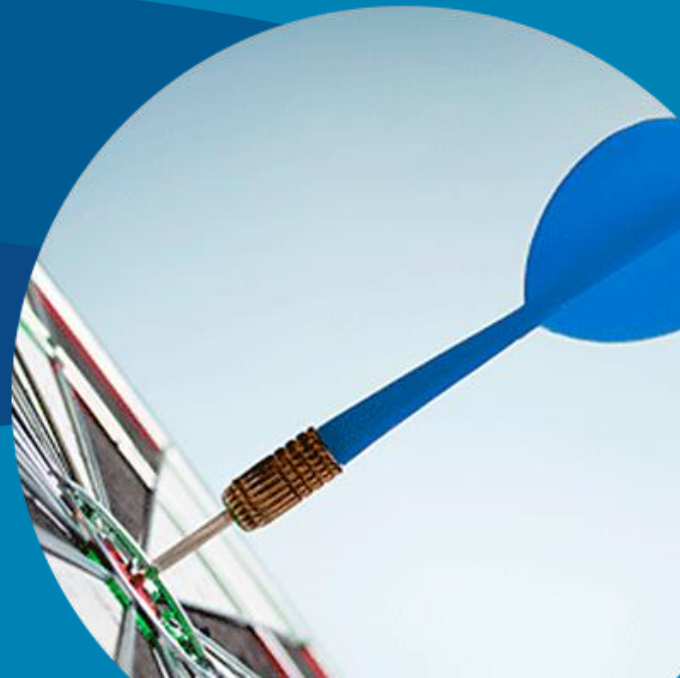


Wisconsin Retirement System

36th Annual Actuarial Valuation of
Retired Lives
December 31, 2018



Operation of the System (simplified description)

| | Core Annuities | Variable Annuities |
|--|--|--|
| Investment Return Hurdle to Trigger Annuity Adjustment | Returns over/under 5% | Returns over/under 5% |
| Ratio of Assets to Liabilities | If > 0.5%, dividend may be granted If <-0.5%, prior dividends reduced | If > 2%, variable annuity increased If <-2%, variable annuity decreased |
| Increase/Decrease Rounding Conventions | Rounded to nearest 0.1% | Truncated, carried to next year |
| Adjustment Effective Date | April following 12/31 valuation | April following 12/31 valuation |

Smoothing Mechanisms

Core

- Undesirable for retirees to experience wide swings in monthly benefits from year to year (especially downward swings)
- Mitigated in Core division by asset smoothing process and portfolio mix
- Asset smoothing has worked well historically, but could not prevent negative dividends in 2009-2013

Smoothing Mechanisms

Variable

- Variable fund is marked to market each year and subject to wide swings
- Dropping fractions of a percent from the adjustment is a form of smoothing
- Usually has very little effect due to the magnitude of the gains and losses

Summary of Results – December 31, 2018

\$ Millions

| | Core | Variable |
|---------------------------------|--------------|-----------------|
| Number of Annuitants | 211,126 | 41,187 |
| Annual Amount of Annuities Paid | \$ 5,040.9 | \$ 425.8 |
| Fund Balance | 56,493.8 | 3,749.1 |
| Actuarial Reserve | 56,629.3 | 4,207.6 |
| Ratio | 0.998 | 0.891 |

Core effective earnings rate = 5.0%, dividend adjustment = 0.0%.

Variable effective earnings rate = -7.0%, and the variable adjustment = -10.0%.

Core assets and liabilities include a one-time adjustment for LTDI members of approximately \$311.2 million

(Report- Cover Letter & Pages 6 and 16)

Summary of Results

Due to smoothing via Market Recognition Account, as of December 31, 2018 there are approximately \$4.9 billion in unrecognized **losses** in the Core fund

- Last year was \$3.3 billion in unrecognized gains
- Will be recognized over the next 4 years
- Roughly ½ of loss applies to the annuitant reserve, the other half shared by active members and employers
- Will put downward pressure on dividends in the coming years

Operation of Market Recognition Account (MRA) - \$ Millions **2017 Valuation**

| | <u>2017</u> | <u>2018</u> | <u>2019</u> | <u>2020</u> | <u>2021</u> |
|------------------------------|-------------|-------------|-------------|-------------|-------------|
| Actual Investment Earnings | \$ 13,842 | | | | |
| Assumed Investment Earnings | 6,536 | | | | |
| Gain/(Loss) to be phased-in | 7,306 | | | | |
| Phased-in recognition | | | | | |
| • Current year | \$ 1,461 | ? | ? | ? | ? |
| • First prior year | 119 | \$ 1,461 | ? | ? | ? |
| • Second prior year | (1,344) | 119 | \$ 1,461 | ? | ? |
| • Third prior year | (243) | (1,344) | 119 | \$ 1,461 | ? |
| • Fourth prior year | 953 | (243) | (1,344) | 119 | \$ 1,461 |
| Total recognized gain (loss) | \$ 946 | \$ (7) | \$ 236 | \$ 1,580 | \$ 1,461 |

2018-2021: Expect \$3.3 billion in deferred asset GAINS

Operation of Market Recognition Account (MRA) - \$ Millions **2018 Valuation**

| | <u>2018</u> | <u>2019</u> | <u>2020</u> | <u>2021</u> | <u>2022</u> |
|------------------------------|--------------|----------------|-------------|--------------|------------------|
| Actual Investment Earnings | \$(3,585) | | | | |
| Assumed Investment Earnings | 6,657 | | | | |
| Gain/(Loss) to be phased-in | (10,242) | | | | |
| Phased-in recognition | | | | | |
| • Current year | \$(2,048) | ? | ? | ? | ? |
| • First prior year | 1,461 | \$(2,048) | ? | ? | ? |
| • Second prior year | 119 | 1,461 | \$(2,048) | ? | ? |
| • Third prior year | (1,344) | 119 | 1,461 | \$(2,048) | ? |
| • Fourth prior year | <u>(243)</u> | <u>(1,344)</u> | <u>119</u> | <u>1,461</u> | <u>\$(2,048)</u> |
| Total recognized gain (loss) | \$(2,055) | \$ (1,812) | \$ (468) | \$ (587) | \$ (2,048) |

