgment and may choose different reasonable assumptions. As a result, a narrow range of reasonable assumptions may develop both for an individual actuary and across actuarial practice.

Inflation

By "inflation," we mean price inflation, as measured by annual increases in the Consumer Price Index (CPI). This inflation assumption underlies all of the other economic assumptions we employ. It not only impacts investment return, but also salary increase rates and the payroll growth assumption. The current annual inflation assumption is 2.75 percent.

Over the five-year period from June 2012 through June 2017, the CPI-U has increased at an average rate of 1.31 percent. However, please remember that the assumed inflation rate is only weakly tied to past results.

The following table shows the average inflation over various periods, ending June 2017.

Fiscal Year	Annual Increase in CPI-U
2012-13	1.75%
2013-14	2.07%
2014-15	0.12%
2015-16	1.00%
2016-17	1.63%
3-Year Average	0.92%
5-Year Average	1.31%
10-Year Average	1.63%
20-Year Average	2.14%
25-Year Average	2.26%
30-Year Average	2.60%
40-Year Average	3.55%
50-Year Average	4.07%

The graph on the next page shows the average annual inflation, as measured by the increase in CPI-U, in each of the 10 consecutive 5-year periods over the last 50 years.

Economic Assumptions

Average Annual Inflation
CPI-U Five Fiscal Year Averages

Period	Five year average increase
1968 - 1972	4.60%
1973 - 1977	7.80%
1978 - 1982	9.83%
1983 - 1987	3.19%
1988 - 1992	4.32%
1993 - 1997	2.72%
1998 - 2002	2.33%
2003 - 2007	2.98%
2008 - 2012	1.95%
2013 - 2017	1.31%
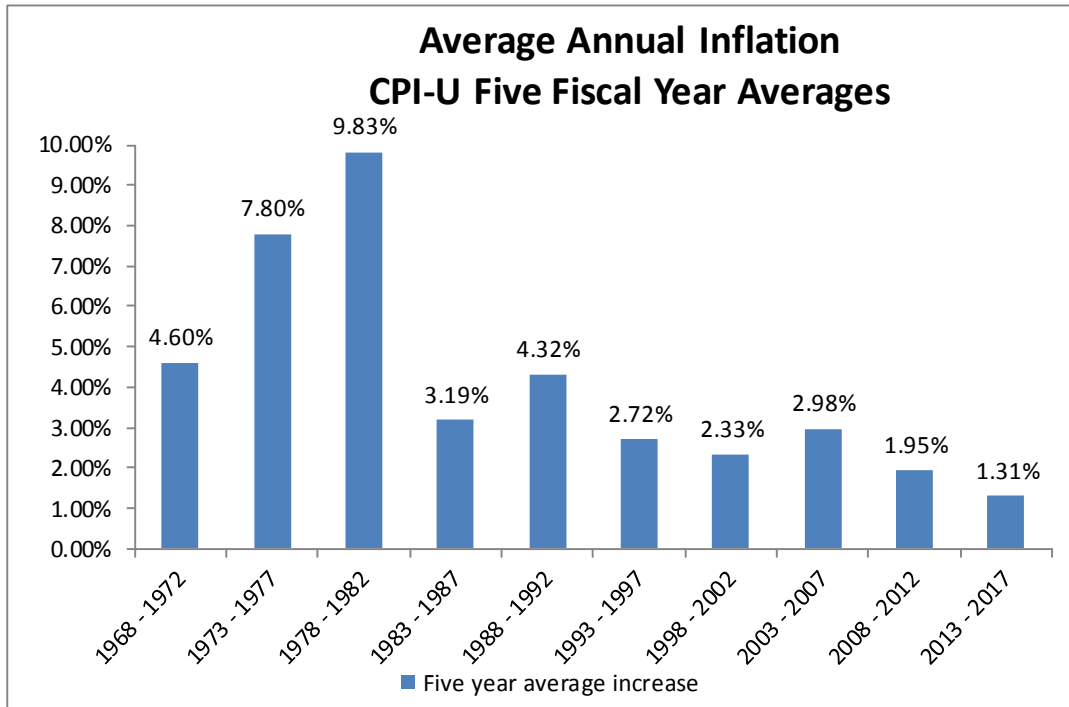
As the above chart illustrates, the high inflation of the 1970s and 1980s is well in the past. The geometric average annual increase in price inflation was 2.60 percent per year over the last 30 years from June 1987 to June 2017, 2.14 percent over the last 20 years and 1.63 percent over the last 10 years.

The following graph illustrates the rate of inflation on a year by year basis over the last 30 years.
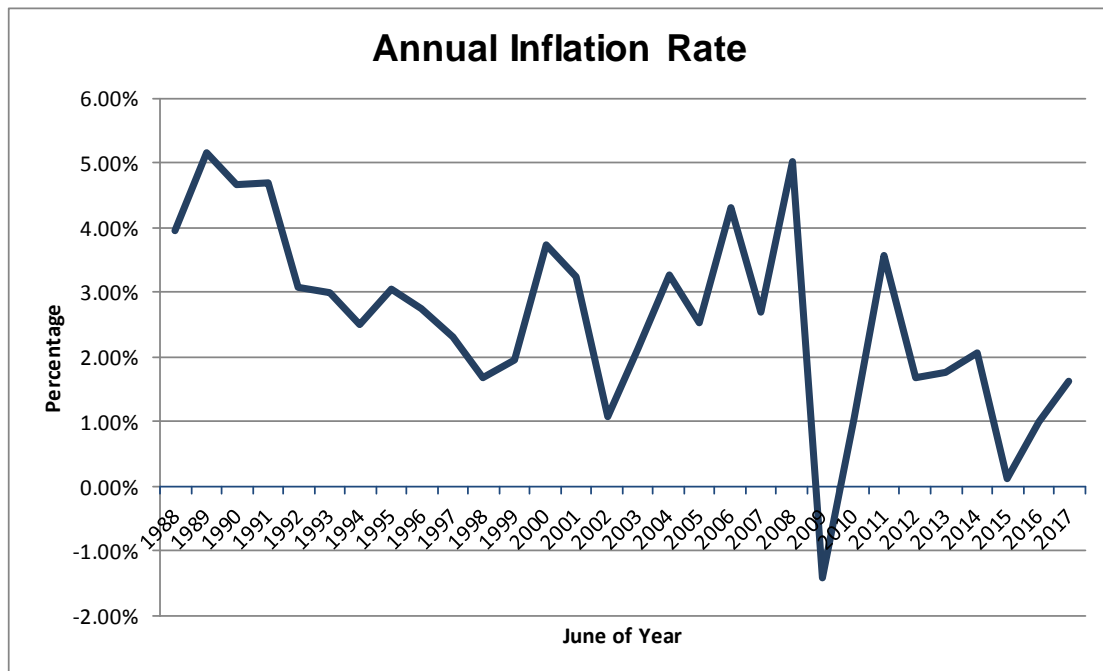
Annual Inflation Rate

Since price inflation is relatively volatile and is subject to a number of influences not based on recent history, economic assumptions are less reliably based on recent past experience than are the demographic

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assumptions. Therefore, it is important not to give undue weight to recent experience. We must also consider future expectations as well.

Another source of information about future inflation is the market for US Treasury bonds. Simplistically, the difference in yield between non-indexed and indexed treasury bonds should be a reasonable estimate of what the bond market expects on a forward looking basis for inflation. As of the end of June 2017, the difference between non-indexed and indexed 20-year bonds implies that inflation over the next 20 years would average 1.77 percent. The difference in yield for 30-year bonds implies that inflation over the next 30 years would average 1.85 percent.

However, this analysis is not perfect as it ignores (1) the inflation risk premium that buyers of US Treasury bonds often demand, as well as (2) possible differences in liquidity between US Treasury bonds and Treasury Inflation-Protected Securities (TIPS).

We also surveyed the inflation assumption used by well-known investment consulting firms across the country. In our sample of these firms, the inflation assumption ranged from 2.00 percent to 2.75 percent, with an average of 2.25 percent.

Another point of reference is the Social Security Administration's (SSA) 2017 Trustees Report, in which the Office of the Chief Actuary is projecting a long-term average ultimate annual inflation rate of 2.0 percent in the high cost projection scenario, 2.6 percent under the intermediate cost projection scenario and 3.2 percent in the low cost projection scenario. The Social Security Trustees report uses the ultimate rates for their 75-year projections, much longer than the longest horizon we can discern from Treasuries and TIPS.

The following table presents a summary of inflation rate forecasts from various professional experts.

Economic Assumptions

Forward-looking Annual Inflation Forecasts	
Federal Reserve Board's Federal Open Market Committee	
Current Long-run Price Inflation Objective (Since Jan 2012; Personal Consumer Expenditures)	2.00%
Congressional Budget Office: *The Budget and Economic Outlook*	
Overall Consumer Price Index (June 2017; Ultimate)	2.40%
Overall Consumer Price Index (June 2017; 11 Years)	2.36%
Personal Consumer Expenditures (June 2017; Ultimate)	2.00%
Personal Consumer Expenditures (June 2017; 11 Years)	1.98%
2017 Social Security Trustees Report	
CPI-W 15-Year Intermediate Assumption	2.60%
CPI-W 30-Year Intermediate Assumption	2.60%
GDP Deflator 15-Year Intermediate Assumption	2.20%
GDP Deflator 30-Year Intermediate Assumption	2.20%
Quarterly Survey of Professional Forecasters	
1Q2018 Federal Reserve Bank of Philadelphia 10-Year Forecast	2.25%
Federal Reserve Bank of Cleveland	
30-Year Expectation on January 1, 2018	2.21%
20-Year Expectation on January 1, 2018	2.10%
10-Year Expectation on January 1, 2018	1.92%
Bond Investors	
(Excess Yield of Non-indexed Treasuries Over Indexed Treasuries)	
30-Year Expectation on June 30, 2017	1.85%
Median 30-year Expectation over 6/30/12 - 6/30/17	2.09%
20-Year Expectation on June 30, 2017	1.77%
Median 20-year Expectation over 6/30/12 - 6/30/17	2.02%
10-Year Expectation on June 30, 2017	1.73%
Median 10-year Expectation over 6/30/12 - 6/30/17	1.96%
Investment Consultants and Forecasters	
2017 GRS Survey major national investment forecasters and consultants	
Median expectation among 8 firms (averaging 9.4 years)	2.25%
Median expectation among 4 firms (averaging 26.3 years)	2.21%
2017 HAS* Survey of 12 investment advisors: Median (10 years)	2.32%
2017 HAS* Survey of 12 investment advisors: Median (20 years)	2.44%

Horizon Actuarial Services 2017 Survey of Capital Market Assumptions

Based on this information, our opinion is that it would be reasonable to lower the current price inflation assumption of 2.75 percent. However, we caution against lowering the price inflation too low (i.e., below

Economic Assumptions

2.00 percent). (The Federal Reserve's target and the Social Security Trustees' ultimate high cost assumptions are both 2.00 percent.) We are recommending the inflation assumption be reduced from 2.75 percent to 2.25 percent. This reduction recognizes lower inflation expectations in both the near term and longer term. The change will bring it closer to recent inflation levels and closer to levels expected in the financial markets. As you will see, this change also affects all other economic assumptions.

Retiree Cost-of-Living Adjustment (COLA) and Increases in the Pay Cap for Pensionable Pay for Participants Hired on and After January 1, 2011

Automatic annual increases in the retirement annuity differ for employees who first become a participant before or on or after January 1, 2011. Employees who first became a participant before January 1, 2011, receive an increase equal to 3 percent of the current retirement annuity amount. Employees who first become a participant on or after January 1, 2011, receive an increase equal to the lesser of 3 percent or one-half the annual change in the Consumer Price Index-U, whichever is less, based on the originally granted retirement annuity.

Based on the recommended price inflation assumption of 2.25 percent, we recommend a retiree COLA assumption of 1.125 percent for employees who first become a participant on or after January 1, 2011.

For participants who first became members on and after January 1, 2011, and are Tier 2 members, pensionable salary, upon which benefits and member contributions are based, is limited to $106,800 in 2011 and increased by the lesser of 3 percent and one-half of the annual unadjusted percentage increase in the Consumer Price Index-U (but not less than zero) as measured in the preceding 12-month period ending with the September preceding the November 1, which is the date that the new amount will be calculated and made available to the pension funds.

Based on the recommended price inflation assumption of 2.25 percent, we recommend an assumption of 1.125 percent for future increases in the pay cap for pensionable pay.

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Investment Return

ASOP No. 27

Actuaries are required to comply with Actuarial Standard of Practice No. 27 (ASOP No. 27) in setting economic assumptions for retirement plans, including the assumed investment return rate.

In a public retirement system like SURS, it is ultimately the Retirement Board's responsibility to approve the actuarial assumptions used in the actuarial valuations. It is the actuary's duty to provide the Board with information needed to make those decisions and to make recommendations to the Board. Although the Board is the ultimate decision-making body, we are still bound by ASOP No. 27 in providing advice or recommendations to the Board.

According to ASOP No. 27 applicable to valuations with a measurement date on or after September 30, 2014, each economic assumption selected by the actuary should be reasonable. For this purpose, an assumption is reasonable if it has the following characteristics:

- It is appropriate for the purpose of the measurement;
- It reflects the actuary's professional judgment;
- It takes into account historical and current economic data that is relevant as of the measurement date;
- It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and
- It has no significant bias (i.e., it is not significantly optimistic or pessimistic).

Also according to ASOP No. 27, the actuary should recognize the uncertain nature of the items for which assumptions are selected and, as a result, may consider several different assumptions reasonable for a given measurement. The actuary should also recognize that different actuaries will apply different professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop both for an individual actuary and across actuarial practice.

For purposes of budgeting contributions as a level percentage of payroll, the assumed rate of investment return is used as the discount rate to determine the present value of the system's pension obligations. It is important to note that an actuarial investment return assumption based on expected future experience is a single estimate for all years and therefore implicitly assumes that returns above and below expectations will "average out" over time. In other words, the expected risk premium is reflected in the assumed rate of investment return in advance of being earned, while the investment risk is not reflected until actual experience emerges with each actuarial valuation.

The review of the investment return assumption in this report considers forward-looking measures of likely investment return outcomes for the asset classes in the current SURS investment policy. For purposes of this analysis, we have analyzed the SURS investment policy with the capital market assumptions from 10 nationally recognized investment consultants.

Our analysis is based on the GRS Capital Market Assumption Modeler (CMAM). Because GRS is a benefits consulting firm and does not develop or maintain our own capital market expectations, we request and monitor forward-looking expectations developed by a number of well-known major investment consulting

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firms. We update our CMAM on an annual basis. The capital market assumptions in the 2017 CMAM are from the following investment consultants (in alphabetical order) Aon Hewitt, BNY Mellon, JPMorgan, Marquette Associates, Mercer, NEPC, Principal, PCA, RVK and Voya. It is important to understand that in general no two investment consultants will consider the same asset classes. Moreover, there are differences in investment horizons, price inflation, treatment of investment expenses, excess manager performance (i.e., alpha), geometric vs. arithmetic averages and other technical issues. We have attempted to align the various assumption sets from the different investment consultants to be as consistent as possible.

To the best of our ability, we have utilized the 10 consultants' capital market assumptions adjusting these assumptions to fit the SURS investment policy (i.e., target asset allocation). In the following charts, all returns are net of investment expenses and do not consider excess manager performance (alpha). The information in this report is not intended to be construed as investment advice.

Real Return

The allocation of assets within the universe of investment options will significantly impact the overall performance. Therefore, it is meaningful to identify the range of expected returns based on each fund's targeted allocation of investments and an overall set of capital market assumptions.

Based on the strategic policy approved by the Board in June of 2014, below is a table with SURS' current target asset allocation:

Target Asset Allocation	
Asset Class	**Target Percentage**
U.S. Equity	23%
Non-U.S. Equity	19%
Global Equity	8%
Core Fixed Income	19%
Emerging Market Debt	3%
Treasury-Inflation Protected Securities	4%
Private Equity	6%
Real Estate	6%
REITS	4%
Hedged Equity	5%
Opportunity Fund / Infrastructure	1%
Commodities	2%
Total	**100%**
Total Equity	**56%**
Total Fixed Income	**26%**
Total Real Estate	**10%**
Total Other Investments	**8%**

Economic Assumptions

The capital market assumptions in the 2017 CMAM from the 10 nationally recognized investment consultants are for varying time horizons. Eight investment consulting firms provided capital market expectations for shorter time horizons (10 years or less). Two of the investment consulting firms that provided capital market expectations for shorter time horizons also provided capital market expectations for longer time horizons (20 to 30 years) and two investment consulting firms provided capital market expectations for longer time horizons only.

Given SURS current target asset allocation and the capital market assumptions from the investment consultants, the development of the average nominal return, net of investment expenses, is provided in the following tables.

Short-term Investment Horizon (10 years or less)

Investment Consultant	Investment Consultant Expected Nominal Return	Investment Consultant Inflation Assumption	Expected Real Return (2)–(3)	Actuary Inflation Assumption	Expected Nominal Return (4)+(5)	Investment Expenses	Expected Nominal Return Net of Expenses (6)-(7)	Standard Deviation of Expected Return (1-Year)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	5.41%	2.20%	3.21%	2.25%	5.46%	0.00%	5.46%	12.35%
2	6.15%	2.00%	4.15%	2.25%	6.40%	0.00%	6.40%	11.18%
3	6.74%	2.50%	4.24%	2.25%	6.49%	0.00%	6.49%	12.75%
4	6.61%	2.26%	4.35%	2.25%	6.60%	0.00%	6.60%	10.51%
5	6.89%	2.50%	4.39%	2.25%	6.64%	0.00%	6.64%	12.19%
6	7.25%	2.25%	5.00%	2.25%	7.25%	0.00%	7.25%	13.36%
7	7.30%	2.21%	5.09%	2.25%	7.34%	0.00%	7.34%	12.60%
8	7.65%	2.25%	5.40%	2.25%	7.65%	0.00%	7.65%	11.51%
Average	**6.75%**	**2.27%**	**4.48%**	**2.25%**	**6.73%**	**0.00%**	**6.73%**	**12.06%**

Long-term Investment Horizon (20 to 30 years)

Investment Consultant	Investment Consultant Expected Nominal Return	Investment Consultant Inflation Assumption	Expected Real Return (2)–(3)	Actuary Inflation Assumption	Expected Nominal Return (4)+(5)	Investment Expenses	Expected Nominal Return Net of Expenses (6)-(7)	Standard Deviation of Expected Return (1-Year)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	8.05%	2.75%	5.30%	2.25%	7.55%	0.00%	7.55%	12.19%
2	6.89%	2.00%	4.89%	2.25%	7.14%	0.00%	7.14%	11.57%
3	7.73%	2.20%	5.53%	2.25%	7.78%	0.00%	7.78%	12.60%
4	7.23%	2.21%	5.02%	2.25%	7.27%	0.00%	7.27%	12.16%
Average	**7.47%**	**2.29%**	**5.18%**	**2.25%**	**7.43%**	**0.00%**	**7.43%**	**12.13%**

Based on each investment consulting firm's capital market assumptions, we estimated the expected real return of SURS' portfolio (col. (4)). Next, based on the actuary's recommended inflation and investment

Economic Assumptions

expense assumption, we estimated the nominal return net of expenses (col. (8)). As the table shows, the average one-year nominal return (net of expenses) of the firms with short-term investment horizons is 6.73 percent, which is 0.52 percentage points lower than the current assumption of 7.25 percent. The average one-year nominal return (net of expenses) of the firms with long-term investment horizons is 7.43 percent.

