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Teachers' and State Employees' Retirement System Principal Results of Actuarial Valuation as of December 31, 2019

October 29, 2020 Board of Trustees Meeting

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Purpose of the Annual Actuarial Valuation

- As of the end of each calendar year:
  - An annual actuarial valuation is performed on TSERS
  - The actuary determines the amount of employer contributions to be made to TSERS during each member's career that, when combined with investment return and member contributions, are expected to be sufficient to pay for retirement benefits.
- • In addition, the annual actuarial valuation is performed to:
  - Determine the progress on funding TSERS
  - Explore why the results of the current valuation differ from the results of the valuation of the previous year
  - Satisfy regulatory and accounting requirements

The Valuation Process

- The diagram to the right summarizes the inputs and results of the actuarial valuation process.
- A detailed summary of the valuation process and a glossary of actuarial terms are provided in Appendix A of the actuarial report.
- This diagram will appear throughout the presentation to designate where we are in the process.

Inputs

Member Data
Asset Data
Benefit Provisions
Assumptions
Funding Methodology

↓

Results

Actuarial Value of Assets
Actuarial Accrued Liability
Net Actuarial Gain or Loss
Funded Ratio
Benefit Enhancement
Additional Disclosures
Projections

Member Data

The table below provides a summary of the membership data used in this valuation compared to the prior valuation.

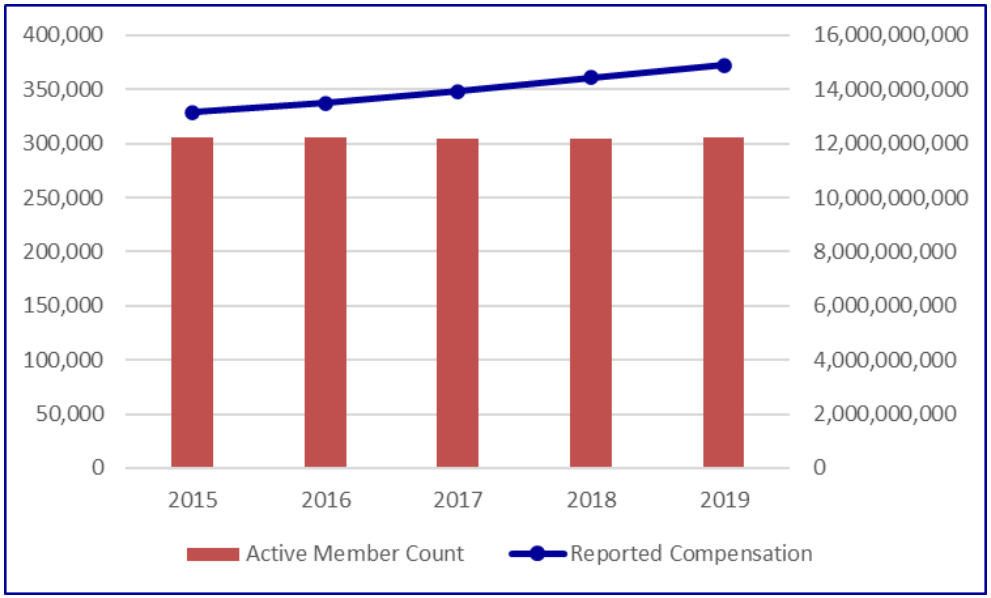
Number as of	12/31/2019	12/31/2018
Active Members	305,962	304,575
Members currently receiving Disability Income Plan benefits	5,774	6,190
Terminated members and survivors of deceased members Entitled to benefits but not yet receiving benefits	177,573	168,755
Retired members and survivors of deceased members currently receiving benefits	228,291	222,084
Total	717,600	701,604

The number of active members increased by 0.5% from the previous valuation date. The number of retired members and survivors of deceased members currently receiving benefits increased by 2.8% from the previous valuation. The increase in retiree population is consistent with expectations.

A detailed summary of the membership data used in this valuation is provided in Section 3 and Appendix B.

Active Members

The graph below provides a history of the number of active members and reported compensation over the past five years.

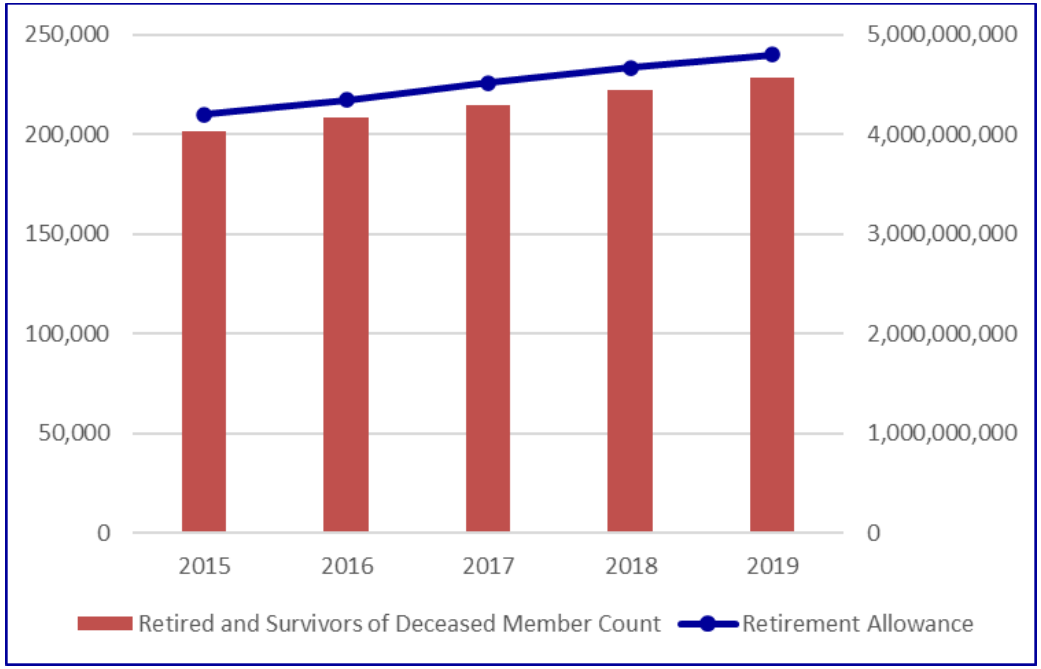


Reported compensation has increased by 3.1% and has averaged 3.2% over the past four years. Covered payroll is expected to increase by approximately 3.5% annually in the future. Payroll that is not increasing as fast as we assume results in less benefits accruing than we anticipate, but also fewer contributions supporting the system.

A detailed summary of the membership data used in this valuation is provided in Section 3 and Appendix B.

Membership Data

The graph below provides a history of the number of retired members and survivors of deceased members and benefit amounts payable over the past five years.



The number of retired members and survivors of deceased members and the benefits paid to these members has been increasing steadily, as expected based on plan assumptions.

A detailed summary of the membership data used in this valuation is provided in Section 3 and Appendix B.

Asset Data

The table below provides details of the Market Value of Assets for the current and prior year's valuations.

Asset Data as of	12/31/2019	12/31/2018
Beginning of Year Market Value of Assets	$ 67,536,480,309	$ 70,607,887,248
Employer Contributions	1,982,469,767	1,758,110,760
Employee Contributions	955,063,189	927,251,021
Benefit Payments Other Than Refunds	(4,757,088,409)	(4,666,520,152)
Refunds	(102,281,124)	(109,504,134)
Administrative Expenses	(12,107,623)	(11,856,738)
Investment Income	9,884,244,364	(968,887,696)
Net Increase / (Decrease)	7,950,300,164	(3,071,406,939)
End of Year Market Value of Assets	$ 75,486,780,473	$ 67,536,480,309
Estimated Net Investment Return	14.85%	-1.39%

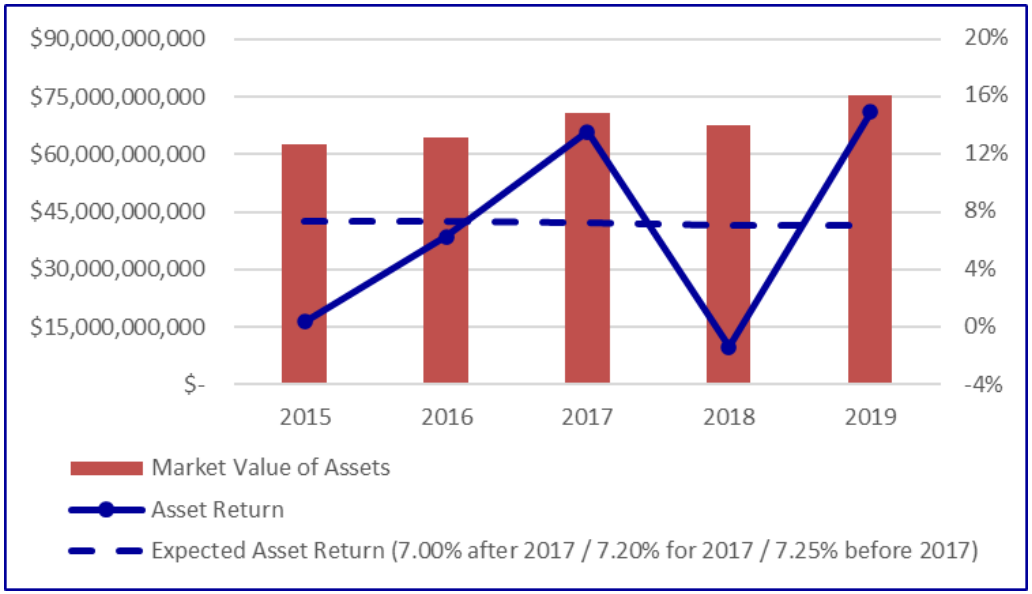
TSERS assets are held in trust and are invested for the exclusive benefit of plan members.

Incoming contributions cover around 60% of outgoing benefit payments and administrative expenses. Over the long term, benefit payments and administrative expenses not covered by contributions are expected to be covered with investment income, illustrating the benefits of following actuarial pre-funding since inception.

A detailed summary of the market value of assets is provided in Section 4.

Asset Data

The graph below provides a history of the market value of assets and asset returns over the past five years.

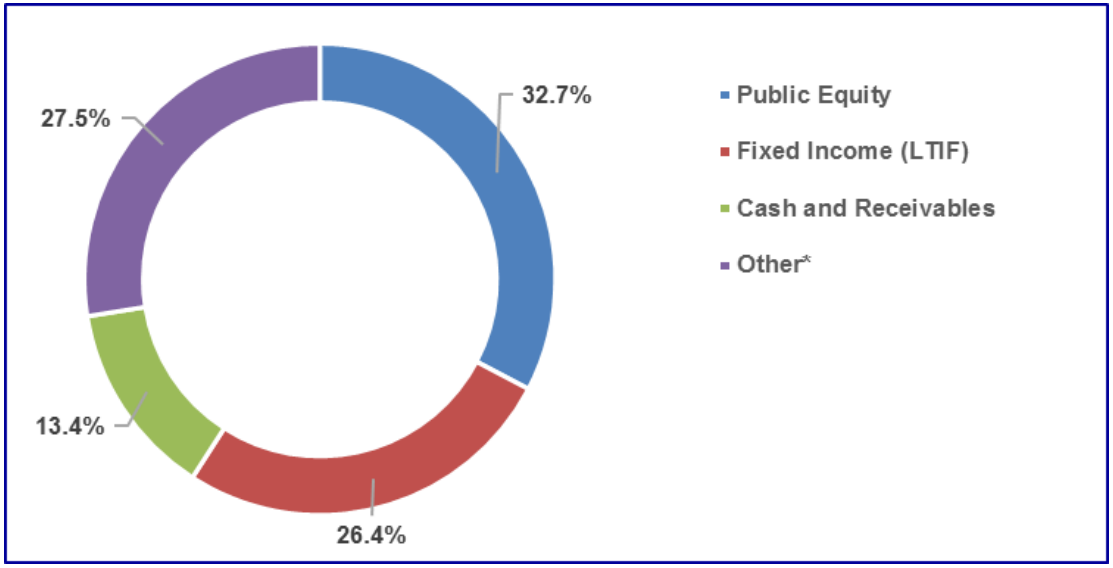


The investment return for the market value of assets for 2018 was 14.85%, well above the expected return of 7.00%. The return on the actuarial value of assets which is used to determine the contribution rates fell short of the 7.00% expected return at 6.18%. This resulted in an increase in the UAAL of $572 million.

A detailed summary of the market value of assets is provided in Section 4.

Asset Data

The graph below provides the breakdown of the market value of assets at December 31, 2019 by asset category.



*Real Estate, Alternatives, Inflation and Credit

Based on historical market returns, the current asset allocation, the current investment policy, and the expectation of future asset returns, as reviewed in the last experience study, the 7.00% discount rate used in this valuation is reasonable and appropriate.

A detailed summary of the market value of assets is provided in Section 4.

Benefit Provisions

Benefit provisions are described in North Carolina General Statutes, Chapter 135.

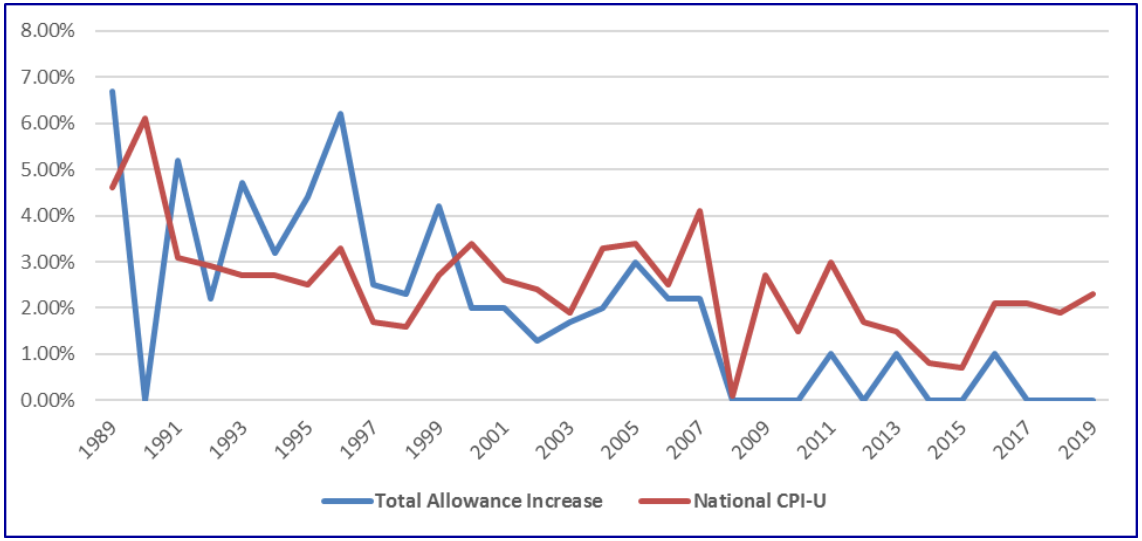
- There have been no changes to the benefit provisions since the last valuation.

Many Public Sector Retirement Systems in the United States have undergone pension reform where the benefits of members (active or future members) have been reduced. Because of the well-funded status of TSERS due to the legislature contributing the actuarially determined employer contribution, benefit cuts have not been made in North Carolina as they have been in most other states. Instead, we have seen a modest expansion of benefits in recent years based on sound plan design.

A detailed summary of the benefit provisions is provided in Appendix C.

Benefit Provisions

The graph below provides a 30-year history of allowance increases for TSERS and the national CPI-U. It does not include one-time supplements granted in recent years.



Prior to 2000, asset returns generally exceeded expectations and allowance increases exceeded the cost of living. Subsequently, asset returns on average have been lower than expected leading to lower allowance increases. This graph does not include one-time pension supplements that are sometimes granted.

A detailed summary of the benefit provisions is provided in Appendix C of the actuarial report.

Actuarial Assumptions

Actuarial assumptions bridge the gap between the information that we know with certainty as of the valuation date and what may happen in the future. The assumptions used include the following:

- Demographic
  - Retirement
  - Termination
  - Disability
  - Death
- Economic
  - Interest rate – 7.00% per year
  - Salary increase (individual, varies by service)
  - Inflation – 3.00%
  - Real wage growth – 0.50%

The assumptions used for the December 31, 2019 actuarial valuation are based on the experience study prepared as of December 31, 2014 and adopted by the Board of Trustees on January 21, 2016. The discount rate was updated to be 7.00%, as adopted by the Board of Trustees on April 26, 2018. The impact on the contribution rate was direct-rate smoothed over a three-year period.

A detailed summary of the actuarial assumptions and methods is provided in Appendix D.

Funding Methodology

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The Funding Methodology is the payment plan for TSERS and is composed of the Actuarial Cost Method, the Asset Valuation Method and Amortization Method.

- Actuarial Cost Methods allocate costs to the actuarial accrued liability (i.e. the amount of money that should be in the fund) for past service and normal cost (i.e. the cost of benefits accruing during the year) for current service.
  - The Board of Trustees has adopted Entry Age Normal as its actuarial cost method
  - This method develops normal costs that stay level as a percent of payroll

The following "Objectives and Principles for Funding Public Sector Pension Plans" provides information on funding of Public Plans: https://www.actuary.org/sites/default/files/files/Public-Plans_IB-Funding-Policy_02-18-2014.pdf.

Page 15 of the following - https://www.ccactuaries.org/Portals/0/pdf/CCA_PPC_White_Paper_on_Public_Pension_Funding_Policy.pdf - denotes Entry Age as a model practice for cost methods.

A detailed summary of the actuarial assumptions and methods is provided in Appendix D.

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The Funding Methodology is the payment plan for TSERS and is composed of the Actuarial Cost Method, the Asset Valuation Method and Amortization Method.

- Asset Valuation Methods smooth or average the market value returns over time to alleviate contribution volatility that results from market returns.
  - Asset returns in excess of or less than the expected return on market value of assets reflected over a five-year period
  - Assets corridor: not greater than 120% of market value and not less than 80% of market value

Page 20 of the following https://www.ccactuaries.org/Portals/0/pdf/CCA_PPC_White_Paper_on_Public_Pension_Funding_Policy.pdf denotes the policy being used is an acceptable policy.

Almost all Public Sector Retirement Systems in the United States use asset valuation methods to alleviate contribution volatility. The use of a four- or five-year period is most common.

A detailed summary of the actuarial assumptions and methods is provided in Appendix D.

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The Funding Methodology is the payment plan for TSERS and is composed of the Actuarial Cost Method, the Asset Valuation Method and Amortization Method.

- Amortization Methods determine the payment schedule for unfunded actuarial accrued liability (i.e. the difference between the actuarial accrued liability and actuarial value of assets)
  - Payment level: the payment is determined as a level dollar amount, like a mortgage payment
  - Payment period: a 12-year closed amortization period was adopted for fiscal year ending 2012. A new amortization base is created each year based on the prior years' experience.
- For fiscal years beginning after January 1, 2017, the sum of the "normal contribution" and the "accrued liability contribution" shall not be less than the employee contribution.

Page 26 of the following - https://www.ccactuaries.org/Portals/0/pdf/CCA_PPC_White_Paper_on_Public_Pension_Funding_Policy.pdf - suggests the Amortization Method is an acceptable practice.

When compared to other Public Sector Retirement Systems in the United States, the Amortization Method results in higher pension debt payments. This is because of:

- A shorter period of 12 years compared to a national average of 24
- Level dollar payments instead of payments designed to increase which is more typical in the Public Sector

A detailed summary of the actuarial assumptions and methods is provided in Appendix D.

Actuarial Value of Assets

The table below provides the calculation of the Actuarial Value of Assets (AVA) at the valuation date.

Asset Data as of	12/31/2019
Beginning of Year Actuarial Value of Assets	$ 70,959,093,440
Beginning of Year Market Value of Assets	67,536,480,309
Total Contributions	2,937,532,956
Benefit Payments, Refunds and Administrative Expenses	(4,871,477,156)
Net Cash Flow	(1,933,944,200)
Expected Investment Return	4,661,010,386
Expected End of Year Market Value of Assets	70,263,546,495
End of Year Market Value of Assets	75,486,780,473
Excess of Market Value of Assets over Expected Market Value of Assets	5,223,233,978
80% of 2019 Asset Gain / (Loss)	4,178,587,182
60% of 2018 Asset Gain / (Loss)	(3,503,457,738)
40% of 2017 Asset Gain / (Loss)	1,584,231,313
20% of 2016 Asset Gain / (Loss)	(126,340,247)
Total Deferred Asset Gain / (Loss)	2,133,020,510
Preliminary End of Year Actuarial Value of Assets	73,353,759,963
Final End of Year Actuarial Value of Assets (not less than 80% and not greater than 120% of Market Value of Assets)	$ 73,353,759,963
Estimated Net Investment Return	6.18%

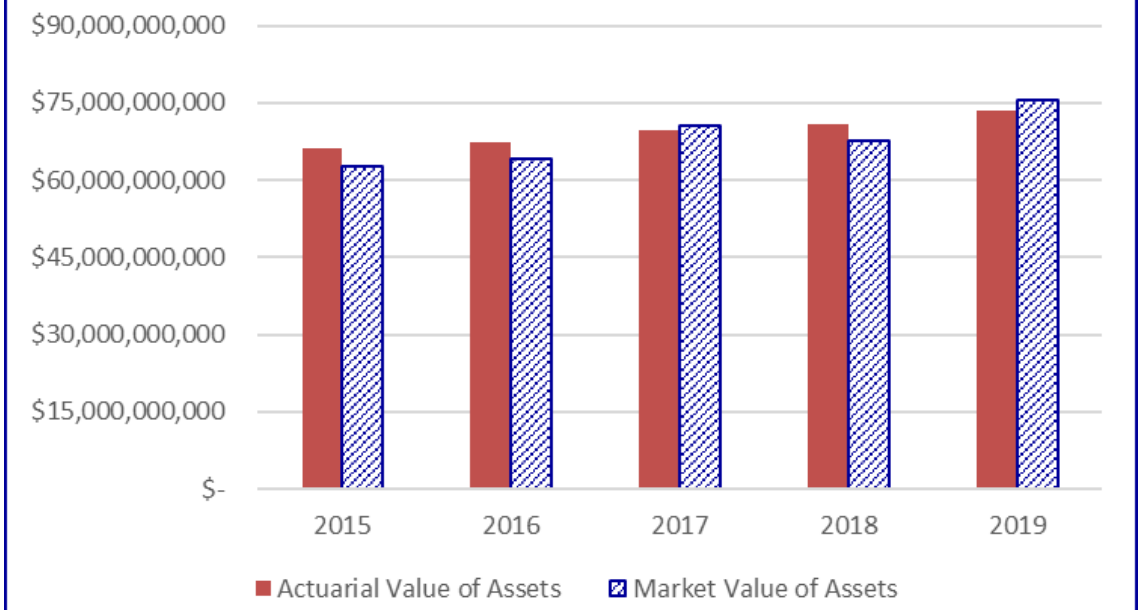
The actuarial value of assets smooths investment gains/losses, resulting in less volatility in the employer contribution. The asset valuation recognizes asset returns in excess of or less than the expected return on the market value of assets over a five-year period. Actuarial value of assets was reset to the market value of assets at December 31, 2014.

Lower than expected market returns, in 2015, 2016, and 2018, resulted in an actuarial value of asset return for calendar year 2019 of 6.18% and a recognized actuarial asset loss of $0.6 billion during 2019.

A detailed summary of the Actuarial Value of Assets is provided in Section 4.

Actuarial Value of Assets

The graph below provides a history of the market value and actuarial value of assets over the past five years.



The market value of assets is higher than the actuarial value of assets, which is used to determine employer contributions. This indicates that overall there are unrecognized asset gains to be recognized in future valuations.

A detailed summary of the Actuarial Value of Assets is provided in Section 4.

Actuarial Value of Assets

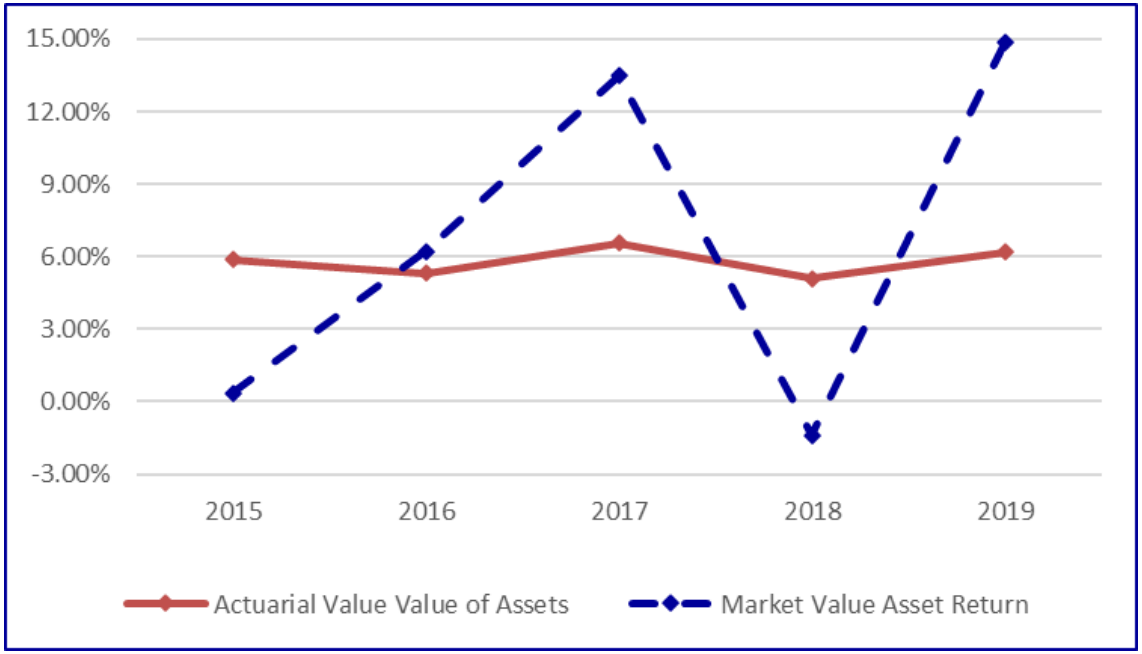
Calendar Year	Expected Asset Return	Actuarial Value of Asset Return	Market Value of Asset Return	20 Year Average Market Return
1997	7.25%	10.18%	18.16%	NA
1998	7.25%	9.92%	16.66%	NA
1999	7.25%	10.60%	10.15%	NA
2000	7.25%	11.55%	2.50%	NA
2001	7.25%	8.51%	-1.87%	NA
2002	7.25%	5.66%	-5.21%	NA
2003	7.25%	7.98%	18.23%	NA
2004	7.25%	8.56%	10.73%	NA
2005	7.25%	8.26%	6.97%	NA
2006	7.25%	8.94%	11.41%	NA
2007	7.25%	8.87%	8.38%	NA
2008	7.25%	2.89%	-19.50%	NA
2009	7.25%	4.74%	14.84%	NA
2010	7.25%	5.89%	11.47%	NA
2011	7.25%	5.15%	2.19%	NA
2012	7.25%	6.32%	11.82%	NA
2013	7.25%	7.43%	12.21%	NA
2014	7.25%	7.19%	6.21%	NA
2015	7.25%	5.87%	0.36%	NA
2016	7.25%	5.32%	6.22%	6.71%
2017	7.20%	6.56%	13.49%	6.49%
2018	7.00%	5.10%	-1.39%	5.60%
2019	7.00%	6.18%	14.85%	5.82%
20-Yr Average	7.22%	6.83%	5.82%	NA
Range	0.25%	8.66%	37.73%	NA

The average investment return recognized for purposes of determining the annual change in contribution each year is the actuarial value of assets return. Currently, the average actuarial return over the past 20 years of 6.83% compares with an average market return of 5.82%. The difference is partially due to asset gains of the late 1990's being included in the actuarial value of assets. The range of returns is markedly more volatile 37.73% versus 8.66%. This results in much lower employer contribution volatility using the actuarial value of assets versus market, while ensuring that the actuarial needs of TSERS are met.

A detailed summary of the Actuarial Value of Assets is provided in Section 4.

Actuarial Value of Assets

The graph below provides a history of the market value and actuarial value of asset returns over the past five years.