2019-2022: Expect \$4.9 billion in deferred asset LOSSES

Asset Rate of Return Calculation

$$\text{Rate of Return} = \text{Investment Earnings} / \text{Asset Value}$$

- Rate of Return will vary based on calculation inputs:
 - Asset value could be smoothed or unsmoothed
 - Asset value could be beginning, middle or end of year
 - Timing of Contributions and Benefit Payments will vary
- Result is different Rate of Return calculated by:
 - SWIB (investment manager)
 - ETF (calculations governed by statute)
 - GRS (actuaries)

Translating Asset Rate of Return to Core Dividend

Actual 2018 SWIB net of fee return = -3.66%

Hurdle 1: 7.0% Investment Return Assumption

- Return < assumption smoothed over 5 years
 - **Leads to \$7 billion in unrecognized Core Fund losses**
- Core fund return available for dividend = **4.78%**

Hurdle 2: Investment Return 5% Threshold

- Core fund return > threshold provides **dividend before adjustments**: $1.0478/1.05-1 = -0.21\%$

Adjustments result in 0.0% dividend on next page

Primary Sources of Core Dividend

| | <u>% of APV</u> |
|---|-----------------|
| 1. SWIB net of fee investment return | (3.66)% |
| 2. MRA adjustment | 8.66% |
| 3. Published effective earnings rate | 5.00% |
| 4. Adjustment to relate earnings to average core annuity fund balance | (0.22)% |
| 5. Earnings rate based on average balance | 4.78% |
| 6. Expected dividend before adjustments: $1.0478/1.05-1$ | (0.21)% |
| 7. Adjustment to relate average asset to ending liability | 0.03% |
| 8. Carryover from last year due to timing of dividend accounting adjustments and rounding | 0.15% |
| 9. Experience study/mortality reserve adjustment | (0.20)% |
| 10. Experience and other effects | (0.01)% |
| 11. Statutory adjustment to round to nearest one-tenth percent | 0.04% |
| 12. Computed average dividend rate: (6)+(7)+(8)+(9)+(10)+(11) | (0.2)% |
| 13. Adjustment for members at or near the statutory floor | 0.0% |
| 14. Final computed dividend rate: (12)+(13), if greater than 0.5% (or less than -0.5%) of core annuities, otherwise 0% | 0.0% |

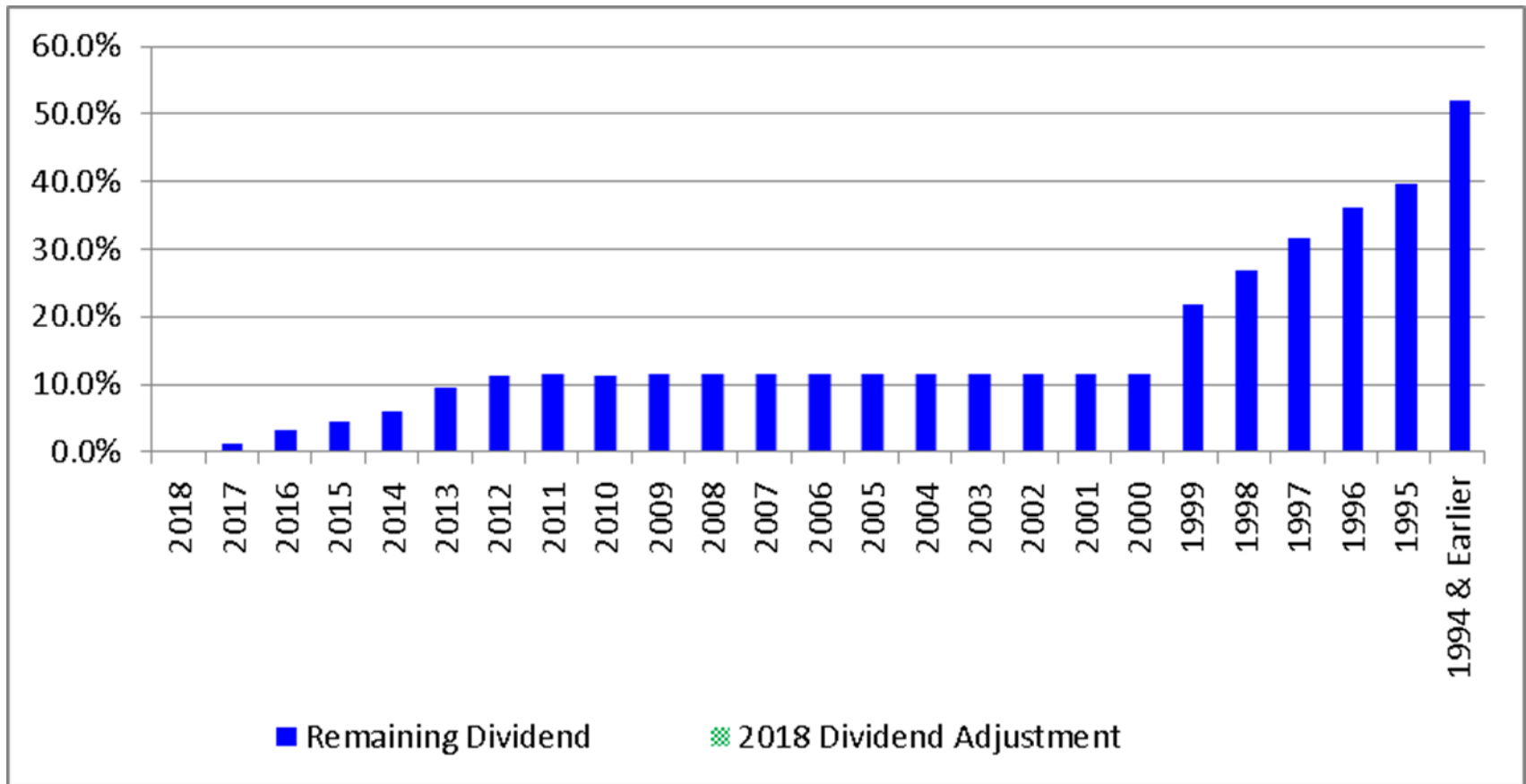


Liability Attributable to Dividends

| <u>Valuation</u> | <u>Liability for Dividend Remaining (billions)</u> | <u>Liability for Dividend Adjustment (billions)</u> |
|------------------|--|---|
| 12/31/2012 | \$4.5 | \$(1.3) |
| 12/31/2013 | 3.0 | 2.0 |
| 12/31/2014 | 4.6 | 1.3 |
| 12/31/2015 | 5.5 | 0.2 |
| 12/31/2016 | 5.4 | 1.0 |
| 12/31/2017 | 6.1 | 1.3 |
| 12/31/2018 | 6.9 | 0.0 |
| 12/31/2019 (est) | 6.5 | |