In addition to examining the expected one-year return, it is important to review anticipated volatility of the investment portfolio and understand the range of long-term net returns that could be expected to be produced by the investment portfolio.

The following tables provide the 40th, 50th and 60th percentiles of the 10-year (20-year for longer time horizon assumptions) geometric average of the expected nominal return, net of expenses based on the recommended inflation assumption of 2.25 percent. The table also shows the probability of exceeding the current 7.25 percent assumption, and alternate assumptions of 7.00 percent, 6.75 percent and 6.50 percent.

Short-term Investment Horizon (10 years or less)

| Investment Consultant | Distribution of 10-Year Average Geometric Net Nominal Return | | | Probability of exceeding 7.25% | Probability of exceeding 7.00% | Probability of exceeding 6.75% | Probability of exceeding 6.50% |
	40th	50th	60th				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	3.77%	4.74%	5.73%	26.07%	28.16%	30.34%	32.60%
2	4.93%	5.82%	6.71%	34.25%	36.87%	39.56%	42.31%
3	4.73%	5.74%	6.75%	35.35%	37.67%	40.05%	42.47%
4	5.25%	6.08%	6.92%	36.27%	39.12%	42.03%	45.00%
5	4.98%	5.94%	6.92%	36.70%	39.17%	41.68%	44.23%
6	5.37%	6.43%	7.49%	42.22%	44.56%	46.93%	49.31%
7	5.61%	6.61%	7.61%	43.57%	46.07%	48.58%	51.11%
8	6.13%	7.04%	7.96%	47.66%	50.42%	53.18%	55.94%
Average	**5.10%**	**6.05%**	**7.01%**	**37.76%**	**40.25%**	**42.79%**	**45.37%**

The average results of the eight firms with short-term investment horizons indicate there is only about a 38 percent chance that the System will produce an average return that exceeds 7.25 percent over the next 10 years (based on an inflation assumption of 2.25 percent). A rate of about 6.00 percent would have a 50 percent chance of being exceeded over the next 10 years.

Economic Assumptions

Long-term Investment Horizon (20 to 30 years)

| Investment Consultant | Distribution of 20-Year Average Geometric Net Nominal Return | | | Probability of exceeding 7.25% | Probability of exceeding 7.00% | Probability of exceeding 6.75% | Probability of exceeding 6.50% |
	40th	50th	60th				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	5.90%	6.87%	7.84%	46.00%	48.02%	51.71%	55.40%
2	5.61%	6.52%	7.45%	42.08%	42.64%	46.48%	50.36%
3	6.06%	7.05%	8.06%	47.99%	50.73%	54.30%	57.85%
4	5.62%	6.58%	7.55%	43.07%	43.86%	47.53%	51.23%
Average	**5.80%**	**6.76%**	**7.72%**	**44.79%**	**46.31%**	**50.01%**	**53.71%**

The average results of the four firms with long-term investment horizons indicate there is only about a 45 percent chance that the System will produce an average return that exceeds 7.25 percent over the next 20 years (based on an inflation assumption of 2.25 percent). A rate of about 6.75 percent would have a 50 percent chance of being exceeded over the next 20 years.

As another point of reference, NEPC expects an average five- to seven-year geometric return of 6.13 percent (based on US inflation of 2.50 percent) and an average 30-year geometric return of 7.29 percent (based on US inflation of 2.75 percent) based on the SURS current asset allocation. (Based on the NEPC 2018 Investment Outlook report from January of 2018.)

A very important fact to consider when deciding what weight to put on shorter term results or longer term results is the amount of benefits that are projected to be paid in the next 10 years. As shown in the following table, about 50 percent of the actuarial accrued liability as of June 30, 2017, is attributable to benefits that are projected to be paid in the next 10 years. Therefore, it is extremely important to consider shorter-term expectations in addition to longer-term expectations in setting the economic assumptions.

($ In Millions) SURS Values as of June 30, 2017	
(1) Projected Unit Credit Actuarial Accrued Liability (7.25%)	$41,853.35
(2) Market Value of Assets	$18,484.82
(3) Present Value of Benefit Payments in Next 10 Years at 7.25%	$20,504.70
as % of Current Liability (3)/(1)	49%
(4) Present Value of Benefit Payments in Next 15 Years at 7.25%	$28,101.19
as % of Current Liability (4)/(1)	67%
(5) Present Value of Benefit Payments in Next 20 Years at 7.25%	$33,916.69
as % of Current Liability (5)/(1)	81%
(6) Present Value of Benefit Payments in Next 30 Years at 7.25%	$35,803.16
as % of Current Liability (6)/(1)	86%

Economic Assumptions

Recommendation

Based on our analysis of the expected investment return, our recommended assumption for inflation of 2.25 percent and the current SURS target asset allocation, we recommend reducing the investment return assumption of 7.25 percent to 6.75 percent for the actuarial valuation as of June 30, 2018. The recommended assumption is about equal to the average arithmetic return for the eight investment consulting firms who provided capital market expectations for shorter time horizons. A lower assumption of 6.75 percent will result in a higher probability of the assumption being achieved in the future (about a 43 percent probability based on the shorter-term time horizon capital market assumptions and about a 50 percent probability based on the longer-term time horizon capital market assumptions).

We recommend that the assumed investment return assumption be monitored for continued appropriateness between full experience reviews. Also, any significant changes in the target asset allocation of the System may warrant an additional review of the rate of return assumption.

We believe that the recommended assumption can be supported by Actuarial Standard of Practice No. 27. Under the Standard, all economic assumptions must be selected to be consistent with the purpose of the measurement. The purpose of the measurement is to determine the contribution rate which will lead to the accumulation of assets to pay benefits when due.

Additional Considerations

The prescribed interest rate used to develop the money purchase conversion factors is equal to the investment return assumption used in the annual actuarial valuation. The money purchase conversion factors, which apply to Rule 2 benefit calculations (for members hired before July 1, 2005), by statute, are to be updated each time there is a change in the investment return assumption or the post retirement mortality assumption. Therefore, the money purchase factors would need to be updated in the near future based on our recommendation to lower the investment return assumption (and the mortality assumption recommendation).

The investment return assumption was decreased from 7.75 percent to 7.25 percent first effective with the actuarial valuation as of June 30, 2014, and the post-retirement mortality assumption was changed first effective with the valuation as of June 30, 2015. The Board adopted an effective date of January 4, 2016, for the most recent money purchase factors to reflect those changes.

Illustrations of the impact on money purchase benefits of changing the money purchase conversion factors can be found later in this report under "Other Valuation Assumptions."

Economic Assumptions

Effective Rate of Interest (ERI)

The assumed effective rate of interest impacts the projected benefits calculated in the actuarial valuation for members who were hired before July 1, 2005, and are eligible for benefits calculated under the highest of three formulas – the general formula, the money purchase formula and the minimum benefit formula. The assumed effective rate of interest also impacts the projected member contributions under the Portable Plan for purposes of refunds and lump sum retirements.

In order to value all future liabilities in the plan during the annual actuarial valuation, the actuary makes an assumption about the future effective rate of interest to be used in crediting the money purchase accounts and for Portable Plan lump sum retirements and refunds.

The actual Rule 2 Money Purchase ERI, or Effective Rate of Interest, is set by the Comptroller's office each year. Beginning with the Money Purchase ERI for fiscal year 2006, the State Comptroller determined the rate for purposes of crediting member contributions balances for the Rule 2 money purchase formula. The SURS Board of Trustees determined the ERI for years prior to fiscal year 2006 for all purposes, including money purchase, and continues to certify the ERI for purposes of calculating service purchases, refunds for excess contributions and for lump sum retirements and refunds under the Portable Plan.

The following table shows the ERI assumptions used in the actuarial valuation, the ERI assumption approved by the SURS Board and the actual ERI declared by the Comptroller's office for the last 10 years:

Fiscal Years Ending June 30,	Assumed overall Rate of Return - Valuation	ERI assumption used in the actuarial valuation	ERI "Legacy" approved by the SURS Board of Trustees	ERI declared by the Comptroller's Office
2018			6.50%	6.50%
2017	7.25%	7.00%	7.00%	6.75%
2016	7.25%	7.00%	7.00%	7.00%
2015	7.25%	7.00%	7.00%	6.75%
2014	7.25%	7.00%	7.00%	6.75%
2013	7.75%	7.00%	7.50%	6.50%
2012	7.75%	7.75%	7.50%	6.75%
2011	7.75%	7.75%	7.50%	7.00%
2010	8.50%	8.50%	8.00%	7.50%
2009	8.50%	8.50%	8.50%	8.50%
2008	8.50%	8.50%	8.50%	8.00%

* For purposes of calculating service purchases, refunds for excess contributions and for lump sum retirements and refunds under the Portable Plan.

Economic Assumptions

As an actuarial assumption change, this will only affect the actuarial valuation and the liability and funding results. This will not impact the actual benefits earned by the members. This change in actuarial assumption will reduce the liabilities of the plan, since the assumption of a lower long-term rate of interest in the money purchase account will produce a lower assumed money purchase balance and therefore a lower future retirement benefit. A change in the assumed ERI credited to member accounts does not affect the factors used to convert the money purchase account balance to an annuity. (These factors are impacted by the assumed long-term rate of investment return and the mortality assumption.)

Based on the ERI calculation for fiscal year 2018 (completed in February of 2017) performed for the Office of the Comptroller, the expected rate of return for a 20-year period for SURS was 6.91 percent. This amount was reduced by 0.42 percent to account for the deviation between actual investment experience and past ERIs to arrive at the ERI of 6.50 percent for fiscal year 2018.

Based on lower expectations for investment return, we recommend lowering the assumed Effective Rate of Interest to 6.75 percent for the purpose of estimating future benefits and liabilities in the actuarial valuation for the Rule 2 money purchase conversions and for Portable Plan lump sum refunds and retirement conversions. The ERI each year that will be used to actually credit member accounts will continue to be calculated by the Office of the Comptroller and by SURS.

General Wage Inflation and Payroll Growth

A General Wage Inflation (GWI) assumption represents the real wage growth over time in the general economy, (i.e., how much the pay scales themselves will change year to year). It does not necessarily reflect actual pay increases received by individuals or even how payroll in total may change, which can be impacted by population changes, etc. Wage inflation consists of two components, (1) a portion due to pure price inflation (i.e., increases due to changes in the CPI), and (2) increases in average salary levels in excess of pure price inflation (i.e., increases due to changes in productivity levels, supply and demand in the labor market and other macroeconomic factors).

The Average Wage Index (AWI), formerly named the National Average Earnings (NAE), series published in connection with the operation of the Social Security program, is a useful proxy for measuring general changes in wage levels in the economy. Increases in AWI typically exceed increases in the Consumer Price Index (CPI), although there are periods where the patterns are reversed. The economic argument for wages exceeding prices in the long run is that CPI is based on the prices of a fixed basket of goods whereas wages reflect innovations, real productivity growth, labor supply and demand and other factors in addition to pure price inflation.

History of CPI and AWI 1951 - 2016
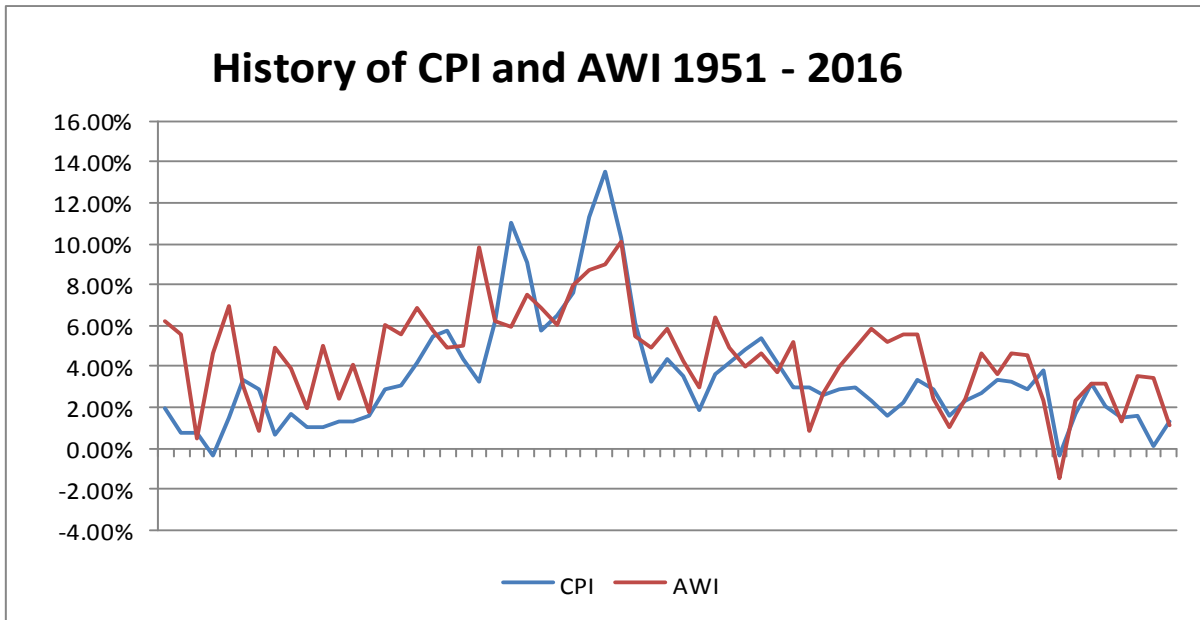
Over the last 65 years, AWI has exceeded CPI 43 times and the averages over that period are 4.5 percent for AWI and 3.5 percent for CPI. The last 25 years has had fewer cases of high inflation, but the distinction between prices and wages still appears. Over the last 25 years, the average increase in AWI is 3.3 percent and the average increase in CPI is 2.3 percent.

As with the investment return assumption, past experience does not necessarily dictate future expectations. Current expectations are mixed on whether price and wage inflation will remain low in the short term, particularly due to the after effects of recent federal government spending. For a long-term view, the 2017 Annual Report from the Trustees of the Social Security Administration (SSA) assumes an intermediate average ultimate CPI of 2.6 percent over the next 75 years and an ultimate intermediate growth assumption for average wages in covered employment of 3.8 percent. The SSA report provides

alternate "High-cost" assumptions of 2.0 percent CPI/2.6 percent wages and "Low-cost" assumptions of 3.2 percent CPI/5.0 percent wages.

With ongoing pressure on the ability of states to sustain across the board increases in wages consistent with historical norms, we do not believe there is justification to increase the assumption for productivity increases; in other words, to increase the assumed gap between price increase and wage growth. We recommend maintaining the assumption for productivity increases of 1.00 percent. The 1.00 percent assumption is consistent with the average salary increases (in excess of price inflation) that were received by SURS members with 35 or more years of service during the experience study period. Combining the recommendation of 1.00 percent for productivity increases with a 2.25 percent inflation assumption implies a wage growth assumption of 3.25 percent. These assumptions are summarized below:

	Current Assumption	Recommended Assumption
Price Inflation	2.75%	2.25%
Productivity Increases	1.00%	1.00%
Total Wage Inflation	3.75%	3.25%

Economic Assumptions

Salary Increase

The components that determine the total salary increase are wage inflation, merit and longevity increases and promotion increases. We recommend a change to the merit and longevity and promotion increase portion of the salary increase assumption to better reflect actual experience.

Following is a summary of the average actual salary increases during the first two years of service from the current experience study and the last two experience studies. GRS has worked with SURS staff and will continue to do so to refine the salary data that is provided for newer members. Although very short service members have a low liability, we will continue working to improve the valuation of liabilities for these members.

Years of Service	Average Total Salary Increase			Average Real Salary Increase (Over Inflation)		
	2010	2014	2018	2010	2014	2018
1	77%	21%	5%	NA	19%	4%
2	33%	21%	17%	NA	19%	16%
Average Rate	53%	21%	11%	NA	19%	10%

The experience in Table I shows that actual salary increases (real) were higher than the current assumptions during the experience study period for members with two or more years of service. However, average inflation over the experience study period was about 0.92 percent, which is lower than the current assumption of 2.75 percent. Therefore, our recommended rates of salary increases in excess of inflation are based on reviewing the real salary increase experience. The recommended real rates are higher than or equal to the current assumed rates of salary increase for members with more than one years of service.

Table and Graph I compare the salary experience, current assumptions and recommended assumptions by years of service for each of the following:

- Table I – Salary Experience by Service
- Graph I – Salary Experience by Service

The following table compares the rates of increase for an active member's remaining career.