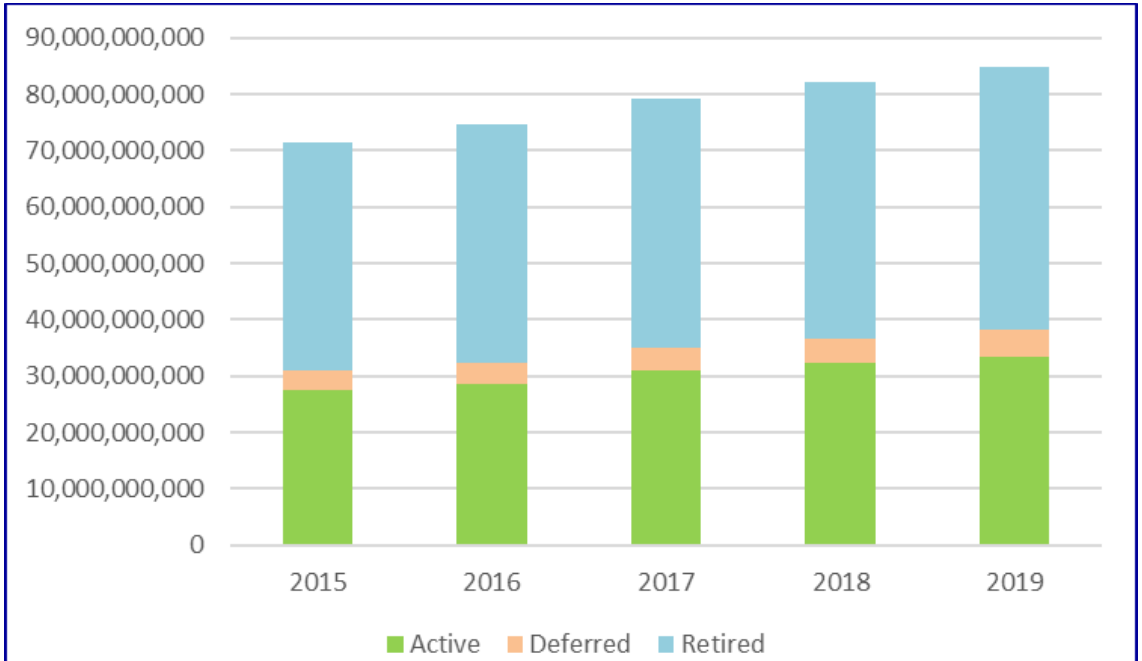


The investment return for the market value of assets for calendar year 2019 was 14.85%. The actuarial value of assets smooths investment gains and losses. Lower than expected market returns, in 2015, 2016, and 2018, resulted in an actuarial value of asset return for calendar year 2019 of 6.18% and a recognized actuarial asset loss of $0.6 billion during 2019.

A detailed summary of the Actuarial Value of Assets is provided in Section 4.

Actuarial Accrued Liability

The graph below provides a history of the actuarial accrued liability (AAL) over the past five years.

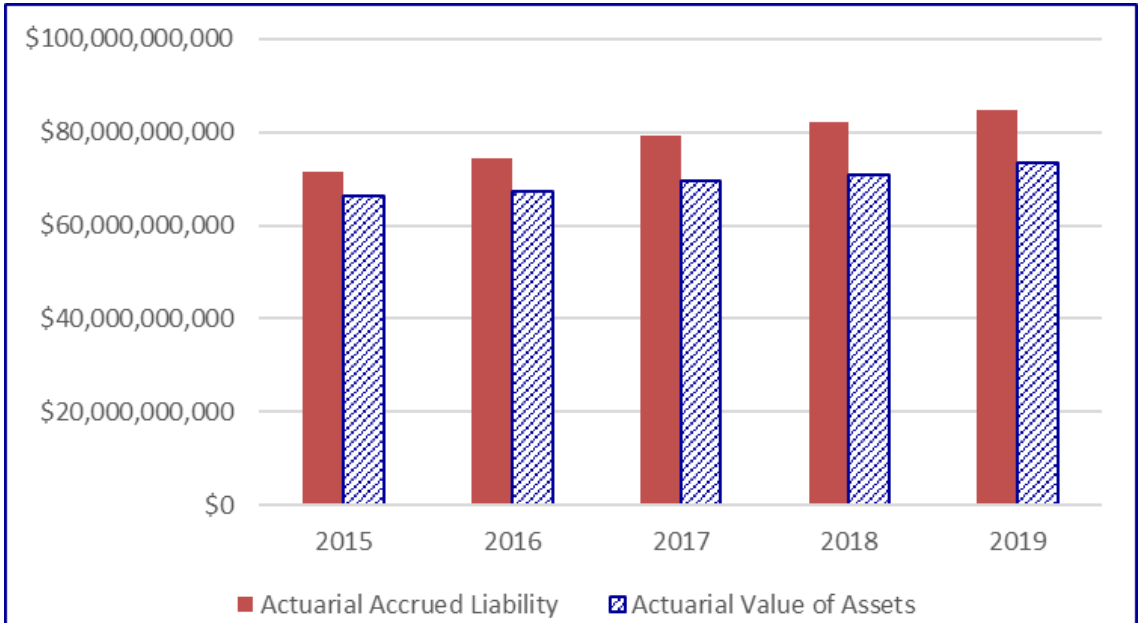


The AAL increased from $82.1 billion to $84.9 billion during 2019. The Retirement System is an open plan, which means that new members enter the plan each year. In an open plan, liabilities are expected to grow from one year to the next as more benefits accrue and the membership approaches retirement. The AAL was $236 million higher than expected resulting from demographic losses. The largest source of the loss was salary increases higher than expected.

A detailed summary of the Actuarial Accrued Liability is provided in Section 5.

AVA and AAL

The graph below provides a history of the actuarial accrued liability and actuarial value of assets.



The difference in the actuarial accrued liability and the actuarial value of assets is known as the Unfunded Actuarial Accrued Liability (UAAL). The UAAL is $11.52 billion as of 12/31/2019 and is to be paid off over a 12-year period.

Detailed summaries of the AVA and AAL are provided in Sections 4 and 5 respectively.

Net Actuarial Gain or Loss

The table below provides a reconciliation of the prior year's unfunded actuarial accrued liability to the current year's unfunded actuarial accrued liability.

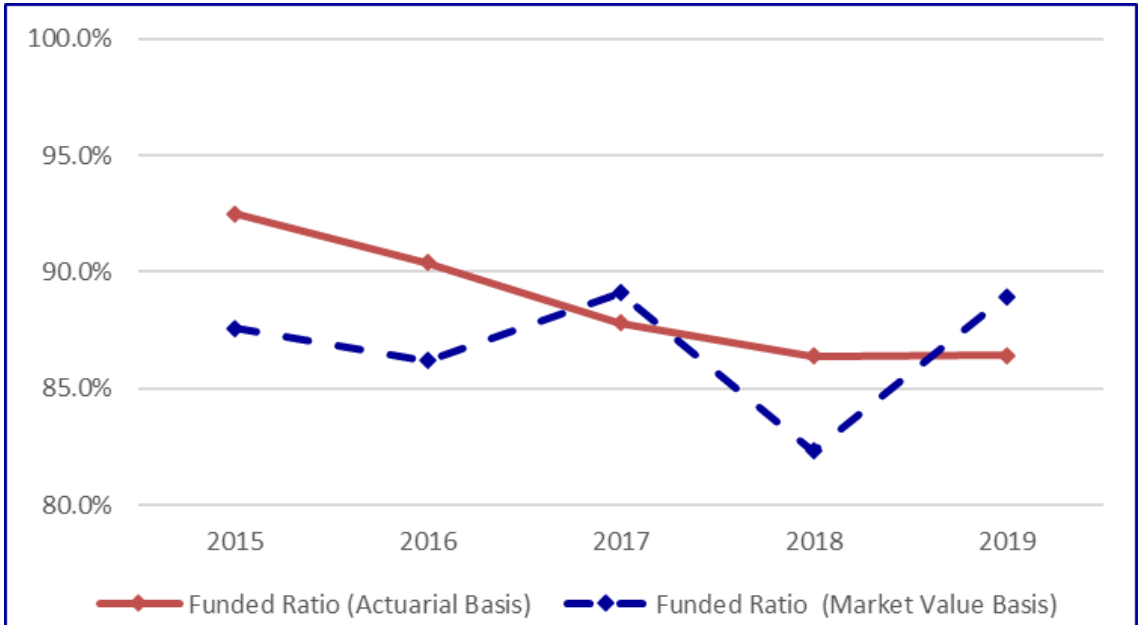
(in millions)	
Unfunded Actuarial Accrued Liability (UAAL) as of 12/31/2018	$ 11,147
Normal Cost and Administrative Expense during 2019	1,741
Reduction due to Actual Contributions during 2019	(2,915)
Interest on UAAL, Normal Cost, and Contributions	739
Asset (Gain) / Loss	572
Actuarial Accrued Liability (Gain) / Loss	236
Impact of Assumption Changes	-
Impact of Legislative Changes	-
Unfunded Actuarial Accrued Liability (UAAL) as of 12/31/2019	$ 11,520

During 2019, the UAAL increased by $373 million. The loss recognized in the Actuarial Value of Assets during the year increased the UAAL by $572 million. Demographic losses were $236 million primarily due to salary increases larger than expected.

A detailed summary of the net actuarial gain or loss is provided in Section 5.

Funded Ratio

The graph below provides a history of the funded ratio on a market and actuarial basis over the past five years.



The ratio of assets to liabilities shows the health of the plan on an accrued basis. The funded ratio on an actuarial basis did not change from 86.4% at December 31, 2018 to 86.4% at December 31, 2019.

A detailed summary of the funded ratio is provided in Section 5.

Employer Contributions

The graph below provides a history of actuarially determined employer contribution rates over the past five years before applying funding policy minimums.

The rates are split into the normal rate and the accrued liability rate. The normal rate is the employer's portion of the cost of benefits accruing after reducing for the member contribution. The accrued liability rate is the payment toward the unfunded liability. See slide 26 for more detail.

The actuarially determined employer contribution rate is the amount needed to pay for the cost of the benefits accruing and to pay off the unfunded liability over a 12-year period, offset for the 6% of pay contribution the members make. The 12-year period is a short period for Public Sector Retirement Systems in the United States, with the funding period for most of these Systems much longer. The shorter period results in higher contributions and more benefit security.

A detailed summary of the actuarially determined employer contribution rates is provided in Section 6.

Employer Contributions

The ECRSP (Employer Contribution Rate Stabilization Plan) would result in a recommended contribution rate of 15.74% of payroll for fiscal year ending 2022.

- 15.74% is the actuarially determined employer contribution calculated in this most recent valuation.
- The minimum is 15.13%; the appropriated contribution from last year of 14.78% plus 0.35%.
- The maximum is approximately 75.68%; the estimated actuarially determined employer contribution using a discount rate equal to the long-term Treasury bond yield (2.39%).

The ECRSP adopted by the Board of Trustees on January 21, 2016 requires that recommended contributions be 0.35% of payroll greater than the appropriated contribution during the prior year, with the following bounds: (1) contributions may not be less than the actuarially determined employer contribution (ADEC) and (2) contributions may not be greater than a contribution determined using the same assumptions used to calculate the ADEC based on the long-term Treasury bond yield.

A detailed summary of the actuarially determined employer contribution rates is provided in Section 6.

Employer Contributions

The table below provides a history of the actuarially determined employer contribution and the corresponding appropriated rate.

Valuation Date	Fiscal Year Ending	Normal Rate	Accrued Liability Rate	Change due to Legislation*	Final ADEC**	Appropriated Rate
12/31/2019	06/30/2022	5.16%	10.58%	N/A	N/A	N/A
12/31/2018	06/30/2021	5.18%	10.19%	0.00%	14.78%	14.78%
12/31/2017	06/30/2020	5.17%	8.99%	0.00%	12.97%	12.97%
12/31/2016	06/30/2019	4.48%	7.50%	0.31%	12.29%	12.29%
12/31/2015	06/30/2018	4.31%	5.77%	0.45%	10.53%	10.78%
12/31/2014	06/30/2017	5.21%	3.26%	1.49%	9.96%	9.98%

*The change due to legislation for the contribution for fiscal year ending 6/30/2019 includes a 0.31% increase in the ADEC due to the one-time cost-of-living supplement payable in October 2018.

**Final ADEC reduced for direct-rate smoothing of discount rate change for FYE 2020 and 2021.

The appropriated rate for fiscal year ending 2021 is 14.78% of payroll. The preliminary ADEC for fiscal year ending 2022 is 15.74% of payroll.

In addition to calculating the ADEC, we calculated the increase in ADEC for a 1% COLA to be 0.41% of payroll and the increase in UAAL to be $511,088,000. We also calculated the increase in ADEC for a 0.1% increase in the Defined Benefit Formula to be 0.41% of payroll and the increase in UAAL to be $440,942,000.

A detailed summary of the actuarially determined employer contribution rates is provided in Section 6.

Employer Contributions

The table below provides a reconciliation of the actuarially determined employer contribution rate shown as a percentage of covered payroll.

Fiscal year ending June 30, 2021 Preliminary ADEC (based on December 31, 2018 valuation)	14.78%
Impact of Legislative Changes	0.00%
Fiscal year ending June 30, 2021 ADEC for Reconciliation	14.78%
Change Due to Anticipated Reduction in UAAL*	(0.31%)
Change Due to Demographic (Gain)/Loss	0.17%
Change Due to Investment (Gain)/Loss	0.46%
Change Due to Contributions Less (Greater) than ADEC**	0.05%
Impact of Assumption Change	0.00%
Impact of Direct Rate Smoothing	0.59%
Fiscal year ending June 30, 2022 Preliminary ADEC (based on December 31, 2019 valuation)	15.74%

The change in rate due to investment loss is based on the actuarial value of assets return of 6.18%, which was less than the 7.00% assumed return.

The change in rate due to demographics was mostly due to salaries increasing more than expected.

The impact of direct rate smoothing is the final year of the deferred recognition of the 12/31/2017 discount rate change from 7.20% to 7.00%.

* Amortization of the UAAL is determined as a level dollar amount with payments expected to remain the same over the amortization period, but was calculated as a percentage of valuation payroll in the previous valuation. Payroll is expected to increase annually while the expected amortization payment does not increase. This causes the expected amortization payment to be a lesser percentage of the expected payroll.
**Includes impact of direct rate smoothing of FYE 2020 contribution.

A detailed summary of the actuarially determined employer contribution rates is provided in Section 6.

Potential COLAs

- Based on the actuarial losses recognized in this December 31, 2019, valuation, no Cost-of-Living Adjustment (COLA) effective July 1, 2021, could be funded by actuarial gains.
- Based on the methods and assumptions used for the projections discussed later in the presentation, we estimate that a potential COLA effective July 1, 2022, may be funded by actuarial investment gains following the December 31, 2020, valuation in the following circumstances:
  - If calendar year 2020 market value returns exceed 2.4% (or about $1.8B for TSERS), the plan is estimated to have an actuarial investment gain (rather than a loss) for 2020 and a COLA that would take effect on July 1, 2022, could be considered.
  - If calendar year 2020 market value returns exceed 5.9% (or about $4.4B for TSERS), the plan is estimated to have an actuarial investment gain (rather than a loss) for 2020 and such gain may be enough to consider providing a 1% COLA that would take effect on July 1, 2022.
    - Estimated actuarial investment gain of $528.3M
    - Estimated cost of 1% COLA payable to retirees effective July 1, 2022 of $525.1M
  - Estimates above assume no other offsetting actuarial losses in the December 31, 2020, valuation and no change to the actuarial assumptions.
- Note: CMC cannot provide legal advice. This slide should not be interpreted as legal advice as to the Board's ability to provide a COLA to retirees or recommend a COLA to the legislature

A detailed summary of the cost of benefit enhancements is provided in Section 6.

Additional Disclosures

The table below illustrates the sensitivity of certain valuation results to changes in the discount rate on a market value of assets basis.

Discount Rate	2.39%	4.70%	7.00%	9.31%	11.61%
Market Value of Assets	$ 75,486,780,473	$ 75,486,780,473	$ 75,486,780,473	$ 75,486,780,473	$ 75,486,780,473
Actuarial Accrued Liability	$149,987,223,635	$110,121,704,889	$ 84,873,315,272	$ 68,160,583,222	$ 56,771,444,974
Unfunded Accrued Liabilty (AAL)	$ 74,500,443,162	$ 34,634,924,416	$ 9,386,534,799	$ (7,326,197,251)	$ (18,715,335,499)
Funded Ratio	50.3%	68.5%	88.9%	110.7%	133.0%
20-Year Amortization of UAL	$ 4,842,503,437	$ 2,836,252,255	$ 948,036,347	N/A	N/A
(as % of general state revenue)	14.8%	8.7%	2.9%	N/A	N/A

Section 6(c) of Session Law 2016-108 requires that the actuarial valuation report provide the valuation results using a 30-year Treasury rate as of December 31 of the year of the valuation as the discount rate. The 30-year treasury rate is 2.39% as of December 31, 2019.

The difference between the UAAL measured at 7.00% and 2.39% is $65.1 billion at December 31, 2019.

A detailed summary of the additional disclosures is provided in Appendix F.

Additional Disclosures

The table below provides an estimate of future market value of asset returns based on the study performed in 2016.

Horizon	95% Chance (19 out of every 20 scenarios)	75% Chance (3 out of every 4 scenarios)	50% Chance (1 out of every 2 scenarios)	25% Chance (1 out of every 4 scenarios)	5% Chance (1 out of every 20 scenarios)
10 Years (2025)	0.2%	4.0%	5.9%	8.0%	11.5%
20 Years (2035)	2.2%	4.8%	6.7%	8.5%	11.8%
30 Years (2045)	3.1%	5.3%	7.1%	8.7%	12.0%

These results are summarized in the "TSERS Asset-Liability and Investment Strategy Project" report dated April 19th, 2016 prepared by Conduent, the prior actuary.

The lower bound of 2.39% falls below the 5th percentile of estimated future 30-year returns. In other words, there is less than a 5% chance of seeing a 30-year return of 2.39% or lower based on the current portfolio structure.

A detailed summary of the additional disclosures is provided in Appendix F.

Projections

- Projections of contribution requirements and funded status into the future can be helpful planning tools for stakeholders. This section provides such projections. The projections of the actuarial valuation are known as deterministic projections. Deterministic projections are based on one scenario in the future. The baseline deterministic projection is based on December 31, 2019 valuation results as assumptions.

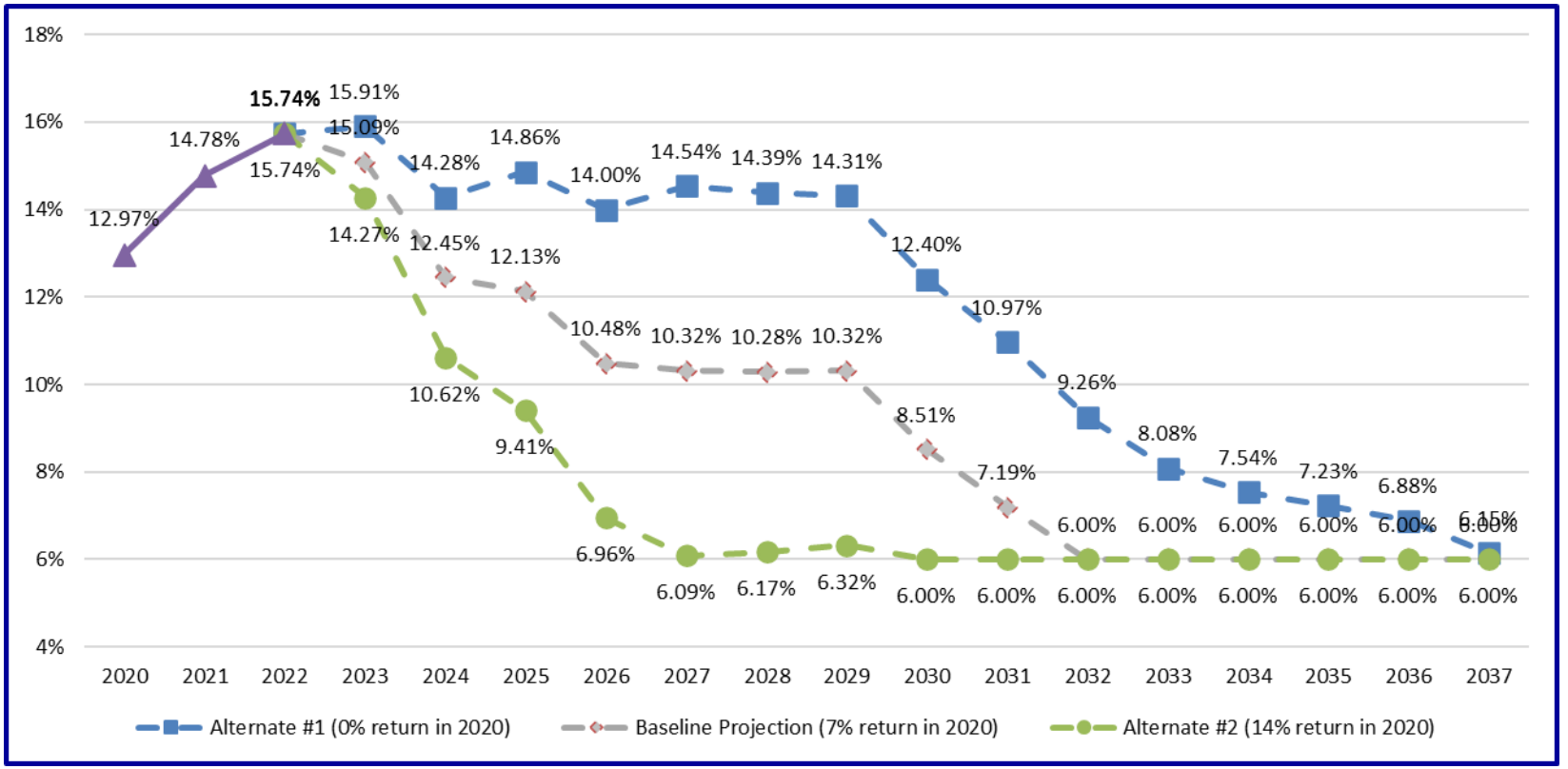
- Key Projection Assumptions
  - Valuation interest rate of 7.00% for all years in conjunction with direct rate smoothing of the employer contribution rate over a 3-year period beginning July 1, 2019.
  - 7.00% investment return on market value of assets
  - Actuarial assumptions and methods as described in Appendix D. All future demographic experience is assumed to be exactly realized.
  - The contribution rate under the Employer Contribution Rate Stabilization Policy (ECRSP) is contributed until fiscal year ending 2022.
  - The actuarially determined employer contribution rate is contributed for fiscal years ending 2023 and beyond.
  - 0% increase in the total active member population
  - No cost-of-living adjustments granted
  - Future pay increases based on long-term salary increase assumptions

- The ECRSP adopted by the Board of Trustees on January 21, 2016 requires that recommended contributions be 0.35% of payroll greater than the appropriated contribution during the prior year, with the following bounds: (1) contributions may not be less than the actuarially determined employer contribution (ADEC) rate and (2) contributions may not be greater than a contribution determined using the same assumptions used to calculate the ADEC but using a discount rate equal to the long-term Treasury bond yield.

- In addition, we have provided two alternate deterministic projections. The first alternate deterministic projection is based on the same assumptions as the baseline deterministic projection except that it assumes a 0.0% asset return for calendar year 2020. The second alternate deterministic projection is based on the same assumptions as the baseline deterministic projection except that it assumes a 14.0% asset return for calendar year 2020.

A detailed summary of the deterministic projections is provided in Section 9.

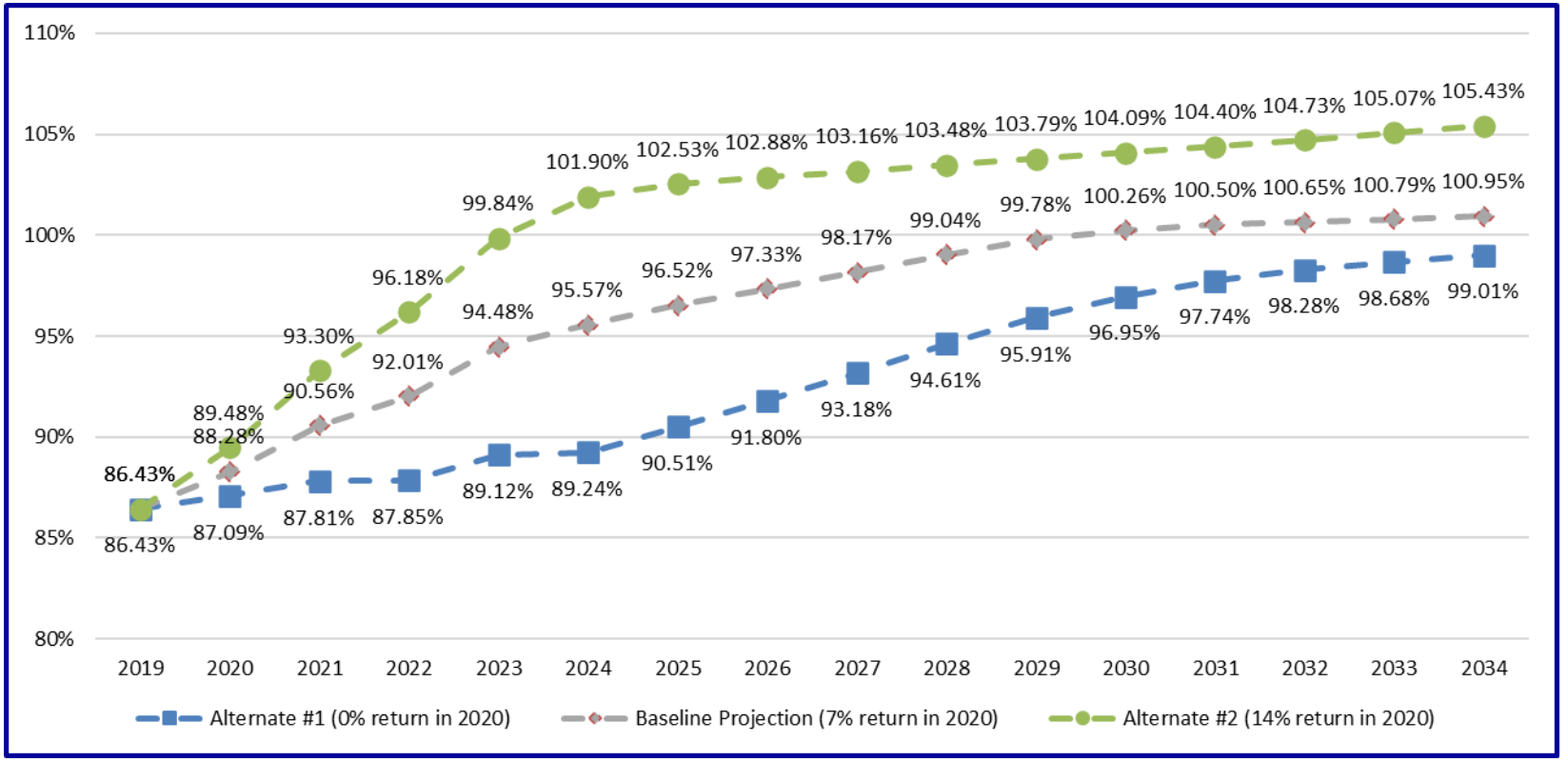
Projected Contribution Rates



But for the floor of 6.00% on the employer contribution, the actuarially determined employer contribution rate trends to around 5.3%, which is the level of the cost of benefits accruing each year, or the long-term employer cost of TSERS when there is no unfunded actuarial accrued liability. The amounts above the long-term employer cost of TSERS of 5.3% serve to increase the funded ratio above 100%.

A detailed summary of the deterministic projections is provided in Section 9.

Projected Funded Ratio



Note that under all scenarios, the funded ratio reaches at least 99% within 15 years. This is a direct result of using a 12-year period to pay off the unfunded actuarial accrued liability.