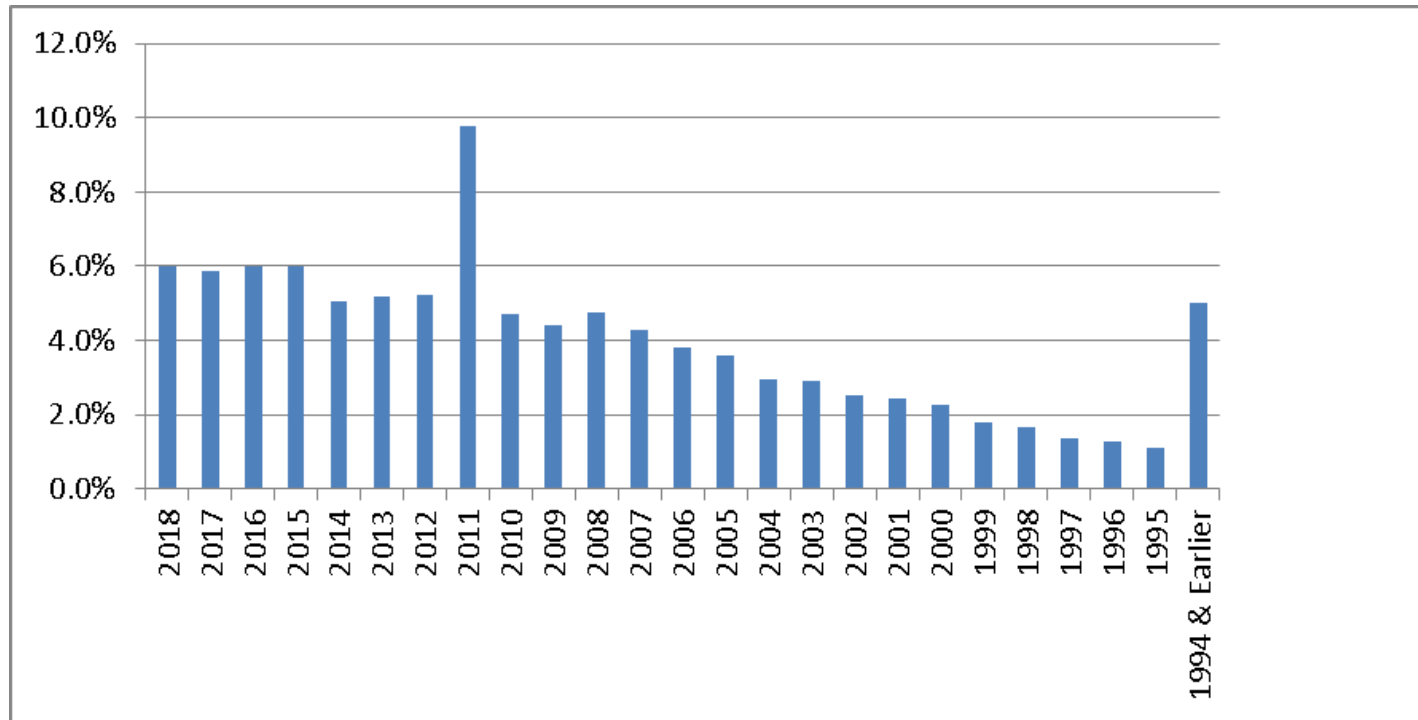
- Liability for dividend remaining represents the value of all previously granted dividends (= \$9.2B at 12/31/2008)
- If a market event similar to 2008 were to occur, the complete depletion of the dividend could occur
- Statutes do not define what would happen in such a case

Dividend Remaining (as a Percentage of Total Benefit) by Year of Retirement



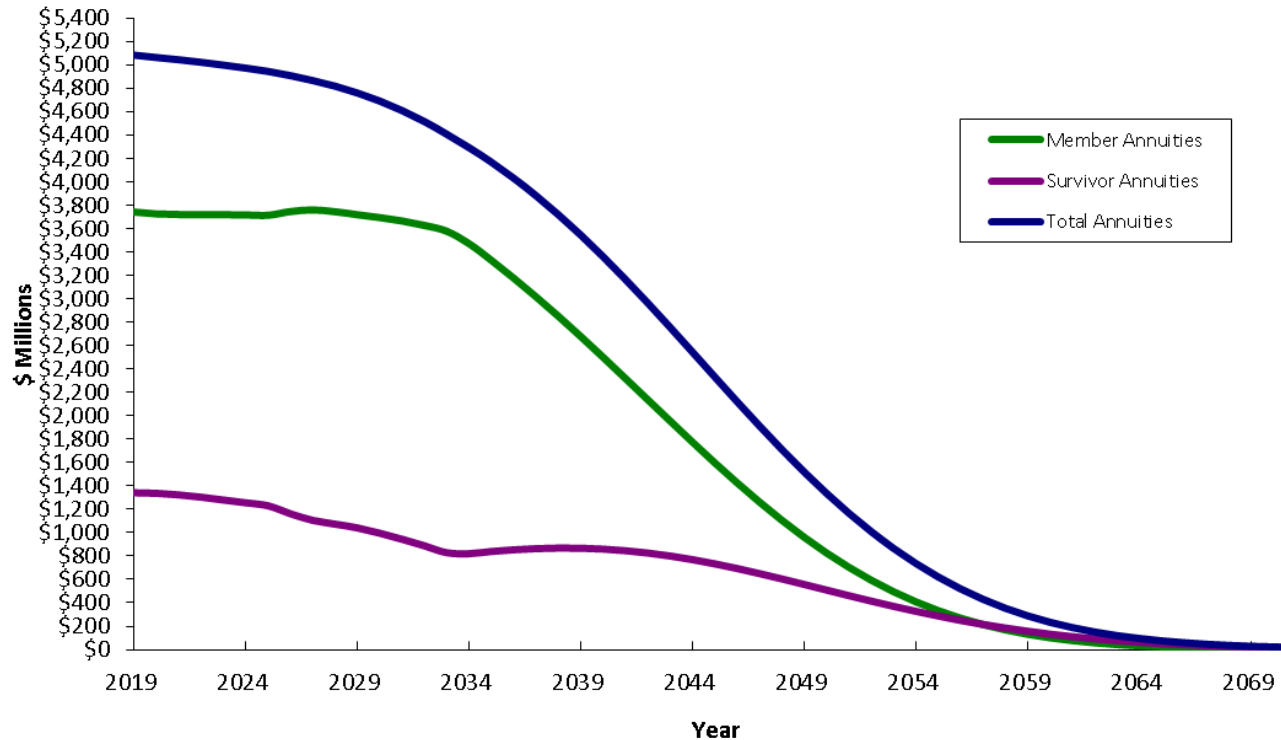
(Report-7)