Service At Valuation	Service at End of Career	Average Annual Real Salary Increases			Average Annual Total Salary Increases		
		Actual Increase	Current Assumption	Proposed Assumption	Actual Increase	Current Assumption	Proposed Assumption
0	20	3.46%	3.16%	3.28%	4.38%	5.91%	5.53%
0	25	3.04%	2.78%	2.87%	3.96%	5.53%	5.12%
0	30	2.76%	2.52%	2.60%	3.68%	5.27%	4.85%
0	35	2.55%	2.33%	2.40%	3.47%	5.08%	4.65%
10	20	1.91%	1.42%	1.65%	2.83%	4.17%	3.90%
10	25	1.73%	1.37%	1.52%	2.65%	4.12%	3.77%
10	30	1.64%	1.34%	1.45%	2.56%	4.09%	3.70%
10	35	1.57%	1.31%	1.40%	2.49%	4.06%	3.65%

Salary Scale Assumption

Table I

Service at End of Year	Number	Actual Prior Year	Actual Current Year	Actual Real Increase[1]	Actual Total Increase	Expected Real Increase[2]	Expected Total Increase	Proposed Real Increase[3]	Proposed Total Increase
1	2,485	99,076,131	103,788,536	3.84%	4.76%	12.25%	15.00%	10.00%	12.25%
2	9,568	364,600,832	426,472,847	16.05%	16.97%	9.25%	12.00%	10.00%	12.25%
3	10,835	477,097,524	514,085,422	6.83%	7.75%	6.25%	9.00%	6.50%	8.75%
4	11,332	478,712,435	506,552,786	4.90%	5.82%	4.50%	7.25%	4.75%	7.00%
5	10,308	451,160,587	473,117,825	3.95%	4.87%	3.75%	6.50%	4.00%	6.25%
6	8,607	396,109,077	413,230,913	3.40%	4.32%	3.25%	6.00%	3.25%	5.50%
7	7,950	386,188,818	403,931,437	3.67%	4.59%	3.00%	5.75%	3.25%	5.50%
8	8,164	411,699,435	429,851,259	3.49%	4.41%	2.75%	5.50%	3.25%	5.50%
9	8,263	434,617,515	450,170,757	2.66%	3.58%	2.50%	5.25%	2.50%	4.75%
10	7,880	427,805,036	441,594,538	2.30%	3.22%	2.25%	5.00%	2.25%	4.50%
11	7,048	392,398,688	404,923,684	2.27%	3.19%	2.00%	4.75%	2.25%	4.50%
12	6,325	361,379,413	372,008,762	2.02%	2.94%	1.75%	4.50%	1.75%	4.00%
13	5,832	346,837,751	358,060,635	2.32%	3.24%	1.50%	4.25%	1.75%	4.00%
14	5,786	356,683,148	367,852,240	2.21%	3.13%	1.50%	4.25%	1.75%	4.00%
15	5,810	366,318,140	377,233,064	2.06%	2.98%	1.25%	4.00%	1.75%	4.00%
16	5,504	343,773,632	352,961,748	1.75%	2.67%	1.25%	4.00%	1.50%	3.75%
17	4,928	307,763,342	315,400,861	1.56%	2.48%	1.25%	4.00%	1.50%	3.75%
18	4,345	274,117,534	280,666,844	1.47%	2.39%	1.25%	4.00%	1.50%	3.75%
19	3,820	248,894,494	255,340,455	1.67%	2.59%	1.25%	4.00%	1.50%	3.75%
20	3,465	235,651,089	241,920,600	1.74%	2.66%	1.25%	4.00%	1.25%	3.50%
21	3,297	236,948,940	242,590,316	1.46%	2.38%	1.25%	4.00%	1.25%	3.50%
22	3,133	235,786,641	241,527,621	1.51%	2.43%	1.25%	4.00%	1.25%	3.50%
23	2,909	222,032,851	227,153,395	1.39%	2.31%	1.25%	4.00%	1.25%	3.50%
24	2,946	220,327,326	224,879,100	1.15%	2.07%	1.25%	4.00%	1.25%	3.50%
25	2,810	217,957,934	222,828,474	1.31%	2.23%	1.25%	4.00%	1.25%	3.50%
26	2,585	208,349,761	213,563,326	1.58%	2.50%	1.25%	4.00%	1.25%	3.50%
27	2,130	177,220,133	181,183,239	1.32%	2.24%	1.25%	4.00%	1.25%	3.50%
28	1,796	149,936,943	153,415,160	1.40%	2.32%	1.25%	4.00%	1.25%	3.50%
29	1,465	127,047,257	129,830,231	1.27%	2.19%	1.25%	4.00%	1.25%	3.50%
30	1,136	105,428,000	107,858,499	1.39%	2.31%	1.25%	4.00%	1.25%	3.50%
31	902	86,645,757	88,500,265	1.22%	2.14%	1.25%	4.00%	1.25%	3.50%
32	647	64,736,724	66,197,553	1.34%	2.26%	1.25%	4.00%	1.25%	3.50%
33	424	44,678,763	45,634,908	1.22%	2.14%	1.25%	4.00%	1.25%	3.50%
34	261	29,322,124	30,095,906	1.72%	2.64%	1.25%	4.00%	1.25%	3.50%
35+	1,008	123,088,450	125,348,496	0.92%	1.84%	1.00%	3.75%	1.00%	3.25%
Total	**165,704**	**9,410,392,225**	**9,789,771,702**	**3.11%**	**4.03%**	**2.61%**	**5.36%**	**2.76%**	**5.01%**
Total Years 3+	**153,651**	**8,946,715,262**	**9,259,510,319**	**2.58%**	**3.50%**	**2.23%**	**4.98%**	**2.38%**	**4.63%**

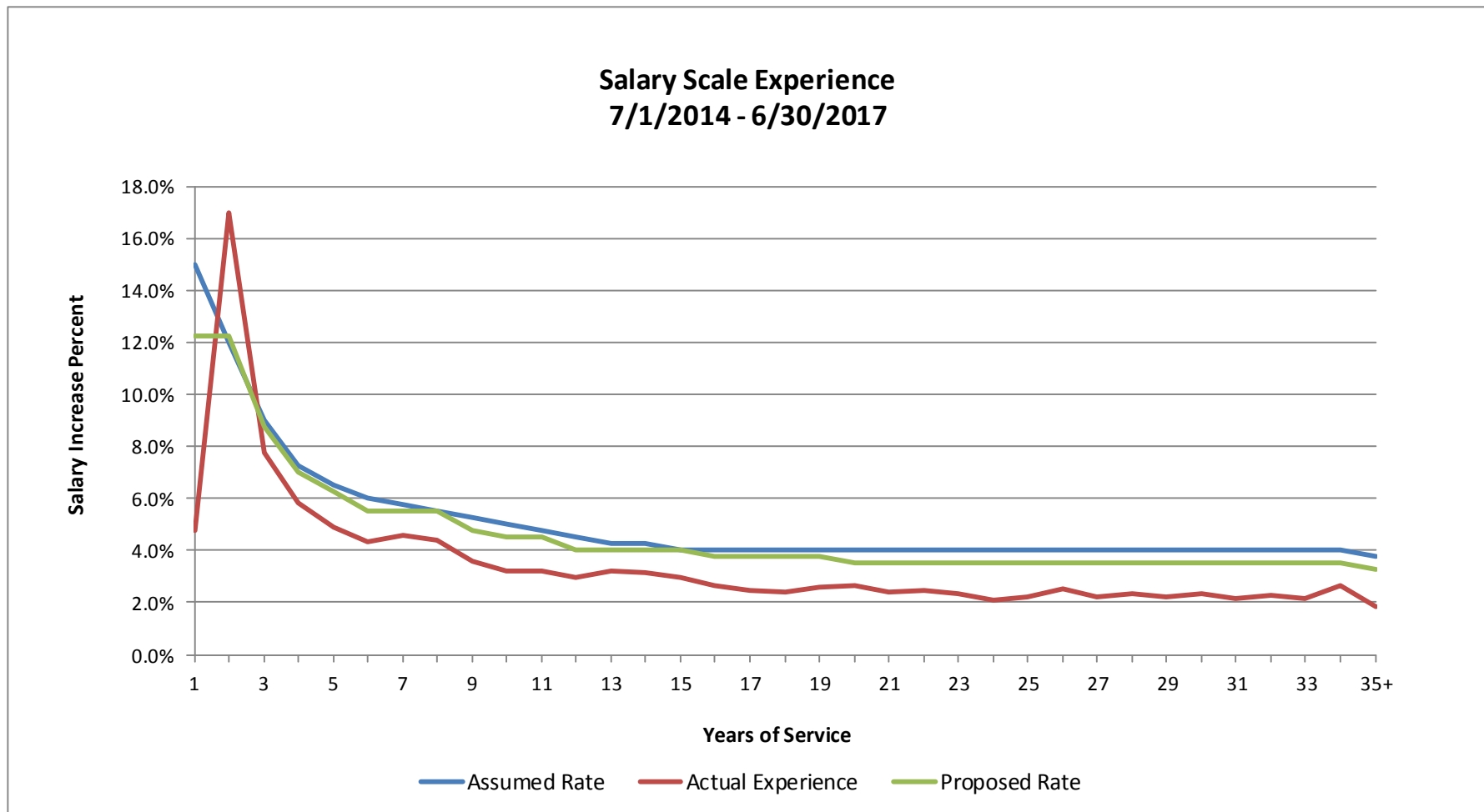[1] Total increase less average inflation of 0.92% over experience study period.
[2] Total increase less average assumed inflation of 2.75%.
[3] Total increase less proposed assumed inflation of 2.25%.

Salary Scale Assumption

Graph I

Salary Scale Experience
7/1/2014 - 6/30/2017

Actual inflation was about 180 basis points lower than assumed inflation during the experience study period.

Demographic Assumptions

The following pages present the analysis of the demographic assumptions. These assumptions include assumed rates of mortality among active and retired members, retirement patterns, disability incidence and turnover patterns. These patterns generally take the form of tables of rates of incidence based on age and/or years of service.

Absent any significant changes in benefit provisions, these assumptions generally exhibit relative consistency over periods of time. As a result, each demographic assumption is normally reviewed by relating actual experience to that assumed over the recent past.

Actuarial Standard of Practice No. 35 - Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations

ASOP 35 applies to actuaries when they are selecting demographic and all other assumptions not covered by ASOP No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, to measure obligations under any defined benefit pension plan that is not a social insurance program as described in section 1.2, Scope, of ASOP No. 32, Social Insurance.

The actuary should identify the types of demographic assumptions to use for a specific measurement. In doing so, the actuary should determine the following:

(a) The purpose and nature of the measurement;
(b) The plan provisions or benefits and factors that will affect the timing and value of any potential benefit payments;
(c) The characteristics of the obligation to be measured (such as measurement period, pattern of plan payments over time, open or closed group, and volatility);
(d) The contingencies that give rise to benefits or result in loss of benefits;
(e) The significance of each assumption; and
(f) The characteristics of the covered group.

Not every contingency requires a separate assumption. For example, for a plan that is expected to provide benefits of equal value to employees who voluntarily terminate employment or become disabled, retire, or die, the actuary may use an assumption that reflects some or all of the above contingencies in combination rather than selecting a separate assumption for each.

Analysis Approach

The analysis of demographic experience is conducted for each assumption using a measure known as the "Actual to Expected (A/E) Ratio." The A/E Ratio is simply the ratio of the actual number of occurrences of the event to which the assumption applies (e.g., deaths or retirements) to the number expected to occur in accordance with the assumption. An A/E Ratio of 1.00 indicates that the assumption precisely predicted the number of occurrences. An A/E Ratio exceeding 1.00 indicates that the assumption underestimated actual experience. Conversely, an A/E Ratio lower than 1.00 indicates that the assumption overestimated actual experience.

These are statistical analyses. As a result, there are several considerations we must keep in mind as we analyze these ratios:

Demographic Assumptions

(1) An actuarial assumption is designed to reflect average experience over long periods of time (30 - 50 years). As a result:

   (a) A deviation between actual experience and that expected from our assumptions for one or two years does not necessarily mean that the assumption should be changed.

   b) A change in actuarial assumption should result if the experience indicates a consistent pattern which is different from that assumed over a period of years.

(2) The larger the amount of data available, the more reliable the statistics used in the analysis. As a result:

   (a) Events that occur with great frequency (e.g., general employment turnover) are more credibly predictable than those occurring less frequently (e.g., active member death).

   (b) In all cases, data covering the entire study period produce more credible results than data for a single year.

   (c) Year by year experience is helpful only in identifying trends and determining whether the three-year data is truly reflective of the entire period.

This analysis is based on the actuarial valuation data for the three-year period from June 30, 2014, to June 30, 2017.

Retirement Assumption

Retirement

The Plan provisions establish the minimum eligibility requirements for retirement. Participants of the plan who became members before January 1, 2011[1], are eligible for immediate normal retirement benefits at the earlier of 30 years of service at any age, age 60 with 8 years of service, or age 62 with five years of service. (Police officers and firefighters are eligible at age 50 with 25 years of service or age 55 with 20 years of service.) Participants of the plan who became members before January 1, 2011[1], are eligible for early (reduced) retirement benefits on or after the attainment of age 55 with 8 years of service.

Retirement cost, however, is determined not by the minimum eligibility requirements but by the ages at which members actually retire. The actuarial valuation does not assume that everyone retires at earliest eligibility. The assumption about the timing of retirement once eligibility has been established is a major component in cost calculations. Note that higher rates of retirement at earlier retirement ages or years of service upon attaining retirement eligibility generally result in higher actuarially determined contributions, and vice versa.

Experience during the last three years was considered in the analysis shown on the following pages. The "Exposure" column shows the number of employees eligible to retire at various years of service or ages throughout the experience period. An individual could potentially be counted up to three times if eligible each year in the period. By tabulating employees in this fashion we are able to answer the question "For all employees eligible at condition X, how many retired?"

The table below shows the number of actual retirements during each year of the experience study period compared with the number expected under the current assumptions. There were a higher number of retirements during FY 2016 than during the other two years of the experience study period. New money purchase factors were first effective on January 4, 2016, and are likely the reason for the higher retirements during fiscal year 2016.

Fiscal Year End	Normal Retirement			Early Retirement		
	Actual	Current Assumption	Actual/ Expected	Actual	Current Assumption	Actual/ Expected
2015	1,215	1,888	0.6	235	388	0.6
2016	1,789	1,938	0.9	371	391	0.9
2017	1,397	1,869	0.7	272	369	0.7
Total	**4,402**	**5,695**	**0.8**	**878**	**1,148**	**0.8**

[1] *Participants who become members of the plan on or after January 1, 2011, are eligible for retirement at age 67 with 10 years of service. Assumed retirement rates for these members will differ from current members.*

Retirement Assumption

Normal Retirement Experience

Current and past experience has shown that retirement rates under this plan are correlated with age. Currently, the Plan uses age-based rates with higher rates at key ages, with 100 percent retirement at age 80. Based on the retirement experience, we recommend the following changes to the Tier 1 retirement rates:

- A slight increase in the retirement rate at age 50
- No change to the rates for ages 60-61, 67-74 and 80+
- A slight decrease in rates at all other ages
- A rate of 50 percent if the member has 40 or more years of service and is younger than age 80

The recommended changes to the retirement rates reflect both the actual experience over the past three years from the current experience study and also reflect that the actual rates of retirement were slightly higher during the last five-year experience study. We will likely recommend further decreases in the rates during the next experience study if actual experience continues to show a downward trend in the actual rates of retirement at ages younger than 80.

Applying the proposed Tier 1 retirement rates to historical data generates the following number of retirements by age at retirement:

| | Number of Retirements | | |
Nearest Age	Actual	Current Assumption	Proposed Assumption
Under 50	32	32	32
50-54	277	359	324
55-59	358	517	443
60-64	1,752	2,187	2,097
65-69	1,362	1,575	1,506
70-74	434	500	538
75-79	123	186	164
80+	64	340	340
Total	**4,402**	**5,696**	**5,444**

Early Retirement Experience

Fewer participants retired under Tier 1 early retirement eligibility than expected under the current assumptions. We recommend a decrease in rates for all Tier 1 early retirement eligibility ages (55-59).

GRS Retirement Consulting

Retirement Experience and Recommendations

The tables and graphs on the following pages show experience for Tier 1 normal and early retirement.

- Table and Graph II(a) – Normal Retirement Experience
- Table and Graph II(b) – Early Retirement Experience

There is currently no retirement experience for Tier 2 members. However, we need to make assumptions on the retirement patterns for members under Tier 2. The table on page 34 shows the current and recommended retirement rates applicable to members in Tier 2. The retirement rates are based on the Tier 1 rates and reflect that a higher number of members are expected to retire at first eligibility (because first eligibility for retirement under Tier 2 is about seven years later than under Tier 1).

Normal Retirement Assumption

Table II(a)

Nearest Age @ Retirement	Actual Experience			Current Assumptions			Proposed Assumptions		
	Exposures	Retirements	Actual Rate	Expected Retirements	Assumed Rate	Actual / Expected	Expected Retirements	Proposed Rate	Actual / Expected
Under 50	64	32	50.0%	32	50.0%	1.0	32	50.0%	1.0
50	71	36	50.7%	32	45.0%	1.1	36	50.0%	1.0
51	107	40	37.4%	48	45.0%	0.8	43	40.0%	0.9
52	168	52	31.0%	76	45.0%	0.7	67	40.0%	0.8
53	233	67	28.8%	93	40.0%	0.7	82	35.0%	0.8
54	275	82	29.8%	110	40.0%	0.7	96	35.0%	0.9
55	292	79	27.1%	111	38.0%	0.7	102	35.0%	0.8
56	323	70	21.7%	116	36.0%	0.6	97	30.0%	0.7
57	332	72	21.7%	100	30.0%	0.7	84	25.0%	0.9
58	321	66	20.6%	96	30.0%	0.7	81	25.0%	0.8
59	312	71	22.8%	94	30.0%	0.8	79	25.0%	0.9
60	3,895	350	9.0%	428	11.0%	0.8	430	11.0%	0.8
61	3,636	363	10.0%	400	11.0%	0.9	403	11.0%	0.9
62	3,777	396	10.5%	491	13.0%	0.8	456	12.0%	0.9
63	3,476	336	9.7%	452	13.0%	0.7	419	12.0%	0.8
64	3,199	307	9.6%	416	13.0%	0.7	389	12.0%	0.8
65	2,801	406	14.5%	476	17.0%	0.9	425	15.0%	1.0
66	2,278	332	14.6%	387	17.0%	0.9	348	15.0%	1.0
67	1,864	265	14.2%	280	15.0%	0.9	286	15.0%	0.9
68	1,624	201	12.4%	244	15.0%	0.8	250	15.0%	0.8
69	1,259	158	12.5%	189	15.0%	0.8	197	15.0%	0.8
70	1,017	134	13.2%	153	15.0%	0.9	162	15.0%	0.8
71	756	92	12.2%	113	15.0%	0.8	121	15.0%	0.8
72	661	81	12.3%	99	15.0%	0.8	108	15.0%	0.8
73	509	80	15.7%	76	15.0%	1.0	82	15.0%	1.0
74	388	47	12.1%	58	15.0%	0.8	65	15.0%	0.7
75	285	34	11.9%	57	20.0%	0.6	49	15.0%	0.7
76	214	34	15.9%	43	20.0%	0.8	37	15.0%	0.9
77	178	25	14.0%	36	20.0%	0.7	32	15.0%	0.8
78	137	19	13.9%	27	20.0%	0.7	25	15.0%	0.8
79	116	11	9.5%	23	20.0%	0.5	21	15.0%	0.5
80+	340	64	18.8%	340	100.0%	0.2	340	100.0%	0.2
Totals:	**34,908**	**4,402**	**12.6%**	**5,696**	**16.3%**	**0.8**	**5,444**	**15.6%**	**0.8**
Excluding 80+:	**34,568**	**4,338**	**12.5%**	**5,356**	**15.5%**	**0.8**	**5,104**	**14.8%**	**0.8**

Rates are for Tier 1 members only. There is not current retirement experience for Tier 2 members who have different eligibility conditions. Separate retirement rates apply for Tier 2 members.