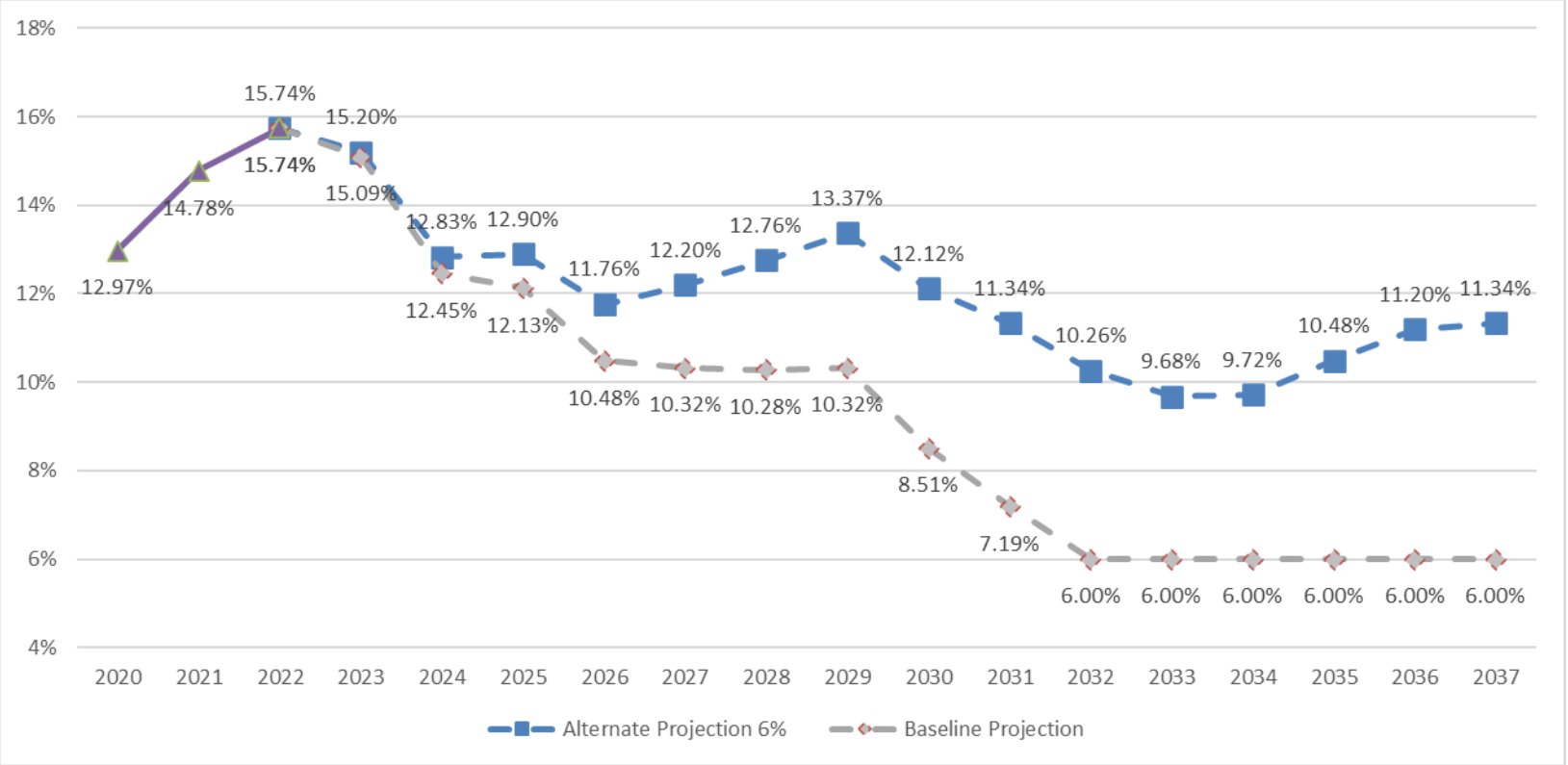
A detailed summary of the deterministic projections is provided in Section 9.

Projections

- The baseline projection uses the same basis described earlier in this presentation. The alternate deterministic projection is based on the same assumptions as the baseline deterministic projection except that it assumes a 6.0% investment return on market value of assets for all calendar years starting in 2020.

A detailed summary of the deterministic projections is provided in Section 9.

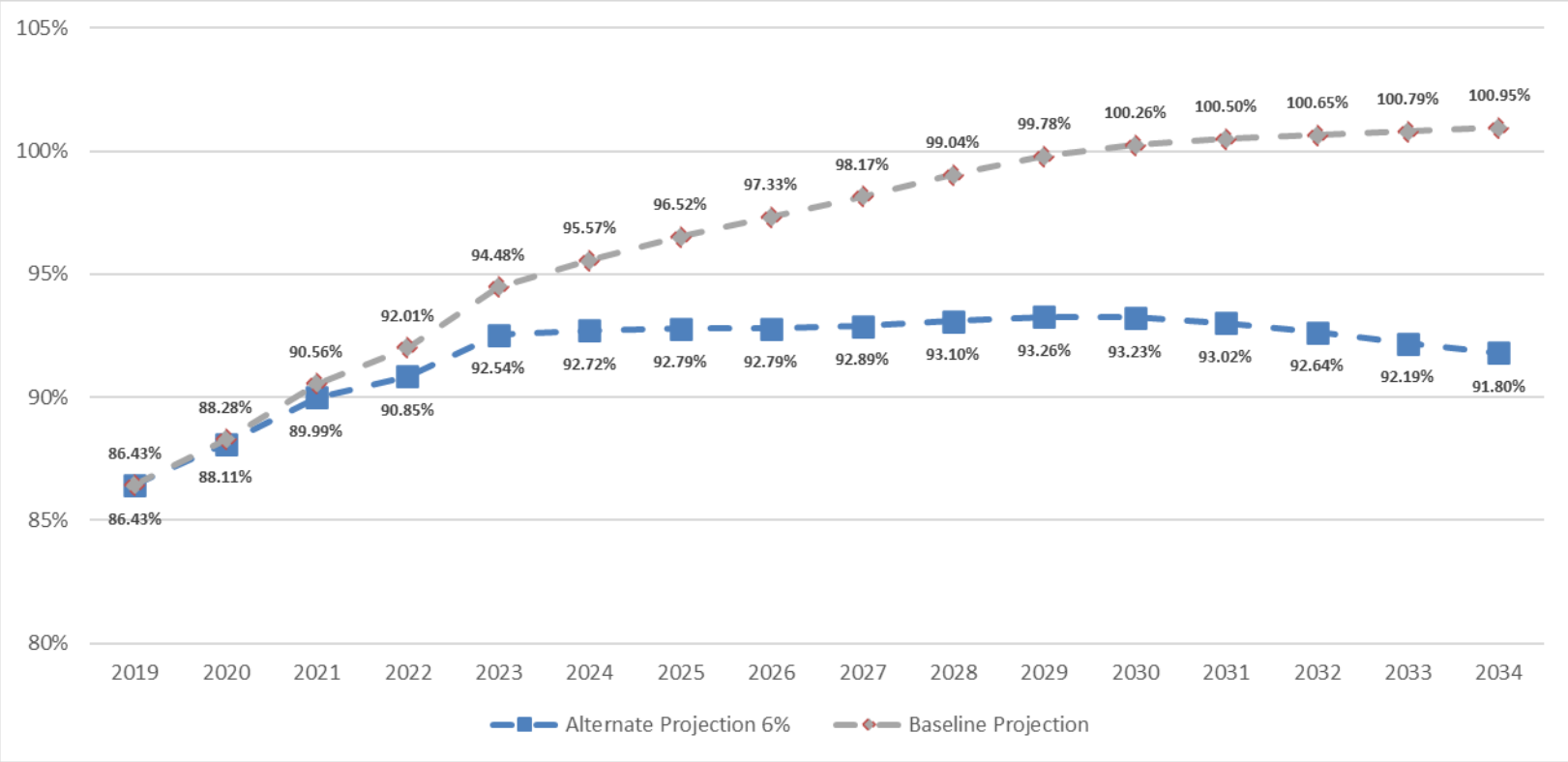
Projected Contribution Rates



Alternate Projection assumes 6.00% asset returns every year starting in 2020 compared to the 7.00% assumption in the Baseline Projection. As a result, the unfunded accrued liability will be higher resulting in higher projected contributions.

A detailed summary of the deterministic projections is provided in Section 9.

Projected Funded Ratio



Alternate Projection assumes 6.00% asset returns every year starting in 2020 compared to the 7.00% assumption in the Baseline Projection. As a result, the unfunded accrued liability will be higher resulting in a lower projected funded ratio.

A detailed summary of the deterministic projections is provided in Section 9.

Key Takeaways

- Key results of the December 31, 2019 valuation were:
  - Market value return of 14.85% compared to 7.00% assumed
  - Actuarial value return of 6.18% resulting in an increase of the UAAL by $0.57 billion and an increase in the employer contribution rate of 0.46% of pay.
  - Demographic losses mostly due to new entrants and salary increases more than expected increased the UAAL by $0.24 billion and the employer contribution rate by 0.17%.

Key Takeaways (continued)

- When compared to the December 31, 2018 baseline projections, the above resulted in:
  - A higher funded ratio as of December 31, 2019 (86.4% in the valuation compared to 85.3% in the baseline projection)
  - Lower actuarially determined employer contribution rate for fiscal year ending June 30, 2022 (15.74% in the valuation compared to 16.24% in the baseline projection)

Key Takeaways (continued)

- TSERS is well funded compared to its peers. This is due to:
  - Stakeholders working together to keep TSERS well-funded since inception
  - A history of appropriating and contributing the recommended contribution requirements
  - Assumptions that in aggregate are more conservative than peers
  - A funding policy that aggressively pays down unfunded liability over a 12-year period
  - An ad hoc cost-of-living adjustment, which typically only provides benefit increases when certain financial conditions are met, supports the health of the system
  - Modest changes in benefits when compared to peers
- As has been done over the past 75+ years, continued focus on these measures will be needed to maintain the sustainability of TSERS well into the future

Certification

Future actuarial measurements may differ significantly from current measurements due to plan experience differing from that anticipated by the economic and demographic assumptions, increases or decreases expected as part of the natural operation of the methodology used for these measurements, and changes in plan provisions or applicable law. Because of limited scope, Cavanaugh Macdonald performed no analysis of the potential range of such future differences, except for some limited analysis in financial projections or required disclosure information. Results prior to December 31, 2017 were provided by the prior consulting actuary.

We meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained in this report. This report has been prepared in accordance with all applicable Actuarial Standards of Practice, and we are available to answer questions about it.

Larry Langer, ASA, EA, FCA, MAAA
Principal and Consulting Actuary

Jonathan T. Craven, ASA, EA, FCA, MAAA
Consulting Actuary

Cavanaugh Macdonald
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The experience and dedication you deserve

Teachers' and State Employees' Retirement System of North Carolina

Report on the Seventy-Seventh Actuarial Valuation
Prepared as of December 31, 2019

October 2020

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Cavanaugh Macdonald
CONSULTING, LLC
The experience and dedication you deserve

October 8, 2020

Board of Trustees
Teachers' and State Employees'
Retirement System of North Carolina
3200 Atlantic Avenue
Raleigh, NC 27604

Members of the Board:

We submit herewith our report on the seventy-seventh annual valuation of the Teachers' and State Employees' Retirement System of North Carolina (referred to as "TSERS" or the "State Plan") prepared as of December 31, 2019. The report has been prepared in accordance with North Carolina General Statute 135-6(o). Information contained in our report for plan years prior to December 31, 2017 is based upon valuations performed by the prior actuary.

The primary purpose of the valuation report is to determine the required member and employer contribution rates, to describe the current financial condition of TSERS, and to analyze changes in such condition. In addition, the report provides information that the Office of the State Controller (OSC) requires for its Comprehensive Annual Financial Report (CAFR) and it summarizes census data. Use of this report for any other purposes or by anyone other than OSC and its auditors, or North Carolina Retirement System Division and Department of State Treasurer staff may not be appropriate and may result in mistaken conclusions because of failure to understand applicable assumptions, methods, or inapplicability of the report for that purpose. The attached pages should not be provided without a copy of this cover letter. Because of the risk of misinterpretation of actuarial results, you should ask Cavanaugh Macdonald Consulting (CMC) to review any statement you wish to make on the results contained in this report. CMC will not accept any liability for any such statement made without prior review.

The valuation is based upon membership data and financial information as furnished by the Retirement Systems Division and the Financial Operations Division and as summarized in this report. Although reviewed for reasonableness and consistency with the prior valuation, these elements have not been audited by CMC and we cannot certify as to the accuracy and completeness of the data supplied. Sometimes assumptions are made by CMC to interpret membership data that is imperfect. The valuation is also based on benefit and contribution provisions as presented in this report. If you have reason to believe that the plan provisions are incorrectly described, that important plan provisions relevant to this valuation are not described, or that conditions have changed since the calculations were made, you should contact the authors of this actuarial report prior to relying on this information.

The valuation is further based on the actuarial valuation assumptions, approved by the Board of Trustees, as presented in this report. We believe that these assumptions are appropriate and reasonable and also comply with the requirements of GASB Statement No. 67. We prepared this valuation in accordance with the requirements of this standard and in accordance with all applicable Actuarial Standards of Practice (ASOP).

The assumptions used for the December 31, 2019 actuarial valuation are based on the experience study prepared as of December 31, 2014 and adopted by the Board of Trustees on January 21, 2016, as further updated to use a discount rate of 7.00% in conjunction with direct rate smoothing of the employer contribution rate, as adopted by the Board of Trustees on April 26, 2018. The economic assumptions with respect to investment yield, salary increase and inflation have been based upon a review of the existing portfolio structure as well as recent and anticipated experience.

Where presented, references to "funded ratio" and "unfunded accrued liability" typically are measured on an actuarial value of assets basis. It should be noted that the same measurements using market value of assets would result in different funded ratios and unfunded accrued liabilities. Moreover, the funded ratio presented is appropriate for evaluating the need and level of future contributions but makes no assessment regarding the funded status of the plan if the plan were to settle (i.e. purchase annuities) for a portion or all of its liabilities. In various places in the report the results also show funded ratios and unfunded liabilities based upon varying sets of assumptions as well as market values of assets as that is required for certain disclosure information required per accounting rules or statutes. Where this has been done it has been clearly indicated.

Future actuarial results may differ significantly from the current results presented in this report due to such factors as the following: fund experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; and changes in plan provisions or applicable law. Such changes in law may include additional costs resulting from future legislated benefit improvements or cost-of-living pension increases or supplements, which are not anticipated in the actuarial valuation. Because of limited scope, CMC performed no analysis of the potential range of such future differences, except for some limited analysis in financial projections or required disclosure information.

We meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained in this report. This report has been prepared in accordance with all applicable Actuarial Standards of Practice, and we are available to answer questions about it.

Respectfully submitted,

Larry Langer, ASA, EA, FCA, MAAA
Principal and Consulting Actuary

Jonathan T. Craven, ASA, EA, FCA, MAAA
Consulting Actuary

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Executive Summary

Overview

The North Carolina Retirement Systems Division (RSD) was established in 1941 to provide retirement benefits for public servants in the State of North Carolina. Today, under the management of the Department of State Treasurer, RSD administers seven public pension plans (defined benefit plans), three supplemental retirement plans (voluntary defined contributions plans), a health trust fund, a disability income plan, death benefit funds and a number of other benefit programs. As of December 31, 2019, the RSD defined benefit plans cover over one million current and prior public servants of the state of North Carolina. During the fiscal year ending June 30, 2020, RSD paid over $6.5 billion in pensions to more than 320,000 retirees. And as of June 30, 2020, RSD's defined benefit plan assets were valued at over $103 billion.

Under the supplemental retirement plans, the amount of contributions in any given year is defined by law. The amount of benefits derived is dependent on the investment returns the individual achieves. Conversely, under the pension plans, the amount of the benefit paid to a member upon retirement, termination, death or disability is defined by law. The amount of contributions needed to fund these benefits cannot be known with certainty. In North Carolina, like other states, these contributions are paid during a public servant's career so that upon retirement, termination, death, or disability, there are funds available to pay these benefits. These amounts are determined through an actuarial valuation. Actuarial valuations are performed for each of the pension plans administered by RSD and the results are contained in actuarial valuation reports like this.

In 1941, the Teachers' and State Employees' Retirement System (referred to as "TSERS" or the "State Plan") was established. TSERS provides benefits to all full-time teachers and state employees in all public school systems, universities, departments, institutions and agencies of the state. With over $75 billion in assets and over 710,000 members as of December 31, 2019, it is the largest pension plan within the NC Retirement Systems. This actuarial valuation report is our annual analysis of the financial health of TSERS. This report, prepared as of December 31, 2019, presents the results of the seventy-seventh annual valuation of TSERS.

Purpose

An actuarial valuation is performed on TSERS annually as of the end of the calendar year. The actuary determines the amount of contributions to be made to TSERS during each member's career that, when combined with investment return, will be sufficient to pay for retirement benefits.

In addition, the annual actuarial valuation is performed to:

- Determine the progress of funding TSERS,
- Explore why the results of the current valuation differ from the results of the valuation of the previous year, and
- Satisfy regulatory and accounting requirements.

A detailed summary of the valuation process and a glossary of actuarial terms are provided in Appendix A.

Executive Summary

Risk

Measuring pension obligations and actuarially determined contributions requires the use of assumptions regarding future economic and demographic experience. Whenever assumptions are made about future events, there is risk that actual experience will differ from expected. Actuarial valuations include the risk that actual future measurements will deviate from expected future measurements due to actual experience that is different than the actuarial assumptions.

The primary areas of risk in this actuarial valuation are:

- Investment Risk – the potential that investment returns will be different than expected. Section 9 of this report demonstrates the sensitivity of future projected results to asset returns deviating from expected returns.
- Longevity and Other Demographic Risks – the potential that mortality or other demographic experience will be different than expected.
- Interest Rate Risk – To the extent market rates of interest affect the expected return on assets, there is a risk of change to the discount rate which determines the present value of liabilities and actuarial valuation results. Table F-1 of this report demonstrates the sensitivity of valuation results to differing discount rates.
- Contribution Risk – The potential that actual contributions are different than the actuarially determined contributions.

Annual actuarial valuations are performed for RSD which re-measure the assets and liabilities and compute a new actuarially determined contribution. RSD also has experience studies performed every five years to analyze the discrepancies between actuarial assumptions and actual experience and determine if the actuarial assumptions need to be changed. Annual actuarial valuations and periodic experience studies are practical ways to monitor and reassess risk.

Executive Summary

Key Takeaways

The actuarial valuation is performed each year to replace the estimates the actuary assumed for the prior valuation with the actual events that happened. This past year, as expected, some of the assumptions used in the prior valuation were not realized. Key results of the December 31, 2019 valuation as compared to the December 31, 2018 valuation were:

- Market value returns of 14.85% during calendar year 2019 compared to 7.00% assumed

When compared to the December 31, 2018 projections, the above resulted in:

- A higher funded ratio as of December 31, 2019 (86.4% in the valuation compared to 85.3% in the baseline projection)
- Lower actuarially determined employer contribution rates for fiscal year ending June 30, 2022 (15.74% in the valuation compared to 16.24% in the baseline projection)

TSERS is well funded compared to its peers. This is due to:

- Stakeholders working together to keep TSERS well-funded since inception
- A history of appropriating and contributing a minimum of the recommended contribution requirements
- Implementation of the ECRSP which provides additional funding of the System
- Assumptions that in aggregate are more conservative than peers
- A funding policy that aggressively pays down the unfunded liability over a 12-year period
- An ad hoc cost-of-living adjustment, which typically only provides benefit increases when certain financial conditions are met, that supports the health of the system
- Modest changes in benefits when compared to peers

As has been done over the past 79 years, continued focus on these measures will be needed to maintain the solid status of TSERS well into the future.

More details can be found later in this report. We encourage readers to start with Sections 1 and 2 and refer to other sections for additional details as needed.

This report, prepared as of December 31, 2019, presents the results of the annual valuation of the system. The principal results of the valuation and a comparison with the preceding year's results are summarized in the following table.

Section 1: Principal Results

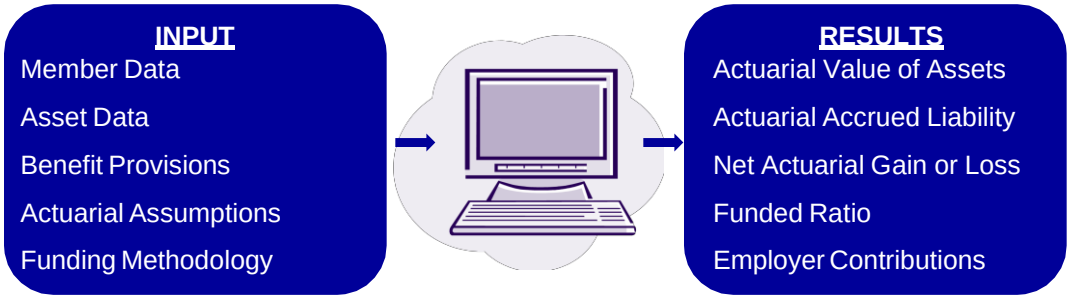
Table 1: Summary of Principal Results

Valuation Results as of	12/31/2019	12/31/2018
Active Members		
Number	305,962	304,575
Reported Compensation	$ 14,886,467,797	$ 14,436,435,848
Valuation Compensation *	$ 16,112,232,177	$ 15,623,198,876
Retired Members and Survivors of Deceased Members Currently Receiving Benefits		
Number	228,291	222,084
Annual Allowances	$ 4,804,178,473	$ 4,668,925,869
Assets		
Actuarial Value (AVA)	$ 73,353,759,963	$ 70,959,093,440
Market Value (MVA)	$ 75,486,780,473	$ 67,536,480,309
Actuarial Accrued Liability (AAL)	$ 84,873,315,272	$ 82,105,943,131
Unfunded Accrued Liability (AAL – AVA)	$ 11,519,555,309	$ 11,146,849,691
Funded Ratio (AVA / AAL) **	86.4%	86.4%
Results for Fiscal Year Ending	**6/30/2022**	**6/30/2021**
Actuarially Determined Employer Contribution (ADEC), as a percentage of payroll		
Normal Cost	5.16%	5.18%
Accrued Liability	10.58%	10.19%
Total Preliminary ADEC	15.74%	15.37%
Total Based on Direct Rate Smoothing	15.74%	14.78%
Impact of Legislative Changes	N/A	0.00%
Final ADEC	15.74%	14.78%
Board of Trustees Recommended Contribution Under the Employer Contribution Rate Stabilization Policy (ECRSP)	15.74%	14.78%
Required Employer Contribution NCGS 135-8(d)	15.74%	14.78%
Appropriation Act for Fiscal Year Ending	**6/30/2021**	**6/30/2020**
Employer Contribution Rate as a percentage of payroll		
Normal Cost	5.16%	5.18%
Accrued Liability	9.62%	7.79%
Total	14.78%	12.97%

* Reported compensation annualized for new hires and projected for valuation purposes.
**The Funded Ratio on a Market Value of Assets basis is 88.9% at December 31, 2019.

Section 2: The Valuation Process

The following diagram summarizes the inputs and results of the actuarial valuation process.



A more detailed description of the valuation process is provided in Appendix A.

Valuation Input: Membership Data

As with any estimate, the actuary collects information that we know now. Under the actuarial valuation process, current information about TSERS members is collected annually by the Retirement Systems Division staff at the direction of the actuary. Membership data will assist the actuary in estimating benefits that could be paid in the future. Information about benefit provisions and assets held in the trust as of the valuation date is also collected.

The member information the actuary collects includes data elements such as current service, salary and benefit group identifier for members that have not separated service, and actual benefit amounts and form of payment for members that have separated service. Data elements such as gender and date of birth are used to determine when a benefit might be paid and for how long.

Section 2: The Valuation Process

Valuation Input: Membership Data (continued)

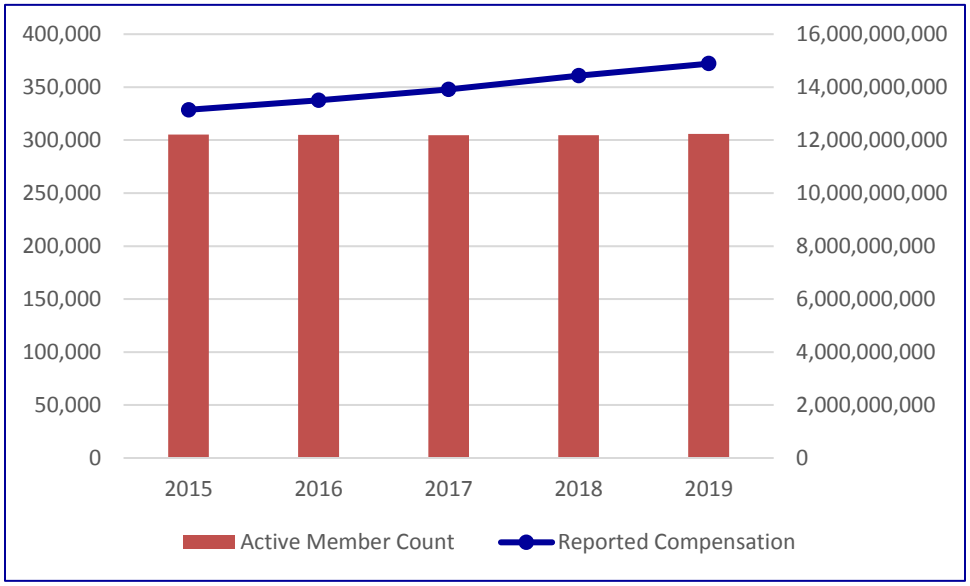
The table below provides a summary of the membership data used in this valuation compared to the prior valuation.

Number as of	12/31/2019	12/31/2018
Active Members	305,962	304,575
Members currently receiving Disability Income Plan benefits	5,774	6,190
Terminated members and survivors of deceased members Entitled to benefits but not yet receiving benefits	177,573	168,755
Retired members and survivors of deceased members currently receiving benefits	228,291	222,084
Total	717,600	701,604

Commentary: The number of active members increased 0.5% from the previous valuation date. The number of retired members and survivors of deceased members currently receiving benefits increased by 2.8% from the previous valuation date. The increase in retiree population is consistent with expectations.

Graph 1: Active Members

The graph below provides a history of the number of active members and reported compensation over the past five years.



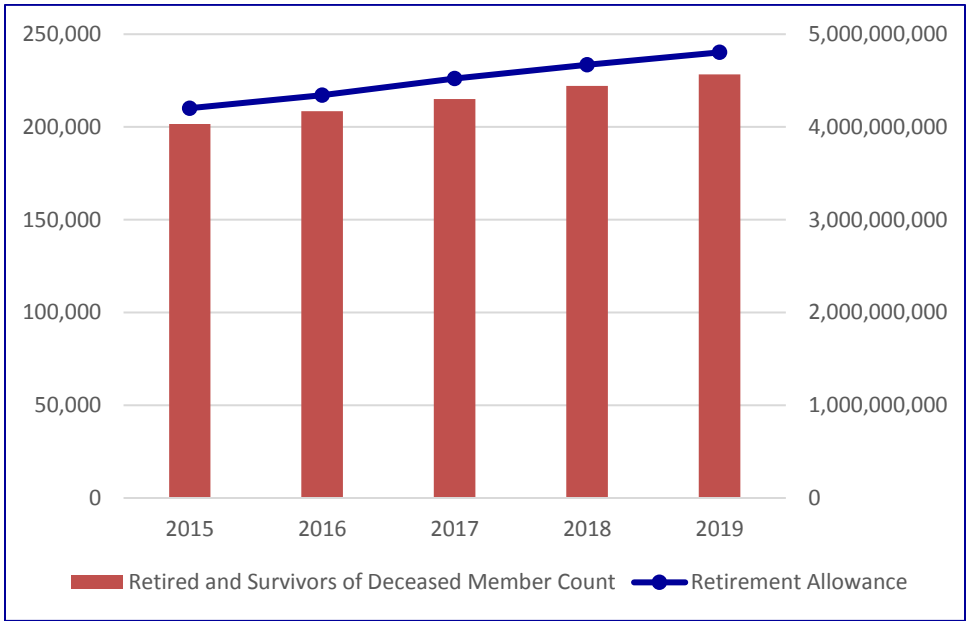
Commentary: Reported compensation has increased by 3.1% and the increase has averaged 3.2% over the past four years. Covered payroll is expected to increase by 3.5% annually in the future. Payroll that is not increasing as fast as we assume results in less benefits accruing than we anticipate, but also fewer contributions supporting the system.