Liabilities (as a Percentage of Total) by Year of Retirement



(Report-7)

Projected Future Core Annuities



| | \$ Billions | |
|---------------------------------|--------------------------------|-----------------------------------|
| | <u>With Expected Dividends</u> | <u>Without Expected Dividends</u> |
| Total Future Benefit Payments | \$125.6 | \$96.5 |
| Present Assets | 56.5 | 56.5 |
| Future Investment Return Needed | 69.1 | 40.0 |

(Report-13)



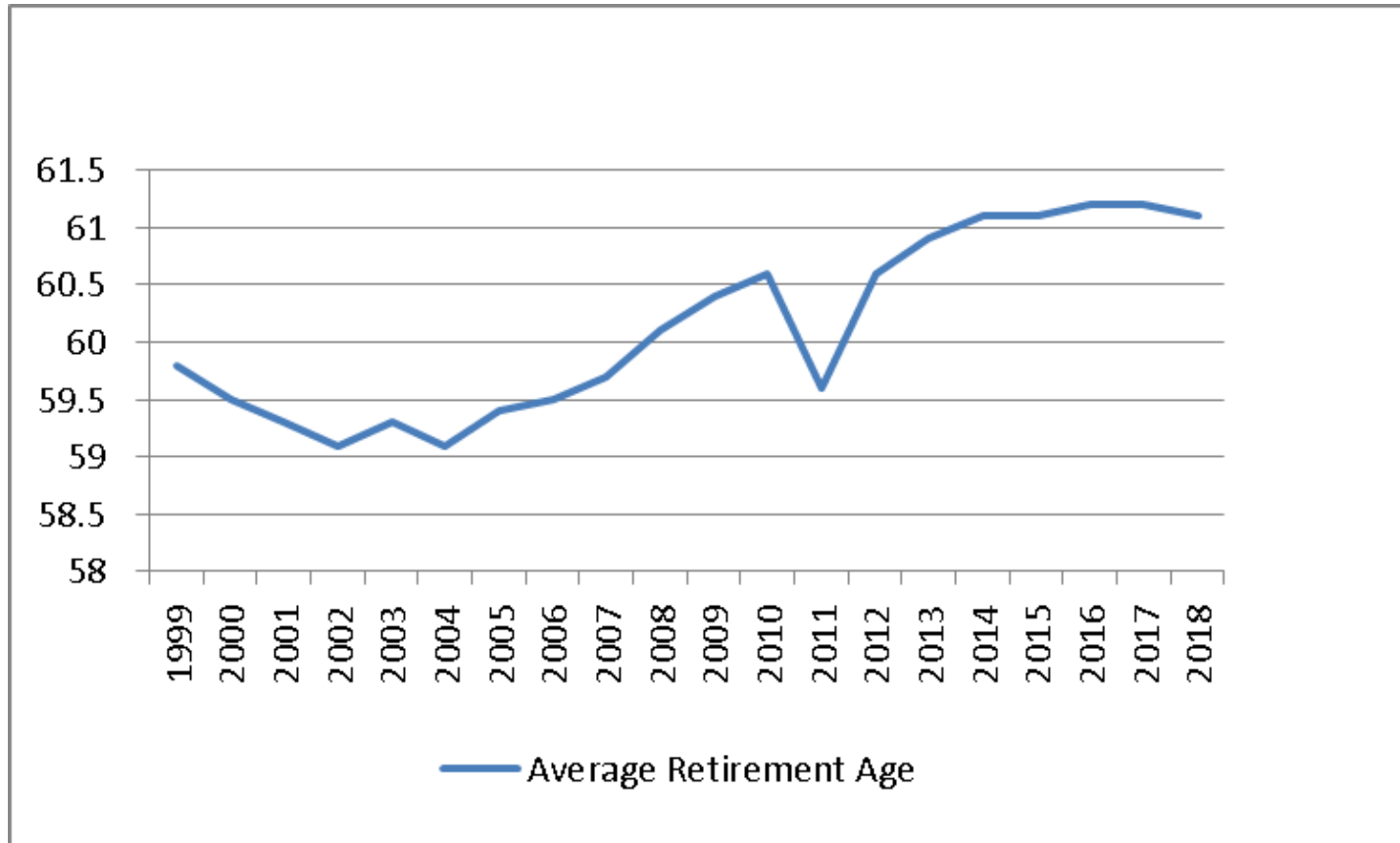
Based upon the assumptions used in the valuation, future dividends are expected to be a approximately 1.9% per year. Of course actual dividends will be based upon actual future investment return and the operation of the Market Recognition Account.

Primary Sources of Variable Adjustment

| | <u>% of APV</u> |
|--|-----------------|
| 1. SWIB net of fee investment return | (8.0)% |
| 2. Adjustment to published effective rate | <u>1.0%</u> |
| 3. Published effective earnings rate | (7.0)% |
| 4. Adjustment to relate earnings to average variable annuity fund balance | <u>0.2%</u> |
| 5. Earnings rate based on average balance | (6.8)% |
| 6. Expected change before adjustments: $(1-0.068)/1.05-1$ | (11.2)% |
| 7. Adjustment to relate average asset to ending liability | (0.4)% |
| 8. Carryover from last year due to timing of distribution, accounting adjustments and truncation | 0.7% |
| 9. Experience study/mortality reserve adjustment | (0.2)% |
| 10. Experience and other effects | 0.2% |
| 11. Statutory adjustment: (truncate to whole percent) | <u>0.9%</u> |
| 12. Variable annuity change: (6)+(7)+(8)+(9)+(10)+(11) | (10.0)% |