Expected retirements under the proposed assumptions reflect a rate of 50 percent if a member has 40 or more years of service. The proposed rates shown are those for members with less than 40 years of service.

Normal Retirement Assumption

Graph II(a)

Normal Retirement Experience
7/1/2014 - 6/30/2017
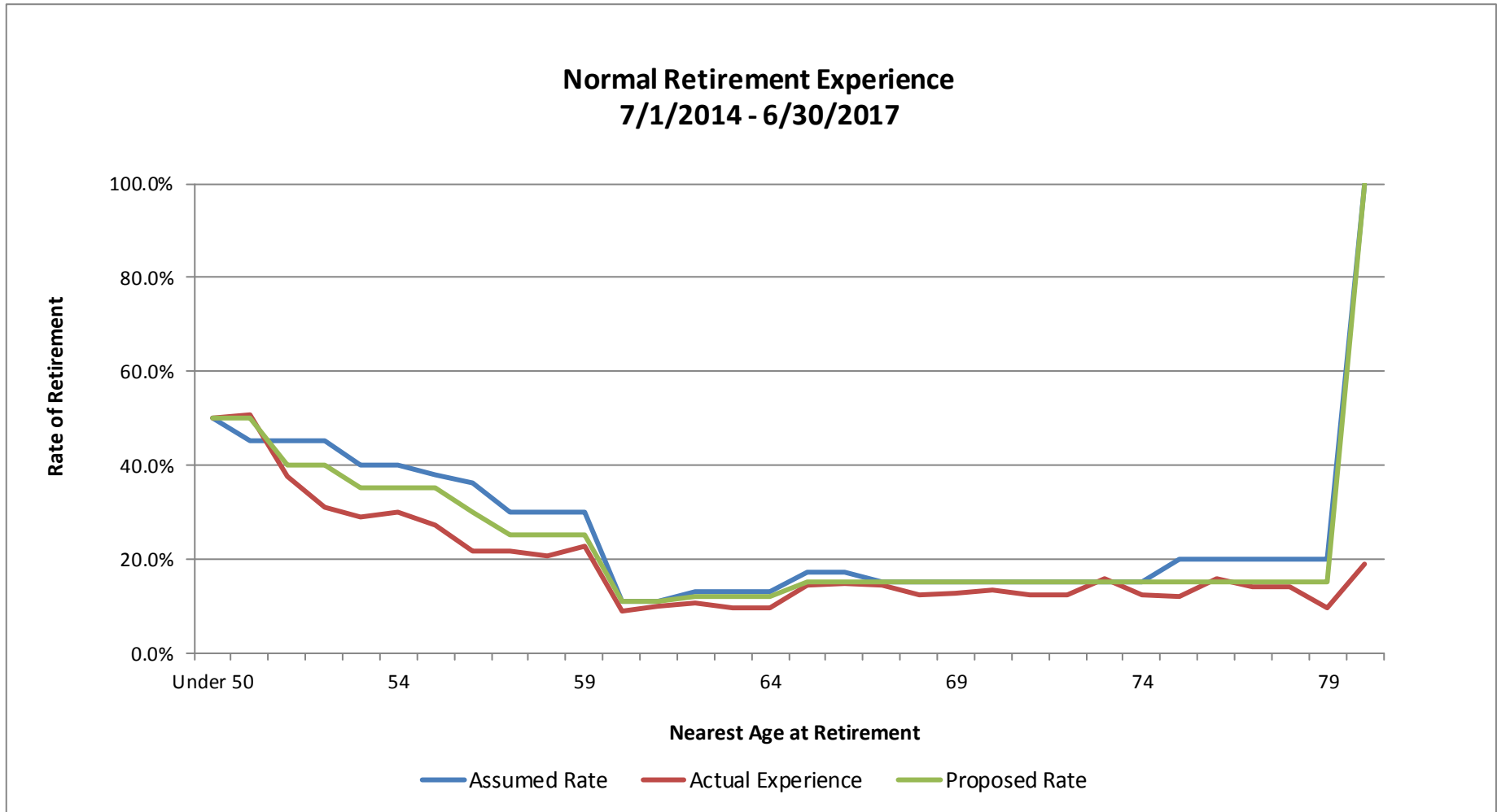
Early Retirement Assumption

Table II(b)

Nearest Age @ Retirement	Actual Experience			Current Assumptions			Proposed Assumptions		
	Exposures	Retirements	Actual Rate	Expected Retirements	Assumed Rate	Actual / Expected	Expected Retirements	Proposed Rate	Actual / Expected
55	4,120	257	6.2%	309	7.5%	0.8	288	7.0%	0.9
56	3,947	193	4.9%	237	6.0%	0.8	217	5.5%	0.9
57	3,821	140	3.7%	172	4.5%	0.8	153	4.0%	0.9
58	3,808	136	3.6%	209	5.5%	0.7	190	5.0%	0.7
59	3,690	152	4.1%	221	6.0%	0.7	203	5.5%	0.7
Totals:	**19,386**	**878**	**4.5%**	**1,148**	**5.9%**	**0.8**	**1,051**	**5.4%**	**0.8**

Rates are for Tier 1 members only. There is not current retirement experience for Tier 2 members who have different eligibility conditions. Separate retirement rates apply for Tier 2 members.

Early Retirement Assumption

Graph II(b)

Early Retirement Experience
7/1/2014-6/30/2017
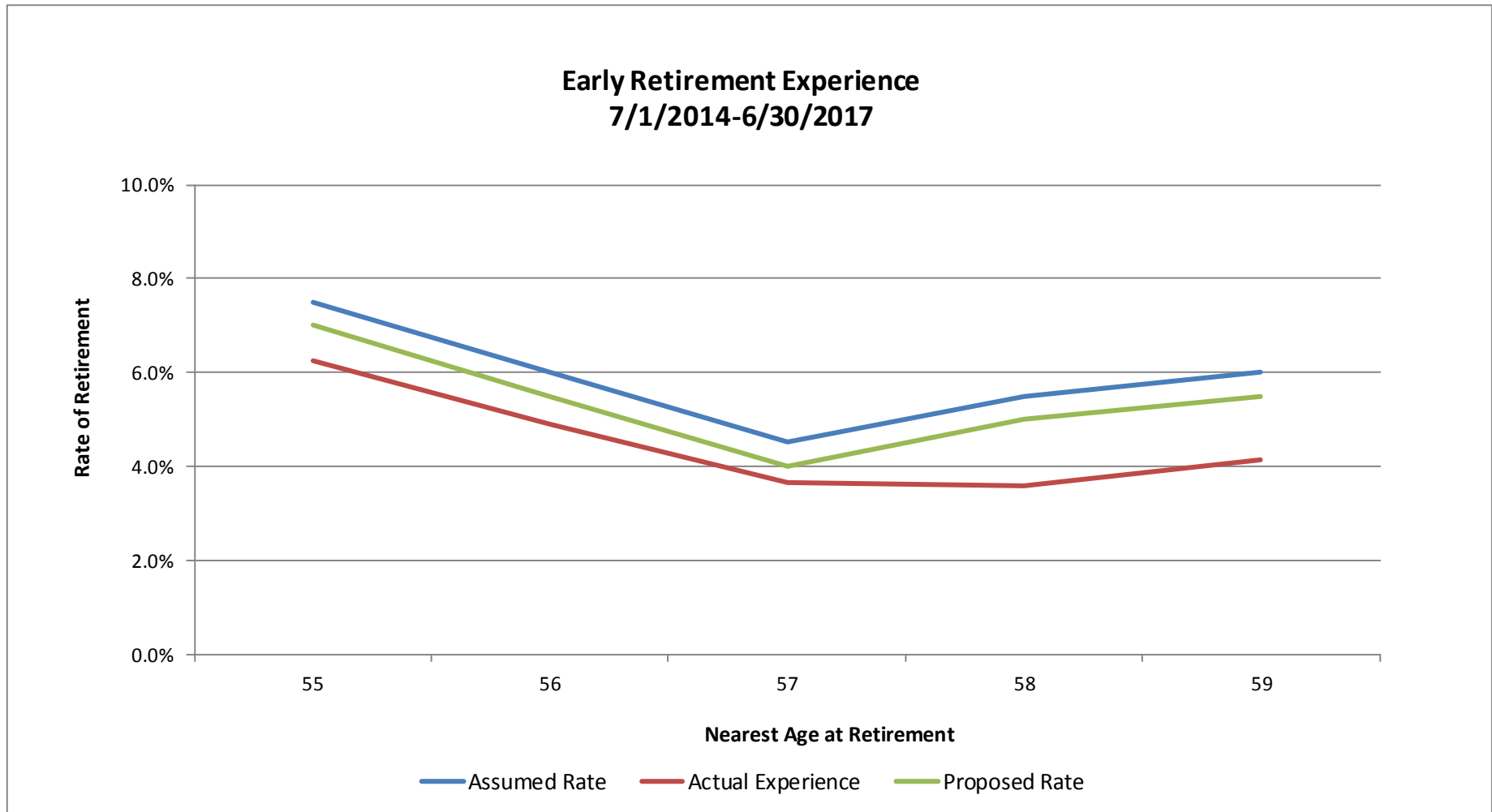
Tier 2 Retirement Assumption

Table II(c)

Nearest Age @ Retirement	Tier 2 - Normal Retirement		Tier 2 - Early Retirement	
	Assumed Rate	Proposed Rate	Assumed Rate	Proposed Rate
62			35.0%	25.0%
63			15.0%	10.0%
64			15.0%	10.0%
65			15.0%	10.0%
66			15.0%	10.0%
67	50.0%	35.0%		
68	35.0%	15.0%		
69	30.0%	15.0%		
70	15.0%	15.0%		
71	15.0%	15.0%		
72	15.0%	15.0%		
73	15.0%	15.0%		
74	15.0%	15.0%		
75	20.0%	15.0%		
76	20.0%	15.0%		
77	20.0%	15.0%		
78	20.0%	15.0%		
79	20.0%	15.0%		
80+	100.0%	100.0%		

A rate of 50 percent is assumed if a member has 40 or more years of service, is eligible for normal retirement and is younger than age 80.
A rate of 50 percent is assumed if a member has 40 or more years of service, is eligible for early retirement and is age 62.

Turnover

Turnover experience during the last three years was considered in the analysis shown on the following pages. The "Exposure" column shows the number of employees at various years of service throughout the experience period.

The "Turnover" column shows the number of employees at various years of service who have gone from active status for reasons other than retirement and death. This includes members moving to inactive status as well as members terminating and receiving a refund of contributions.

Typically, we would consider a status change from active to inactive a termination in developing turnover rates. However, because some of these participants return to active status and accrue additional benefits, we have considered this in our analysis of turnover experience. The "Net Turnover" column shows the number of employees, by years of service, who went from inactive to active status between the experience study period of June 30, 2014, and June 30, 2017. While these participants are not necessarily the same exact participants who went to inactive status during the experience study period, we believe that using this data helps us develop proposed net effective turnover rates.

There were more terminations than expected under the current assumptions. Based on our analysis, we recommend maintaining service-based rates and making the following changes to the turnover rates:

- Slight increase in rates at most ages; and
- Maintain a pattern of decreasing termination rates by years of service.

In addition, we recommend continuing to assume that members who are eligible for a deferred benefit elect the option that is more valuable – return of contributions or a deferred benefit. This will provide a level of conservatism in the actuarial valuation.

The table and graph on the following pages show termination experience by service, including the impact of members returning from inactive to active status.

- Table III and Graph III – Termination Experience by Service

Turnover Assumption

Table III

Service	Actual Experience					Current Assumptions			Proposed Assumptions		
BOY	Exposures	Turnover	Actual Rate	Net Turnover[1]	Actual Rate	Expected Turnover	Assumed Rate	Actual / Expected[1]	Expected Turnover	Proposed Rate	Actual / Expected[2]
0	3,617	1,137	31.43%	720	19.91%	723	20.00%	1.0	723	20.00%	1.0
1	12,736	2,947	23.14%	2,705	21.24%	2,547	20.00%	1.1	2,547	20.00%	1.1
2	13,431	2,052	15.28%	1,724	12.84%	2,015	15.00%	0.9	2,015	15.00%	0.9
3	13,739	2,336	17.00%	2,024	14.73%	1,923	14.00%	1.1	1,923	14.00%	1.1
4	11,831	1,964	16.60%	1,726	14.59%	1,420	12.00%	1.2	1,538	13.00%	1.1
5	9,228	1,345	14.58%	1,169	12.67%	923	10.00%	1.3	1,107	12.00%	1.1
6	8,056	992	12.31%	859	10.66%	725	9.00%	1.2	806	10.00%	1.1
7	7,832	906	11.57%	769	9.82%	587	7.50%	1.3	705	9.00%	1.1
8	7,581	733	9.67%	650	8.57%	512	6.75%	1.3	606	8.00%	1.1
9	7,103	648	9.12%	587	8.26%	426	6.00%	1.4	497	7.00%	1.2
10	6,201	518	8.35%	442	7.13%	326	5.25%	1.4	372	6.00%	1.2
11	5,421	421	7.77%	356	6.57%	244	4.50%	1.5	271	5.00%	1.3
12	4,937	352	7.13%	291	5.89%	197	4.00%	1.5	222	4.50%	1.3
13	4,858	315	6.48%	274	5.64%	180	3.70%	1.5	194	4.00%	1.4
14	4,815	255	5.30%	216	4.49%	154	3.20%	1.4	193	4.00%	1.1
15	4,502	235	5.22%	213	4.73%	135	3.00%	1.6	180	4.00%	1.2
16	3,966	185	4.66%	155	3.91%	119	3.00%	1.3	139	3.50%	1.1
17	3,392	150	4.42%	129	3.80%	102	3.00%	1.3	119	3.50%	1.1
18	2,963	151	5.10%	130	4.39%	89	3.00%	1.5	104	3.50%	1.3
19	2,640	96	3.64%	77	2.92%	79	3.00%	1.0	79	3.00%	1.0
20	2,533	93	3.67%	82	3.24%	63	2.50%	1.3	76	3.00%	1.1
21	2,378	88	3.70%	74	3.11%	59	2.50%	1.3	71	3.00%	1.0
22	2,149	71	3.30%	59	2.75%	54	2.50%	1.1	54	2.50%	1.1
23	1,986	74	3.73%	66	3.32%	50	2.50%	1.3	50	2.50%	1.3
24	1,907	56	2.94%	47	2.46%	48	2.50%	1.0	48	2.50%	1.0
25	1,774	36	2.03%	30	1.69%	35	2.00%	0.9	35	2.00%	0.9
26	1,599	44	2.75%	42	2.63%	32	2.00%	1.3	32	2.00%	1.3
27	1,322	31	2.34%	27	2.04%	26	2.00%	1.0	26	2.00%	1.0
28	1,140	25	2.19%	22	1.93%	23	2.00%	1.0	23	2.00%	1.0
29	251	32	12.75%	30	11.95%	5	2.00%	6.0	5	2.00%	6.0
Totals:	155,888	18,288	11.73%	15,695	10.07%	13,821	8.87%	1.1	14,760	9.47%	1.1

[1] Reflects actual turnover net of inactive members who returned to active service.
[2] Actual to expected ratio based on net turnover.

Turnover Assumption

Graph III

Turnover Experience (Net)
7/1/2014 - 6/30/2017
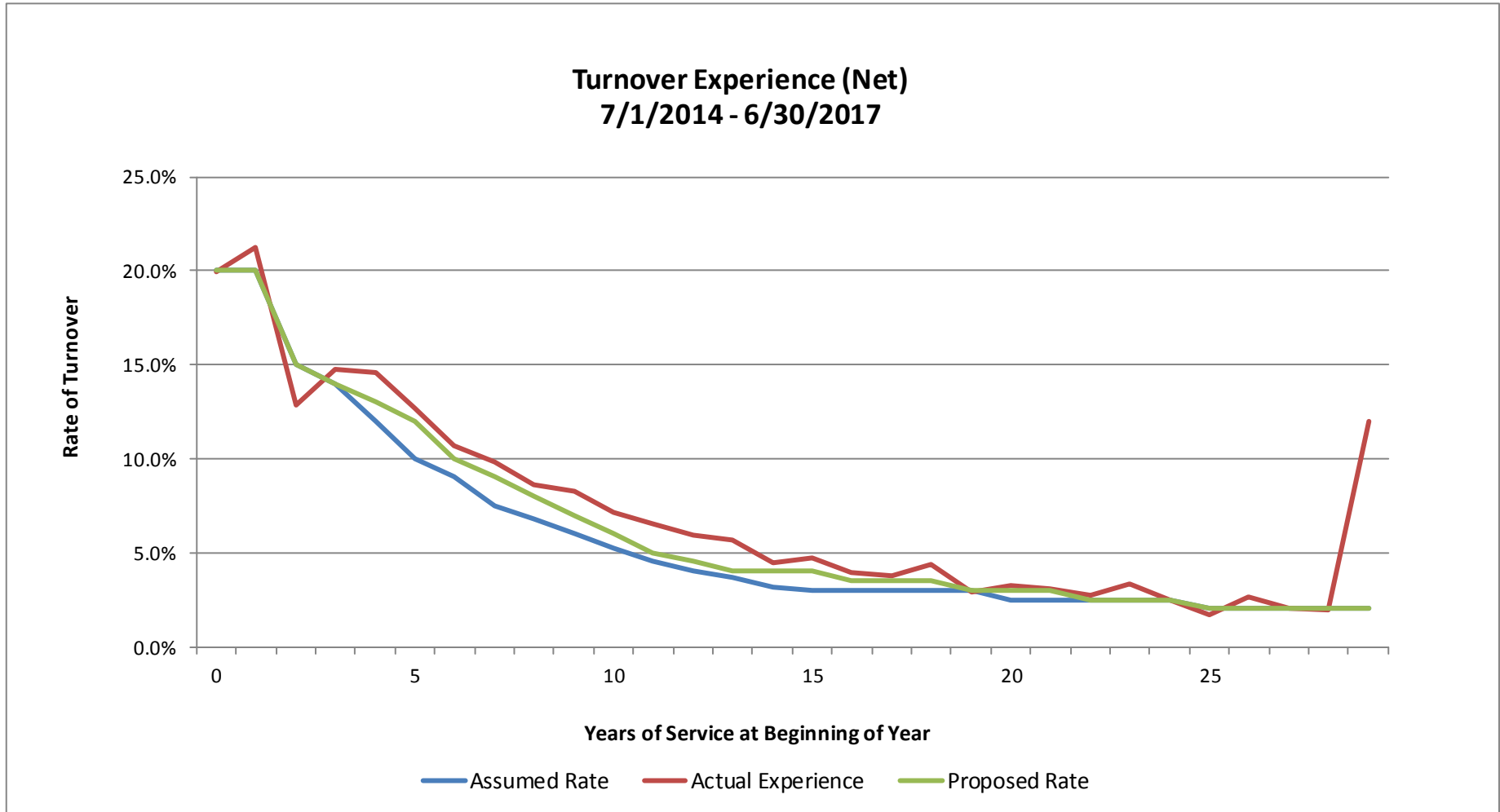
Disability Assumption

Disability

Disability experience during the last three years was considered in the analysis shown on the following pages. The "Exposure" column shows the number of employees in five-year age bands throughout the experience period.