Section 2: The Valuation Process

Valuation Input: Membership Data (continued)

Graph 2: Retired Members and Survivors of Deceased Members

The graph below provides a history of the number of retired members and survivors of deceased members and benefit amounts payable over the past five years.



Commentary: The number of retired members and survivors of deceased members and the benefits paid to these members has been increasing steadily, as expected based on plan assumptions.

A detailed summary of the membership data used in this valuation is provided in Section 3 and Appendix B of this report.

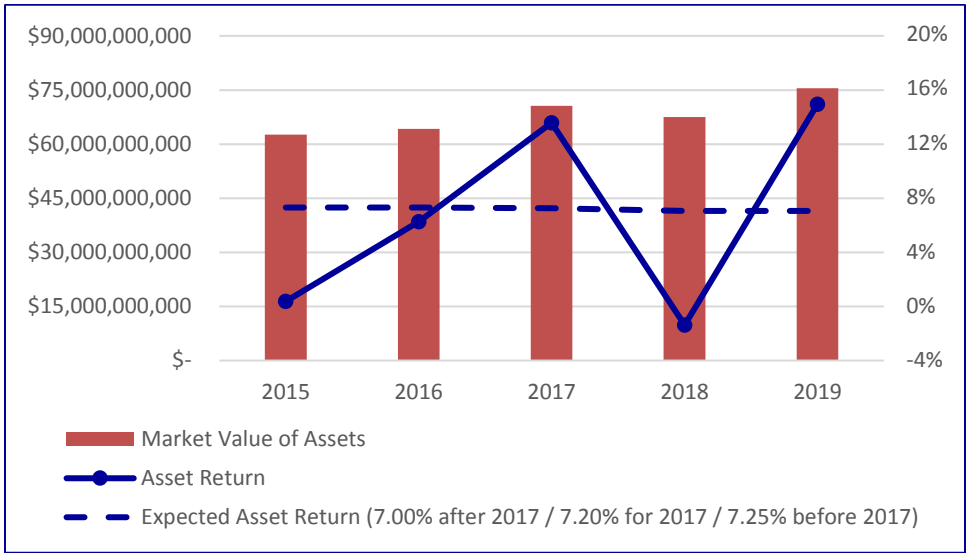
Section 2: The Valuation Process

Valuation Input: Asset Data

TSERS assets are held in trust and are invested for the exclusive benefit of plan members. The Market Value of Assets is $75.5 billion as of December 31, 2019 and was $67.5 billion as of December 31, 2018. The investment return for the market value of assets for calendar year 2019 was 14.85%.

Graph 3: Market Value of Assets and Asset Returns

The graph below provides a history of the market value of assets and asset returns over the past five years.

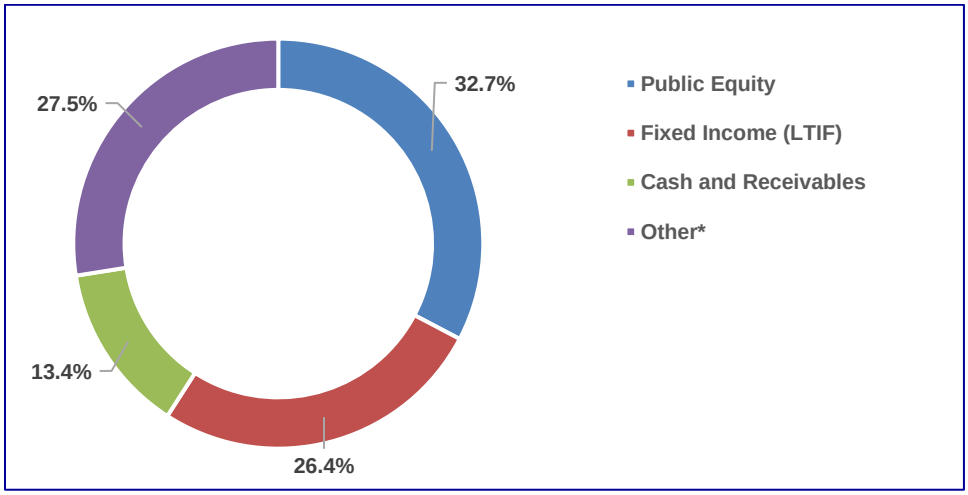


Commentary: Market value returns during 2019 were much greater than the 7.0% assumed rate of return, resulting in lower required contributions and a higher funded ratio than anticipated in the December 31, 2018 baseline projections presented in the December 31, 2018 actuarial report.

Valuation Input: Asset Data (continued)

Graph 4: Allocation of Investments by Category

The graph below provides the breakdown of the market value of assets at December 31, 2019 by asset category.



* Real Estate, Alternatives, Inflation and Credit

Commentary: Based on historical market returns, the current asset allocation, the current investment policy, and the expectation of future asset returns, as reviewed in the last experience study, the 7.00% discount rate used in this valuation is reasonable and appropriate.

A detailed summary of the market value of assets is provided in Section 4 of this report.

Section 2: The Valuation Process

Valuation Input: Benefit Provisions

Benefit provisions are described in North Carolina General Statutes, Chapter 135.

Highlights of the benefit provisions are described below.

- An unreduced retirement allowance is payable to non-law enforcement members who retire from service:
  - after attaining age 65 and five years of creditable service;
  - after attaining age 60 and 25 years of creditable service; or
  - after attaining 30 years of creditable service
- An unreduced retirement allowance is payable to law enforcement members who retire from service:
  - after attaining age 55 and five years of creditable service; or
  - after attaining 30 years of creditable service
- The unreduced retirement allowance is equal to 1.82% of a member's average final compensation multiplied by the number of years of creditable service. Average final compensation is based on the four highest consecutive years of compensation.
- A reduced retirement allowance is payable to non-law enforcement members who retire from service:
  - after attaining age 60 and five years of creditable service; or
  - after attaining age 50 and 20 years of creditable service
- A reduced retirement allowance is payable to law enforcement members who retire from service after attaining age 50 and 15 years of creditable service or after attaining 25 years of creditable service (15 as an officer).
- Ancillary benefits are also payable upon the death or disability of a member.
- TSERS does not provide for automatic cost of living increases as part of the benefit package. Instead, increases may be provided if certain financial conditions are met. More details on cost-of-living increases are provided in Graph 5.

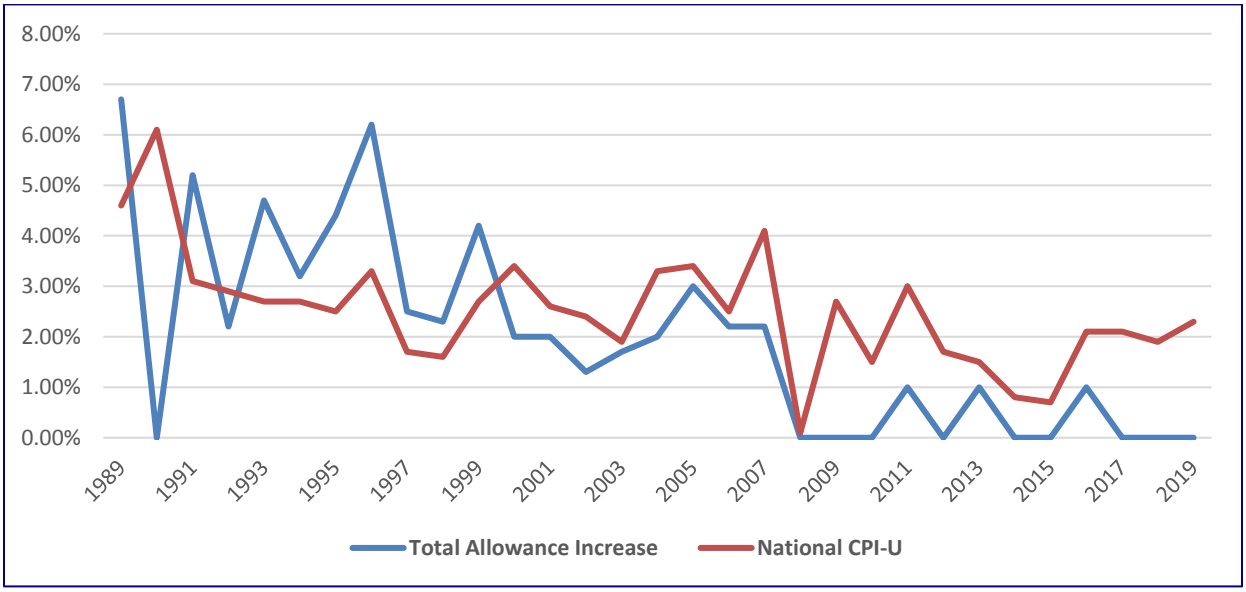
Commentary: Many Public Sector Retirement Systems in the United States have undergone pension reform where the benefits of members (active or future members) have been reduced. Because of the well-funded status of TSERS, benefit cuts have not been made in North Carolina as they have been in most other states. Instead, we have seen a modest expansion of benefits in recent years based on sound plan design. However, if North Carolina's investment policy shifts substantively or if the system incurs other unfavorable investment, economic, or demographic experience, the system should review likely impacts of the shift and consider corresponding changes to actuarial assumptions, funding policy and/or benefit levels.

Valuation Input: Benefit Provisions (continued)

As noted previously, cost-of-living increases are periodically considered by the Board of Trustees to the extent that certain financial conditions are met. Specifically, benefit allowance increases are generally considered when the trust experiences sufficient investment gains to cover the additional actuarial accrued liabilities created by providing the cost-of-living adjustment (generally, limited to the lesser of the CPI increase year-over-year or 4%). In addition to employers consistently contributing the actuary's recommended contribution, this benefit increase policy has helped keep costs manageable when compared to other Public Sector Retirement Systems in the United States. That being said, post-retirement increases help to reduce the risk that the benefit will be eroded by inflation.

Graph 5: Cost-of-Living Increase and CPI-U History

The graph below provides a 30-year history of the allowance increases for TSERS and the national CPI-U.



* Allowance increases are effective at July 1 the following year

Commentary: Prior to 2000, asset returns generally exceeded expectations and allowance increases exceeded the cost of living. Subsequently, asset returns on average have been lower than expected leading to lower allowance increases. Graph shows only permanent increases to the retirement allowance and not one-time supplements that have been granted.

A detailed summary of the benefit provisions is provided in Appendix C of this report.

Valuation Input: Actuarial Assumptions

Actuarial assumptions bridge the gap between the information that we know with certainty as of the valuation date (age, gender, service, pay, and benefits of the members) and what may happen in the future. The actuarial assumptions of TSERS are reviewed at least every five years. Based on this review, the actuary will make recommendations on the demographic and economic assumptions.

Demographic assumptions describe future events that relate to people such as retirement rates, termination rates, disability rates, and mortality rates. Economic assumptions describe future events such as the interest rate, salary increases, the real return, and payroll growth.

Section 2: The Valuation Process

Valuation Input: Actuarial Assumptions (continued)

The assumptions used for the December 31, 2019 actuarial valuation, with the exception of the discount rate, are based on the experience study prepared as of December 31, 2014 and adopted by the Board of Trustees on January 21, 2016. The discount rate was updated to be 7.00%, as adopted by the Board of Trustees on April 26, 2018.

Valuation Input: Funding Methodology

The Funding Methodology is the payment plan for TSERS and is composed of the following three components:

- Actuarial Cost Methods allocate costs to the actuarial accrued liability (i.e. the amount of money that should be in the fund) for past service and normal cost (i.e. the cost of benefits accruing during the year) for current service.
  - The Board of Trustees has adopted Entry Age Normal as its actuarial cost method
  - Develops normal costs that stay level as a percent of payroll
- Asset Valuation Methods smooth or average the market value returns over time to alleviate contribution volatility that results from market returns. The Board of Trustees has adopted the following:
  - Asset returns in excess of or less than the expected return on market value of assets reflected over a five-year period
  - Asset corridor: not greater than 120% of market value and not less than 80% of market value
- Amortization Methods determine the payment schedule for unfunded actuarial accrued liability (i.e. the difference between the actuarial accrued liability and actuarial value of assets). The Board of Trustees has adopted the following:
  - Payment level: the payment is determined as a level dollar amount, similar to a mortgage payment
  - Payment period: a 12-year closed amortization period was adopted for fiscal year ending 2012. A new amortization base is created each year based on the prior year experience

Commentary: When compared to other Public Sector Retirement Systems in the United States, the funding policy for TSERS is quite aggressive in that the policy pays down the unfunded accrued liability over a much shorter period of time (12 years) compared to the longer funding periods of most Public Sector Systems. As such it is a best practice in the industry.

A detailed summary of the actuarial assumptions and methods is provided in Appendix D of this report.

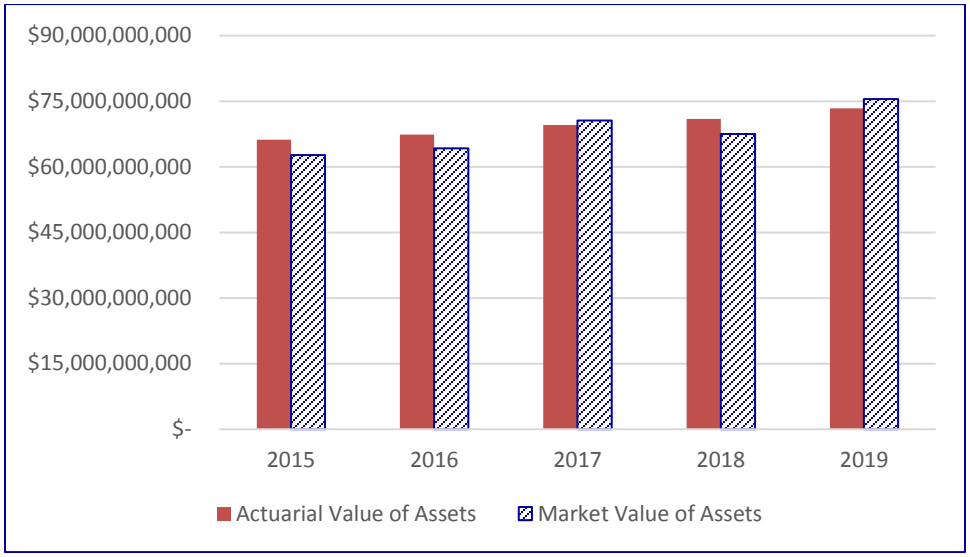
Section 2: The Valuation Process

Valuation Results: Actuarial Value of Assets

In order to reduce the volatility that investment gains and losses can have on required contributions and funded status of TSERS, the Board adopted an asset valuation method to determine the Actuarial Value of Assets used for funding purposes. The Actuarial Value of Assets is $73.4 billion as of December 31, 2019 and $71.0 billion as of December 31, 2018.

Graph 6: Actuarial Value and Market Value of Assets

The graph below provides a history of the market value and actuarial value of assets over the past five years.

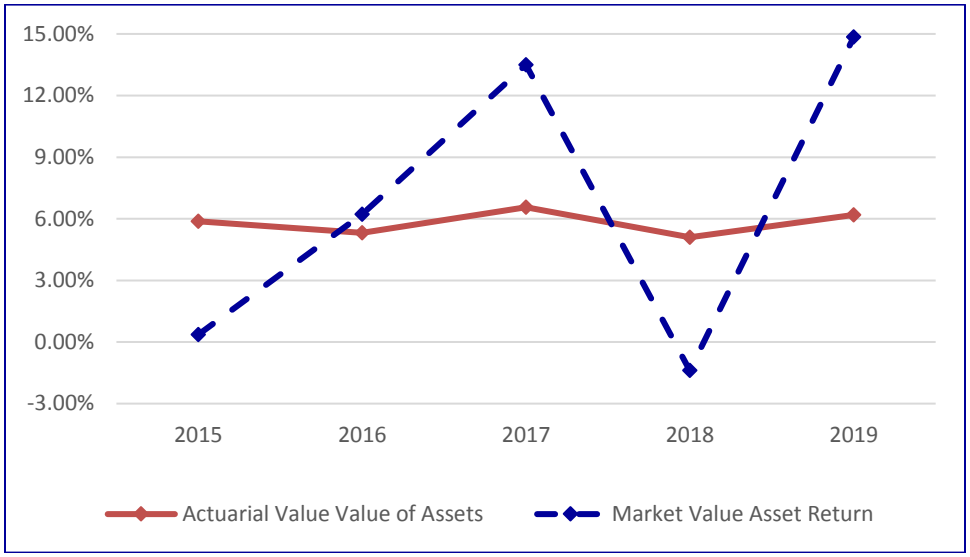


Commentary: The market value of assets is higher than the actuarial value of assets, which is used to determine employer contributions. This indicates that overall there are unrecognized asset gains to be recognized in future valuations.

Valuation Results: Actuarial Value of Assets (continued)

Graph 7: Asset Returns

The graph below provides a history of the market value and actuarial value of asset returns over the past five years.



Commentary: The investment return for the market value of assets for calendar year 2019 was 14.85%. The actuarial value of assets smooths investment gains and losses. Lower than expected market returns, in 2015, 2016, and 2018, resulted in an actuarial value of asset return for calendar year 2019 of 6.18% and a recognized actuarial asset loss of $0.6 billion during 2019.

A detailed summary of the Actuarial Value of Assets is provided in Section 4 of this report.

Section 2: The Valuation Process

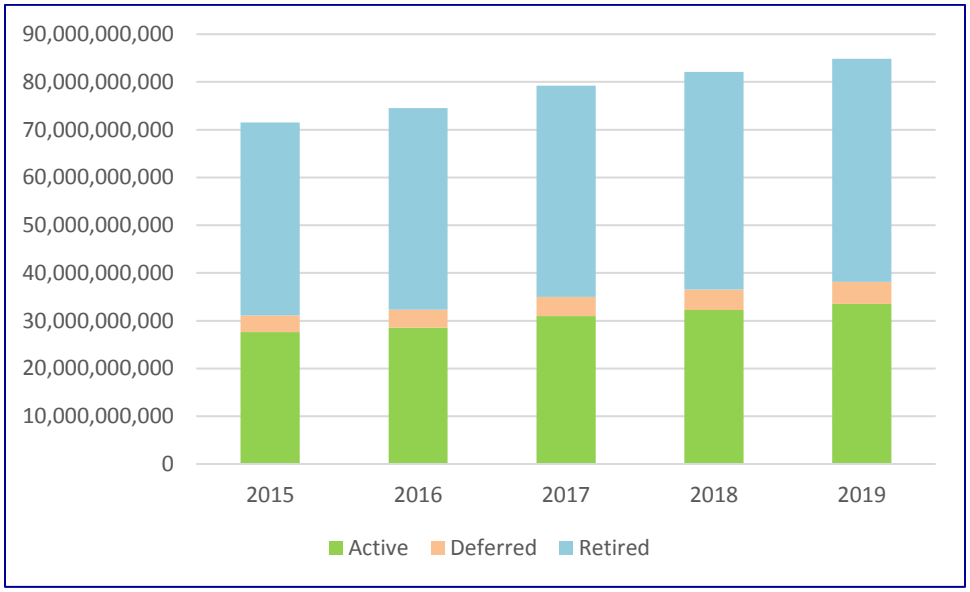
Valuation Results: Actuarial Accrued Liability

Using the provided membership data, benefit provisions, and actuarial assumptions, the future benefit payments of TSERS are estimated. These projected future benefit payments are discounted into today's dollars using the assumed rate of investment return assumption to determine the Present Value of Future Benefits (PVFB) of TSERS. The PVFB is an estimate of the current value of the benefits promised to all members as of a valuation date.

Once the PVFB is developed, an actuarial cost method is used to allocate the PVFB. Under the actuarial cost method, the PVFB is allocated to past, current and future service, respectively known as the actuarial accrued liability (AAL), normal cost (NC) and present value of future normal costs (PVFNC). The AAL is also referred to as the amount of money TSERS should ideally have in the trust. The NC is also referred to as the cost of benefits accruing during the year.

Graph 8: Actuarial Accrued Liability

The graph below provides a history of the actuarial accrued liability over the past five years.



Commentary: The AAL increased from $82.1 billion to $84.9 billion during 2019. The Retirement System is an open plan, which means that new members enter the plan each year. In an open plan, liabilities are expected to grow from one year to the next as more benefits accrue and the membership approaches retirement. The AAL was $236 million higher than expected, resulting from demographic losses.

A detailed summary of the AAL is provided in Section 5 of this report.

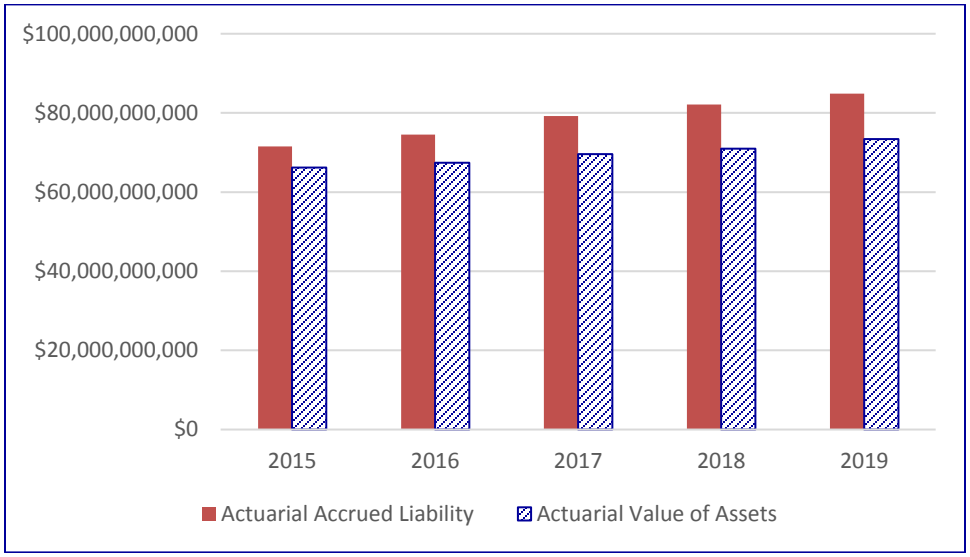
Section 2: The Valuation Process

Valuation Results: Funded Ratio

The funded ratio is a measure of the progress that has been made in funding the plan as of the valuation date. It is the ratio of how much money TSERS actually has in the fund to the amount TSERS should have in the fund.

Graph 9: Actuarial Accrued Liability and Actuarial Value of Assets

The graph below provides a history of the actuarial accrued liability compared to the actuarial value of assets over the past five years.

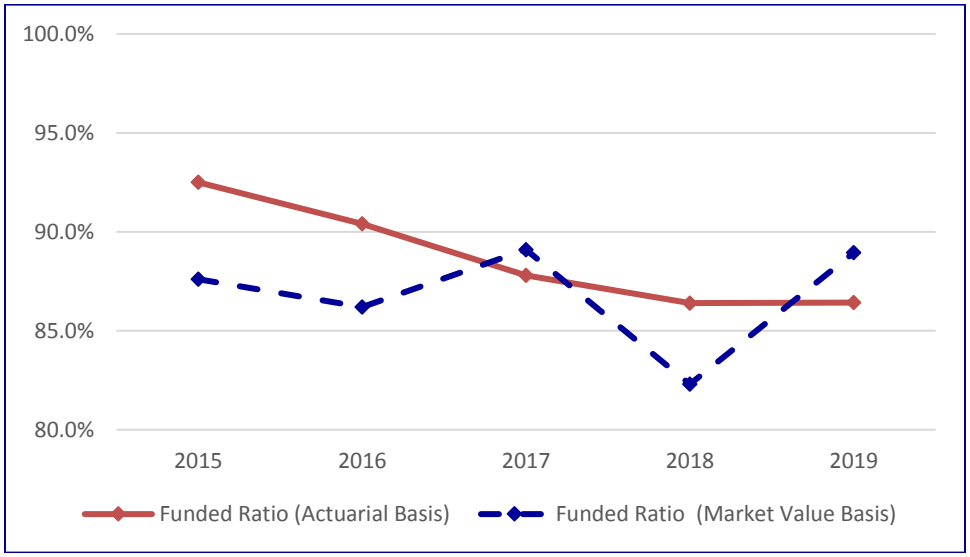


Commentary: The actuarial value of assets basis is used for computing contributions to alleviate contribution volatility. The difference in the actuarial accrued liability and the actuarial value of assets is the amount of unfunded actuarial accrued liability to be paid off over a 12 year period.

Valuation Results: Funded Ratio (continued)

Graph 10: Funded Ratios

The graph below provides a history of the funded ratio on a market and actuarial basis over the past five years.



Commentary: The ratio of assets to liabilities shows the health of the plan on an accrued basis. The funded ratio on an actuarial basis remained level from December 31, 2018 to December 31, 2019 at 86.4%.

Section 2: The Valuation Process

Valuation Results: Employer Contributions

The North Carolina General Statutes provide that the contributions of employers shall consist of a normal contribution and an accrued liability contribution. G.S. 135-8(g) allows for the Board of Trustees of TSERS to make changes to accounting methods and procedures that, in its opinion, are in the interest of sound and proper administration of TSERS.

The December 31, 2018 valuation suggested that the preliminary total employer contribution rate be set at 14.78% of payroll for the fiscal year ending June 30, 2021. As a result of this December 31, 2019 valuation, the preliminary actuarially determined employer contribution rate is 15.74% of payroll for the fiscal year ending June 30, 2022, subject to the impact of any future legislative changes effective during that fiscal year.

Graph 11: Actuarially Determined Employer Contribution Rates Before Applying Funding Policy Minimums

The graph below provides a history of actuarially determined employer contribution rates over the past five years.

* Subject to the impact of future legislative changes effective before or during that fiscal year

Commentary: The actuarially determined employer contribution rate is the amount needed to pay for the cost of the benefits accruing and to pay off the unfunded actuarial accrued liability over a 12-year period, offset for the 6% of pay contribution the members make. The 12-year period is a relatively short period for Public Sector Retirement Systems in the United States, with the funding period for most of these Systems much longer. The shorter period results in higher contributions and more benefit security.

A detailed summary of the actuarially determined employer contribution rates is provided in Section 6 of this report.

Section 2: The Valuation Process

Valuation Results: Projections

Projections of contribution requirements and funded status into the future can be helpful planning tools for stakeholders. This section provides such projections. The projections of the actuarial valuation are known as deterministic projections. Deterministic projections are based on one scenario in the future. The baseline deterministic projection is based on December 31, 2019 valuation results and assumptions.

Key Projection Assumptions:

- Valuation interest rate of 7.00% for all years, with direct rate smoothing of the employer contribution rates over a three-year period beginning July 1, 2019.
- 7.00% investment return on market value of assets
- Actuarial assumptions and methods as described in Appendix D. All future demographic experience is assumed to be exactly realized.
- The contribution rate under the Employer Contribution Rate Stabilization Policy (ECRSP) is contributed until fiscal year ending 2022.
- The actuarially determined contribution rate is contributed for fiscal years ending 2023 and beyond.
- 0% increase in the total active member population
- No cost-of-living adjustments granted
- Future pay increases based on long-term valuation assumptions

The ECRSP adopted by the Board of Trustees on January 21, 2016 requires that recommended contributions be 0.35% of payroll greater than the appropriated contribution during the prior year, with the following bounds: (1) contributions may not be less than the actuarially determined employer contribution (ADEC) rate and (2) contributions may not be greater than a contribution determined using the same assumptions used to calculate the ADEC but using a discount rate equal to the long-term Treasury bond yield.