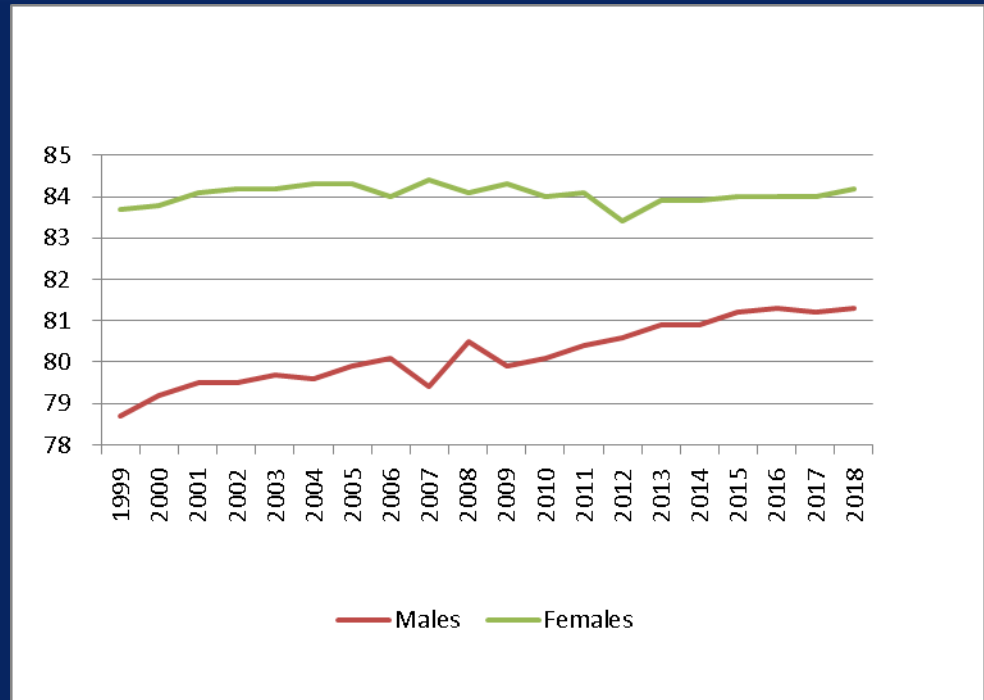


Average Retirement Age



Average Age at Death

Average age at death, while an interesting statistic, is not a proper measure of life expectancy, because it does not include people who have not yet died. The expected age at death for a 65 year old is 86.3 for males and 88.7 for females.



Comparative Statement - Core

| Valuation Date | Number | \$ Millions | | | | Ratio | Change in | | |
|------------------------|---------|---------------------|-----------------|----------------------|-----------|--------------|-----------|--------------|--|
| | | Annual Annuities | Fund Balance | Actuarial Reserve | Annuities | | CPI* | | |
| | | | | | | Average | | Maximum | |
| 2009 | 150,671 | 3,449.3 | 36,655.8 | 37,072.7 | 0.989 | (1.1)% | (1.3)% | 2.7 % | |
| 2010 | 155,775 | 3,532.4 | 37,798.4 | 38,148.5 | 0.991 | (0.9)% | (1.2)% | 1.5 % | |
| 2011 | 167,453 | 3,842.0 | 40,411.5 | 42,078.3 | 0.960 | (4.0)% | (7.0)% | 3.0 % | |
| 2012 | 173,655 | 3,806.3 | 40,591.6 | 41,852.4 | 0.970 | (3.0)% | (9.6)% | 1.7 % | |
| 2013 | 180,056 | 3,800.7 | 44,273.2 | 42,300.5 | 1.047 | 4.7 % | 4.7 % | 1.5 % | |
| 2014 | 185,605 | 4,102.3 | 47,135.7 | 45,790.7 | 1.029 | 2.9 % | 2.9 % | 0.8 % | |
| 2015 | 191,795 | 4,364.9 | 49,147.0 | 48,897.5 | 1.005 | 0.5 % | 0.5 % | 0.7 % | |
| 2016 | 197,647 | 4,523.1 | 51,972.0 | 50,941.4 | 1.020 | 2.0 % | 2.0 % | 2.1 % | |
| 2017 | 203,202 | 4,747.0 | 54,900.0 | 53,590.0 | 1.024 | 2.4 % | 2.4 % | 2.1 % | |
| 2018 | 211,126 | 5,040.9 | 56,493.8 | 56,629.3 | 0.998 | 0.0 % | 0.0 % | 1.9 % | |
| 35-Year Average | | | | | | 3.7 % | | 2.6 % | |
| 20-Year Average | | | | | | 2.0 % | | 2.2 % | |
| 10-Year Average | | | | | | 0.3 % | | 1.8 % | |
| 5-Year Average | | | | | | 1.6 % | | 1.5 % | |

**Based on December CPI-U67 index.*

(Report-21)