We reviewed historical disability experience over the past five years and found that a high percentage of members receiving disability benefits cease receiving disability benefits and either return to active status or are classified as inactive status. Therefore, in addition to reviewing the number of new disabilities each year from active status, we reviewed the number of "net disabilities" each year. "Net disabilities" are disabilities that are expected to be long-term and exclude the incidences of disability where the benefits ceased. In addition, there are members who start receiving disability benefits who were classified as either active members or inactive members in the previous actuarial valuation. Therefore, we considered this in recommending disability rates. Approximately 50 percent of disabled members (on average) do not maintain their disabled status and return to active or inactive status. Therefore, we recommend proposed rates that are 60% of the recommended rates we would have proposed based on actual disability experience (without consideration of disabilities that cease). We are recommending 60 percent (and not 50 percent) to account for the short-term cost for the disabled members who subsequently change from disabled status after receiving disability benefits.

	2013	2014	2015	2016	2017	5-Year Total
New Disabilities from Active Status	126	95	114	137	96	568
Return to Active Status	39	32	28	17	45	161
Change to Terminated Status	51	53	35	43	33	215
Net Disabilities	36	10	51	77	18	192
Net Disabilities as % of New Disabilities from Active	29%	11%	45%	56%	19%	34%
New Disabilities from Inactive Status	47	41	42	47	39	216
Net Disabilities from Active and Inactive Status	83	51	93	124	57	408
Net Disabilities as % of New Disabilities from Active and Inactive	48%	38%	60%	67%	42%	52%

Annualized disability benefits for new disability recipients from active status as of June 30, 2017, were approximately $2.4 million. The recommended disability rates and methodology would account for the 60 percent of payments that are expected to be long-term. We recommend adding a small load to the projected benefit payments to account for the short-term cost of the projected disability benefits that are expected to cease. The projected additional amount is $1 million for the year ending June 30, 2018.

The tables and graphs on the following pages show experience for disability.

- Table and Graph IV(a) – Male Disability Experience
- Table and Graph IV(b) – Female Disability Experience

The disability experience reflected on the following pages does not include disability experience for the SMP. The SMP disability assumption was separately studied and a separate report was issued.

Disability Assumption

Table IV(a)

Male

Age @ Disablement	Actual Experience					Current Assumptions			Proposed Assumptions		
	Exposures	Disabilities	Actual Rate	Estimated Net Disabilities	Actual Rate (Net)	Expected Disabilities	Assumed Rate	Actual / Expected	Expected Disabilities	Proposed Rate	Actual (Net)/ Expected
Under 20	2	0	0.00%	0	0.00%	0	0.04%	0.0	0	0.02%	0.0
20-25	541	1	0.18%	1	0.11%	0	0.05%	4.1	0	0.03%	4.2
25-29	3,590	2	0.06%	1	0.03%	2	0.05%	1.1	1	0.03%	1.1
30-34	7,413	5	0.07%	3	0.04%	4	0.06%	1.1	3	0.03%	1.2
35-39	8,753	3	0.03%	2	0.02%	6	0.07%	0.5	4	0.04%	0.5
40-44	8,745	9	0.10%	5	0.06%	10	0.11%	0.9	6	0.07%	0.9
45-49	10,026	16	0.16%	10	0.10%	17	0.17%	0.9	10	0.10%	1.0
50-54	10,932	32	0.29%	19	0.18%	25	0.23%	1.3	15	0.14%	1.3
55-59	10,890	22	0.20%	13	0.12%	30	0.28%	0.7	17	0.16%	0.8
60-64	9,040	31	0.34%	19	0.21%	28	0.32%	1.1	14	0.16%	1.3
65+	7,558	14	0.19%	8	0.11%	27	0.36%	0.5	12	0.16%	0.7
Totals:	**77,490**	**135**	**0.17%**	**81**	**0.10%**	**151**	**0.19%**	**0.9**	**81**	**0.10%**	**1.0**
Under 40	**20,299**	**11**	**0.05%**	**7**	**0.03%**	**13**	**0.06%**	**0.9**	**8**	**0.04%**	**0.9**
40-59	**40,593**	**79**	**0.19%**	**47**	**0.12%**	**82**	**0.20%**	**1.0**	**48**	**0.12%**	**1.0**
60+	**16,598**	**45**	**0.27%**	**27**	**0.16%**	**55**	**0.33%**	**0.8**	**26**	**0.16%**	**1.0**

Disability rates vary by age. Average rates for the five-year age bands are shown in the table above.
Actual to expected ratios for the proposed rates are based on estimated net disabilities (60 percent of actual disabilities).

Disability Assumption

Graph IV(a)
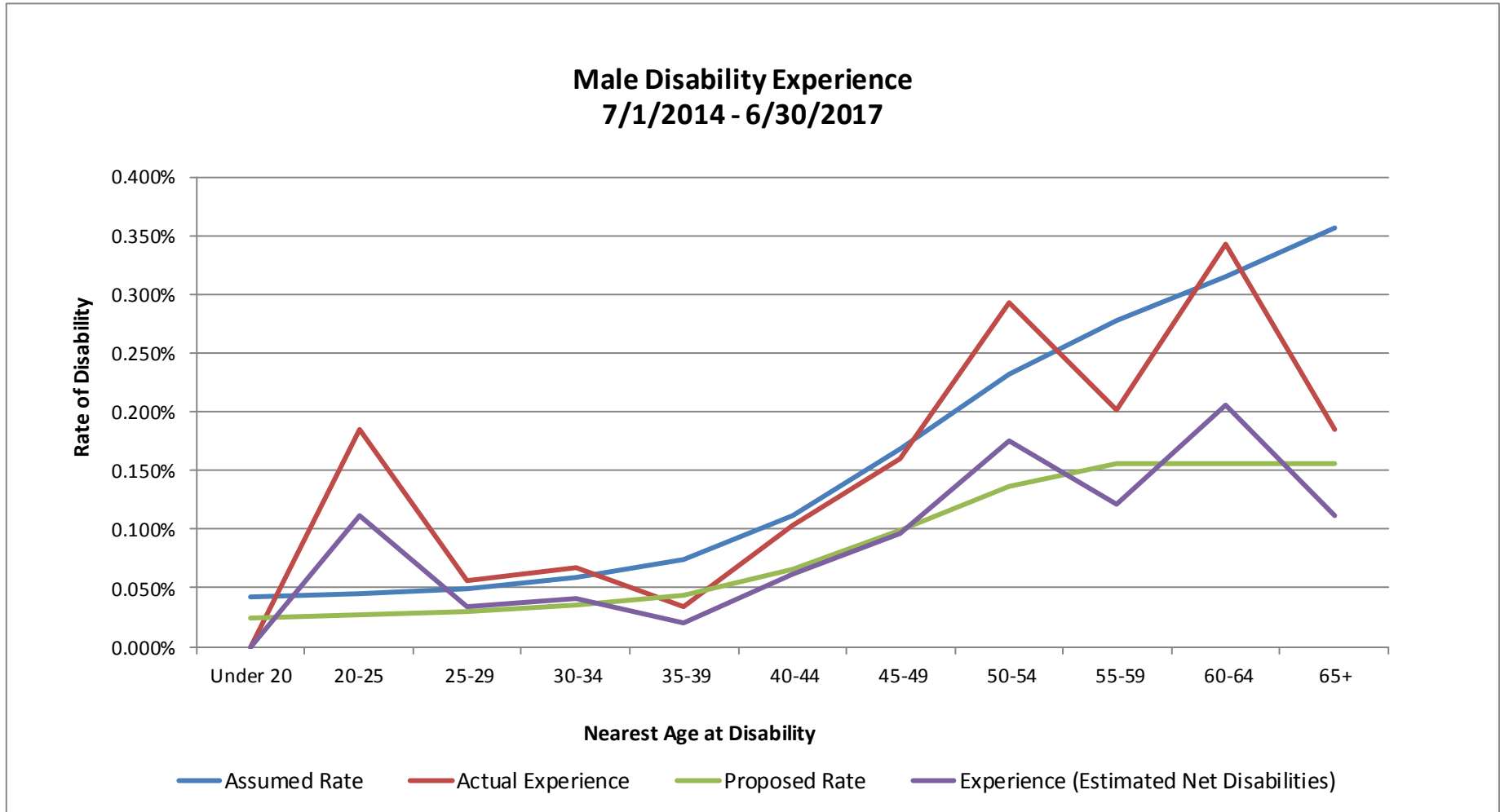
Male Disability Experience
7/1/2014 - 6/30/2017

Experience (Estimated Net Disabilities) is equal to 60 percent of actual disabilities.

Disability Assumption

Table IV(b)

Female

Age @ Disablement	Actual Experience					Current Assumptions			Proposed Assumptions		
	Exposures	Disabilities	Actual Rate	Estimated Net Disabilities	Actual Rate (Net)	Expected Disabilities	Assumed Rate	Actual / Expected	Expected Disabilities	Proposed Rate	Actual (Net)/ Expected
Under 20	1	0	0.00%	0	0.00%	0	0.06%	0.0	0	0.03%	0.0
20-25	587	0	0.00%	0	0.00%	0	0.07%	0.0	0	0.04%	0.0
25-29	5,353	0	0.00%	0	0.00%	5	0.09%	0.0	3	0.05%	0.0
30-34	10,547	6	0.06%	4	0.03%	12	0.12%	0.5	7	0.06%	0.5
35-39	11,890	11	0.09%	7	0.06%	18	0.15%	0.6	10	0.08%	0.7
40-44	12,205	20	0.16%	12	0.10%	23	0.19%	0.9	13	0.10%	1.0
45-49	13,849	31	0.22%	19	0.13%	31	0.23%	1.0	17	0.12%	1.1
50-54	15,917	49	0.31%	29	0.18%	42	0.26%	1.2	23	0.14%	1.3
55-59	15,654	50	0.32%	30	0.19%	47	0.30%	1.1	24	0.16%	1.2
60-64	11,920	31	0.26%	19	0.16%	40	0.34%	0.8	19	0.16%	1.0
65+	7,571	14	0.18%	8	0.11%	29	0.38%	0.5	12	0.16%	0.7
Totals:	**105,494**	**212**	**0.20%**	**127**	**0.12%**	**248**	**0.23%**	**0.9**	**127**	**0.12%**	**1.0**
Under 40	**28,378**	**17**	**0.06%**	**10**	**0.04%**	**35**	**0.12%**	**0.5**	**19**	**0.07%**	**0.5**
40-59	**57,625**	**150**	**0.26%**	**90**	**0.16%**	**144**	**0.25%**	**1.0**	**77**	**0.13%**	**1.2**
60+	**19,491**	**45**	**0.23%**	**27**	**0.14%**	**69**	**0.35%**	**0.7**	**30**	**0.16%**	**0.9**

Disability rates vary by age. Average rates for the five-year age bands are shown in the table above.
Actual to expected ratios for the proposed rates are based on estimated net disabilities (60 percent of actual disabilities).

Graph IV(b)

Female Disability Experience
7/1/2014 - 6/30/2017

Experience (Estimated Net Disabilities) is equal to 60 percent of actual disabilities.

Mortality Assumptions

Mortality

Post-retirement mortality is an important component in cost calculations and should be updated from time to time to reflect current and expected future longevity improvements. Pre-retirement mortality is a relatively minor component in cost calculations. The frequency of pre-retirement deaths is so low that mortality assumptions based on actual experience can only be produced for very large retirement systems.

Actuarial Standards of Practice

Actuarial Standards of Practice (ASOP) No. 35 Disclosure Section 4.1.1 states, "The disclosure of the mortality assumption should contain sufficient detail to permit another qualified actuary to understand the provision made for future mortality improvement. If the actuary assumes zero mortality improvement after the measurement date, the actuary should state that no provision was made for future mortality improvement." The current mortality rates used in the valuation include a provision for future mortality improvement.

The New Mortality Tables and Projection Scale

The Society of Actuaries' (SOA's) Retirement Plans Experience Committee ("RPEC") released updated mortality tables late in 2014 (the RP-2014 tables) which reflect the improvement in longevity of the studied group of private pension plan participants, and which also reflects projected future improvements for current and future generations of participants. The approach we have taken to recommending a mortality assumption for the SURS actuarial valuation is based on the RPEC 2014 model described by the Society of Actuaries (SOA). In effect, we select a base mortality table from the RP-2014 mortality tables (consisting of blue collar, white collar and total gender-specific base mortality tables for actives, retireds and disabled plan members) and a mortality improvement scale based on the 2-dimensional MP-2017 mortality improvement scales projected from the base year of 2006 after adjusting for MP-2014 improvements. Although it is anticipated that the SOA will release new improvement scales annually, for purposes of SURS actuarial valuations, we recommend maintaining the MP-2017 improvement scales until the next experience study. (The mortality improvement scale is applied to the RP-2014 table to reflect improvements in mortality that are expected to occur with each new generation of participants.)

Mortality Improvement Observations at a National Level

The updated mortality and mortality improvement tables show that among males age 65, overall longevity rose 2.0 years, from age 84.6 in 2000 to 86.6 in 2014. Saying it another way, men aged 65 in the year 2000 were expected to live to be 84.6 years old. Men aged 65 in the year 2014 were expected to live to be 86.6 years old. For women age 65, overall longevity rose 2.4 years from age 86.4 in 2000 to age 88.8 in 2014.

Partial Credibility

We use what is termed "the limited fluctuation credibility procedure" to determine the appropriate scaling factor of the base mortality tables for each gender and each member classification. We used a benefits weighted basis for postretirement non-disabled mortality and used a headcount basis for

Mortality Assumptions

preretirement and post-retirement disabled mortality. In each case, the partial credibility factor (or "Z-factor") is computed based on the experience of the specific group being studied. This Z-factor is a measure of the credibility of the pertinent group.

The Best Fit is the ratio of actual to expected deaths using the base table. The final scale is then determined as the weighted average of the Best Fit and 100% based on the Z-factor. For example, the Z-factor for Male Active Members is 37%, suggesting that the data for this group is 37% credible (there were not enough deaths among active members to be completely credible). The Best Fit for this group would be to scale the base tables by 82%. The final scale of 93% is the credibility-weighted average (93% = 37% x 82% + 63% x 100%). Factors for other groups are determined similarly. For retired males, there were enough deaths (on a benefits basis) to warrant full credibility on a lives basis. Therefore, the Best Fit is used as the final scale.

	Benefits or Deaths Needed For Full Credibility	Observed Deaths	Z-Factor	Best Fit	Final Scale Factor
Healthy Male Retirees	953	987	102%	96%	96%
Healthy Female Retirees	550	405	86%	92%	93%
Disabled Male Retirees	1,082	55	23%	155%	112%
Disabled Female Retirees	1,082	76	27%	185%	123%
Male Active Members	1,082	151	37%	82%	93%
Female Active Members	1,082	142	36%	101%	100%

Disabled and active member experience is based on counts and healthy retiree experience is based on benefit amounts (total benefit amounts divided by 100,000).

Recommendations

We reviewed the mortality experience separately for active members, service retirees and disabled members during the three-year study period. The results are shown on the following pages.

Following is a summary of the current mortality assumptions:

Base Table with 2014 Base Year	Male Set Forward	Female Set Forward	Male Multiplier	Female Multiplier
RP-2014 White Collar Employee, sex distinct (pre-retirement)	None	None	110% pre 60, 80% at ages 60+	90% pre 60, 90% at ages 60+
RP-2014 White Collar Healthy Annuitant, sex distinct (non-disabled post-retirement)	1 year	1 year	100%	100%
RP-2014 Disabled Annuitant, sex distinct (disabled post-retirement)	9 years	10 years	100%	100%

Future mortality improvements are reflected by using the MP-2014 projection scale from the year 2014.

Mortality Assumptions

Following is summary of the recommended mortality assumptions:

Applicable Group	Base Table Mortality Table	Male Scaling Factor	Female Scaling Factor
Preretirement	RP-2014 White Collar Employee, sex distinct	93%	100%
Postretirement (non-disabled)	RP-2014 White Collar Healthy Annuitant, sex distinct	96%	93%
Postretirement (disabled)	RP-2014 Disabled Annuitant, sex distinct	112%	123%

Future mortality improvements are reflected by projecting the base mortality tables back from the year 2014 to the year 2006 using the MP-2014 projection scale and projecting from 2006 using the MP-2017 projection scale.

A Note about Mortality Rates

The recommended mortality assumptions include generational mortality improvements, which means that the probability of a 60-year-old retired male dying in any particular year is lower for a 60-year old born in 1994 than a 60-year old born in 1954.

The use of generational mortality tables is based on the assumption that life expectancy increases from generation to generation. Simply put, this means that the life expectancy of someone born in 1994 is greater than that of someone born in 1954.