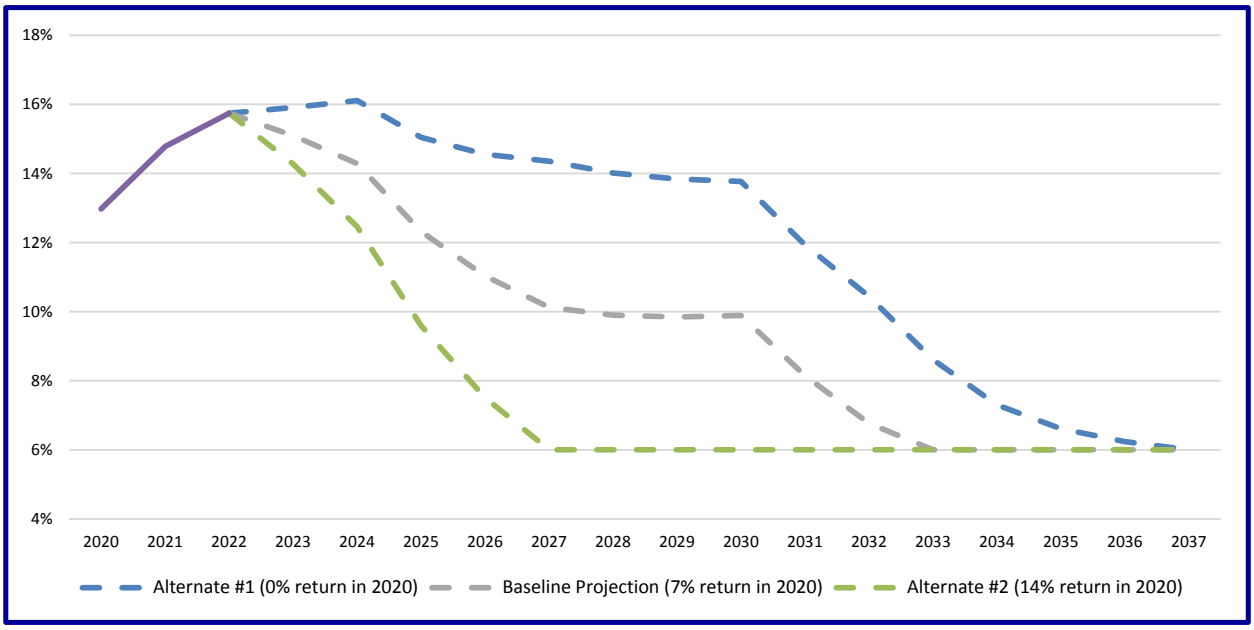
In addition, we have provided two alternate deterministic projections. The first alternate deterministic projection is based on the same assumptions as the baseline deterministic projection except that it assumes a 0.0% asset return for calendar year 2020. The second alternate deterministic projection is based on the same assumptions as the baseline deterministic projection except that it assumes a 14.0% asset return for calendar year 2020.

Finally, stochastic projections, where hundreds of projections based on varying rates of return are performed and results are ordered, are periodically performed by the Investment Management Division and shared with the Board of Trustees and RSD staff.

Valuation Results: Projections (continued)

Graph 12: Projected Actuarially Determined Employer Contribution Rates

The graph below provides the actuarially determined employer contributions rates projected for 15 years.

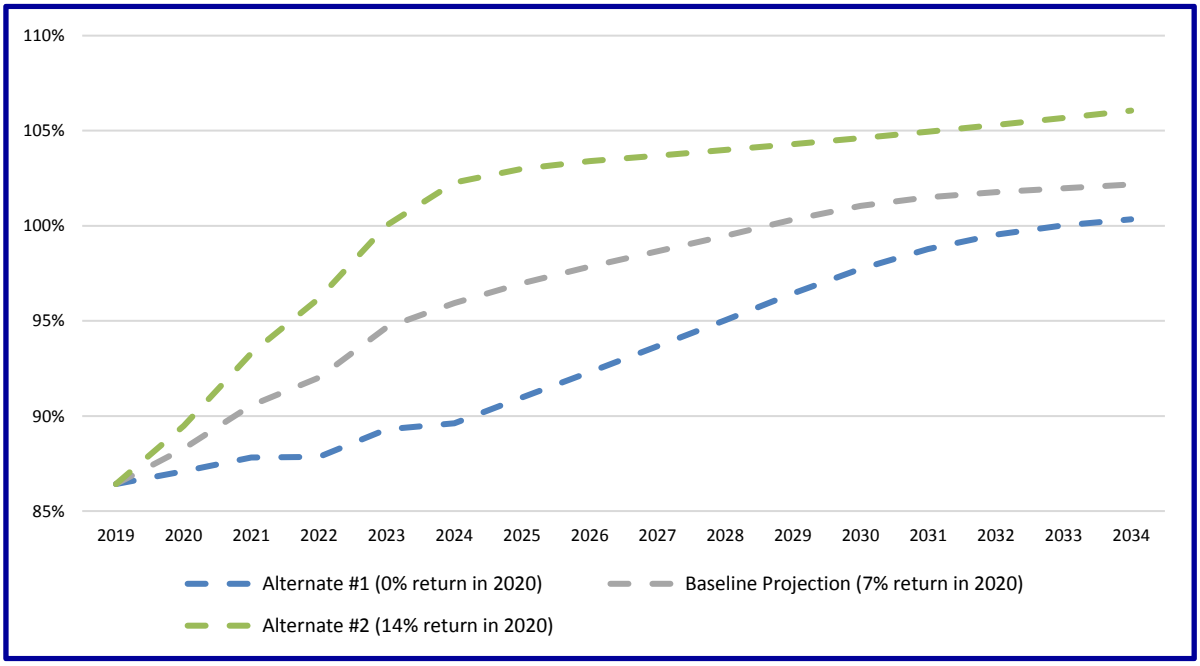


Commentary: The minimum employer contribution rate is equal to the employee contribution rate of 6.00%.

Valuation Results: Projections (continued)

Graph 13: Projected Funded Ratio

The graph below provides the funded ratio projected for 15 years.



Commentary: Note that if the 7.00% return under the Baseline Projection is achieved, the funded ratio reaches the long term target of 100% within 15 years. This is a direct result of using a 12-year period to pay off the unfunded actuarial accrued liability.

A detailed summary of the deterministic projections is provided in Section 9 of this report.

Valuation Results: Accounting Information

The Governmental Accounting Standards Board (GASB) issues statements which establish financial reporting standards for defined benefit pension plans and accounting for pension expenditures and expenses for governmental employers.

The valuation has been prepared in accordance with the parameters of Statement No. 67 of the GASB and all applicable Actuarial Standards of Practice. The Net Pension Liability (Asset) under GASB 67 for the fiscal year ending June 30, 2020, is $12,081,997,000 (compared to $10,366,957,000 for fiscal year ending June 30, 2019). The required financial reporting information for TSERS under GASB No. 67 can be found in Section 8 of this report.

Section 3: Membership Data

The Retirement Systems Division provided membership data as of the valuation date for each member of TSERS. The membership data assists the actuary in estimating benefits that could be paid in the future. The tables below provide a summary of the membership data used in this valuation. Detailed tabulations of data are provided in Appendix B.

Table 2: Active Member Data

	Member Count	Average Age	Average Service	Reported Compensation
Teachers, Librarians and Counselors	150,366	43.68	10.76	$ 7,221,097,504
Other Education	48,009	49.37	11.24	2,062,650,952
General Employees	102,062	46.73	10.63	5,286,075,974
Law Enforcement Officers	5,525	40.27	11.92	316,643,367
Total	305,962	45.53	10.81	$ 14,886,467,797

The table above includes members not in receipt of benefits who had reported compensation in 2019.

Table 3: Disabled Member Data (Receiving Benefit from the Disability Income Plan of North Carolina)

	Member Count	Average Age	Average Service	Valuation Compensation
Teachers, Librarians and Counselors	1,849	55.49	13.98	$ 71,631,196
Other Education	744	56.58	13.40	21,202,017
General Employees	3,146	56.00	12.99	114,759,865
Law Enforcement Officers	35	49.60	16.17	2,253,346
Total	5,774	55.87	13.38	$ 209,846,424

The table above includes members not in receipt of benefits who did not have reported compensation in 2019 and who were reported as disabled in the current or prior valuations and not subsequently reported as returned to work.

Section 3: Membership Data

Table 4: Terminated Vested Member Data

	Member Count	Average Age	Average Service	Accumulated Contributions
Teachers, Librarians and Counselors	71,789	41.63	4.27	$ 940,300,786
Other Education	17,193	46.10	4.08	200,114,528
General Employees	87,122	46.75	3.68	1,142,013,224
Law Enforcement Officers	1,469	41.46	5.28	28,478,658
Total	177,573	44.57	3.97	$ 2,310,907,196

The table above includes members not in receipt of benefits who did not have reported compensation in 2019 and who were not valued as disabled members.

Table 5: Data for Members Currently Receiving Benefits

	Member Count	Average Age	Annual Retirement Allowances
Retired Members (Healthy at Retirement)			
Teachers and Other Education	112,469	70.86	$ 2,711,918,530
General Employees	84,225	72.18	1,535,062,170
Law Enforcement Officers	3,173	65.69	101,534,403
Total	199,867	71.33	$ 4,348,515,103
Retired Members (Disabled at Retirement)*			
Teachers and Other Education	4,468	71.17	$ 87,930,636
General Employees	8,068	70.67	127,095,818
Law Enforcement Officers	176	69.40	4,402,222
Total	12,712	70.82	$ 219,428,676
Survivors of Deceased Members			
Teachers and Other Education	5,282	73.31	$ 96,703,976
General Employees	9,962	73.86	129,356,041
Law Enforcement Officers	468	72.93	10,174,677
Total	15,712	73.65	$ 236,234,694
Grand Total	228,291	71.46	$ 4,804,178,473

* Includes retired members reported as disabled in a prior valuation and not subsequently reported as returned to work.

Section 4: Asset Data

Assets are held in trust and are invested for the exclusive benefit of TSERS members. The tables below provide the details of the Market Value of Assets for the current and prior years' valuations.

Table 6: Market Value of Assets

Asset Data as of	12/31/2019	12/31/2018
Beginning of Year Market Value of Assets	$ 67,536,480,309	$ 70,607,887,248
Employer Contributions	1,982,469,767	1,758,110,760
Employee Contributions	955,063,189	927,251,021
Benefit Payments Other Than Refunds	(4,757,088,409)	(4,666,520,152)
Refunds	(102,281,124)	(109,504,134)
Administrative Expenses	(12,107,623)	(11,856,738)
Investment Income	9,884,244,364	(968,887,696)
Net Increase / (Decrease)	7,950,300,164	(3,071,406,939)
End of Year Market Value of Assets	$ 75,486,780,473	$ 67,536,480,309
Estimated Net Investment Return	14.85%	-1.39%

Table 7: Allocation of Investments by Category of the Market Value of Assets

Asset Data as of	12/31/2019	12/31/2018
Allocation by Dollar Amount		
Public Equity	$ 24,716,066,368	$ 24,485,299,104
Fixed Income (LTIF)	19,902,316,895	17,806,074,839
Cash and Receivables	10,146,379,496	4,987,337,332
Other *	20,722,017,714	20,257,769,034
Total Market Value of Assets	$ 75,486,780,473	$ 67,536,480,309
Allocation by Percentage of Asset Value		
Public Equity	32.7%	36.3%
Fixed Income (LTIF)	26.4%	26.4%
Cash and Receivables	13.4%	7.4%
Other *	27.5%	29.9%
Total Market Value of Assets	100.0%	100.0%

***** Real Estate, Alternatives, Inflation and Credit

Section 4: Asset Data

In order to reduce the volatility that investment gains and losses can have on the required contributions and funded status of TSERS, the Board adopted an asset valuation method to determine the Actuarial Value of Assets used for funding purposes. The table below provides the calculation of the Actuarial Value of Assets at the valuation date.

Table 8: Actuarial Value of Assets

Asset Data as of	12/31/2019
Beginning of Year Actuarial Value of Assets	$ 70,959,093,440
Beginning of Year Market Value of Assets	67,536,480,309
Total Contributions	2,937,532,956
Benefit Payments, Refunds and Administrative Expenses	(4,871,477,156)
Net Cash Flow	(1,933,944,200)
Expected Investment Return	4,661,010,386
Expected End of Year Market Value of Assets	70,263,546,495
End of Year Market Value of Assets	75,486,780,473
Excess of Market Value of Assets over Expected Market Value of Assets	5,223,233,978
80% of 2019 Asset Gain / (Loss)	4,178,587,182
60% of 2018 Asset Gain / (Loss)	(3,503,457,738)
40% of 2017 Asset Gain / (Loss)	1,584,231,313
20% of 2016 Asset Gain / (Loss)	(126,340,247)
Total Deferred Asset Gain / (Loss)	2,133,020,510
Preliminary End of Year Actuarial Value of Assets	73,353,759,963
Final End of Year Actuarial Value of Assets (not less than 80% and not greater than 120% of Market Value of Assets)	$ 73,353,759,963
Estimated Net Investment Return	6.18%

Commentary: The actuarial value of assets smooths investment gains/losses, resulting in less volatility in the employer contribution. The asset valuation recognizes asset returns in excess of or less than the expected return on the market value of assets over a five-year period. Actuarial value of assets was reset to the market value of assets at December 31, 2014.

Lower than expected market returns, in 2015, 2016, and 2018, resulted in an actuarial value of asset return for calendar year 2019 of 6.18% and a recognized actuarial asset loss of $0.6 billion during 2019.

Section 4: Asset Data

The valuation assumes that the funds will earn a 7.00% asset return. The table below provides a history of the Actuarial Value and Market Value of Asset returns.

Table 9: Historical Asset Returns

Calendar Year	Expected Asset Return	Actuarial Value of Asset Return	Market Value of Asset Return	20 Year Average Market Return
1996	7.50%	10.18%	9.39%	NA
1997	7.25%	10.18%	18.16%	NA
1998	7.25%	9.92%	16.66%	NA
1999	7.25%	10.60%	10.15%	NA
2000	7.25%	11.55%	2.50%	NA
2001	7.25%	8.51%	-1.87%	NA
2002	7.25%	5.66%	-5.21%	NA
2003	7.25%	7.98%	18.23%	NA
2004	7.25%	8.56%	10.73%	NA
2005	7.25%	8.26%	6.97%	NA
2006	7.25%	8.94%	11.41%	NA
2007	7.25%	8.87%	8.38%	NA
2008	7.25%	2.89%	-19.50%	NA
2009	7.25%	4.74%	14.84%	NA
2010	7.25%	5.89%	11.47%	NA
2011	7.25%	5.15%	2.19%	NA
2012	7.25%	6.32%	11.82%	NA
2013	7.25%	7.43%	12.21%	NA
2014	7.25%	7.19%	6.21%	NA
2015	7.25%	5.87%	0.36%	6.86%
2016	7.25%	5.32%	6.22%	6.71%
2017	7.20%	6.56%	13.49%	6.49%
2018	7.00%	5.10%	-1.39%	5.60%
2019	7.00%	6.18%	14.85%	5.82%
20-Yr Average	7.22%	6.83%	5.82%	NA
Range	0.25%	8.66%	37.73%	NA

Commentary: The average investment return recognized for purposes of determining the annual change in contribution each year is the actuarial value of assets return. Currently, the average actuarial return over the past 20 years of 6.83% compares with an average market return of 5.82%. The difference is partially due to asset gains of the late 1990's being included in the actuarial value and not in the market value. The range of returns on market value of assets is markedly more volatile, 37.73% versus 8.66%. Using the actuarial value of assets instead market value results in much lower employer contribution volatility, while ensuring that the actuarial needs of TSERS are met.

Section 5: Liability Results

Using the provided membership data, benefit provisions, and actuarial assumptions, the Retirement System's future benefit payments are estimated. These projected future benefit payments are discounted into today's dollars using the assumed rate of investment return assumption to determine the Present Value of Future Benefits. The Present Value of Future Benefits is allocated to past, current and future service, respectively known as the actuarial accrued liability, normal cost and present value of future normal costs. The table below provides these liability numbers for the current and prior years' valuations.

Table 10: Liability Summary

Valuation Results as of	12/31/2019	12/31/2018
(a) Present Value of Future Benefits		
(a) Active Members	$ 47,435,181,634	$ 45,769,146,668
(b) Terminated Members	4,621,814,392	4,337,483,404
(c) Members Currently Receiving Benefits	46,723,661,952	45,534,377,845
(d) Total	$ 98,780,657,978	$ 95,641,007,917
(b) Present Value of Future Normal Costs		
(a) Employee Future Normal Costs	$ 7,432,300,698	$ 7,228,909,149
(b) Employer Future Normal Costs	6,475,042,008	6,306,155,637
(c) Total	$ 13,907,342,706	$ 13,535,064,786
(c) Actuarial Accrued Liability: (a4) – (b3)	$ 84,873,315,272	$ 82,105,943,131
(d) Actuarial Value of Assets	$ 73,353,759,963	$ 70,959,093,440
(e) Unfunded Actuarial Accrued Liability: (c) – (d)	$ 11,519,555,309	$ 11,146,849,691

Section 5: Liability Results

The table below provides a reconciliation of the prior year's unfunded actuarial accrued liability to the current year's unfunded actuarial accrued liability.

Table 11: Reconciliation of Unfunded Actuarial Accrued Liability

(in millions)	
Unfunded Actuarial Accrued Liability (UAAL) as of 12/31/2018	$ 11,147
Normal Cost and Administrative Expense during 2019	1,741
Reduction due to Actual Contributions during 2019	(2,915)
Interest on UAAL, Normal Cost, and Contributions	739
Asset (Gain) / Loss	572
Actuarial Accrued Liability (Gain) / Loss	236
Impact of Assumption Changes	-
Impact of Legislative Changes	-
Unfunded Actuarial Accrued Liability (UAAL) as of 12/31/2019	$ 11,520

Commentary: During 2019, the UAAL increased more than expected primarily due to the asset loss during the year of $572 million. Additionally, demographic experience increased the UAAL by $236 million.

Section 6: Actuarially Determined Employer Contribution

The actuarially determined employer contribution consists of a normal cost rate, an accrued liability rate and an administrative expense rate. The normal cost rate is the employer's portion of the cost of benefits accruing during the year after reducing for the member contribution. The accrued liability rate is the payment toward the unfunded accrued liability in order to pay off the unfunded accrued liability over 12 years. The expense rate is the payment for expected administrative expenses.

The table below provides the calculation of the actuarially determined employer contribution for the current and prior years' valuations.

The Employer Contribution Rate Stabilization Policy (ECRSP) adopted by the Board of Trustees on January 21, 2016 requires that recommended contributions be 0.35% of payroll greater than the appropriated contribution during the prior year, with the following bounds: (1) contributions may not be less than the actuarially determined employer contribution (ADEC) calculated below and (2) contributions may not be greater than a contribution determined using the same assumptions used to calculate the ADEC but using a discount rate equal to the long-term Treasury bond yield.

The ECRSP would result in a recommended contribution rate of 15.74% of payroll for fiscal year ending 2022.

- The minimum (before considering the ADEC) is 15.13%; the appropriated contribution from last year of 14.78% plus 0.35%.
- 15.74% is the actuarially determined employer contribution calculated in this most recent valuation.
- The maximum is approximately 75.68%; the estimated actuarially determined employer contribution using a discount rate equal to the long-term Treasury bond yield (2.39%).

Table 12: Calculation of the Actuarially Determined Employer Contribution (ADEC)

Valuation Date ADEC for Fiscal Year Ending	12/31/2019 6/30/2022	12/31/2018 6/30/2021
Normal Cost Rate Calculation		
(a) Normal Cost Rate	5.06%	5.08%
(b) Expense Rate	0.10%	0.10%
(c) Total Normal Cost Rate	5.16%	5.18%
Accrued Liability Rate Calculation		
(d) Total Annual Amortization Payments*	$ 1,769,941,231	$ 1,653,288,562
(e) Projected Compensation**	16,733,893,898	16,223,213,913
(f) Accrued Liability Rate: (d) / (e)	10.58%	10.19%
Preliminary ADEC: (c) + (f)	15.74%	15.37%
ADEC With Direct Rate Smoothing	15.74%	14.78%
Impact of Legislative Changes	N/A	N/A
Final ADEC	N/A	N/A

*See Table 15 for more detail
** Beginning with the December 31, 2017 valuation, compensation is projected to the fiscal year over which contributions will occur

Section 6: Actuarially Determined Employer Contribution

The table below provides a reconciliation of the actuarially determined employer contributions.

Table 13: Reconciliation of the Change in the ADEC

Fiscal year ending June 30, 2021 Preliminary ADEC (based on December 31, 2018 valuation)	14.78%
Impact of Legislative Changes	0.00
Fiscal year ending June 30, 2021 ADEC for Reconciliation	14.78%
Change Due to Anticipated Reduction in UAAL*	(0.31)
Change Due to Demographic (Gain) / Loss	0.17
Change Due to Investment (Gain) / Loss	0.46
Change Due to Contributions Different than ADEC**	0.05
Impact of Assumption Change	0.00
Impact of Direct Rate Smoothing	0.59
Fiscal year ending June 30, 2022 Preliminary ADEC (based on December 31, 2019 valuation)	15.74%

*Amortization of the UAAL is determined as a level dollar amount with payments expected to remain the same over the amortization period, but was calculated as a percentage of valuation payroll in the previous valuation. Payroll is expected to increase annually while the expected amortization payment does not increase. This causes the expected amortization payment to be a lesser percentage of the expected payroll.

**Includes impact of direct rate smoothing of FYE 2020 contribution.

Section 6: Actuarially Determined Employer Contribution

Amortization methods determine the payment schedule for the unfunded actuarial accrued liability. TSERS adopted a 12-year closed amortization period for fiscal year ending 2012. A new amortization base is created each year based on the prior years' experience. The tables below provide the calculation of the new amortization base and the amortization schedule for the current year's valuation.

Table 14: Calculation of the New Amortization Base

Calculation as of	12/31/2019	12/31/2018
(a) Unfunded Actuarial Accrued Liability	$ 11,519,555,309	$ 11,146,849,691
(b) Prior Years' Outstanding Balance	$ 10,653,623,411	$ 9,310,418,300
(c) New Amortization Base: (a) – (b)	$ 865,931,898	$ 1,836,431,391
(d) New Amortization Payment	$ 116,652,669	$ 247,392,000

Table 15: Amortization Schedule for Unfunded Accrued Liability

Date Established	Original Balance	12/31/2019 Outstanding Balance	Annual Payment
December 31, 2009	2,360,173,025	1,000,035,266	320,944,137
December 31, 2010	242,581,914	127,822,464	32,954,055
December 31, 2011	911,037,989	567,734,498	123,641,188
December 31, 2012	78,277,759	55,806,390	10,613,353
December 31, 2013	(114,027,863)	(90,837,684)	(15,446,283)
December 31, 2014	(206,952,282)	(181,017,018)	(28,008,711)
December 31, 2015	2,586,581,023	2,450,337,142	349,707,749
December 31, 2016	1,983,860,720	2,012,201,207	267,752,250
December 31, 2017	2,551,629,668	2,746,559,557	343,738,824
December 31, 2018	1,836,431,391	1,964,981,589	247,392,000
December 31, 2019	865,931,898	865,931,898	116,652,669
Total		11,519,555,309	1,769,941,231

Commentary: This is the payment schedule for the unfunded actuarial accrued liability of TSERS.

Section 6: Actuarially Determined Employer Contribution

The tables below provide a history of the actuarially determined employer contribution and the corresponding appropriated rate.

Table 16: History of Actuarially Determined Employer Contribution and Appropriated Rates

Valuation Date	Fiscal Year Ending	Normal Rate	Accrued Liability Rate	Change due to Legislation*	Final ADEC**	Appropriated Rate
12/31/2019	06/30/2022	5.16%	10.58%	N/A	N/A	N/A
12/31/2018	06/30/2021	5.18%	10.19%	0.00%	14.78%	14.78%
12/31/2017	06/30/2020	5.17%	8.99%	0.00%	12.97%	12.97%
12/31/2016	06/30/2019	4.48%	7.50%	0.31%	12.29%	12.29%
12/31/2015	06/30/2018	4.31%	5.77%	0.45%	10.53%	10.78%
12/31/2014	06/30/2017	5.21%	3.26%	1.49%	9.96%	9.98%

*The change due to legislation for the contribution for fiscal year ending 6/30/2019 includes a 0.31% increase in the ADEC due to the one-time cost-of-living supplement payable in October, 2018.

**Final ADEC reduced for direct-rate smoothing of discount rate change for FYE 2020 and 2021.

The following table shows estimates of the potential cost of two types of benefit improvements if they were enacted based on the results of the December 31, 2019 or December 31, 2018 valuations. The first benefit improvement is a permanent one-time cost-of-living increase and the second is an increase in the defined benefit formula multiplier.

Table 17: Cost of Benefits Enhancements

Calculation as of	**12/31/**2019	**12/31/**2018
Increase in UAAL for a 1% COLA	$ 511,088,000	$ 497,775,000
Increase in ADEC for a 1% COLA	0.41%	0.42%
Increase in UAAL for a 0.1% Increase in the Defined Benefit Formula	$ 440,942,000	$ 427,299,000
Increase in ADEC for a 0.1% Increase in the Defined Benefit Formula	0.41%	0.42%

The 1% COLA in the 12/31/2019 column would be effective July 1, 2021 and includes expected costs of COLAs paid for retirements after 12/31/2019 and before June 30, 2021. The COLA would be paid in full to retired members and survivors of deceased members on the retirement roll on July 1, 2020 and would be prorated for retired members and survivors of deceased members who commence benefits after July 1, 2020 but before June 30, 2021.

A corresponding increase in retirement allowances would be paid in the event of an increase in the defined benefit formula.

Section 7: Valuation Balance Sheet

The valuation balance sheet shows the projected assets and liabilities of TSERS. The items shown in the balance sheet are present values actuarially determined as of the relevant valuation date. The table below provides the valuation balance sheet for the current year and prior year.

Table 18: Valuation Balance Sheet on a Projected Basis

Balance Sheet as of	12/31/2019	12/31/2018
Assets		
Current Actuarial Value of Assets		
Annuity Savings Fund	$ 13,893,664,489	$ 13,409,691,083
Pension Accumulation Fund	59,460,095,474	57,549,402,357
Total	$ 73,353,759,963	$ 70,959,093,440
Future Member Contributions to the Annuity Savings Fund	$ 7,432,300,698	$ 7,228,909,149
Prospective Contributions to the Pension Accumulation Fund		
Normal Contributions	$ 6,475,042,008	$ 6,306,155,637
Unfunded Accrued Liability Contributions	11,519,555,309	11,146,849,691
Total	$ 17,994,597,317	$ 17,453,005,328
Total Assets	$ 98,780,657,978	$ 95,641,007,917
Liabilities		
Annuity Savings Fund		
Past Member Contributions	$ 13,893,664,489	$ 13,409,691,083
Future Member Contributions	7,432,300,698	7,228,909,149
Total Contributions	$ 21,325,965,187	$ 20,638,600,232
Pension Accumulation Fund		
Benefits Currently in Payment	$ 46,723,661,952	$ 45,534,377,845
Benefits to be Paid to Current Active and Inactive Members	30,731,030,839	29,468,029,840
Reserve for Increases in Retirement Allowances	0	0
Total Benefits Payable	$ 77,454,692,791	$ 75,002,407,685
Total Liabilities	$ 98,780,657,978	$ 95,641,007,917

Section 8: Accounting Results

This section contains the accounting information for Governmental Accounting Standards Board (GASB) Statement No. 67 for fiscal year ending June 30, 2020 based on a valuation date of December 31, 2019.

Please note that GASB Statement No. 67 (*Financial Reporting for Pension Plans)* is applicable for fiscal years ending 2014 and later.

The June 30, 2020 total pension liability presented in this section was determined by an actuarial valuation as of December 31, 2019, based on the assumptions, methods and plan provisions described in this report. The actuarial cost method used to develop the total pension liability is the Entry Age Normal Cost method, as required by GASB Statement No. 67.

GASB Statement No. 67 set forth certain items of information to be disclosed in the financial statements of the Plan. The tables below provide a distribution of the number of employees by type of membership.

Table 19: Number of Active and Retired Members as of December 31, 2019

Group	Number
Retired members and survivors of deceased members currently receiving benefit	228,291
Terminated members and survivors of deceased members entitled to benefits but not yet receiving benefits	177,573
Active Members*	311,736
Total	717,600

* Includes current recipients of DIP benefits.

Section 8: Accounting Results

GASB Statement No. 67 set forth certain items of information to be disclosed in the financial statements of the Plan. The tables below provide the schedule of changes in Net Pension Liability (Asset).