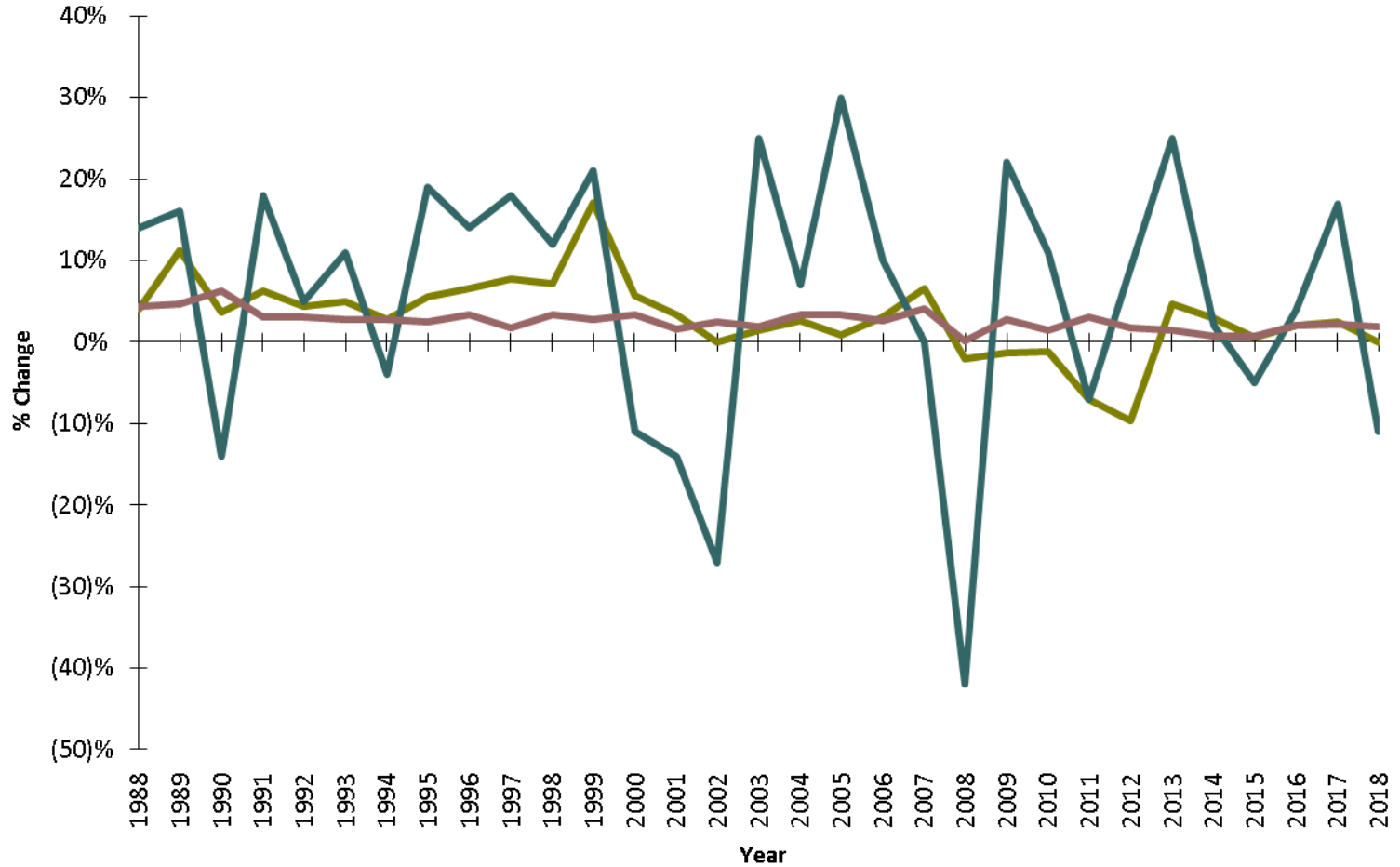
Comparative Statement - Variable

| Valuation Date | Number | \$ Millions | | | | Change in | |
|------------------------|--------|---------------------|-----------------|----------------------|-------|--------------|--------------|
| | | Annual Annuities | Fund Balance | Actuarial Reserve | Ratio | Annuities | CPI* |
| 2009 | 34,836 | 240.3 | 3,078.4 | 2,512.7 | 1.225 | 22.0 % | 2.7 % |
| 2010 | 35,866 | 288.4 | 3,340.6 | 3,005.4 | 1.111 | 11.0 % | 1.5 % |
| 2011 | 38,949 | 330.3 | 3,197.9 | 3,462.9 | 0.924 | (7.0)% | 3.0 % |
| 2012 | 39,873 | 304.6 | 3,463.9 | 3,169.6 | 1.093 | 9.0 % | 1.7 % |
| 2013 | 40,317 | 324.5 | 4,187.3 | 3,347.0 | 1.251 | 25.0 % | 1.5 % |
| 2014 | 39,420 | 386.5 | 3,995.4 | 3,917.1 | 1.020 | 2.0 % | 0.8 % |
| 2015 | 40,152 | 387.8 | 3,704.8 | 3,910.1 | 0.947 | (5.0)% | 0.7 % |
| 2016 | 40,647 | 363.6 | 3,792.0 | 3,645.1 | 1.040 | 4.0 % | 2.1 % |
| 2017 | 40,877 | 369.9 | 4,324.9 | 3,682.1 | 1.175 | 17.0 % | 2.1 % |
| 2018 | 41,187 | 425.8 | 3,749.1 | 4,207.6 | 0.891 | (10.0)% | 1.9 % |
| 35-Year Average | | | | | | 3.8 % | 2.6 % |
| 20-Year Average | | | | | | 0.4 % | 2.2 % |
| 10-Year Average | | | | | | 6.2 % | 1.8 % |
| 5-Year Average | | | | | | 1.2 % | 1.5 % |

**Based on December CPI-U67 index.*

(Report-22)

History of % Changes



(Report-23)



Looking Ahead

- As of the December 31, 2018 valuation, there are about \$4.9 billion in unrecognized asset losses in the Core fund
 - About half of this will be applied to annuitant reserve
 - Will be recognized over the next four years
 - Will put downward pressure on dividends
- A few more years of positive dividends for all annuitants is needed to decrease the probability of leveraged negative dividends such as those that occurred between 2008 and 2012



Current Events

CURRENT EVENTS

ACTUARIAL AUDITS

Purpose of An Actuarial Audit

- Provide assurance that the financial condition of the plan and contribution requirements, as stated by the retained actuary, are accurate.
- Similar to a second opinion in medical practice.
- Provides both the Retirement System and the Actuary with the views of another professional.
- Everyone benefits

Types of Audits

- Audits can range from
 - A brief review of the actuarial report with a few results and recommendations summarized in the letter.
 - A full reproduction of most facets of the retained actuary's work with the results summarized in a full report.

Segal Audit of 2013 WRS Valuation

- Results
 - Data is complete
 - Assumptions and methods comply with Actuarial Standards
 - Actuarial calculations on sample people are correct
 - Recommendations in Experience Study are reasonable and appropriate
 - Fine tuning suggestions.