The following tables and graphs contain the mortality experience for the experience study period:

- Table and Graph V(a) – Post-Retirement Mortality Experience
- Table and Graph V(b) – Pre-Retirement Mortality Experience
- Table and Graph V(c) – Disabled Mortality Experience
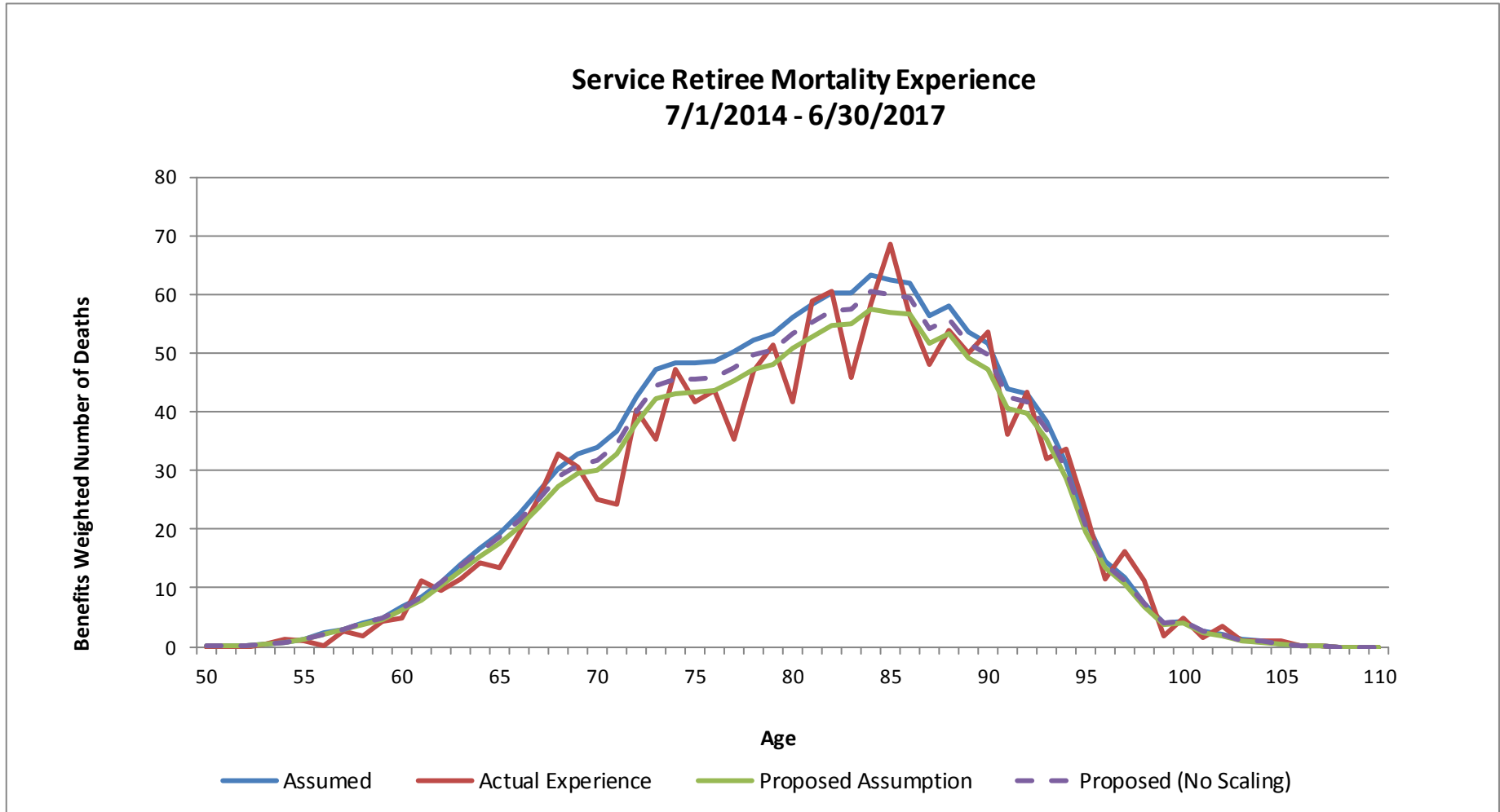
Mortality Assumptions

Table V(a)

	Male Service Retiree Mortality Experience										
	Actual Experience						Current Assumptions			Proposed Assumptions		
	Population Weighted		Benefits Weighted		Actual Rates Weighted by		Expected	Assumed	Actual /	Expected	Proposed	Actual /
Age	Exposures	Deaths	Exposures	Deaths	Population	Benefits	Deaths	Rate	Expected	Deaths	Rate	Expected
Under 50	19	0	8	0	0.000%	0.000%	0	0.257%	0.00	0	0.240%	0.00
50-54	400	2	209	1	0.500%	0.613%	1	0.480%	1.28	1	0.480%	1.28
55-59	3,855	15	1,659	5	0.389%	0.321%	8	0.482%	0.67	7	0.422%	0.76
60-64	9,823	64	4,399	26	0.652%	0.597%	29	0.659%	0.91	28	0.636%	0.94
65-69	16,101	177	7,382	77	1.099%	1.042%	75	1.016%	1.03	70	0.948%	1.10
70-74	14,891	266	7,917	124	1.786%	1.564%	134	1.693%	0.92	124	1.566%	1.00
75-79	10,976	313	6,090	154	2.852%	2.522%	176	2.890%	0.87	164	2.693%	0.94
80-84	7,953	403	4,272	199	5.067%	4.660%	222	5.196%	0.90	207	4.845%	0.96
85-89	4,632	436	2,297	206	9.413%	8.968%	216	9.402%	0.95	202	8.793%	1.02
90-94	1,903	329	896	142	17.288%	15.876%	148	16.509%	0.96	140	15.616%	1.02
95-99	390	119	157	45	30.513%	28.589%	39	24.920%	1.15	36	23.003%	1.24
100+	42	19	15	7	45.238%	47.747%	5	32.758%	1.46	5	32.758%	1.46
Totals:	**70,985**	**2,143**	**35,303**	**987**	**3.019%**	**2.795%**	**1,053**	**2.983%**	**0.94**	**984**	**2.787%**	**1.00**
	Female Service Retiree Mortality Experience										
Under 50	18	0	7	0	0.000%	0.000%	0	0.202%	0.00	0	0.182%	0.00
50-54	597	1	281	0	0.168%	0.147%	1	0.356%	0.41	1	0.356%	0.41
55-59	6,343	16	2,135	4	0.252%	0.207%	7	0.328%	0.63	7	0.328%	0.63
60-64	15,600	73	4,920	25	0.468%	0.508%	27	0.549%	0.93	25	0.508%	1.00
65-69	21,232	165	6,252	44	0.777%	0.707%	54	0.864%	0.82	49	0.784%	0.90
70-74	16,606	175	4,969	48	1.054%	0.971%	69	1.388%	0.70	62	1.248%	0.78
75-79	10,730	247	3,012	65	2.302%	2.158%	71	2.357%	0.92	64	2.125%	1.02
80-84	6,423	282	1,664	66	4.390%	3.986%	69	4.146%	0.96	64	3.846%	1.04
85-89	4,196	334	922	71	7.960%	7.668%	70	7.591%	1.01	65	7.049%	1.09
90-94	2,081	293	416	56	14.080%	13.563%	55	13.225%	1.03	52	12.504%	1.08
95-99	561	129	90	19	22.995%	21.059%	19	21.050%	1.00	18	19.942%	1.06
100+	80	27	18	5	33.750%	26.085%	6	33.717%	0.77	5	28.098%	0.93
Totals:	**84,467**	**1,742**	**24,687**	**404**	**2.062%**	**1.638%**	**448**	**1.815%**	**0.90**	**412**	**1.669%**	**0.98**
Grand Totals:	**155,452**	**3,885**	**59,989**	**1,391**	**2.499%**	**2.319%**	**1,501**	**2.502%**	**0.93**	**1,396**	**2.327%**	**1.00**

Expected deaths under the current and proposed assumptions are on a benefits weighted basis.

Graph V(a)

Service Retiree Mortality Experience
7/1/2014 - 6/30/2017

Mortality Assumptions

Table V(b)

	Actual Experience						Current Assumptions			Proposed Assumptions		
Male Active Mortality Experience												
	Population Weighted		Liability Weighted		Actual Rates Weighted by		Expected	Assumed	Actual /	Expected	Proposed	Actual /
Age	Exposures	Deaths	Exposures	Deaths	Population	Liability	Deaths	Rate	Expected	Deaths	Rate	Expected
Under 30	5,049	0	455	0	0.000%	0.000%	0	0.034%	0.00	0	0.032%	0.00
30-39	17,237	7	7,554	1	0.041%	0.011%	3	0.041%	0.27	3	0.039%	0.28
40-49	19,298	22	28,628	38	0.114%	0.134%	23	0.080%	1.66	21	0.073%	1.85
50-59	22,225	38	67,623	91	0.171%	0.135%	146	0.217%	0.62	131	0.193%	0.70
60-69	14,275	50	49,709	128	0.350%	0.257%	201	0.405%	0.63	251	0.505%	0.51
70-79	2,456	28	7,842	72	1.140%	0.920%	95	1.209%	0.76	119	1.523%	0.60
Totals:	**80,540**	**145**	**161,812**	**330**	**0.180%**	**0.204%**	**469**	**0.290%**	**0.70**	**525**	**0.325%**	**0.63**
Less than 60:	**63,809**	**67**	**104,260**	**131**	**0.105%**	**0.125%**	**173**	**0.166%**	**0.76**	**155**	**0.148%**	**0.84**
Female Active Mortality Experience												
	Population Weighted		Liability Weighted		Actual Rates Weighted by		Expected	Assumed	Actual /	Expected	Proposed	Actual /
Age	Exposures	Deaths	Exposures	Deaths	Population	Liability	Deaths	Rate	Expected	Deaths	Rate	Expected
Under 30	7,286	0	630	0	0.000%	0.000%	0	0.014%	0.00	0	0.017%	0.00
30-39	23,877	8	10,043	1	0.034%	0.014%	2	0.023%	0.60	3	0.029%	0.47
40-49	26,943	23	33,929	20	0.085%	0.059%	18	0.053%	1.11	21	0.062%	0.95
50-59	32,157	54	74,551	140	0.168%	0.188%	93	0.125%	1.51	111	0.149%	1.26
60-69	17,618	44	43,094	124	0.250%	0.288%	106	0.245%	1.17	129	0.299%	0.96
70-79	2,022	12	4,163	35	0.593%	0.839%	26	0.631%	1.33	32	0.759%	1.11
Totals:	**109,903**	**141**	**166,411**	**320**	**0.128%**	**0.193%**	**245**	**0.147%**	**1.31**	**296**	**0.178%**	**1.08**
Less than 60:	**90,263**	**85**	**119,154**	**161**	**0.094%**	**0.135%**	**113**	**0.095%**	**1.42**	**135**	**0.114%**	**1.19**
Grand Totals:	**190,443**	**286**	**328,222**	**651**	**0.150%**	**0.198%**	**714**	**0.218%**	**0.91**	**821**	**0.250%**	**0.79**
Less than 60:	**154,072**	**152**	**223,414**	**292**	**0.099%**	**0.131%**	**286**	**0.128%**	**1.02**	**290**	**0.130%**	**1.01**

Expected deaths under the current and proposed assumptions are on a liability weighted basis.

Graph V(b)

Active Mortality Experience
7/1/2014 - 6/30/2017
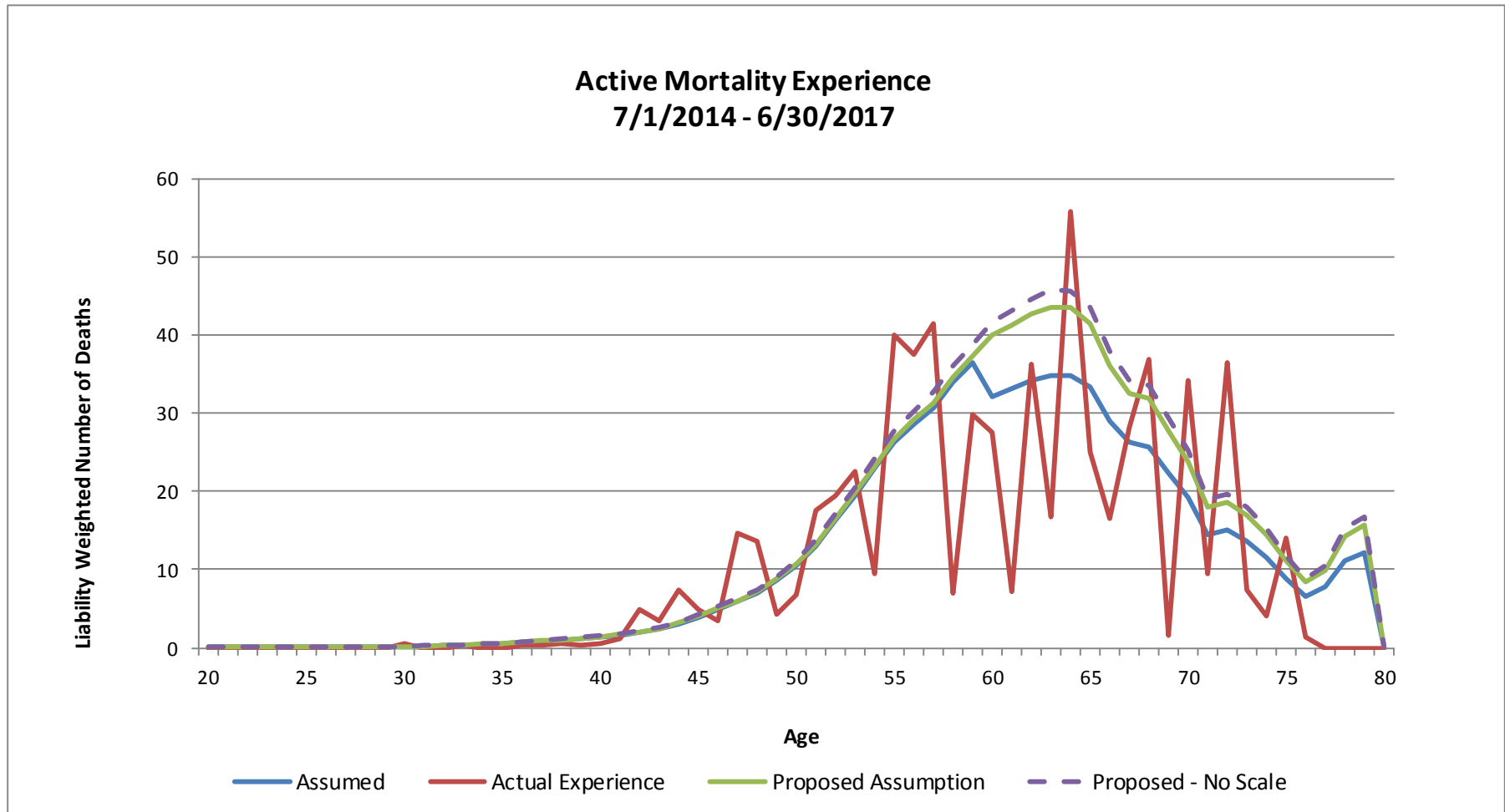
Mortality Assumptions

Table V(c)

	Male Disabled Retiree Mortality Experience											
	Actual Experience						Current Assumptions			Proposed Assumptions		
	Population Weighted		Liability Weighted		Actual Rates Weighted by		Expected	Assumed	Actual /	Expected	Proposed	Actual /
Age	Exposures	Deaths	Exposures	Deaths	Population	Liability	Deaths	Rate	Expected	Deaths	Rate	Expected
25-29	1	0	0	0	0.000%	0.000%	0	0.000%		0	0.000%	
30-34	11	0	2	0	0.000%	0.000%	0	0.000%		0	0.000%	
35-39	12	0	2	0	0.000%	0.000%	0	0.000%		0	0.000%	
40-44	45	1	9	0	2.222%	1.153%	0	0.000%		0	0.000%	
45-49	63	3	14	1	1.587%	4.806%	0	0.000%		0	0.000%	
50-54	153	3	34	1	2.614%	1.989%	1	2.917%	0.68	1	2.917%	0.68
55-59	193	6	41	1	3.109%	2.726%	1	2.445%	1.11	1	2.445%	1.11
60-64	280	13	64	4	3.571%	6.040%	2	3.130%	1.93	2	3.130%	1.93
65-69	187	12	46	3	6.417%	6.037%	3	6.494%	0.93	2	4.329%	1.39
70-74	74	6	13	2	9.459%	12.010%	1	7.429%	1.62	1	7.429%	1.62
75-79	49	6	11	1	14.286%	5.193%	2	17.998%	0.29	1	8.999%	0.58
80-84	20	4	4	1	20.000%	23.913%	1	24.889%	0.96	0	0.000%	
Other	9	1	1	0	11.111%	10.079%	0	0.000%		0	0.000%	
Totals:	**1,097**	**55**	**243**	**13**	**4.831%**	**5.145%**	**11**	**4.523%**	**1.14**	**8**	**3.289%**	**1.56**
	Female Disabled Retiree Mortality Experience											
25-29	4	0	1	0	0.000%	0.000%	0	0.000%		0	0.000%	
30-34	20	0	4	0	0.000%	0.000%	0	0.000%		0	0.000%	
35-39	47	1	11	0	0.000%	1.714%	0	0.000%		0	0.000%	
40-44	74	2	14	0	1.351%	2.265%	0	0.000%		0	0.000%	
45-49	162	7	33	1	1.852%	3.503%	1	3.020%	1.16	0	0.000%	
50-54	270	7	54	1	1.852%	2.395%	1	1.835%	1.31	1	1.835%	1.31
55-59	429	11	91	2	2.331%	2.530%	2	2.207%	1.15	2	2.207%	1.15
60-64	563	19	109	3	2.842%	2.867%	3	2.745%	1.04	2	1.830%	1.57
65-69	256	7	48	1	5.469%	2.756%	3	6.284%	0.44	2	4.189%	0.66
70-74	97	6	12	1	7.216%	5.823%	1	8.274%	0.70	1	8.274%	0.70
75-79	57	5	7	1	12.281%	8.734%	1	13.443%	0.65	1	13.443%	0.65
80-84	33	3	3	0	15.152%	8.968%	0	0.000%		0	0.000%	
Other	23	8	3	1	8.696%	36.237%	0	0.000%		0	0.000%	
Totals:	**2,035**	**76**	**391**	**12**	**3.440%**	**3.141%**	**12**	**3.073%**	**1.02**	**9**	**2.305%**	**1.36**
Grand Totals:	**3,132**	**131**	**634**	**25**	**3.927%**	**3.910%**	**23**	**3.629%**	**1.08**	**17**	**2.682%**	**1.46**

Expected deaths under the current and proposed assumptions are on a liability weighted basis.