Table 20: Schedule of Changes in Net Pension Liability (Asset)

Schedule of Changes in Net Pension Liability as of June 30, 2020	
Total Pension Liability	
Service Cost	$ 1,851,058,000
Interest	5,663,045,000
Changes of Benefit Terms	0
Difference between Expected and Actual Experience	258,502,000
Change of Assumptions	0
Benefit Payments, including Refund of Member Contributions	(4,934,999,000)
Net Change in Total Pension Liability	2,837,606,000
Total Pension Liability - Beginning of Year	$ 83,326,405,000
Total Pension Liability - End of Year	$ 86,164,011,000
Plan Fiduciary Net Position	
Employer Contributions	$ 2,055,075,000
Member Contributions	964,544,000
Net Investment Income	3,050,585,000
Benefit Payments, including Refund of Member Contributions	(4,934,999,000)
Administrative Expenses	(12,910,000)
Other	271,000
Net Change in Plan Fiduciary Net Position	1,122,566,000
Plan Fiduciary Net Position - Beginning of Year	$ 72,959,448,000
Plan Fiduciary Net Position - End of Year	$ 74,082,014,000

Table 21: Net Pension Liability (Asset)

Net Pension Liability (Asset)	June 30, 2020	June 30, 2019
Total Pension Liability	$ 86,164,011,000	$ 83,326,405,000
Plan Fiduciary Net Position	74,082,014,000	72,959,448,000
Net Pension Liability (Asset)	$ 12,081,997,000	$ 10,366,957,000
Plan Fiduciary Net Position as a Percentage of the Total Pension Liability (Asset)	85.98%	87.56%

Section 8: Accounting Results

The table below is the sensitivity of the net pension liability to changes in the discount rate.

Table 22: Sensitivity of the Net Pension Liability (Asset) at June 30, 2020 to Changes in the Discount Rate

Sensitivity of the Net Pension Liability to Changes in the Discount Rate			
	1% Decrease	Current	1% Increase
Discount Rate	6.00%	7.00%	8.00%
Net Pension Liability (Asset)	$ 21,744,757,000	$ 12,081,997,000	$ 3,976,941,000

The discount rate used to measure the total pension liability was 7.00%. The projection of cash flows used to determine the discount rate assumed that for fiscal year ending 2021 to fiscal year ending 2022, System contributions will follow the Employer Contribution Rate Stabilization Policy as adopted by the Board of Trustees on January 21, 2016, and "direct-rate smoothing" as adopted by the Board of Trustees on April 26, 2018. It is assumed that for fiscal years ending 2023 and beyond, System contributions will be based on the actuarially determined contribution rates with a minimum employer contribution rate of 6.00% of payroll in accordance with G.S 135-8(d)(1a). Based on those policies, the System's fiduciary net position was projected to be available to make all projected future benefit payments of current plan members. Please see Appendix E for additional details.

The table below provides the methods and assumptions used to calculate the actuarially determined contribution rate.

Table 23: Additional Information for GASB Statement No. 67

Valuation Date	12/31/2019
Actuarial Cost Method	Entry Age
Amortization Method	Level dollar closed
Amortization Period	12 year closed periods
Asset Valuation Method	Asset returns in excess of or less than the expected return on market value of assets reflected over a five-year period (not greater than 120% of market value and not less than 80% of market value)
Actuarial Assumptions:	
Investment Rate of Return*	7.00%
Projected Salary Increases**	3.50% - 8.10%
*Includes Inflation of	3.00%
**Includes Inflation and Productivity of	3.50%
Cost-of-living Adjustments	N/A

Section 9: Projections

Projections of contribution requirements and funded status into the future can be helpful planning tools for stakeholders. This section provides such projections. The projections of the actuarial valuation are known as deterministic projections. Deterministic projections are based on one scenario in the future. The baseline deterministic projection is based on December 31, 2019 valuation results and assumptions.

Key Projection Assumptions

- Valuation interest rate of 7.00% for all years in conjunction with direct rate smoothing of the employer contribution rate over a 3-year period beginning July 1, 2019.
- 7.00% investment return on market value of assets
- Actuarial assumptions and methods as described in Appendix D. All future demographic experience is assumed to be exactly realized.
- The contribution rate under the Employer Contribution Rate Stabilization Policy (ECRSP) is contributed until fiscal year ending 2022.
- The actuarially determined contribution rate is contributed for fiscal years ending 2023 and beyond.
- 0% increase in the total active member population
- No cost-of-living adjustments granted
- Future pay increases based on long-term salary increase assumptions

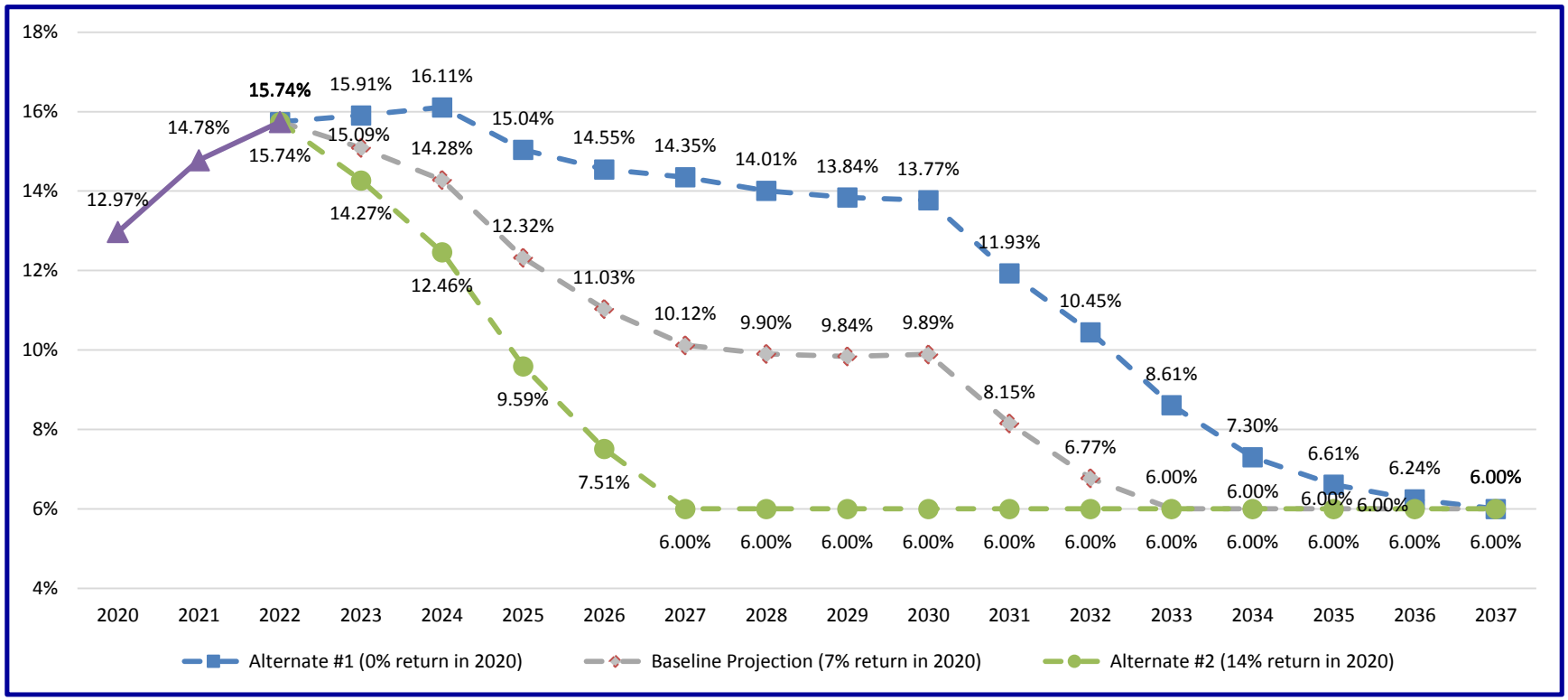
The ECRSP adopted by the Board of Trustees on January 21, 2016 requires that recommended contributions be 0.35% of payroll greater than the appropriated contribution during the prior year, with the following bounds: (1) contributions may not be less than the actuarially determined employer contribution (ADEC) rate and (2) contributions may not be greater than a contribution determined using the same assumptions used to calculate the ADEC but using a discount rate equal to the long-term Treasury bond yield.

In addition, we have provided two alternate deterministic projections. The first alternate deterministic projection is based on the same assumptions as the baseline deterministic projection except that it assumes a 0.0% asset return for calendar year 2020. The second alternate deterministic projection is based on the same assumptions as the baseline deterministic projection except that it assumes a 14.0% asset return for calendar year 2020.

Section 9: Projections

The graph below provides the actuarially determined employer contribution rates projected for 15 years.

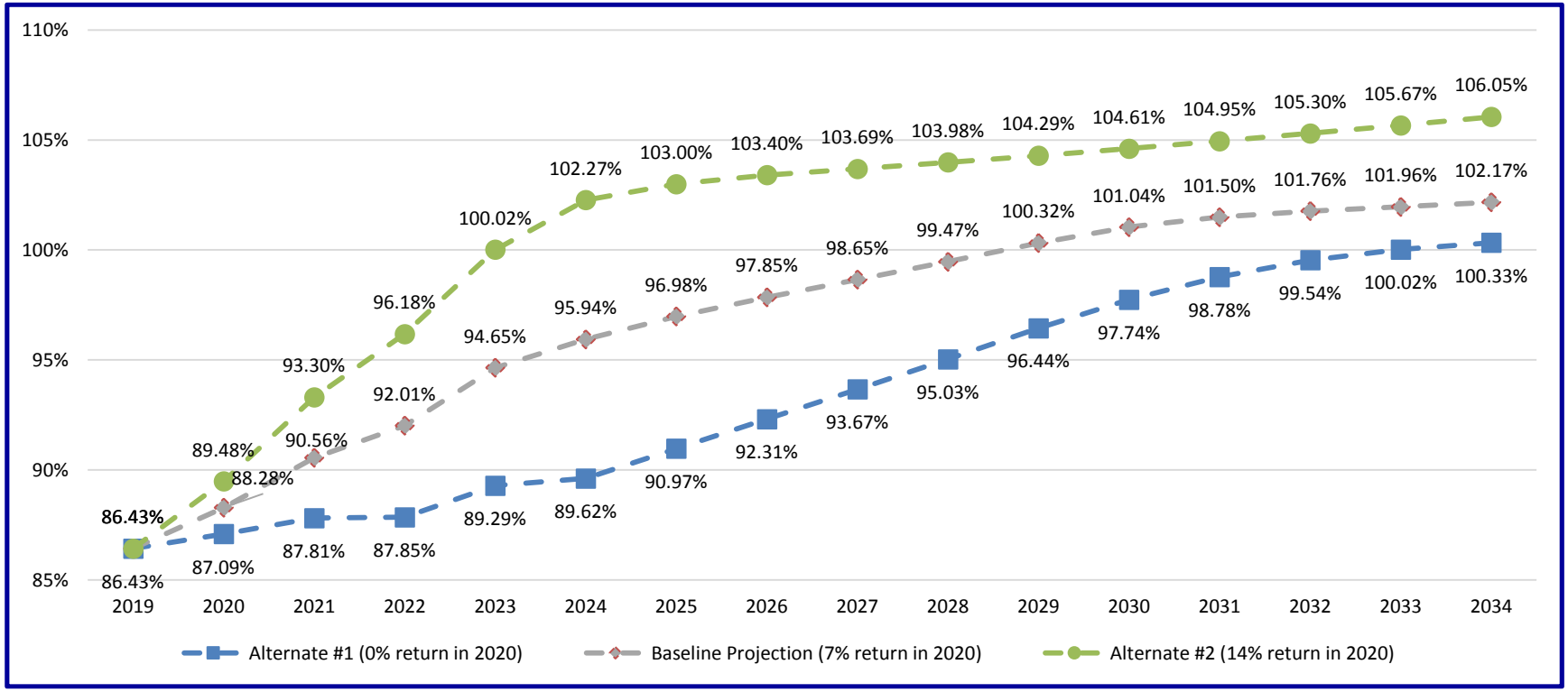
Projected Actuarially Determined Employer Contribution Rates



Section 9: Projections

The graph below provides the funded ratio projected for 15 years.

Projected Funded Ratio



Appendix A: Valuation Process and Glossary of Actuarial Terms

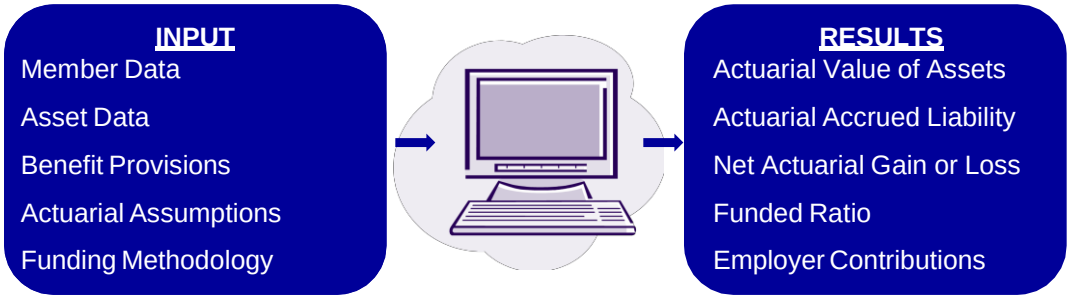
Purpose of an Actuarial Valuation

The majority of Public Sector Retirement Systems in the State of North Carolina are defined benefit (DB) retirement systems. Under a DB retirement system, the amount of benefits payable to a member upon retirement, termination, death or disability is defined in various contracts and legal instruments and is based, in part, on the member's years of credited service and final compensation. The amount of contribution needed to fund these benefits cannot be known with certainty. A primary responsibility of the Board of Trustees of a Retirement System is to establish and monitor a funding policy for the contributions made to the Retirement System.

While somewhat uncommon, in some jurisdictions, contributions are made by the plan sponsor as benefits come due. This is known as pay-as-you-go financing. More commonly, contributions for benefits are made in advance during the course of active employment of the members. This is known as actuarial pre-funding. For example, the State of North Carolina mandates for the Teachers' and State Employees' Retirement System ("TSERS") under G.S.135-8(d), that "on account of each member there shall be paid into the pension accumulation fund by employers an amount equal to a certain percentage of the actual compensation of each member to be known as the 'normal contribution' and an additional amount equal to a percentage of the member's actual compensation to be known as the 'accrued liability contribution'. The rate per centum of such contributions shall be fixed on the basis of the liabilities of the Retirement System as shown by actuarial valuation, duly approved by the Board of Trustees, and shall be called the 'actuarially determined employer contribution rate'…The actuarially determined employer contribution rate shall be calculated annually by the actuary using assumptions and a cost method approved by the Actuarial Standards Board of the American Academy of Actuaries and selected by the Board of Trustees."

The Actuarial Valuation Process

The following diagram summarizes the inputs and results of the actuarial valuation process. A narrative of the process follows the diagram. The reader may find it worthwhile to refer to the diagram from time to time.



Under the actuarial valuation process, current information about Retirement System members is collected annually by staff at the direction of the actuary, namely member data, asset data and information on benefit provisions. Member data is collected for each member of the Retirement System. The member data will assist the actuary in estimating benefits that could be paid in the future. The member information the actuary collects to estimate the amount of benefit includes elements such as current service, salary and benefit group identifier for members that have not separated service; for those that have, the actual benefit amounts are collected. The actuary collects information such as gender and date of birth to determine when a benefit might be paid and for how long.

Appendix A: Valuation Process and Glossary of Actuarial Terms

The actuary collects summary information about assets as of the valuation date and information on cash flows for the year ending on the valuation date. Information about benefit provisions as of the valuation date is also collected. To bridge the gap between the information collected and potential benefits to be paid in the future, the actuary must make assumptions about future activities. These assumptions are recommended by the actuary to the Boards based on the results of an experience review. An experience review is a review of the Retirement System over a period of time, typically five years, where the actuary analyzes the demographic and economic assumptions of the Retirement System. Based on this review, the actuary will make recommendations on the demographic assumptions, such as when members will be projected to retire, terminate, become disabled and/or die in the future, as well as the economic assumptions, such as what rate of return is projected to be earned by the fund based on the Retirement System investment policy and what level of future salary increases is expected for members. To maintain the assumptions, the Board should adopt a prudent policy of having an experience review being performed every five years. The next experience review for the North Carolina Retirement Systems will be based on the five-year period ending on December 31, 2019 and will be presented during 2020. Using these assumptions, the actuary is able to use the member data, asset data and benefit provision information collected to project the benefits that will be paid from the Retirement System to current members. These projected future benefit payments are based not only on service and pay through the valuation date but includes future pay and service, which has not yet been earned by the members but is expected to be earned.

These projected future benefit payments are discounted into today's dollars using the assumed rate of investment return assumption to determine the Present Value of Future Benefits (PVFB) of the Retirement System. The PVFB is an estimate of the value of the benefits promised to all members as of a valuation date. If the Retirement System held assets equal to the PVFB and all the assumptions were realized, there would be sufficient funds to pay off all the benefits to be paid in the future for members in the Retirement System as of the valuation date.

The PVFB is a large sum of money, typically much larger than the amount of Retirement System assets held in the trust. The next step is for the actuary to apply the Funding Policy as adopted by the Board to determine the employer contributions to be made to the Retirement System so that the gap between the PVFB and assets is systematically paid off over time. The Funding Policy is adopted by the Board based on discussions with the actuary. When the Board develops a funding policy, a balance between contributions which are responsive to the needs of the Retirement System yet stable should be struck. There are many different funding policies for the Board to consider, and the actuary is responsible for discussing the various features of the funding policies under consideration. Funding Policies are generally reviewed during an experience review, but it is not uncommon to review a funding policy in between, particularly during period where large increases or decreases in contributions are expected. The Funding Policy is composed of three components: the actuarial cost method, the asset valuation method, and the amortization method.

Once the PVFB is developed, an actuarial cost method is used to allocate the PVFB. Under the actuarial cost method, the PVFB is allocated to past, current and future service, respectively known as the actuarial accrued liability (AAL), normal cost (NC) and present value of future normal costs (PVFNC). The actuary computes the liability components (PVFB, NC, AAL, and PVFNC) for each participant in the Retirement System at the valuation date. These liability components are then totaled for the Retirement System. There are many actuarial cost methods. Different actuarial methods will produce different contribution patterns, but do not change the ultimate cost of the benefits. The entry age normal cost method is the most prevalent method used for public sector plans in the United States, because the expected normal cost is calculated in such a way that it will tend to stay level as a percent of pay over a member's career.

The actuarial accrued liability (AAL) is also referred to as the amount of money the Retirement System should ideally have in the trust. The unfunded actuarial accrued liability (UAAL) is the portion of actuarial accrued liability that is not covered by the assets of the Retirement System. The UAAL can be a negative number, which means that the Retirement System has more assets than actuarial accrued liability. We refer to this condition as overfunded liability in this summary. Having UAAL does not indicate that the Retirement System is in failing actuarial health. Most retirement systems have UAAL. Another related statistic of the Retirement System is the funded ratio. The funded ratio is the percent of the actuarial accrued liabilities covered by the actuarial value of assets. The assets used for these purposes are an actuarial value of assets (AVA), not market. The actuarial value of assets is based on the asset valuation method as recommended by the actuary and adopted by the Board. An actuarial value of assets is a smoothed, or averaged, value of assets, which is used to limit employer contribution volatility. Typically, assets are smoothed, or averaged, over a period of 3 to 5 years. By averaging returns, the UAAL is not as volatile, which we will see later results in contributions that are not as volatile as well. The North Carolina Retirement Systems use an actuarial value of assets with a smoothing period of 5 years.

While having UAAL is common, it is acceptable only if it is systematically being paid off. The method by which the UAAL is paid off is known as the amortization method. The concept is similar to that of a mortgage payment. The Board adopts the amortization method used to pay off the UAAL over a period of time. The amortization method is composed of the amortization period, the amount of payment increase, whether the period is open or closed and by the amount of amortization schedules. The amortization period is the amount of time over which the UAAL will be paid off. This is generally a period of thirty years or less, but actuaries are beginning to recommend shorter periods. The payments can be developed to stay constant from year to year like a mortgage, but often they are developed to increase each year at the same level payroll increases. Amortization type can be closed or open. Under a closed period, the UAAL is expected to be paid off over the amortization period. This is similar to a typical mortgage. Under an open period, the amortization period remains unchanged year after year. The concept is similar to re-mortgaging annually. In many instances, an amortization schedule is developed, whereby the UAAL is amortized over a closed period from the point the UAAL is incurred. Finally, some amortization methods are defined by a schedule of payments, where a new schedule of payments is added with each valuation. Regardless of the amortization type or period, the funding policy should generate a contribution that pays off the UAAL, which results in the funded ratio trending to 100% over time. Caution should be used when an open method is used, because typically an open amortization policy does not result in the UAAL being paid off. North Carolina pays off a much larger amount of UAAL compared to other states. While many states struggle to pay a 30-year level percent of pay UAAL contribution, which doesn't even reduce the amount of UAAL, North Carolina pays down the UAAL with level dollar payments over a 12 year period. This aggressive payment schedule of the UAAL results in North Carolina being home to many of the best funded Public Retirement Systems in the United States.

To satisfy the requirements of the State of North Carolina, the actuary calculates the total annual contribution to the Retirement System as the normal cost plus a contribution towards UAAL. Said another way, this contribution is sufficient to pay for the cost of benefits accruing during the year (normal cost) plus the mortgage payment (UAAL payment). The total contribution is reduced by the amount of member contributions, if any, to arrive at the employer contribution. Continuing to follow the aggressive North Carolina contribution policy will keep the North Carolina Retirement Systems among the best funded in the United States.

Appendix A: Valuation Process and Glossary of Actuarial Terms

An actuarial valuation report is produced annually, which contains the contribution for the fiscal year as well as the funded ratio of the Retirement System. The primary purpose of performing an actuarial valuation annually is to replace the estimated activities from the previous valuation, which were based on assumptions, with the actual experience of the Retirement System for the prior year. The experience gain (loss) is the difference between the expected and the actual UAAL of the Retirement System. An experience loss can be thought of as the amount of additional UAAL over and above the amount that was expected from the prior year due to deviation of actual experience from the assumption. Similarly, an experience gain can be thought of as having less UAAL than that which was expected from the prior year assumptions. As an example, if the Retirement System achieves an asset return of 15% when the assumption was a 7.00% return, an actuarial gain is said to have happened, which typically results in lower contributions and higher funded ratio, all else being equal. Alternatively, a return of 2% under the same circumstances would result in an actuarial loss, requiring an increase in contributions and a funded ratio that is lower than anticipated. Experience gains and losses are common within the valuation process. Typically gains and losses offset each other over time. To the extent that does not occur, the reasons for the gains and losses should be understood, and appropriate recommendations should be made by the actuary after an experience review to adjust the assumptions.

The actuarial valuation report will contain histories of key statistics from prior actuarial valuation reports. In particular, a history of the funded ratio of the Retirement System is an important exhibit. Trustees should understand the reason for the trend of the funded ratio of the Retirement System over time. The actuary will discuss the reasons for changes in the funded ratio of the Retirement System with each valuation report. To the extent that there are unexplained changes in funded ratio corrective action should be explored and the actuary will make recommendations as to whether there should be changes in the assumptions, funding policy, or some other portion of the actuarial valuation process.

In addition to historical information, projections of contributions and funded ratio based on current assumptions can sometimes be found in an actuarial valuation report. Projections of contributions can allow the employer to plan their budget accordingly. Surprises in Retirement System contributions to be paid by the employer serve no one. A one-year projection based on "bad" asset returns can provide ample time for the employer to plan, or allow for a discussion of changing the funding policy to occur. Contribution surprises are a primary contributor to employers considering pension reform. It is important to keep the employer apprised of future contribution requirements. A projection of funded ratio can serve the Trustees by illustrating the trend of the funded ratio over time. The funded ratio, under a prudent funding policy, should trend to 100% over a period of less than 30 years. (It is worthwhile to note that while 30 years has served as an industry standard for the longest period over which 100% funding should be achieved, that period is coming under scrutiny by the actuarial community and will likely be shortened.) If a projection of funded ratio does not trend to 100% over time, consideration should be given to fixing the funding policy to achieve this goal. For the North Carolina Retirement Systems, projections are generally performed for the January board meetings.

Appendix A: Valuation Process and Glossary of Actuarial Terms

The actuarial report will contain schedules of information about the census, plan and asset information submitted by Retirement System staff upon which the actuarial valuation is based. It is important that the Board of Trustees review that information and determine if the information is consistent with their understanding of the Retirement System. If after questioning staff, the Board of Trustees is not comfortable that the information provided is correct, the actuary should be notified to determine if the actuarial valuation report should be corrected.

Finally, the valuation report and/or presentation should contain sufficient information in an understandable fashion to allow the Board to take action and adopt the contribution rate for the upcoming year. It should also allow stakeholders to understand key observations over the past year that resulted in contributions increasing (or decreasing) and where contributions are headed. The actuary is always open to making the results understandable. CMC works with the North Carolina Retirement Systems Division to make your reports and presentations understandable and actionable. If something doesn't make sense – speak up!!

Appendix A: Valuation Process and Glossary of Actuarial Terms

Glossary

Note that the first definitions given are the "official" definitions of the term. For some terms there is a second definition, in italics, which is the unofficial definition.

Actuarial Accrued Liability (AAL). The portion of the Present Value of Projected Benefits (PVFB) allocated to past service. Also difference between (i) the actuarial present value of future benefits, and (ii) the present value of future normal cost. Sometimes referred to as "accrued liability" or "past service liability." The amount of money that should be in the fund. *The funding target.*

Actuarial Assumptions. Estimates of future plan experience with respect to rates of mortality, disability, retirement, investment income and salary increases. Demographic ("people") assumptions (rates of mortality, separation, and retirement) are generally based on past experience, often modified for projected changes in conditions. Economic ("money") assumptions (salary increases and investment income) consist of an underlying rate appropriate in an inflation-free environment plus a provision for a long-term average rate of inflation. *Estimates of future events used to project what we know now- current member data, assets, and benefit provisions – into an estimate of future benefits.*

Actuarial Cost Method. A mathematical budgeting procedure for allocating the dollar amount of the Present Value of Projected Benefits (PVFB) between the normal costs to be paid in the future and the actuarial accrued liability. Sometimes referred to as the "actuarial funding method."

Actuarial Methods. The collective term for the Actuarial Cost Method, the Amortization Payment for UAAL Method, and the Asset Valuation Method used to develop the contribution requirements for the Retirement System. *The funding policy*.

Actuarial Equivalent. Benefits whose actuarial present values are equal.

Actuarial Present Value. The amount of funds presently required to provide a payment or series of payments in the future. It is determined by discounting the future payments at a predetermined rate of interest, taking into account the probability of payment.

Actuarial Value of Assets (AVA). A smoothed value of assets which is used to limit contribution volatility. Also known as the funding value of assets. *Smoothed value of assets.*

Amortization Payment for UAAL. Payment of the unfunded actuarial accrued liability by means of periodic contributions of interest and principal, as opposed to a lump sum payment. The components of the amortization payment for UAAL include:

- Amortization Period Length – Generally amortization periods up to 15 to 20 years (and certainly not longer than 30) are allowed. Similar to a mortgage, the shorter the amortization period, the higher the payment and the faster the UAAL is paid off.
- Amortization payment increases – Future payments can be level dollar, like a mortgage, or as a level percent of pay. Most Retirement Systems amortize UAAL as a level percent of pay which when combined with the employer normal cost that is developed as a level percent of pay can result in contributions that are easier to budget.
- Amortization type – An amortization schedule can be closed or open. A closed amortization schedule is similar to a mortgage – at the end of the amortization period the UAAL is designed to be paid off. An open amortization period is similar to refinancing the UAAL year after year.
- Amortization schedule – UAAL can be amortized over a single amortization period, or it can be amortized over a schedule.

The amortization payment for UAAL can be thought of as the UAAL mortgage payment.