Next Audit

- Government Finance Officers Association recommends that plans conduct an audit every 5 Years
- Will cover the 2018 valuations
- RFP released in February 2019
- Report to the Board late in 2019 or possibly early in 2020

ASOP 51

Assessment and Disclosure of Risk

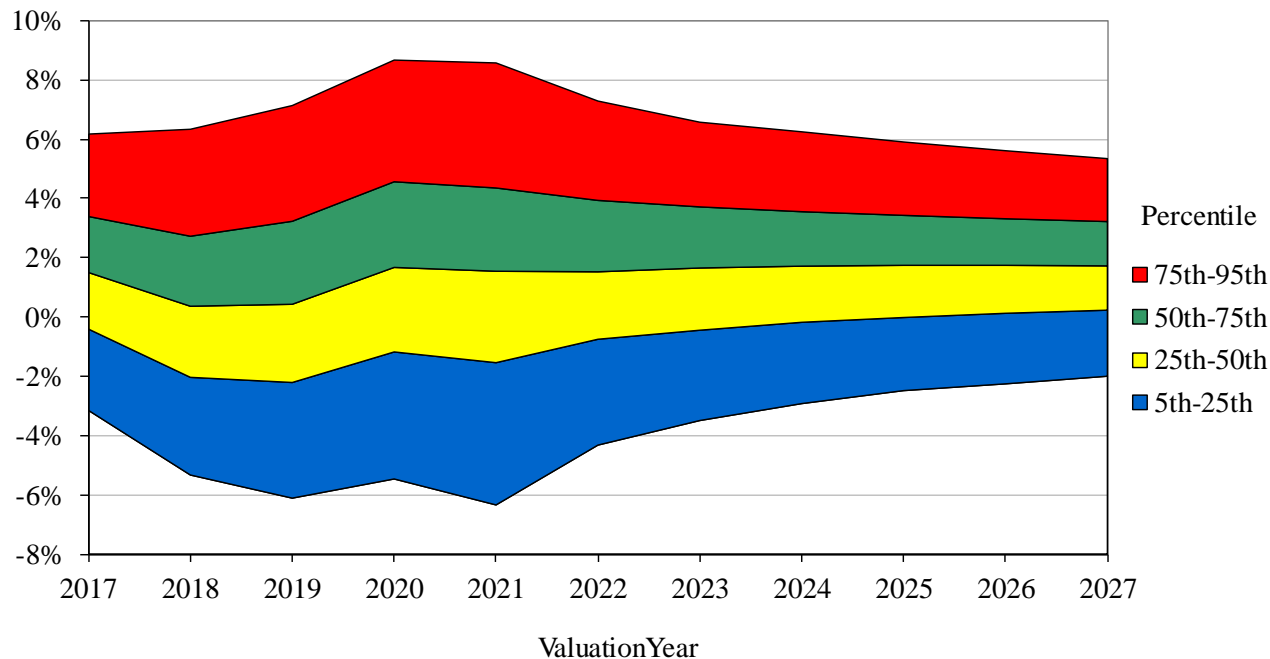
- Investment Risk
- Asset Liability Mismatch risk
- Interest rate risk
- Demographic Risk (mortality , etc)
- Contribution Risk

Specific Risks – Retiree Side

- Risk of a Negative Dividend
- Risk of Dividend Exhaustion

Dividend Rates

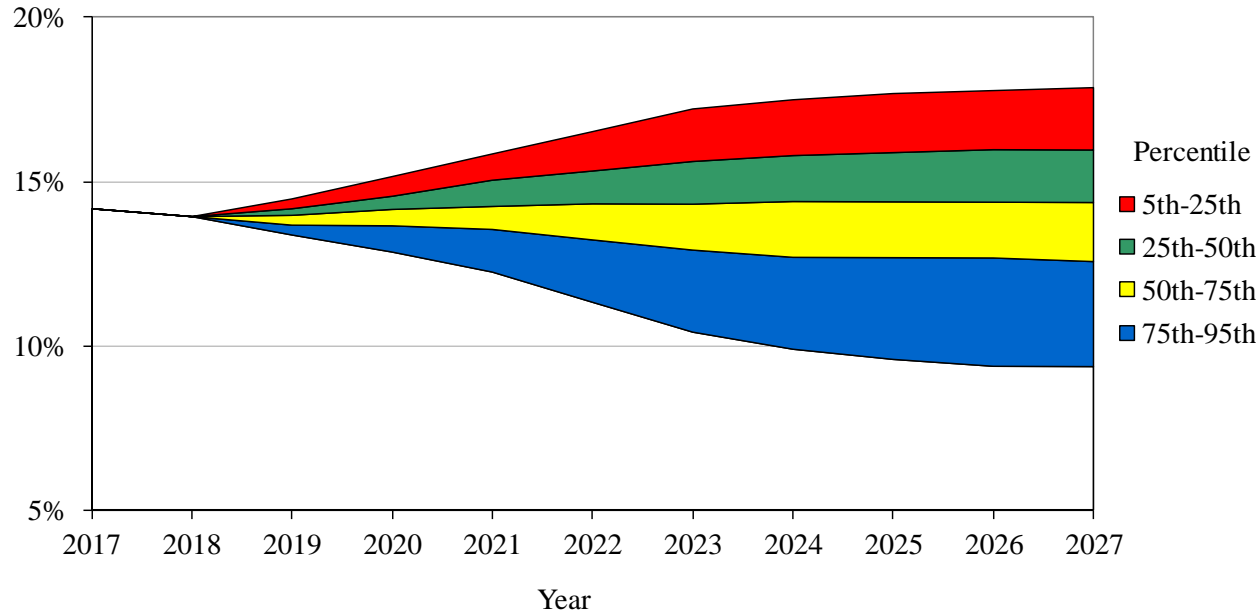
Scenario 3 – 7.0%ER, 15.2%SD



| | | | | | | | | | | | |
|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 5th Percentile | -3.2% | -5.3% | -6.1% | -5.5% | -6.3% | -4.3% | -3.5% | -2.9% | -2.5% | -2.3% | -2.0% |
| 25th Percentile | -0.4% | -2.0% | -2.2% | -1.2% | -1.5% | -0.8% | -0.4% | -0.2% | 0.0% | 0.1% | 0.2% |
| Median | 1.5% | 0.4% | 0.4% | 1.7% | 1.5% | 1.5% | 1.7% | 1.7% | 1.7% | 1.7% | 1.7% |
| 75th Percentile | 3.4% | 2.7% | 3.2% | 4.6% | 4.4% | 3.9% | 3.7% | 3.6% | 3.4% | 3.3% | 3.2% |
| 95th Percentile | 6.2% | 6.3% | 7.1% | 8.7% | 8.6% | 7.3% | 6.6% | 6.2% | 5.9% | 5.6% | 5.3% |