GRS Retirement Consulting

Graph V(c)

Disabled Retiree Mortality Experience
7/1/2014 - 6/30/2017
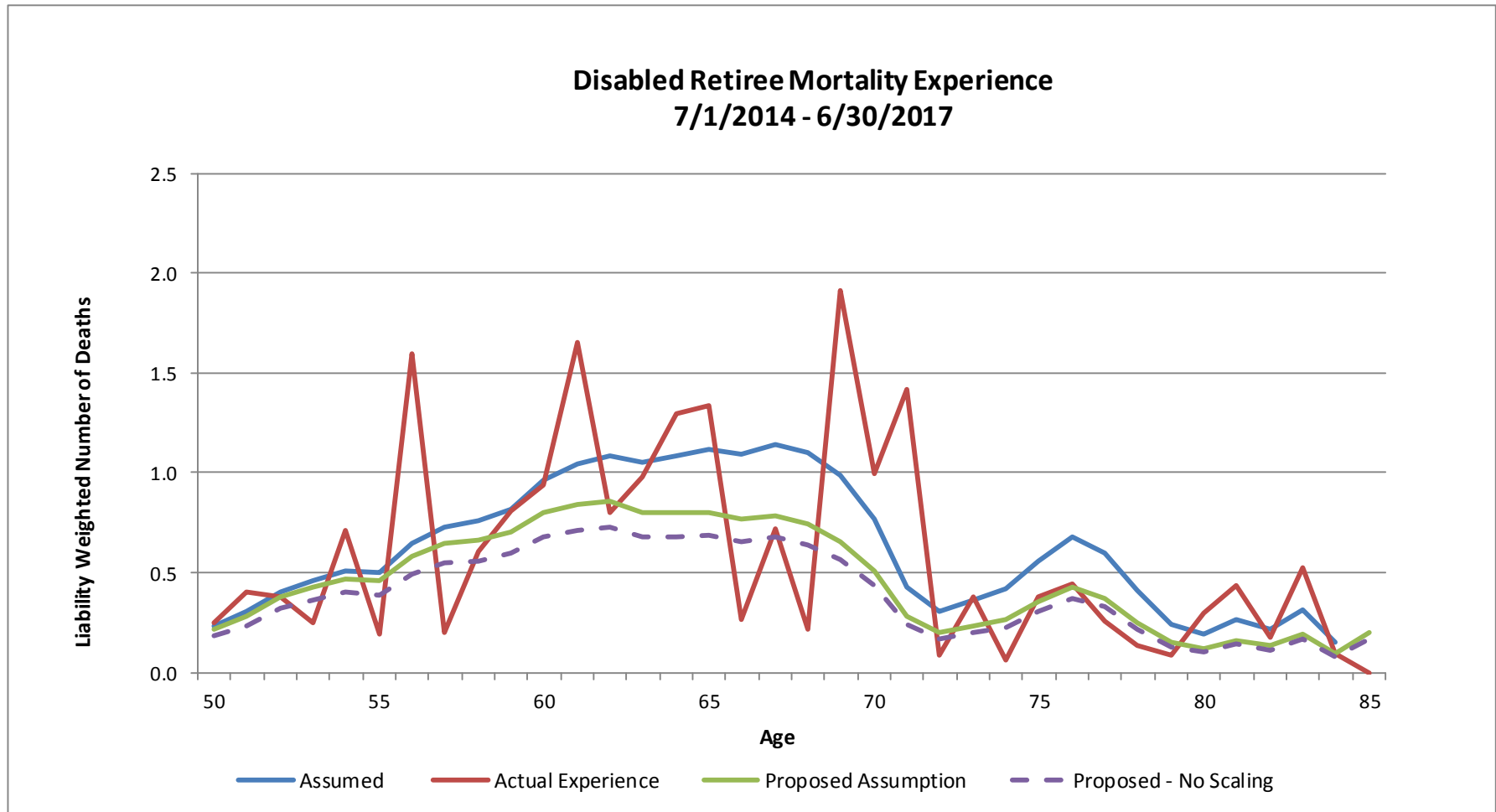
Other Valuation Assumptions

Plan Election Percentage

Historically, members have been able to elect to participate in one of the two defined benefit plans, the Traditional Plan and the Portable Plan, or a defined contribution plan, the Self-Managed Plan (SMP). Effective with Public Act 100-0023 another plan option would be available for future new hires. This new plan is called the Optional Hybrid Plan ("OHP"). In the actuarial valuation as of June 30, 2017, the election percentages for new hires was 60 percent elect the OHP, 20 percent elect Tier 2 and 20 percent elect SMP.

Based on the Board's decision to not implement the OHP until more information is available, we are recommending that future actuarial valuations reflect new hires electing between either Tier 2 or SMP.

Below is a summary of the election percentage for the SMP over the current and prior experience study period for all new members. The SMP election rate has been increasing since the implementation of Tier 2. In addition, the SMP election rate by payroll is higher than the SMP election rate by member count. This means that higher paid members are electing SMP in higher rates than lower paid members.

Fiscal Year End	SMP Election	Total	SMP % of Total	Total with Elections	SMP % of Total Elections	SMP Payroll	Total Payroll	SMP % of Total
2011	576	4,999	12%	3,805	15%	$26,313,040	$158,945,724	17%
2012	905	5,980	15%	4,757	19%	49,647,414	219,476,815	23%
2013	1,182	6,490	18%	5,324	22%	63,653,331	226,530,240	28%
2014	1,206	6,062	20%	4,691	26%	61,439,095	198,297,074	31%
2011-2014	**3,869**	**23,531**	**16%**	**18,577**	**21%**	**201,052,880**	**803,249,854**	**25%**
2015	1,104	6,112	18%	4,869	23%	63,337,720	213,701,866	30%
2016	906	5,019	18%	4,001	23%	52,500,782	180,444,525	29%
2017	907	4,894	19%	3,909	23%	50,705,974	176,714,628	29%
2015-2017	**2,917**	**16,025**	**18%**	**12,779**	**23%**	**166,544,476**	**570,861,019**	**29%**
Total	**6,786**	**39,556**	**17%**	**31,356**	**22%**	**367,597,355**	**1,374,110,873**	**27%**

Below is a summary of the election percentage for the SMP over the experience study period for new members with salaries greater than or equal to $100,000.

Fiscal Year End	SMP Election	Total	SMP % of Total	Total with Elections	SMP % of Total Elections
2011	49	146	34%	126	39%
2012	90	204	44%	190	47%
2013	112	188	60%	182	62%
2014	125	177	71%	168	74%
2011-2014	**376**	**715**	**53%**	**666**	**56%**
2015	126	204	62%	195	65%
2016	112	186	60%	176	64%
2017	103	184	56%	178	58%
2015-2017	**341**	**574**	**59%**	**549**	**62%**
Total	**717**	**1,289**	**56%**	**1,215**	**59%**

Other Valuation Assumptions

We recommend using the following assumptions for plan elections (which is the same that was used in the actuarial valuation as of June 30, 2016).

Plan Election Asumptions for Future New Hires	
Self-Managed Plan	30%
Tier 2 Plan	70%

Money Purchase Factors

The money purchase factors, which apply by statute to Rule 2 benefit calculations, are to be updated each time there is a change in the investment return assumption or the post retirement mortality assumption. The investment return assumption was decreased from 7.75 percent to 7.25 percent first effective with the valuation as of June 30, 2014. Based on the recommendations in this experience study, GRS is recommending a change in the post-retirement mortality assumption to be first effective with the next valuation as of June 30, 2018. In the past when the factors have changed, the Board has adopted an effective date of for implementation of the new money purchase factors. These factors will apply only to members hired before July 1, 2005, who are eligible for the money purchase benefit formula.

Following is a graph illustrating the impact of the change in a member's benefit as a result to the change in the money purchase factors based on the proposed assumptions. The money purchase benefit is calculated such that the money purchase balance is sufficient to pay benefits for the assumed lifetime of the retiree based on assumed future investment earnings. Because the assumed future investment earnings are lower under the new assumptions (6.75 percent compared to 7.25 percent) and the life expectancies at most ages are higher under the new assumptions, a decrease in the benefit amount would be required.

SURS Money Purchase Factors
Percentage Change in Benefit Due to Change in Factors
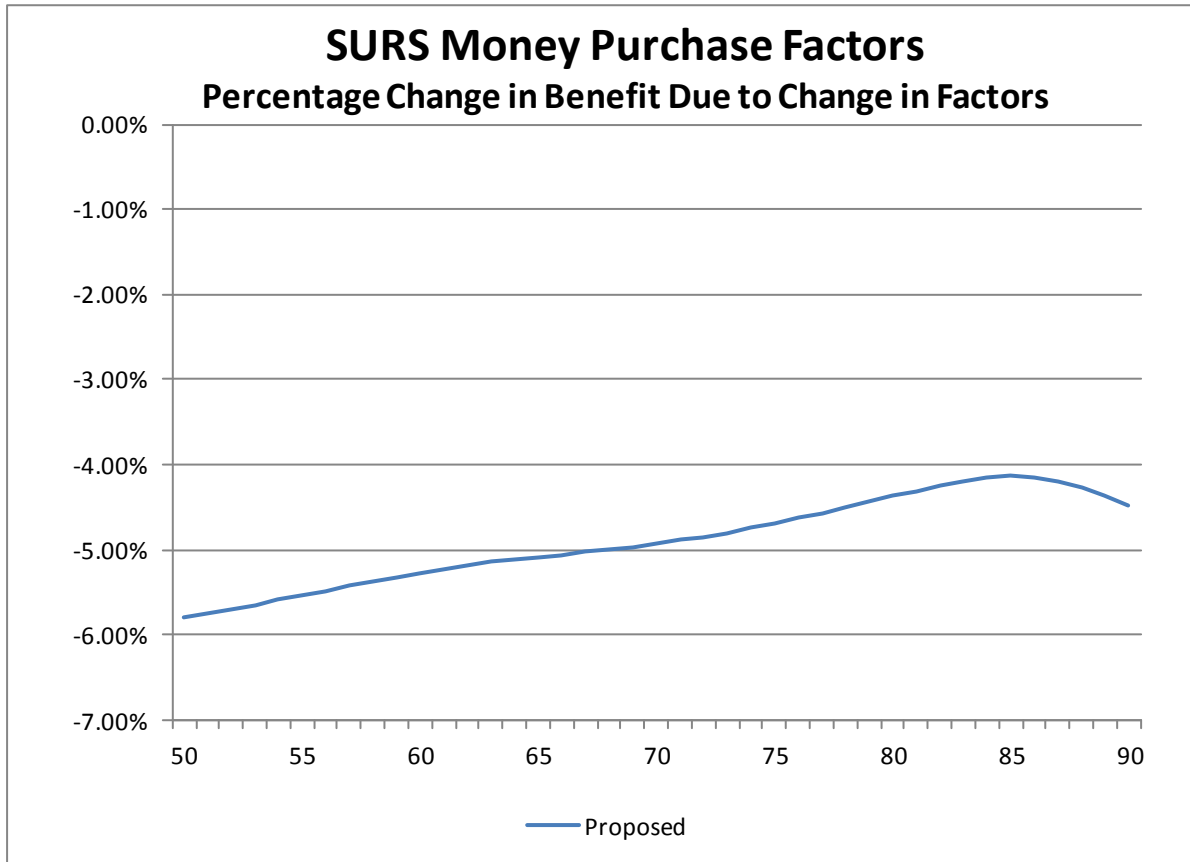
Below is a table summarizing the money purchase benefit under the current factors and the factors using the proposed assumptions. In addition, the table shows the benefit under each set of factors if the member continued working for one additional year and retired with a higher money purchase balance. Although a member would have a lower benefit under the updated money purchase factors, a member would still accrue a higher benefit by working one additional year compared to retiring immediately before the change in the money purchase factors.

| Immediate Monthly Benefit | | | Monthly Benefit 1 Year Later | | | Inc in Monthly Benefit 1 Year | |
| | | | | | | Current to Current | Current to Proposed |
Age	Current	Proposed	Age	Current	Proposed	Current	Proposed
50	$1,272	$1,198	51	$1,446	$1,363	$174	$91
55	$1,324	$1,250	56	$1,509	$1,426	$185	$102
60	$1,398	$1,324	61	$1,599	$1,516	$201	$118
65	$1,506	$1,430	66	$1,732	$1,644	$225	$137
70	$1,668	$1,586	71	$1,929	$1,835	$262	$167
75	$1,914	$1,824	76	$2,233	$2,130	$319	$215

In addition, a member eligible for the money purchase formula will receive the greater of the money purchase formula benefit and the general formula benefit. Therefore, not all money purchase eligible members will be affected and the impact for a member may be less than the example shown above.

Other Valuation Assumptions

The annuity factors are based on member ages in the year 2021. Because the proposed mortality assumption is a generational mortality table, each cohort of retirees based on birth year would have a slightly different factor. In order to have one set of factors that will apply until the next experience study, we have calculated factors based on the mid-point of the expected timeframe in which the factors are expected to be effective.

Following is an age and service schedule for active members from the actuarial valuation as of June 30, 2017, who are eligible for benefits under the money purchase formula. Approximately 12,000 to 13,000 members are eligible to retire immediately under early or normal retirement eligibility conditions and the money purchase formula.

Age	Service						Total
	< 10	10-14	15-19	20-24	25-29	30+	Total
<50	417	2,231	2,892	1,110	272	3	6,925
50-54	191	799	1,561	1,083	874	183	4,691
55-59	147	806	1,565	1,172	989	422	5,101
60-64	160	642	1,215	855	852	402	4,126
65-69	90	398	582	473	400	274	2,217
70-74	36	154	211	156	107	119	783
75+	4	48	73	55	41	56	277
Total	1,045	5,078	8,099	4,904	3,535	1,459	24,120

Load on Liabilities for Service Retirees With Non-finalized Benefits

Prior to 2013, there had been liability losses for recent retired members due to finalized benefits that were higher than the preliminary estimates. Therefore, an additional 10 percent load on the estimated benefits had been assumed. Beginning with the 2013 actuarial valuation, SURS provided additional data for members whose benefits had not been finalized to help improve the liability measurement. A "best formula" benefit was provided which was higher than the benefits which had originally been provided. In the 2014 valuation, the losses generated for these members were significantly reduced.

Beginning with the June 30, 2015, actuarial valuation, the assumption was changed to the following:
  (1) A load of 10 percent on liabilities is assumed for service retirees whose benefits have not been finalized as of the valuation date and a "best formula" benefit *was not* provided in the data by Staff
      (a) The assumption accounts for finalized benefits are on average about 10 percent higher than 100 percent of the preliminary estimated benefit
  (2) A load of 5 percent on liabilities is assumed for service retirees whose benefits have not been finalized as of the valuation date and a "best formula" benefit *was* provided in the data by Staff
      (a) The assumption accounts for finalized benefits are on average about 5 percent higher than the "best formula" benefit

Other Valuation Assumptions

Below is a comparison of the ratio of the finalized benefits to the estimated benefits based on the current assumptions and data from the 2016 and 2017 valuations. The ratio is calculated in accordance with the following example:

    (1) Best formula monthly benefit provided for 2016 actuarial valuation: $4,000
    (2) Projected benefit in 2017: $4,000*1.03 (COLA increase)*1.05 (5% load) = $4,326
    (3) Finalized benefit provided for the 2017 actuarial valuation: $4,200
    (4) Ratio of the estimated benefit to the finalized benefit: $4,200/$4,326-1= -3%

A ratio of less than 0% means that the actual benefit was lower than the estimated benefit (and there was a gain). A ratio of more than 0% means that the actual benefit was higher than the estimated benefit (and there was a loss).

	General Formula	Money Purchase	Police/Fire	Total	% of Total
< -100%	-	-	-	-	0%
-100% - -91%	-	-	-	-	0%
-90% - -81%	-	-	-	-	0%
-80% - -71%	-	-	-	-	0%
-70% - -61%	1	-	-	1	0%
-60% - -51%	3	2	-	5	0%
-50% - -41%	3	1	-	4	0%
-40% - -31%	1	5	-	6	0%
-30% - -21%	10	8	-	18	1%
-20% - -11%	52	41	-	93	6%
-10% - -1%	405	488	6	899	57%
0% - 9%	283	86	3	372	24%
10% - 19%	61	14	-	75	5%
20% - 29%	17	4	-	21	1%
30% - 39%	8	2	-	10	1%
40% - 49%	7	1	-	8	1%
50% - 59%	6	1	-	7	0%
60% - 69%	2	2	-	4	0%
70% - 79%	6	-	-	6	0%
80% - 89%	5	2	-	7	0%
90% - 99%	1	-	-	1	0%
>= 100%	41	1	-	42	3%
Totals	**912**	**658**	**9**	**1,579**	**100%**

Because the ratio was less than 0% for 64 percent of recent retirees whose benefits were finalized, we recommend maintaining the current loads for retired members whose benefits have not been finalized and will continue to monitor actual experience.

    (1) 10 percent load on 100 percent of preliminary estimated benefit (no best formula benefit provided)
    (2) 5 percent load on the best formula benefit

Other Valuation Assumptions

Increase in Pensionable Earnings Greater than 6% during the Final Average Compensation Period (6% Employer Billing Contributions)

Under Section 15-155(g) of the Illinois Compiled Statutes, a participant's employer is required to fund the value of increases in pensionable earnings greater than 6% that would be used in the determination of the final rate of earnings. No additional assumption is currently being made for earnings used in the calculation of the final rate of earnings.

Following is a history of the contributions received from employers due to this provision and the amount as a percentage of projected payroll (from the actuarial valuation used to determine the applicable fiscal year statutory contribution):

| | | $ in Millions | | |
Fiscal Year	Number of Participants	Amount from Employers	Projected Payroll	Amount as % of Payroll
2014	226	$1.9	$4,274.0	0.04%
2015	357	2.5	4,435.6	0.06%
2016	336	2.2	4,499.7	0.05%
2017	379	3.1	4,610.0	0.07%
Average	325	2.4	4,454.9	0.05%

Based on SURS experience, the proposed salary increase assumption is 4.50 percent grading down to an ultimate assumed rate of increase of 2.25 percent for members with 10 or more years of service. Therefore, the actuarial valuation does not assume that members will receive pay increases in excess of 6.00 percent during the period used for the final rate of earnings. To the extent that members do receive increases in excess of 6.00 percent during the period used for the final rate of earnings, there will be a liability loss that will be partially offset by the employer contributions required by statute.

Due to the relatively small amount of contributions that are received to this provision, we recommend that no assumption be made for either the contributions received or the liability losses generated by members receiving pay increases in excess of 6.00 percent during the final average earnings period. In addition, we expect that the pay cap under Tier 2 will result is a decrease in the 6% employer billing contributions as a percentage of payroll in the future.

SECTION III

COST IMPACT OF RECOMMENDED CHANGES

Cost Impact of Recommended Changes

The impact of adopting the recommended assumptions is summarized in the table below and on the following pages. The recommended assumptions increase the actuarial liability and contribution requirements and decrease the funded ratio.