Appendix A: Valuation Process and Glossary of Actuarial Terms

Asset Valuation Method. The components of how the actuarial value of assets is to be developed. TSERS uses a five-year smoothing of asset gains and losses, which is the most commonly used method

Experience Gain (Loss). A measure of the difference between actual experience and experience anticipated by a set of actuarial assumptions during the period between two actuarial valuation dates, in accordance with the actuarial cost method being used. *The experience Gain (Loss) represents how much the actuary missed the mark in a given year.*

Funded Ratio. The percent of the actuarial accrued liabilities covered by the actuarial value of assets. Also known as the funded status. *The ratio of how much money you actually have in the fund to the amount you should have in the fund.*

Normal Cost. The annual cost assigned, under the actuarial funding method, to current and subsequent plan years. Sometimes referred to as "current service cost." An amortization payment toward the unfunded actuarial accrued liability is paid in addition to the normal cost to arrive at the total contribution in a given year. *The cost of benefits accruing during the year*.

Present Value of Future Normal Cost (PVFNC). The portion of the Present Value of Projected Benefits (PVFB) allocated to future service. *The value in today's dollars of the amount of contribution to be made in the future for benefits accruing for members in the Retirement System as of the valuation date.*

Present Value of Future Benefits (PVFB). The projected future benefit payments of the plan are discounted into today's dollars using an assumed rate of investment return assumption to determine the Present Value of Future Benefits (PVFB) of the Retirement System. The PVFB is the discounted value of the projected benefits promised to all members as of a valuation date, including future pay and service for members which has not yet been earned. *If the Retirement System held assets equal to the PVFB and all the assumptions were realized, there would be sufficient funds to pay off all the benefits to be paid in the future for members in the Retirement System as of the valuation date.*

Reserve Account. An account used to indicate that funds have been set aside for a specific purpose and are not generally available for other uses.

Unfunded Actuarial Accrued Liability (UAAL). The difference between the actuarial accrued liability (AAL) and actuarial value of assets (AVA). The UAAL is sometimes referred to as "unfunded accrued liability." *Funding shortfall, or prefunded amount if negative.*

Valuation Date. The date that the actuarial valuation calculations are performed as of. *Also known as the "snapshot date".*

Appendix B: Detailed Tabulation of Member Data

Table B-1: The Number and Average Reported Compensation of Active Members Distributed by Age and Service as of December 31, 2019

Age	Years of Service										
	Under 1	1 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 & Up	Total
Under 25	2,961	4,479	16	0	0	0	0	0	0	0	7,456
	12,775	32,870	36,326	0	0	0	0	0	0	0	24,897
25 to 29	3,259	17,788	4,615	8	0	0	0	0	0	0	25,670
	12,042	38,024	44,531	33,669	0	0	0	0	0	0	35,894
30 to 34	2,119	12,294	13,728	3,124	24	0	0	0	0	0	31,289
	11,791	39,532	47,785	52,069	47,544	0	0	0	0	0	42,532
35 to 39	1,872	9,786	8,774	10,318	4,255	52	0	0	0	0	35,057
	12,063	41,508	49,714	55,513	59,184	51,227	0	0	0	0	48,271
40 to 44	1,566	8,723	7,648	7,433	9,678	3,711	15	0	0	0	38,774
	12,038	41,714	50,219	56,001	61,125	62,197	49,654	0	0	0	51,740
45 to 49	1,409	8,393	7,679	7,597	7,779	9,609	3,076	23	0	0	45,565
	12,278	41,943	48,522	53,745	57,665	63,360	65,299	61,421	0	0	52,889
50 to 54	1,113	7,216	7,037	7,513	7,565	6,849	6,574	1,169	7	0	45,043
	12,244	42,217	47,574	52,145	54,601	59,088	67,529	68,705	60,580	0	52,999
55 to 59	911	5,893	5,935	6,582	7,176	6,151	4,175	1,845	312	5	38,985
	12,527	42,145	47,094	49,206	51,582	53,340	61,965	68,755	71,941	65,836	50,525
60 to 64	439	3,582	4,176	4,893	4,933	4,389	2,442	1,166	497	144	26,661
	11,037	43,340	47,367	50,175	51,452	54,566	60,443	68,533	73,854	65,566	51,399
65 to 69	154	1,063	1,584	1,796	1,485	1,073	653	401	194	186	8,589
	11,135	42,918	48,213	52,552	56,893	58,344	64,015	70,132	90,099	83,642	54,505
70 & Over	68	432	485	572	520	306	198	101	63	128	2,873
	8,981	35,124	44,620	47,211	49,622	55,037	66,337	69,651	99,226	88,803	50,422
Total	15,871	79,649	61,677	49,836	43,415	32,140	17,133	4,705	1,073	463	305,962
	12,161	40,186	48,074	53,030	56,212	58,930	64,599	68,788	77,638	79,255	48,655

Appendix B: Detailed Tabulation of Member Data

Table B-2: The Number and Reported Compensation of Active Member Distributed by Age as of December 31, 2019

Age	Men		Women	
	Number	Compensation	Number	Compensation
18	2	16,454	6	26,156
19	26	364,492	25	298,421
20	92	1,877,010	71	1,014,519
21	200	4,339,782	224	3,715,993
22	327	7,985,217	684	12,671,224
23	663	16,978,701	1,773	38,681,942
24	940	28,355,220	2,423	69,308,510
25	1,196	40,275,444	2,954	93,337,855
26	1,334	46,825,524	3,443	114,545,842
27	1,450	53,958,075	3,699	130,274,713
28	1,609	61,899,133	3,974	146,310,131
29	1,740	70,622,225	4,271	163,344,060
30	1,878	76,679,623	4,340	170,250,229
31	1,862	80,507,456	4,401	177,606,479
32	1,810	80,915,540	4,341	180,422,406
33	1,887	87,367,916	4,374	186,501,408
34	1,925	93,539,840	4,471	196,999,981
35	2,043	99,413,847	4,617	206,375,440
36	2,056	103,314,378	4,659	214,226,102
37	2,138	110,507,505	4,865	230,080,413
38	2,155	113,381,201	5,130	245,435,390
39	2,170	116,163,419	5,224	253,348,015
40	2,253	124,561,085	5,303	258,192,864
41	2,212	124,545,516	5,380	269,267,662
42	2,324	131,155,671	5,508	275,178,770
43	2,323	133,660,479	5,704	282,855,549
44	2,282	132,134,654	5,485	274,628,608
45	2,431	141,136,542	5,872	295,124,387
46	2,552	147,178,587	5,942	299,904,440
47	2,613	154,631,240	6,202	311,193,353
48	2,873	168,423,165	6,695	341,496,064
49	3,086	182,492,449	7,299	368,333,586
50	2,933	180,670,512	7,134	365,664,499
51	2,775	171,424,045	6,708	340,665,729
52	2,631	156,906,683	6,170	305,025,561
53	2,494	146,557,820	6,004	297,287,632
54	2,498	146,754,639	5,696	276,268,224
55	2,418	136,799,994	5,605	268,372,365
56	2,387	135,834,392	5,580	269,276,402

Table B-2: The Number and Reported Compensation of Active Members Distributed by Age as of December 31, 2019 (continued)

Age	Men		Women	
	Number	Compensation	Number	Compensation
57	2,405	136,645,023	5,453	258,473,186
58	2,299	129,361,373	5,433	259,114,592
59	2,308	131,517,097	5,097	244,325,504
60	2,068	114,924,438	4,860	235,647,804
61	1,980	110,775,103	4,148	198,569,473
62	1,798	101,336,332	3,689	178,369,717
63	1,497	88,990,025	3,001	149,604,713
64	1,213	71,630,254	2,407	120,516,482
65	1,087	66,041,948	1,831	91,225,272
66	837	50,621,196	1,297	67,066,243
67	559	33,378,433	862	42,567,438
68	497	31,496,227	688	34,980,483
69	380	23,476,624	551	27,284,380
70	296	16,440,327	364	15,854,009
71	264	15,620,746	273	11,697,699
72	208	13,078,112	220	9,670,668
73	192	11,992,154	186	8,221,383
74	101	5,969,010	115	5,012,046
75	90	4,538,036	84	3,702,608
76	65	3,529,953	64	2,616,725
77	60	3,074,498	58	2,052,741
78	31	1,789,291	40	1,873,377
79	22	1,309,331	19	661,867
80	22	1,479,874	17	810,482
81	14	868,279	10	459,087
82	9	215,035	7	204,881
83	7	311,525	4	200,472
84	4	265,388	4	230,534
85	6	202,893	1	15,305
86	3	220,289	2	98,018
87	1	61,059	4	130,695
88	1	179,932	1	54,132
90	1	45,456	0	0
91	1	39,815	0	0
94	0	0	1	23,708
95	0	0	1	40,598
Total	92,914	4,981,580,551	213,048	9,904,887,246

Appendix B: Detailed Tabulation of Member Data

Table B-3: The Number and Reported Compensation of Active Members Distributed by Service as of December 31, 2019

Service	Men		Women	
	Number	Compensation	Number	Compensation
0	4,158	51,210,189	11,713	141,789,123
1	7,530	273,855,791	16,907	550,170,640
2	6,387	290,615,987	13,936	550,750,703
3	5,823	277,788,306	12,591	519,901,677
4	5,226	259,107,008	11,249	478,542,150
5	4,691	235,300,800	10,150	450,564,059
6	4,183	212,734,555	9,048	407,038,016
7	4,031	207,779,417	8,916	409,730,064
8	3,567	190,154,132	7,458	357,051,020
9	3,125	171,913,000	6,508	322,784,494
10	2,751	153,824,849	5,677	284,246,196
11	2,273	134,922,532	5,197	260,385,286
12	3,557	200,269,231	8,069	407,054,581
13	3,221	191,764,632	7,801	400,093,737
14	3,237	192,111,066	8,053	418,141,389
15	2,985	177,883,024	7,226	381,270,274
16	2,697	164,548,427	6,690	358,505,172
17	2,458	151,910,558	5,867	321,103,196
18	2,072	131,153,943	5,380	296,007,980
19	2,172	140,058,072	5,868	317,975,882
20	2,110	135,490,444	5,599	304,763,243
21	1,988	132,416,878	5,175	284,248,231
22	1,865	123,493,652	4,536	254,182,790
23	1,621	109,265,475	4,022	229,564,160
24	1,594	109,970,691	3,630	210,631,513
25	1,362	92,790,122	3,109	183,789,781
26	1,440	101,536,013	2,731	164,816,562
27	1,131	82,886,080	2,356	147,460,468
28	995	71,707,030	2,031	128,215,931
29	594	45,166,686	1,384	88,411,911
30	560	43,191,705	1,135	72,633,964
31	328	25,050,950	786	49,658,079
32	296	22,598,996	594	37,798,537
33	201	15,245,008	395	27,030,541
34	138	11,309,954	272	19,130,990
35	118	9,686,877	254	17,790,919

Table B-3: The Number and Reported Compensation of Active Members Distributed by Service as of December 31, 2019 (continued)

Service	Men		Women	
	Number	Compensation	Number	Compensation
36	95	8,451,974	179	12,212,660
37	74	7,142,563	113	8,160,684
38	43	4,271,493	80	6,473,211
39	51	4,678,658	66	4,436,389
40	31	3,155,267	65	4,028,263
41	38	3,803,470	62	4,175,620
42	18	1,958,544	53	3,506,325
43	17	1,449,119	33	2,615,651
44	12	1,221,554	17	1,380,346
45	9	624,962	13	1,221,275
46	11	907,177	17	1,076,066
47	6	576,381	8	459,945
48	10	928,252	7	474,165
49	2	322,718	6	411,859
50	5	534,203	9	612,042
51	2	285,794	0	0
52	3	352,952	2	114,269
53	1	100,870	0	0
57	0	0	1	50,447
58	0	0	2	104,803
59	1	102,520	0	0
60	0	0	1	66,133
64	0	0	1	73,834
Total	92,914	4,981,580,551	213,048	9,904,887,246

Appendix B: Detailed Tabulation of Member Data

Table B-4: The Number and Valuation Compensation of Disabled Members Distributed by Age as of December 31, 2019

Age	Men		Women	
	Number	Compensation	Number	Compensation
26	1	45,855	0	0
27	0	0	1	33,019
28	1	53,629	0	0
30	0	0	1	25,601
31	1	31,352	2	89,293
32	0	0	3	125,620
33	1	28,997	2	50,381
34	1	28,987	7	248,336
35	0	0	9	352,083
36	2	58,434	11	315,638
37	3	122,689	12	448,316
38	7	279,018	16	618,697
39	8	282,342	13	570,372
40	6	230,362	20	727,617
41	5	174,752	33	1,275,765
42	14	531,494	39	1,431,961
43	13	452,017	46	1,741,354
44	15	592,304	53	2,070,346
45	29	1,185,332	71	2,804,924
46	32	1,362,687	58	2,289,144
47	41	1,663,781	78	2,972,026
48	36	1,320,807	114	4,302,642
49	46	1,965,970	104	3,711,819
50	49	1,817,092	139	5,205,415
51	61	2,467,899	137	5,239,692
52	78	3,156,553	158	5,906,623

Table B-4: The Number and Valuation Compensation of Disabled Members Distributed by Age as of December 31, 2019 (continued)

Age	Men		Women	
	Number	Contributions	Number	Contributions
53	66	3,051,718	161	5,901,895
54	68	2,726,900	203	7,548,307
55	92	3,422,573	223	8,037,300
56	79	2,863,956	233	7,915,878
57	103	3,730,889	232	8,496,872
58	118	4,431,706	248	8,114,973
59	113	4,278,757	348	11,680,111
60	111	4,363,610	262	8,986,949
61	111	4,094,945	216	7,372,125
62	112	4,429,476	239	8,042,851
63	116	4,294,211	218	7,262,067
64	109	4,290,571	211	7,124,424
65	60	2,221,117	125	4,121,264
66	1	56,748	4	191,216
67	4	114,759	1	15,401
68	0	0	2	25,782
69	1	22,081	2	64,772
70	0	0	2	53,681
72	0	0	1	22,670
78	1	44,346	1	20,486
Total	1,715	66,290,716	4,059	143,555,708

Table B-5: The Number and Accumulated Contributions of Terminated Vested Members Distributed by Age as of December 31, 2019

Age	Men		Women	
	Number	Contributions	Number	Contributions
18	0	0	3	312
19	2	1,169	5	905
20	18	12,811	17	11,944
21	48	53,076	50	52,227
22	97	115,872	130	205,885
23	183	242,214	242	341,826
24	332	622,204	551	910,277
25	429	969,990	976	2,471,928
26	684	1,853,429	1,333	4,307,434
27	861	2,532,808	1,596	6,354,647
28	991	3,722,001	2,167	9,779,323
29	1,153	4,732,531	2,666	13,590,639
30	1,260	6,064,090	2,974	17,253,693
31	1,311	6,878,647	3,097	19,022,547
32	1,356	7,643,460	3,302	22,913,065
33	1,434	8,697,800	3,293	24,824,464
34	1,495	10,001,485	3,536	29,139,100
35	1,584	12,050,881	3,815	32,765,156
36	1,443	12,184,396	4,012	38,871,375
37	1,684	14,280,635	4,082	42,538,876
38	1,658	16,317,828	4,261	46,928,447
39	1,617	17,556,479	4,103	48,151,913
40	1,647	18,000,437	4,190	50,315,922
41	1,565	18,967,647	3,965	50,531,508
42	1,522	19,279,035	3,843	50,219,664
43	1,610	21,388,706	3,695	48,977,302
44	1,415	22,149,604	3,451	48,001,653
45	1,494	23,777,557	3,632	52,848,367
46	1,481	23,922,626	3,303	50,899,177
47	1,504	26,376,160	3,286	52,447,994
48	1,545	28,417,703	3,348	52,827,282
49	1,695	31,310,326	3,664	62,185,232
50	1,549	29,273,659	3,576	59,968,824
51	1,380	24,467,314	3,205	55,320,134
52	1,344	24,961,112	2,983	50,883,548
53	1,266	24,916,753	2,760	46,969,121
54	1,246	23,730,906	2,622	45,015,555
55	1,205	24,197,960	2,806	47,287,750
56	1,169	23,149,105	2,678	48,345,742
57	1,134	24,215,939	2,623	49,216,432
58	1,051	21,679,039	2,614	48,084,156
59	1,150	24,633,857	2,561	50,350,221

Table B-5: The Number and Accumulated Contributions of Terminated Vested Members Distributed by Age as of December 31, 2019 (continued)

Age	Men		Women	
	Number	Contributions	Number	Contributions
60	953	22,078,969	2,166	43,937,187
61	775	16,263,535	1,751	35,071,618
62	705	13,759,978	1,564	30,335,685
63	632	11,417,300	1,342	25,228,975
64	612	9,999,554	1,203	20,803,526
65	564	8,589,597	1,127	18,392,457
66	382	5,919,220	752	11,663,567
67	340	4,477,765	648	9,461,039
68	289	4,252,869	475	5,773,139
69	278	3,228,948	486	5,971,763
70	231	1,790,289	478	4,613,825
71	170	1,435,756	263	2,632,271
72	72	395,801	100	1,259,033
73	53	630,430	80	760,031
74	38	612,445	50	459,390
75	38	430,567	37	328,037
76	29	340,164	19	130,736
77	20	125,211	20	144,417
78	18	139,212	19	222,370
79	12	84,901	14	141,156
80	13	107,359	9	79,668
81	12	158,050	7	37,098
82	9	35,764	9	82,326
83	6	38,853	6	40,220
84	4	10,443	3	20,781
85	8	48,464	6	52,102
86	4	2,475	3	415
87	3	24,273	1	252
88	3	920	3	2,682
89	1	5,242	2	551
90	3	317,623	0	0
91	2	6,395	0	0
92	1	1	0	0
93	1	17,074	2	6,055
94	1	33	2	234
95	1	23,592	2	54
96	1	2,078	2	26
97	0	0	1	87
98	0	0	2	242
99	1	149	1	345
100+	1	1,393	4	326
Total	53,898	712,121,943	123,675	1,598,785,253

Appendix B: Detailed Tabulation of Member Data

Table B-6: The Number and Annual Retirement Allowances of Retired Members (Healthy at Retirement) and Survivors of Deceased Members Distributed by Age as of December 31, 2019

Age	Men		Women	
	Number	Allowances	Number	Allowances
<19	4	22,611	2	22,201
19	0	0	3	45,669
20	1	7,712	1	8,875
21	4	26,834	2	16,779
22	4	67,570	2	32,754
23	5	15,177	2	18,387
24	4	47,767	4	84,040
25	3	33,093	5	61,173
26	4	24,102	2	46,194
27	2	15,467	7	94,548
28	2	45,568	6	39,384
29	6	78,818	7	84,314
30	9	108,224	12	107,330
31	10	85,398	8	93,532
32	9	139,322	13	150,153
33	9	80,109	11	124,222
34	8	54,315	12	121,848
35	9	137,119	13	144,739
36	13	118,670	13	119,407
37	11	140,939	16	204,605
38	19	157,233	22	290,583
39	21	328,406	22	176,866
40	11	113,206	18	182,210
41	13	119,826	15	162,173
42	13	150,195	31	341,690
43	23	292,732	29	289,600
44	16	210,021	32	438,871
45	19	189,512	30	378,731
46	23	255,905	29	300,667
47	25	278,403	36	391,035
48	48	994,677	40	416,752
49	67	1,536,321	57	769,479
50	126	3,154,324	108	2,205,633
51	219	5,586,968	266	5,498,153
52	292	8,364,773	377	9,294,808
53	432	12,887,573	590	15,085,289
54	489	14,739,311	730	20,099,684
55	597	18,142,742	992	27,894,932
56	755	22,968,241	1,154	33,107,021
57	870	27,002,941	1,377	39,823,635
58	894	28,114,249	1,613	46,687,594
59	950	29,697,409	1,922	54,931,902
60	1,084	32,775,382	2,323	63,072,831

Appendix B: Detailed Tabulation of Member Data

Table B-6: The Number and Annual Retirement Allowances of Retired Members (Healthy at Retirement) and Survivors of Deceased Members Distributed by Age as of December 31, 2019 (continued)

Age	Men		Women	
	Number	Allowances	Number	Allowances
61	1,372	39,175,204	3,181	78,221,435
62	1,570	42,012,158	3,963	94,742,023
63	1,962	45,082,826	4,985	106,877,498
64	2,193	50,910,332	5,488	116,311,237
65	2,430	55,542,009	6,141	128,715,789
66	2,719	60,943,502	7,179	146,164,691
67	3,035	69,384,643	7,705	159,419,336
68	3,197	72,651,287	7,681	158,147,553
69	3,235	72,371,418	7,453	153,246,278
70	3,165	72,997,355	7,272	145,822,474
71	3,267	74,599,334	7,222	142,459,306
72	3,320	75,691,372	7,141	137,946,325
73	3,572	83,385,653	7,540	146,247,896
74	2,453	56,245,556	5,164	97,166,241
75	2,429	55,114,724	4,798	88,690,711
76	2,195	50,387,635	4,788	88,781,407
77	2,198	53,851,204	4,717	86,813,837
78	1,787	41,957,930	3,844	69,138,878
79	1,580	37,467,743	3,477	62,129,617
80	1,458	35,119,600	3,173	56,033,760
81	1,350	32,315,982	2,868	50,475,707
82	1,221	29,320,450	2,746	46,837,188
83	1,053	26,771,485	2,434	41,823,373
84	996	24,251,054	2,357	39,737,137
85	855	21,157,394	2,309	38,729,337
86	755	18,659,866	1,813	29,210,890
87	679	16,429,274	1,645	26,891,630
88	611	14,931,783	1,555	25,118,280
89	503	12,780,202	1,352	22,226,235
90	434	11,040,662	1,159	19,232,340
91	309	7,786,501	1,022	15,799,453
92	252	5,789,769	826	13,031,172
93	193	4,721,888	659	10,169,976
94	149	3,567,972	563	8,204,830
95	106	2,157,915	413	5,920,418
96	68	1,306,562	313	4,528,782
97	53	1,004,178	211	2,725,619
98	29	982,783	171	2,476,522
99	33	721,936	126	1,544,714
100+	19	325,728	243	3,305,575
Total	65,928	1,590,224,034	149,651	2,994,525,763

Appendix B: Detailed Tabulation of Member Data

Table B-7: The Number and Annual Retirement Allowances of Retired Members (Healthy at Retirement) and Survivors of Deceased Members Distributed by Annuity Type as of December 31, 2019

Annuity Type	Men		Women	
	Number	Allowances	Number	Allowances
0:Maximum	22,685	527,636,080	82,063	1,615,274,602
1:Option 1: 10-year guaranteed	573	16,488,743	2,363	40,034,713
2:Option 2: 100% joint and survivor	11,874	282,991,118	7,429	123,609,516
3:Option 3: 50% joint and survivor	3,430	100,764,504	3,455	71,561,713
4:Option 4: Social security leveling	9,027	225,007,030	23,727	531,103,449
5:Option 5- 2:100% joint and surv.	105	3,287,274	46	466,944
6:Option 5-3: 50% joint and surv.	66	2,194,612	70	1,305,176
7:Option 6-2: 100% joint and surv. w/ pop-up	10,224	255,723,774	10,807	226,996,391
8:Option 6-3: 50% joint and surv. w/ pop-up	4,243	129,759,596	7,673	194,103,154
9:Special	6	190,211	1	16,503
Survivors of Deceased Members	3,695	46,181,092	12,017	190,053,602
Total	65,928	1,590,224,034	149,651	2,994,525,763

Appendix B: Detailed Tabulation of Member Data

Table B-8: The Number and Annual Retirement Allowances of Retired Members (Disabled at Retirement) Distributed by Age of December 31, 2019

Age	Men		Women	
	Number	Allowances	Number	Allowances
50	4	76,746	3	51,103
51	5	89,849	3	43,359
52	9	186,940	4	98,479
53	11	244,109	15	361,370
54	17	309,760	7	166,316
55	27	577,999	29	655,915
56	34	777,680	35	711,707
57	38	829,157	53	1,142,294
58	39	788,557	72	1,555,478
59	34	731,147	75	1,590,508
60	59	1,325,355	96	1,978,504
61	88	1,723,797	168	3,194,851
62	101	2,103,260	180	3,685,296
63	108	2,166,383	189	3,597,561
64	110	2,202,154	269	5,315,429
65	159	2,919,197	372	6,733,968
66	218	3,718,203	526	8,928,012
67	237	4,062,996	548	9,797,603
68	253	4,376,440	585	10,479,168
69	252	4,365,582	621	10,872,263
70	261	4,377,754	546	9,292,095
71	249	4,265,648	519	9,442,840
72	290	5,249,516	521	8,925,775
73	255	4,762,455	534	9,218,966
74	179	3,173,974	371	6,179,915
75	144	2,459,626	369	5,889,288

Table B-8: The Number and Annual Retirement Allowances of Retired Members (Disabled at Retirement) Distributed by Age of December 31, 2019 (continued)

Age	Men		Women	
	Number	Allowances	Number	Allowances
76	134	2,199,573	330	4,865,151
77	136	2,376,963	324	5,215,791
78	98	1,793,487	255	3,876,018
79	90	1,400,154	198	2,681,537
80	99	1,521,337	156	2,206,052
81	49	686,182	164	2,166,264
82	56	842,020	148	1,937,397
83	31	433,999	79	1,138,953
84	25	468,277	66	808,788
85	20	315,740	40	546,122
86	11	189,034	47	680,246
87	12	281,945	35	392,655
88	13	221,306	23	289,539
89	14	148,967	28	338,376
90	4	37,961	20	263,296
91	3	66,947	18	216,454
92	3	41,025	12	150,494
93	4	30,035	16	258,592
94	4	46,364	14	173,786
95	4	29,511	5	20,751
96	0	0	10	77,696
97	2	34,462	8	76,868
98	1	6,805	0	0
99	0	0	1	3,783
100+	0	0	11	99,626
Total	3,994	71,036,378	8,718	148,392,298

Appendix B: Detailed Tabulation of Member Data

Table B-9: The Number and Annual Retirement Allowances of Retired Members (Disabled at Retirement) Distributed by Annuity Type of December 31, 2019

Annuity Type	Men		Women	
	Number	Allowances	Number	Allowances
0:Maximum	2,006	38,060,565	6,193	108,585,930
1:Option 1: 10-year guaranteed	58	1,112,172	217	3,255,058
2:Option 2: 100% joint and survivor	772	10,918,883	640	8,475,427
3:Option 3: 50% joint and survivor	206	3,911,065	280	4,300,013
4:Option 4: Social security leveling	141	3,122,009	404	7,266,818
5:Option 5-2: 100% joint and surv.	2	25,156	1	8,214
6:Option 5-3: 50% joint and surv.	1	14,645	0	0
7:Option 6-2: 100% joint and surv. w/ pop-up	579	9,245,523	585	9,068,372
8:Option 6-3: 50% joint and surv. w/ pop-up	229	4,626,360	397	7,411,504
9:Special	0	0	1	20,962
Total	3,994	71,036,378	8,718	148,392,298

Appendix B: Detailed Tabulation of Member Data

Table B-10: The Number and Annual Retirement Allowances of Retired Members and Survivors of Deceased Members Distributed by Amount of Annual Retirement Allowance of December 31, 2019

Amount of Annual Retirement Allowance	Number of Retired Members and Survivors	Sum of Annual Retirement Allowances
$0 -$ 4,999	30,841	$ 91,757,183
$5,000 - $9,999	37,176	275,383,516
$10,000 - $14,999	31,313	389,396,480
$15,000 - $19,999	24,944	433,861,125
$20,000 - $24,999	22,207	500,321,038
$25,000 - $29,999	21,910	601,894,392
$30,000 - $34,999	20,701	670,772,259
$35,000 - $39,999	14,642	546,501,167
$40,000 -$ 44,999	9,057	382,996,062
$45,000 - $49,999	5,370	253,742,275
$50,000 & over	10,130	657,552,976
Total	228,291	$ 4,804,178,473

Appendix C: Summary of Main Benefit & Contribution Provisions

A summary of the main benefit provisions of the Retirement System and of the sources of revenue from which benefits are paid is presented in the following digest. Items in parentheses in the text are the provisions applicable to law enforcement officers.

"Average final compensation" as used in the summary means the average annual compensation during the four consecutive years of membership service which afford the highest such average. "Membership service" means service represented by regular contributions. "Creditable service" means membership service and may also include certain special purchased service.