Contribution as a % of Payroll

Scenario 3 – 7.0%ER, 15.2%SD



| | | | | | | | | | | | |
|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 5th Percentile | 14.2% | 13.9% | 14.5% | 15.2% | 15.8% | 16.5% | 17.2% | 17.5% | 17.7% | 17.8% | 17.9% |
| 25th Percentile | 14.2% | 13.9% | 14.2% | 14.6% | 15.0% | 15.3% | 15.6% | 15.8% | 15.9% | 16.0% | 16.0% |
| Median | 14.2% | 13.9% | 14.0% | 14.2% | 14.2% | 14.3% | 14.3% | 14.4% | 14.4% | 14.4% | 14.4% |
| 75th Percentile | 14.2% | 13.9% | 13.7% | 13.7% | 13.5% | 13.2% | 12.9% | 12.7% | 12.7% | 12.7% | 12.6% |
| 95th Percentile | 14.2% | 13.9% | 13.4% | 12.9% | 12.2% | 11.3% | 10.4% | 9.9% | 9.6% | 9.4% | 9.4% |

Discussion of Dividend

Probability That Dividend Reserve Will Be Depleted in Year

| | Expected ROR | Standard Deviation | Year | | | | |
|---|-----------------|-----------------------|------|-------|-------|-------|-------|
| | | | 1 | 5 | 10 | 20 | 50 |
| 1 | 5.0% | 8.2% | 0.0% | 12.5% | 22.7% | 30.0% | 39.6% |
| 2 | 6.0% | 11.4% | 0.0% | 15.4% | 17.6% | 12.4% | 3.9% |
| 3 | 7.0% | 15.2% | 0.0% | 18.2% | 16.4% | 7.7% | 0.9% |
| 4 | 7.2% | 16.0% | 0.0% | 18.7% | 16.4% | 7.3% | 0.6% |
| 5 | 8.0% | 19.4% | 0.0% | 20.9% | 16.7% | 6.5% | 0.4% |
| 6 | 9.0% | 24.1% | 0.3% | 23.2% | 18.0% | 6.6% | 0.3% |
| 7 | 10.0% | 29.5% | 0.9% | 26.2% | 20.0% | 7.5% | 0.4% |

Current →

Discussion of Dividend

Probability of Negative Dividend in Year

| | Expected ROR | Standard Deviation | Year | | | | |
|---|-----------------|-----------------------|-------|-------|-------|-------|-------|
| | | | 1 | 5 | 10 | 20 | 50 |
| 1 | 5.0% | 8.2% | 23.2% | 52.7% | 55.8% | 54.4% | 52.5% |
| 2 | 6.0% | 11.4% | 26.6% | 42.0% | 33.1% | 28.8% | 28.1% |
| 3 | 7.0% | 15.2% | 29.5% | 37.1% | 23.2% | 18.5% | 18.8% |
| 4 | 7.2% | 16.0% | 29.9% | 36.5% | 22.0% | 17.3% | 17.8% |
| 5 | 8.0% | 19.4% | 31.7% | 34.8% | 19.2% | 14.5% | 14.9% |
| 6 | 9.0% | 24.1% | 33.5% | 34.3% | 17.4% | 12.7% | 13.3% |
| 7 | 10.0% | 29.5% | 34.9% | 35.0% | 17.2% | 12.5% | 13.1% |

Current →

Specific Risks – Active Side

- Size of Plan vs Size of Plan Sponsor
- Example
 - Assets are 7 times payroll
 - Plan loses 3% instead of earning 7%
 - 10% “loss” is 70% of payroll

Now what

- Most Plans
 - Asset smoothing
 - Employer Rate
- Wisconsin
 - Asset smoothing
 - Risk Sharing

Risk Sharing in Wisconsin

Employer Rate
Employee Rate

Money Purchase Benefits
Dividends

Of course gains are Shared as well as losses.

MORTALITY RISK

Wisconsin Projected Experience Table

| | Years of Future Life Expectancy of a 65 Year old | | | | |
|-------------------------|---|-------------|-------------|-------------|-------------|
| | 1953 | 1963 | 1973 | 1983 | 1993 |
| Year of Birth | | | | | |
| Year Turn Age 65 | 2018 | 2028 | 2038 | 2048 | 2048 |
| Male | 21.3 | 21.7 | 22.2 | 22.6 | 23.1 |
| Female | 23.7 | 24.1 | 24.5 | 25.0 | 25.4 |

| | Years of Future Life Expectancy of a 75 Year old | | | | |
|-------------------------|---|-------------|-------------|-------------|-------------|
| | 1953 | 1963 | 1973 | 1983 | 1993 |
| Year of Birth | | | | | |
| Year Turn Age 75 | 2028 | 2038 | 2048 | 2058 | 2058 |
| Male | 13.5 | 13.9 | 14.3 | 14.6 | 15.0 |
| Female | 15.3 | 15.7 | 16.0 | 16.4 | 16.8 |

| | Years of Future Life Expectancy of a 85 Year old | | | | |
|-------------------------|---|-------------|-------------|-------------|-------------|
| | 1953 | 1963 | 1973 | 1983 | 1993 |
| Year of Birth | | | | | |
| Year Turn Age 85 | 2038 | 2048 | 2058 | 2068 | 2068 |
| Male | 7.3 | 7.6 | 7.8 | 8.1 | 8.4 |
| Female | 8.4 | 8.7 | 8.9 | 9.2 | 9.5 |

Mortality Experience Comparison of Tables

| Type of Table | Age | Life Expectancy ⁽³⁾ | |
|----------------------------------|-----|--------------------------------|--------|
| | | Male | Female |
| Wisconsin ⁽¹⁾ | 65 | 21.3 | 23.7 |
| PUB-Public Safety ⁽²⁾ | 65 | 20.4 | 22.3 |
| PUB-General ⁽²⁾ | 65 | 20.8 | 23.3 |
| PUB-Teachers ⁽²⁾ | 65 | 22.4 | 24.6 |

(1) Wisconsin table represents the current mortality assumption.

(2) PUB tables have a base year of 2010 and are projected using 60% of MP-2018.

(3) Based on retirements in 2018.

Public Pension Mortality Study Highlights

- Final Report Issued January 2019
- Rates developed by job category
 - Teachers
 - Public Safety
 - General
- Will help us fine tune mortality assumption in the future.

Disclaimers

- This presentation shall not be construed to provide tax advice, legal advice or investment advice.
- This presentation is intended to be used in conjunction with the actuarial valuation report for retired lives issued on February 28, 2019. This presentation should not be relied on for any purpose other than the purpose described in the valuation report.
- Readers are cautioned to examine original source materials and to consult with subject matter experts before making decisions related to the subject matter of this presentation.
- This presentation expresses the views of the authors and does not necessarily express the views of Gabriel, Roeder, Smith & Company.