	Dollars in Millions			
	Actuarial Valuation as of 6/30/17	**Proposed Assumptions**	**Total Change**	**% Increase (Decrease)**
Actuarial Accrued Liability				
1. Active Members	$ 10,977.3	$ 11,574.0	$ 596.7	5.44%
2. Benefit Recipients				
a. Retirement	$ 26,493.6	$ 27,839.1	$ 1,345.5	5.08%
b. Survivor	1,468.7	1,533.5	64.8	4.41%
c. Disability	263.6	266.3	2.7	1.02%
Total - Benefit Recipients	$ 28,226.0	$ 29,638.9	$ 1,412.9	5.01%
3. Other Inactive	$ 2,650.1	$ 2,773.6	$ 123.5	4.66%
4. Grand Total	$ 41,853.3	$ 43,986.5	$ 2,133.1	5.10%
	Actuarial Results			
Actuarial Value of Assets	$ 18,594.3	$ 18,594.3	$ 0.0	0.00%
Unfunded Actuarial Accrued Liability	$ 23,259.0	$ 25,392.2	$ 2,133.1	9.17%
Funded Ratio	44.43%	42.27%	-2.15%	-2.15%

GRS Retirement Consulting

Cost Impact of Recommended Changes – Projected Statutory Contributions

Comparison of Results from 2017 Actuarial Valuation With Updated Baseline Results Using Election Assumptions of 70% Tier 2 and 30% SMP ($ in Millions)

| | SURS Contribution (Excluding SMP) | | | | SMP | | | | Combined SURS and SMP (Includes State and Employer Contribution) | | | | | |
| | Baseline | | Updated Baseline | | Baseline | | Updated Baseline | | Baseline | | Updated Baseline | | Difference | |
Fiscal Year	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay
2018	$1,615.482	36.27%	$1,612.662	36.20%	$64.582	1.45%	$67.402	1.51%	$1,680.064	37.72%	$1,680.064	37.72%	$0.000	0.00%
2019	1,640.726	35.72%	1,682.801	36.64%	64.574	1.41%	70.340	1.53%	1,705.300	37.12%	1,753.140	38.17%	47.840	1.04%
2020	1,723.012	36.26%	1,766.235	37.18%	70.159	1.48%	78.204	1.65%	1,793.171	37.74%	1,844.439	38.83%	51.268	1.09%
2021	1,804.687	36.91%	1,848.498	37.83%	72.729	1.49%	83.131	1.70%	1,877.416	38.40%	1,931.628	39.53%	54.212	1.14%
2022	1,857.946	37.05%	1,901.512	37.97%	75.042	1.50%	87.613	1.75%	1,932.988	38.55%	1,989.124	39.72%	56.136	1.18%
2023	1,891.550	36.78%	1,934.239	37.70%	77.403	1.51%	92.103	1.80%	1,968.953	38.28%	2,026.342	39.50%	57.389	1.21%
2024	1,939.742	36.76%	1,982.196	37.70%	79.774	1.51%	96.619	1.84%	2,019.516	38.27%	2,078.815	39.54%	59.299	1.27%

Comparison of Results Using Recommended Assumptions With and Without 5-Year Phase-In of Change in Contribution Rate ($ in Millions)

| | SURS Contribution (Excluding SMP) | | | | SMP | | | | Combined SURS and SMP (Includes State and Employer Contribution) | | | | | |
| | Impact Without Phase-In | | Impact With Phase-In | | Impact Without Phase-In | | Impact With Phase-In | | Impact Without Phase-In | | Impact With Phase-In | | Difference | |
Fiscal Year	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay
2018	$1,612.855	36.33%	$1,612.855	36.33%	$67.209	1.51%	$67.209	1.51%	$1,680.064	37.84%	$1,680.064	37.84%	$0.000	0.00%
2019	1,682.801	36.94%	1,682.801	36.94%	69.713	1.53%	69.713	1.53%	1,752.514	38.47%	1,752.514	38.47%	0.000	0.00%
2020	1,901.457	40.53%	1,795.160	38.26%	77.187	1.65%	77.187	1.65%	1,978.644	42.18%	1,872.347	39.91%	-106.297	-2.27%
2021	1,979.832	41.21%	1,903.048	39.61%	81.664	1.70%	81.664	1.70%	2,061.497	42.91%	1,984.712	41.31%	-76.785	-1.60%
2022	2,025.861	41.29%	1,982.023	40.40%	85.730	1.75%	85.730	1.75%	2,111.591	43.04%	2,067.753	42.14%	-43.838	-0.89%
2023	2,053.781	41.01%	2,040.927	40.75%	89.782	1.79%	89.782	1.79%	2,143.563	42.80%	2,130.709	42.54%	-12.854	-0.26%
2024	2,088.784	40.85%	2,108.225	41.23%	93.833	1.84%	93.833	1.84%	2,182.617	42.69%	2,202.058	43.07%	19.441	0.38%

Comparison of Results from 2017 Actuarial Valuation With Results Using Recommended Assumptions Incl. 5-Year Phase-In of Change in Contribution Rate ($ in Millions)

| | SURS Contribution (Excluding SMP) | | | | SMP | | | | Combined SURS and SMP (Includes State and Employer Contribution) | | | | | |
| | Baseline | | Impact With Phase-In | | Baseline | | Impact With Phase-In | | Baseline | | Impact With Phase-In | | Difference | |
Fiscal Year	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay	Dollar	% of Pay
2018	$1,615.482	36.27%	$1,612.855	36.33%	$64.582	1.45%	$67.209	1.51%	$1,680.064	37.72%	$1,680.064	37.84%	$0.000	0.13%
2019	1,640.726	35.72%	1,682.801	36.94%	64.574	1.41%	69.713	1.53%	1,705.300	37.12%	1,752.514	38.47%	47.214	1.34%
2020	1,723.012	36.26%	1,795.160	38.26%	70.159	1.48%	77.187	1.65%	1,793.171	37.74%	1,872.347	39.91%	79.176	2.17%
2021	1,804.687	36.91%	1,903.048	39.61%	72.729	1.49%	81.664	1.70%	1,877.416	38.40%	1,984.712	41.31%	107.296	2.91%
2022	1,857.946	37.05%	1,982.023	40.40%	75.042	1.50%	85.730	1.75%	1,932.988	38.55%	2,067.753	42.14%	134.765	3.60%
2023	1,891.550	36.78%	2,040.927	40.75%	77.403	1.51%	89.782	1.79%	1,968.953	38.28%	2,130.709	42.54%	161.756	4.26%
2024	1,939.742	36.76%	2,108.225	41.23%	79.774	1.51%	93.833	1.84%	2,019.516	38.27%	2,202.058	43.07%	182.542	4.80%

SECTION IV

RECOMMENDED ACTUARIAL ASSUMPTIONS

Recommended Actuarial Assumptions

Rate of Investment Return. For all purposes under SURS the rate of investment return is assumed to be 6.75% per annum beginning with the **June 30, 2018**, actuarial valuation. This assumption is net of investment expenses. The most recent assumption was 7.25%.

Price Inflation (Increase in Consumer Price Index "CPI"). The assumed rate is 2.25% per annum.

Effective Rate of Interest. The assumed rate credited to member accounts is 6.75% per annum, beginning with the June 30, 2018, actuarial valuation.

Cost of living adjustment "COLA." The assumed rate is 3.00% per annum for members hired before January 1, 2011, based on the benefit provision of 3.00% annual compound increases. The assumed rate is 1.125% for members hired on or after January 1, 2011, based on the benefit provision of increases equal to ½ of the increase in CPI with a maximum increase of 3.00%.

Annual Compensation Increases. Each member's compensation is assumed to increase by 3.25% each year, 2.25% reflecting salary inflation and 1.00% reflecting standard of living increases. That rate is increased for members with less than 35 years of service to reflect merit, longevity and promotion increases. The rates are based on service at the beginning of the year and are as follows:

Service Year	Total Increase
0	12.25%
1	12.25%
2	8.75%
3	7.00%
4	6.25%
5	5.50%
6	5.50%
7	5.50%
8	4.75%
9-10	4.50%
11-14	4.00%
15-18	3.75%
19-33	3.50%
34+	3.25%

Payroll Growth. The assumed rate of total payroll growth is 3.25%.

Recommended Actuarial Assumptions

Mortality. The mortality assumptions are as follows:

Applicable Group	Base Table Mortality Table	Male Scaling Factor	Female Scaling Factor
Preretirement	RP-2014 White Collar Employee, sex distinct	93%	100%
Postretirement (non-disabled)	RP-2014 White Collar Healthy Annuitant, sex distinct	96%	93%
Postretirement (disabled)	RP-2014 Disabled Annuitant, sex distinct	112%	123%

Future mortality improvements are reflected by projecting the base mortality tables back from the year 2014 to the year 2006 using the Society of Actuaries (SOA) MP-2014 scale and projecting from 2006 using the SOA MP-2017 projection scale. The assumptions are generational mortality tables and include a margin for improvement.

	Future Life Expectancy (years) in 2017				Future Life Expectancy (years) in 2030			
	Postretirement		Disabled - Retiree		Postretirement		Disabled - Retiree	
Age	Male	Female	Male	Female	Male	Female	Male	Female
35	52.08	54.25	32.52	38.01	53.34	55.44	34.52	39.88
40	46.89	49.06	28.95	33.73	48.12	50.23	30.74	35.45
45	41.77	43.93	25.75	29.78	42.97	45.08	27.41	31.40
50	36.73	38.83	22.66	25.97	37.91	39.97	24.26	27.51
55	31.81	33.80	19.71	22.41	32.96	34.91	21.19	23.83
60	27.04	28.90	16.89	19.18	28.12	29.95	18.16	20.40
65	22.44	24.20	14.22	16.04	23.43	25.18	15.27	17.07
70	18.06	19.69	11.63	12.88	18.96	20.61	12.51	13.81
75	13.98	15.45	9.14	9.96	14.80	16.30	9.91	10.79

Disability. A table of disability incidence with sample rates follows:

Age	Male	Female	Age	Male	Female
20	0.024745%	0.032769%	50	0.121368%	0.135991%
21	0.025334%	0.034680%	51	0.128732%	0.140087%
22	0.025923%	0.036592%	52	0.136097%	0.144183%
23	0.026512%	0.038503%	53	0.143461%	0.148279%
24	0.027102%	0.040415%	54	0.150826%	0.152375%
25	0.027691%	0.042326%	55	0.155245%	0.156471%
26	0.028280%	0.044238%	56	0.155245%	0.156471%
27	0.028869%	0.046150%	57	0.155245%	0.156471%
28	0.029458%	0.048061%	58	0.155245%	0.156471%
29	0.030047%	0.049973%	59	0.155245%	0.156471%
30	0.031520%	0.054069%	60	0.155245%	0.156471%
31	0.032993%	0.058165%	61	0.155245%	0.156471%
32	0.034466%	0.062261%	62	0.155245%	0.156471%
33	0.035939%	0.066357%	63	0.155245%	0.156471%
34	0.037412%	0.070453%	64	0.155245%	0.156471%
35	0.039474%	0.074549%	65	0.155245%	0.156471%
36	0.041536%	0.078645%	66	0.155245%	0.156471%
37	0.043598%	0.082741%	67	0.155245%	0.156471%
38	0.045660%	0.086838%	68	0.155245%	0.156471%
39	0.047722%	0.090934%	69	0.155245%	0.156471%
40	0.053614%	0.095030%	70	0.155245%	0.156471%
41	0.059505%	0.099126%	71	0.155245%	0.156471%
42	0.065397%	0.103222%	72	0.155245%	0.156471%
43	0.071289%	0.107318%	73	0.155245%	0.156471%
44	0.077180%	0.111414%	74	0.155245%	0.156471%
45	0.084545%	0.115510%	75	0.155245%	0.156471%
46	0.091909%	0.119606%	76	0.155245%	0.156471%
47	0.099274%	0.123703%	77	0.155245%	0.156471%
48	0.106639%	0.127799%	78	0.155245%	0.156471%
49	0.114003%	0.131895%	79	0.155245%	0.156471%

Disability rates apply during the retirement eligibility period.

Recommended Actuarial Assumptions

Retirement. Upon eligibility, active members are assumed to retire as follows:

Age	Tier 1 Members Hired Before January 1, 2011, and Eligible for Normal Retirement	Early Retirement	Tier 2 Members Hired on or after January 1, 2011, and Eligible for Normal Retirement	Early Retirement
Under 50	50.0%	-	-	-
50	50.0	-	-	-
51	40.0	-	-	-
52	40.0	-	-	-
53	35.0	-	-	-
54	35.0	-	-	-
55	35.0	7.0%	-	-
56	30.0	5.5	-	-
57	25.0	4.0	-	-
58	25.0	5.0	-	-
59	25.0	5.5	-	-
60	11.0	-	-	-
61	11.0	-	-	-
62	12.0	-	-	25.0%
63	12.0	-	-	10.0
64	12.0	-	-	10.0
65	15.0	-	-	10.0
66	15.0	-	-	10.0
67	15.0	-	35.0%	-
68	15.0	-	15.0	-
69	15.0	-	15.0	-
70-79	15.0	-	15.0	-
80+	100.0	-	100.0	-

Members that retire are assumed to elect the most valuable option on a present value basis – refund of contributions (or portable lump sum retirement, if applicable) or a retirement annuity.

For purposes of the projections in the actuarial valuation, members of the Self-Managed Plan are assumed to retire in accordance with the Tier 1 and Tier 2 retirement rates (based on hire date).

Recommended Actuarial Assumptions

General Turnover. A table of termination rates based on experience in the 2015-2017 period. The assumption is a table of turnover rates by years of service. A sample of these rates follows:

Years of Service	All Members
0	20.00%
1	20.00
2	15.00
3	14.00
4	13.00
5	12.00
6	10.00
7	9.00
8	8.00
9	7.00
10	6.00
11	5.00
12	4.50
13	4.00
14	4.00
15	4.00
16	3.50
17	3.50
18	3.50
19	3.00
20	3.00
21	3.00
22	2.50
23	2.50
24	2.50
25	2.00
26	2.00
27	2.00
28	2.00
29	2.00

Part time members with less than three years of service (all members classified as part time for valuation purposes) are assumed to terminate at the valuation date.

Members that terminate with at least five years of service (10 years of service for Tier 2 members) are assumed to elect the most valuable option on a present value basis – refund of contributions or a deferred benefit.

Termination rate for 29 years of service used for Tier 2 members until retirement eligibility is met.

Recommended Actuarial Assumptions

Operational Expenses. The amount of operational expenses incurred in the latest fiscal year are supplied by SURS staff and incorporated in the Normal Cost.

Marital Status. Members are assumed to be married in the following proportions:

Age	Males	Females
20	25 %	40 %
30	70	75
40	80	80
50	85	80
60	85	70

Spouse Age. The female spouse is assumed to be three years younger than the male spouse.

Benefit Commencement Age. Inactive members eligible for a deferred benefit are assumed to commence benefits at their earliest normal retirement age. For Tier 1 members this is age 62 with at least five years of service, age 60 with at least eight years of service, or immediately if at least 30 years of service. For Tier 2 members, this is age 67 with 10 or more years of service.

Load on Final Average Salary. No load is assumed to account for higher than assumed pay increases in final years of employment before retirement.

Load on Liabilities for Service Retirees With Non-finalized Benefits. A load of 10% on liabilities for service retirees whose benefits have not been finalized as of the valuation date is assumed to account for finalized benefits that on average are 10% higher than 100% of the preliminary estimated benefit. A load of 5% is used if a "best formula" benefit was provided in the data by Staff.

Valuation of Inactives. An annuity benefit is estimated based on information provided by staff for Tier 1 inactive members with five or more years of service and Tier 2 members with 10 or more years of service.

Assumption for Missing Data. Members with an unknown gender are assumed to be female. Active and inactive members with an unknown date of birth are assumed to be 37 years old at the valuation date. An assumed spouse date of birth is calculated for current service retirees in the traditional plan for purposes of calculating future survivor benefits. The female spouse is assumed to be three years younger than the male spouse. 70% of current total male retirees and 80% of current total female retirees in the traditional plan who have not elected a survivor refund are assumed to have a spouse at the valuation date.

Reciprocal Service. Reciprocal service is included for current inactive members for purposes of determining vesting eligibility and eligibility age to commence benefits.

The recently updated actuarial assumptions (including retirement and termination rates) were based on SURS service only. Therefore, reciprocal service was not included for current active members.

Recommended Actuarial Assumptions

Projection Assumptions. The number of total active members throughout the projection period will remain the same as the total number of active members in the defined benefit plans and the SMP in the current actuarial valuation.

Future new hires are assumed to elect to participate in the offered plans as follows:
- 30% elect to participate in the Self-Managed Plan.
- 70% elect to participate in the Tier 2 Plan.
    - 75% are assumed to elect the Tradition Plan (consistent with the current election split).
    - 25% are assumed to elect the Portable Plan (consistent with the current election split).

New entrants have an average age of 37.1 and average capped pay of $40,925 and average uncapped pay of $43,362 (2017 dollars). These values are based on the average age and average pay of current members. The range profile is based on the age at hire and assumed pay at hire (using the actuarial assumptions, inflated to 2017 dollars) of current active members with service between one and four years.

Age	Number Males	Average Pay Tier 2 Capped Male	OHP Capped Male	Uncapped Male	Number Females	Average Pay Tier 2 Capped Female	OHP Capped Female	Uncapped Female	Total Number	Average Pay Tier 2 Capped Total	OHP Capped Total	Uncapped Total
<20	46	$18,888	$18,888	$18,659	42	$16,985	$16,985	$16,791	88	$17,980	$17,980	$17,767
20 - 24	667	28,388	28,388	28,055	1,004	27,531	27,531	27,205	1,671	27,873	27,873	27,544
25 - 29	1,516	38,774	38,903	38,614	2,090	36,479	36,555	36,237	3,606	37,444	37,542	37,236
30 - 34	1,339	45,922	46,518	48,192	1,818	39,798	40,042	40,341	3,157	42,395	42,789	43,671
35 - 39	964	46,478	47,223	50,025	1,309	38,820	39,162	39,923	2,273	42,068	42,581	44,208
40 - 44	645	45,376	46,130	47,833	1,014	37,518	37,787	38,354	1,659	40,573	41,030	42,039
45 - 49	571	42,049	42,820	44,978	863	34,701	34,964	35,282	1,434	37,627	38,092	39,143
50 - 54	537	40,670	41,667	46,145	711	33,664	34,036	35,123	1,248	36,678	37,319	39,866
55 - 59	422	38,728	39,960	46,410	500	32,809	33,360	35,050	922	35,518	36,381	40,249
60 - 64	230	33,919	34,990	39,898	236	31,194	31,884	34,940	466	32,539	33,417	37,387
65 - 69	13	22,236	23,282	32,512	11	16,378	16,378	16,208	24	19,551	20,118	25,039
Total	6,950	40,925	41,494	43,362	9,598	35,803	36,037	36,426	16,548	37,954	38,329	39,339

SMP Contribution Assumptions. The projected SMP contributions are equal to 7.6% of SMP payroll, plus estimated SMP expenses minus SMP employer forfeitures. Estimated SMP expenses for FY 2018 are $478,854 and actual FY 2016 SMP employer forfeitures used to reduce the certified contributions for FY 2019 are $8,079,804. Estimated SMP expenses for FY 2019 and after are assumed to increase by the assumed rate of inflation (2.25%). Estimated SMP employer forfeitures used to reduce the certified contributions for FY 2020 and after are assumed to be 7.5% of the gross SMP employer contribution.

Pensionable Earnings Greater than 6%. No additional assumption was made for earnings used in the calculation of the final average compensation. The participant's employer is required to pay the present value of the increase in benefits resulting from the portion of the increase in excess of 6.00%.

Governor's Pay. The governor's pay is $177,500 as of June 30, 2017, and is expected to increase each year by the assumed rate of total payroll growth of 3.25%.