BENEFITS

Unreduced Retirement Allowance

Condition for Allowance

An unreduced retirement allowance is payable to any member who retires from service:

(a) after age 65 (55) and completion of five years of creditable service;

(b) after age 60 and completion of 25 years of creditable service (not applicable to law enforcement officers); or

(c) after completion of 30 years of creditable service.

Amount of Allowance

1.82% of average final compensation multiplied by the number of years of creditable service. In no event will a member whose creditable service commenced on or before June 30, 1963 receive a smaller retirement allowance than he would have received under the benefit provisions of the system in effect on that date.

Reduced Retirement Allowance

Condition for Allowance	A reduced retirement allowance is payable to any member who retires from service prior to becoming eligible for an unreduced retirement allowance but after age 60 and completion of five years of membership service (age 55 and five years of creditable service).
Amount of Allowance	The member's reduced retirement allowance is equal to 1.82% of average final compensation multiplied by the number of years of creditable service at date of retirement reduced by 1/4 of 1% for each month by which the member's age at retirement is less than age 65. In no event will a member whose creditable service commenced on or before June 30, 1963 receive a smaller retirement allowance than he or she would have received under the benefit provisions of the system in effect on that date.

OR

Condition for Allowance	A reduced retirement allowance is payable to any member who retires from service after age 50 and completion of 20 (15) years of creditable service, but prior to becoming eligible for a reduced or unreduced retirement allowance.
Amount of Allowance	The member's reduced retirement allowance is equal to 1.82% of average final compensation multiplied by the number of years of creditable service at date of retirement reduced by the lesser of: (i) 5/12 (1/3) of 1% for each month by which his age is less than 60 (55), plus, if the member is not a law enforcement officer, 1/4 of 1% for each month by which age 60 is less than 65. (ii) 5% times the difference between 30 years and creditable service at retirement.

OR

Condition for Allowance	A reduced retirement allowance is payable to any law enforcement officer who retires from service at any age with 25 years of service (15 years as an officer), but prior to becoming eligible for a reduced or unreduced retirement allowance.
Amount of Allowance	The member's reduced retirement allowance is equal to 1.82% of average final compensation multiplied by the number of years of creditable service at date of retirement reduced by the lesser of: (i) 1/3 of 1% for each month by which his age is less than 55, (ii) 5% times the difference between 30 years and creditable service at retirement plus 4% times the difference between age 50 and the member's age at retirement.

Deferred Retirement Allowance	Any member who separates from service after completing five or more years of membership service prior to becoming eligible for an unreduced or reduced retirement allowance and who leaves his or her total accumulated contributions in the system may receive a deferred retirement allowance, beginning at age 60 (55), computed in the same way as a reduced retirement allowance, or, if the member has 20 (15) or more years of service, at age 50 computed in the same way as a reduced service retirement allowance, on the basis of creditable service and compensation to the date of separation.
Return of Contributions	Upon the withdrawal of a member without a retirement allowance and upon his or her request, the member's contributions are returned, together with accumulated regular interest. Upon the death of a member before retirement, his or her contributions, together with the full accumulated regular interest thereon, are paid to the estate or to person(s) designated by the member unless the designated beneficiary, if eligible, elects the survivor's alternate benefit described below. The current interest rate on member contributions is 4%.
Survivor's Alternate Benefit	Upon the death of a member in service who has met conditions (a) or (b) below, his designated beneficiary may elect to receive a benefit equal to that which would have been payable under the provisions of Option 2 had the member retired on the first day of the month following his death and elected such option, in lieu of the member's accumulated contributions, provided the member had not instructed the Board of Trustees in writing that he or she did not wish the alternate benefit to apply. (a) age 60 (55) and completion of five years of membership (creditable) service; or (b) completion of 20 years of creditable service. Members receiving a benefit from the Disability Income Plan are eligible for this benefit.
Death After Retirement	Upon the death of a beneficiary who did not retire under an effective election of Option 2, 3, 5 or 6, an amount equal to the excess if any, of the member's accumulated contributions at retirement over the retirement allowance payments received is paid to a designated person or to the beneficiary's estate.

Upon the death of the survivor of a beneficiary who retired under an effective election of Option 2, 3, 5 or 6, an amount equal to the excess, if any, of the beneficiary's accumulated contributions at retirement over the total retirement allowance payments received is paid to such other person designated by the beneficiary or to the beneficiary's estate.

Upon the death of a beneficiary, a benefit may be provided by the Retirees' Contributory Death Benefit Plan.

Other Death Benefits

Upon the death of a member in service, other benefits may be provided by the Death Benefit Plan or Separate Insurance Benefit Plan for Law Enforcement Officers.

Optional Arrangements at Retirement

In lieu of the full retirement allowance, any member may elect to receive a reduced retirement allowance equal in value to the full allowance, with the provision that:

Option 1 - A member retiring prior to July 1, 1993, may elect that at his or her death within 10 years from retirement date, an amount equal to the member's accumulated contributions at retirement, less 1/120 for each month he or she has received a retirement allowance, is paid to the estate, or to a person(s) designated by the member, or

Option 2 - At the death of the member his or her allowance shall be continued throughout the life of such other person as the member shall have designated at the time of retirement, or

Option 3 - At the death of the member one-half of his or her allowance shall be continued throughout the life of such other person as the member shall have designated at the time of retirement.

Option 4 - A member may elect to receive a retirement allowance in such amount that, together with his Social Security benefit, he or she will receive approximately the same income per annum before and after the earliest age at which he or she becomes eligible to receive the Social Security benefit.

Option 5 - A member retiring prior to July 1, 1993 may elect to receive a reduced retirement allowance under the provisions of Option 2 or Option 3 in conjunction with the provisions of Option 1.

Option 6 - A member may elect either Option 2 or Option 3 with the added provision that in the event the designated beneficiary predeceases the member, the retirement allowance payable to the member after the designated beneficiary's death shall be equal to the retirement allowance which would have been payable had the member not elected the option.

Post-Retirement Increases in Allowances	Future increases in allowances may be granted at the discretion of the State.
Service Reciprocity	For the purpose of determining eligibility for a deferred, reduced or unreduced service retirement allowance, the membership and creditable service of a member shall include such prior service earned as a member of the Local Governmental Employees' Retirement System (LGERS), the Consolidated Judicial Retirement System (CJRS), or the Legislative Retirement System (LRS). In addition, if the member's accumulated contributions and reserves are transferred from the prior System to this System, the creditable service earned as a member of the prior System may be included for purposes of determining the amount of benefits payable under this System.
Military Service	Periods of active duty in the United States military may be counted as creditable service if the member was an employee upon entering the military and returned to employment within two years of discharge or for a period of 10 additional years.
Service Purchases	Additional creditable service may include service that the member purchased to restore a period of service for which the member (1) received a refund of contributions, (2) had a leave of absence for educational purposes, extended illness or parental or maternity reasons, (3) had full-time temporary or part-time local or State government employment, (4) was in a probationary or waiting period with a unit of the LGERS, (5) had a leave of absence under Workers' Compensation, (6) performed service with a unit of local government not covered by LGERS, (7) performed service with the federal government not covered by any other retirement system, (8) performed service with a public community service entity funded entirely with federal funds, (9) performed service as a member of the General Assembly, (10) performed service as a member of a charter school not participating in the system, (11) was employed by The University of North Carolina and participated in the Optional Retirement Program but not eligible to receive any benefits from that program, or (12) performed service which was omitted by reason of error.
Unused Sick Leave	Unused sick leave counts as creditable service at retirement. Sick leave which was converted from unused vacation leave is also creditable. One month of credit is allowed for each 20 days of unused sick leave, plus an additional month for any part of 20 days left over.

Transfer of Defined Contribution Balances (Special Retirement Allowances)

A member may make a one-time election to transfer any portion of their eligible accumulated contributions to this plan on or after retirement. Eligible accumulated contributions are those from the Supplemental Retirement Income Plan or Public Employee Deferred Compensation Plan, not including Roth after-tax contributions. A member who became a member of the Supplemental Retirement Income Plan prior to retirement and who remains a member of the Supplemental Retirement Income Plan may also make a one-time election to transfer eligible balances, not including any Roth after-tax contributions, from any of the following plans to the Supplemental Retirement Income Plan, subject to the applicable requirements of the Supplemental Retirement Income Plan, and then through the Supplemental Retirement Income Plan to this Retirement System:

(1) A plan participating in the North Carolina Public School Teachers' and Professional Educators' Investment Plan.

(2) A plan described in section 403(b) of the Internal Revenue Code.

(3) A plan described in section 457(b) of the Internal Revenue Code that is maintained by a state, political subdivision of a state, or any agency or instrumentality of a state or political subdivision of a state.

(4) An individual retirement account or annuity described in Section 408(a) or 408(b) of the Internal Revenue Code that is eligible to be rolled over and would otherwise be includible in gross income.

(5) A tax-qualified plan described in section 401(a) or 403(a) of the Internal Revenue Code.

The member may elect to convert the accumulated contributions to a life annuity with or without annual increases equal to the annual increase in the U.S. Consumer Price Index. Any ad-hoc COLA increases granted will not apply to benefits under this section. A member may elect Options 2, 3, or 6 under the Plan and may also elect either a guaranteed number of months of payments or a guarantee of total payments at least equal to the amount of contributions transferred to the Plan. In addition, any transfer may be paid in whole or in part with employer contributions paid directly to the Retirement System at the time of transfer.

Contributions

Member Contributions	Each member contributes 6% of his or her compensation.
Employer Contributions	Employers make annual contributions consisting of a normal contribution and an accrued liability contribution. The normal contribution covers the liability on account of current service and is determined by the actuary after each valuation. The accrued liability contribution covers the past service liability that exceeds the actuarial value of assets. The minimum total employer contribution rate is 6.00%.
Changes Since Prior Valuation	None.

Appendix D: Actuarial Assumptions and Methods

Assumptions are based on the experience investigation prepared as of December 31, 2014 and adopted by the Board of Trustees on January 21, 2016 for use beginning with the December 31, 2015 annual actuarial valuation. The interest rate of 7.00% was adopted by the Board of Trustees on April 26, 2018.

Interest Rate: 7.00% per annum, compounded annually.

Inflation: Both general and wage inflation are assumed to be 3.00% per annum.

Real Wage Growth: 0.50% per annum.

Payroll Growth: 3.50% per annum.

Separations from Active Service: Representative values of the assumed rates of separation from active service are as follows:

Annual Rates of Withdrawal

	General Employees		Teachers, Librarians and Counselors		Law Enforcement Officers		Other Education	
Service	Male	Female	Male	Female	Male	Female	Male	Female
0	.180	.195	.190	.170	.130	.130	.190	.165
1	.155	.170	.160	.145	.100	.100	.160	.135
2	.130	.145	.140	.135	.090	.090	.130	.120
3	.110	.115	.120	.120	.060	.060	.115	.100
4	.090	.100	.095	.100	.060	.060	.100	.085

General Employees

	Annual Rates of					
Age	Withdrawal and Vesting*		Base Mortality**		Disability	
	Male	Female	Male	Female	Male	Female
25	.0800	.1100	.0005	.0002	.0002	.0002
30	.0700	.0850	.0005	.0002	.0004	.0004
35	.0525	.0600	.0005	.0003	.0010	.0010
40	.0400	.0450	.0006	.0004	.0030	.0018
45	.0350	.0375	.0010	.0007	.0050	.0032
50	.0350	.0375	.0017	.0011	.0084	.0050
55	.0350	.0375	.0028	.0017	.0144	.0088
60	.0350	.0375	.0047	.0024	.0240	.0138
65			.0083	.0037		
69			.0125	.0057		

* These rates apply only after five years of membership in the system.

** Base mortality rates as of 2014.

Appendix D: Actuarial Assumptions and Methods

Teachers, Librarians and Counselors

Age	Annual Rates of Withdrawal and Vesting*		Base Mortality**		Disability	
	Male	Female	Male	Female	Male	Female
25	.0800	.0900	.0003	.0001	.0001	.0002
30	.0700	.0750	.0003	.0002	.0001	.0003
35	.0450	.0450	.0004	.0002	.0003	.0006
40	.0350	.0340	.0004	.0003	.0007	.0010
45	.0325	.0325	.0007	.0006	.0014	.0018
50	.0325	.0325	.0012	.0009	.0023	.0032
55	.0325	.0325	.0020	.0014	.0047	.0055
60	.0325	.0325	.0033	.0021	.0077	.0102
65			.0058	.0031		
69			.0092	.0049		

* These rates apply only after five years of membership in the system.

** Base mortality rates as 2014.

Other Education Employees

Age	Annual Rates of Withdrawal and Vesting*		Base Mortality**		Disability	
	Male	Female	Male	Female	Male	Female
25	.0800	.1200	.0003	.0001	.0002	.0002
30	.0600	.0700	.0003	.0002	.0004	.0004
35	.0450	.0450	.0004	.0002	.0010	.0010
40	.0400	.0400	.0004	.0003	.0030	.0018
45	.0400	.0375	.0007	.0006	.0050	.0032
50	.0400	.0375	.0012	.0009	.0084	.0050
55	.0400	.0375	.0020	.0014	.0144	.0088
60	.0400	.0375	.0033	.0021	.0240	.0138
65			.0058	.0031		
69			.0092	.0049		

* These rates apply only after five years of membership in the system.

** Base mortality rates as 2014.

Law Enforcement Officers

Age	Annual Rates of Withdrawal and Vesting*		Base Mortality**		Disability	
	Male	Female	Male	Female	Male	Female
25	.0400	.0400	.0005	.0002	.0033	.0033
30	.0350	.0350	.0005	.0002	.0043	.0043
35	.0300	.0300	.0005	.0003	.0060	.0060
40	.0300	.0300	.0006	.0004	.0079	.0079
45	.0400	.0400	.0010	.0007	.0110	.0110
50	.0400	.0400	.0017	.0011	.0176	.0176
55	.0400	.0400	.0028	.0017		
60	.0400	.0400	.0047	.0024		
65			.0083	.0037		
69			.0125	.0057		

* These rates apply only after five years of membership in the system.

** Base mortality rates as of 2014.

Retirements: Representative values of the assumed rates of retirement from active service are as follows:

General Employees - Male

Age	Service 5	10	15	20	25	30	35
50				0.0350	0.0800	0.3500	0.2000
55				0.0500	0.1000	0.3500	0.2000
60	0.0850	0.0850	0.0850	0.0850	0.2750	0.3000	0.2250
65	0.2500	0.2750	0.2750	0.2750	0.2750	0.2750	0.2750
70	0.3250	0.2250	0.2250	0.2250	0.2250	0.2250	0.2250
75	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

General Employees - Female

Age	Service 5	10	15	20	25	30	35
50				0.0350	0.0600	0.4000	0.3000
55				0.0500	0.0800	0.3250	0.2250
60	0.0950	0.0950	0.0950	0.0950	0.2500	0.3000	0.2000
65	0.4000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
70	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
75	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Teachers, Librarians and Counselors - Male

	Service						
Age	5	10	15	20	25	30	35
50				0.0250	0.0650	0.3000	0.3000
55				0.0450	0.0900	0.3250	0.2500
60	0.1200	0.1200	0.1200	0.1200	0.3000	0.2500	0.2500
65	0.3000	0.3250	0.3250	0.3250	0.2000	0.2000	0.2000
70	0.2250	0.2250	0.2250	0.2250	0.2250	0.2250	0.2250
75	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Teachers, Librarians and Counselors - Female

	Service						
Age	5	10	15	20	25	30	35
50				0.0350	0.0550	0.2750	0.2750
55				0.0600	0.0950	0.4000	0.3000
60	0.1350	0.1350	0.1350	0.1350	0.4500	0.5000	0.3250
65	0.3500	0.3750	0.3750	0.3750	0.3500	0.3500	0.3500
70	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
75	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Other Education Employees - Male

	Service						
Age	5	10	15	20	25	30	35
50				0.0350	0.0800	0.3000	0.1500
55				0.0400	0.1000	0.2500	0.2000
60	0.0900	0.0900	0.0900	0.0900	0.2250	0.2500	0.2500
65	0.2750	0.3000	0.3000	0.3000	0.2750	0.2750	0.2750
70	0.2250	0.2250	0.2250	0.2250	0.2250	0.2250	0.2250
75	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Other Education Employees - Female

	Service						
Age	5	10	15	20	25	30	35
50				0.0400	0.0550	0.3250	0.2250
55				0.0500	0.0900	0.2250	0.2250
60	0.1100	0.1100	0.1100	0.1100	0.2500	0.2500	0.2500
65	0.2500	0.2750	0.2750	0.2750	0.3500	0.3500	0.3500
70	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500
75	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Law Enforcement Officers

	Service						
Age	5	10	15	20	25	30	35
50			0.0900	0.0900	0.0900	0.6000	0.6000
55	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
60	0.2000	0.2000	0.2000	0.2000	0.2000	0.5000	0.5000
65	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500
70	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
75	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Salary Increases: Representative values of the assumed annual rates of salary increases are as follows:

	Annual Rate of Salary Increase			
Service	Teachers, Librarians and Counselors	Other Education Employees	General Employees	Law Enforcement Officers
0	7.55%	7.00%	5.50%	8.10%
5	6.05	6.25	4.50	6.10
10	5.10	5.50	4.00	4.40
15	4.35	4.75	3.50	3.95
20	3.65	4.00	3.50	3.65
25 or more	3.50	3.50	3.50	3.50

Appendix D: Actuarial Assumptions and Methods

Post-Retirement Mortality: Representative values of the assumed post-retirement mortality rates as of 2014 prior to any mortality improvements are as follows:

Annual Rate of Death after Retirement

(Members Healthy at Retirement)

Age	Teachers & Other Education Employees		General Employees		Law Enforcement Officers	
	Male	Female	Male	Female	Male	Female
55	.0036	.0021	.0062	.0029	.0057	.0036
60	.0048	.0030	.0084	.0042	.0078	.0052
65	.0070	.0051	.0119	.0065	.0110	.0080
70	.0114	.0082	.0181	.0104	.0168	.0129
75	.0196	.0137	.0290	.0170	.0268	.0209
80	.0448	.0329	.0555	.0394	.0447	.0348

Annual Rate of Death after Retirement

(Survivors of Deceased Members and Members Disabled at Retirement)

Age	Male Survivors of Deceased Members	Female Survivors of Deceased Members	Male Retired Members Disabled at Retirement	Female Retired Members Disabled at Retirement
55	.0071	.0045	.0241	.0143
60	.0096	.0064	.0274	.0168
65	.0135	.0099	.0326	.0207
70	.0206	.0158	.0416	.0279
75	.0330	.0258	.0559	.0406
80	.0550	.0429	.0789	.0604

Deaths After Retirement (General Employees): Mortality rates are based on the RP-2014 Total Data Set for Healthy Annuitants Mortality Table. Rates for male members are multiplied by 108% for ages 50-78 and by 124% for ages greater than 78. Rates for female members are multiplied by 81% for ages 50-78 and by 113% for ages greater than 78. The RP-2014 annuitant tables have no rates prior to age 50. The RP-2014 Total Data Set Employee Mortality Table (with no adjustments) is used for ages less than 50.

Deaths After Retirement (Teachers and Other Education Employees): Mortality rates are based on the RP-2014 Total Data Set for Healthy Annuitants Mortality Table (with White-Collar Adjustment). Rates for male members are multiplied by 92% for ages 50-78 and by 120% for ages greater than 78. Rates for female members are multiplied by 78% for ages 50-78 and by 108% for ages greater than 78. The RP-2014 annuitant tables have no rates prior to age 50. The RP-2014 Total Data Set Employee Mortality Table (with White Collar Adjustment) is used for ages less than 50.

Deaths After Retirement (Law Enforcement Officers): Mortality rates are based on the RP-2014 Total Data Set for Healthy Annuitants Mortality Table. The RP-2014 annuitant tables have no rates prior to age 50. The RP-2014 Total Data Set Employee Mortality Table (with no adjustments) is used for ages less than 50.

Appendix D: Actuarial Assumptions and Methods

Deaths After Retirement (Survivors of Deceased Members): Mortality rates are based on the RP-2014 Total Data Set for Healthy Annuitants Mortality Table. Rates for all members are multiplied by 123% for ages greater than 50. The RP-2014 annuitant tables have no rates prior to age 50. The RP-2014 Total Data Set Employee Mortality Table (with no adjustments) is used for ages less than 50.

Deaths After Retirement (Disabled Members at Retirement): Mortality rates are based on the RP-2014 Total Data Set for Disabled Annuitants Mortality Table. Rates for male members are multiplied by 103% for all ages. Rates for female members are multiplied by 99% for all ages.

Deaths Prior to Retirement: Mortality rates are based on the RP-2014 Total Data Set Employee Mortality Table for general employees and law enforcement officers. Mortality rates are based on the RP-2014 White Collar Employee Mortality Table for teachers and other education employees.

Mortality Projection: All mortality rates are projected from 2014 using generational improvement with Scale MP-2015.

Timing of Assumptions: All withdrawals, deaths, disabilities, retirements and salary increases are assumed to occur July 1 of each year.

Leave Conversions: Sick leave can be converted to increase creditable service and used to meet the eligibility requirements for retirement. Unused vacation leave can be converted to increase creditable service or compensation, but does not add to the eligibility service. The assumed impact of these conversions is shown in the table below.

	Teachers, Librarians and Counselors		General		Law Enforcement		Other Education Employees	
	Males	Females	Males	Females	Males	Females	Males	Females
Increase in AFC	2.00%	2.00%	2.50%	2.50%	1.75%	1.75%	1.75%	1.75%
Increase in Creditable Service (years)								
Credited	1.10	0.85	1.00	0.70	1.50	1.50	1.30	1.00
Eligibility	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Liability for Inactive Members: The data provided for inactive members does not contain all the elements to calculate the member's deferred benefit. The liability for these members is estimated to be 200% of the member's accumulated contributions. The actuary is collecting data so that future members' deferred benefits can be estimated.

Administrative Expenses: 0.10% of payroll added to the normal cost rate.

Marriage Assumption: 100% married with male spouses four years older than female spouses.

Appendix D: Actuarial Assumptions and Methods

Reported Compensation: Calendar year compensation as furnished by the system's office.

Valuation Compensation: Reported compensation adjusted to reflect the assumed rate of pay as of the valuation date.

Actuarial Cost Method: Entry age normal cost method. Entry age is established on an individual basis.

Normal Cost: Normal cost rate reflects the impact of new entrants during the year.

Amortization Period: 12-year closed, level-dollar amount. The first amortization base was created for the contribution payable for fiscal year ending 2012.

Asset Valuation Method: Actuarial value, as developed in Table 8. The actuarial value of assets is based upon a smoothed market value method. Under this method, asset returns in excess of or less than the expected return on market value of assets will be reflected in the actuarial value of assets over a five-year period. The Actuarial Value of Assets was reset to the market value of assets at December 31, 2014. The calculation of the Actuarial Value of Assets is based on the following formula:

$MV - 80\% \times G/(L)_1 - 60\% \times G/(L)_2 - 40\% \times G/(L)_3 - 20\% \times G/(L)_4$

MV = the market value of assets as of the valuation date

$G/(L)_i$ = the asset gain or (loss) for the i-th year preceding the valuation date

Changes Since Prior Valuation: None.

Appendix E: GASB 67 Fiduciary Net Position Projection

Table E-1: Projection of Fiduciary Net Positions (in thousands)

Calendar Year	Beginning Fiduciary Position	Member Contributions	Employer Contributions*	Benefit Payments	Administrative Expenses	Investment Earnings	Ending Fiduciary Position
2020	$ 75,486,780	$ 966,734	$ 2,152,016	$ 5,468,714	$ 16,112	$ 5,202,663	$ 78,323,367
2021	78,323,367	915,250	2,354,442	5,612,077	15,254	5,401,514	81,367,241
2022	81,367,241	871,588	2,383,386	5,756,995	14,526	5,609,117	84,459,812
2023	84,459,812	831,742	2,252,899	5,906,783	13,862	5,814,605	87,438,413
2024	87,438,413	794,469	2,007,774	6,061,474	13,241	6,008,090	90,174,031
2025	90,174,031	759,151	1,722,694	6,230,960	12,653	6,182,747	92,595,010
2026	92,595,010	724,607	1,531,863	6,416,671	12,077	6,338,091	94,760,822
2027	94,760,822	689,805	1,433,434	6,605,374	11,497	6,478,640	96,745,830
2028	96,745,830	655,021	1,404,938	6,796,885	10,917	6,608,844	98,606,832
2029	98,606,832	620,160	1,395,625	6,991,539	10,336	6,730,917	100,351,658
2030	100,351,658	585,000	1,204,183	7,186,827	9,750	6,838,558	101,782,822
2031	101,782,822	549,822	865,242	7,378,853	9,164	6,919,280	102,729,148
2032	102,729,148	514,818	529,572	7,566,246	8,580	6,966,341	103,165,053
2033	103,165,053	479,876	479,876	7,746,184	7,998	6,987,771	103,358,394
2034	103,358,394	445,362	445,362	7,915,518	7,423	6,993,123	103,319,300
2035	103,319,300	411,603	411,603	7,584,321	6,860	6,999,478	103,550,803
2036	103,550,803	378,494	378,494	7,730,749	6,308	7,008,386	103,579,120
2037	103,579,120	346,370	346,370	7,866,262	5,773	7,003,513	103,403,338
2038	103,403,338	315,155	315,155	7,982,732	5,253	6,985,070	103,030,733
2039	103,030,733	286,201	286,201	8,080,252	4,770	6,953,657	102,471,770
2040	102,471,770	258,461	258,461	8,166,924	4,308	6,909,654	101,727,113
2041	101,727,113	231,221	231,221	8,245,160	3,854	6,852,977	100,793,518
2042	100,793,518	204,647	204,647	8,315,844	3,411	6,783,380	99,666,937
2043	99,666,937	178,239	178,239	8,377,541	2,971	6,700,594	98,343,497
2044	98,343,497	152,636	152,636	8,425,396	2,544	6,604,560	96,825,390
2045	96,825,390	128,238	128,238	8,455,562	2,137	6,495,589	95,119,756
2046	95,119,756	105,743	105,743	8,465,358	1,762	6,374,323	93,238,444
2047	93,238,444	85,120	85,120	8,452,776	1,419	6,241,656	91,196,145
2048	91,196,145	66,537	66,537	8,417,505	1,109	6,098,641	89,009,247
2049	89,009,247	49,712	49,712	8,357,086	829	5,946,489	86,697,245
2050	86,697,245	35,872	35,872	8,260,445	598	5,787,029	84,294,975
2051	84,294,975	26,215	26,215	8,127,655	437	5,622,781	81,842,094
2052	81,842,094	19,455	19,455	7,968,628	324	5,456,089	79,368,141
2053	79,368,141	14,377	14,377	7,790,122	240	5,288,708	76,895,242
2054	76,895,242	10,589	10,589	7,595,647	176	5,122,038	74,442,635
2055	74,442,635	7,774	7,774	7,387,313	130	4,957,332	72,028,073
2056	72,028,073	5,683	5,683	7,166,342	95	4,795,773	69,668,775
2057	69,668,775	4,143	4,143	6,934,493	69	4,638,495	67,380,993
2058	67,380,993	3,006	3,006	6,690,564	50	4,486,665	65,183,056
2059	65,183,056	2,173	2,173	6,440,232	36	4,341,366	63,088,501
2060	63,088,501	1,567	1,567	6,186,374	26	4,203,441	61,108,676
2061	61,108,676	1,123	1,123	5,930,601	19	4,073,624	59,253,926
2062	59,253,926	801	801	5,674,089	13	3,952,595	57,534,021
2063	57,534,021	564	564	5,417,666	9	3,841,009	55,958,483
2064	55,958,483	393	393	5,161,965	7	3,739,507	54,536,805
2065	54,536,805	269	269	4,907,533	4	3,648,736	53,278,542
2066	53,278,542	180	180	4,654,908	3	3,569,344	52,193,335
2067	52,193,335	118	118	4,404,650	2	3,501,986	51,290,904
2068	51,290,904	75	75	4,157,289	1	3,447,324	50,581,089
2069	50,581,089	46	46	3,913,393	1	3,406,027	50,073,814
2070	50,073,814	26	26	3,673,530	-	3,378,770	49,779,105
2071	49,779,105	13	13	3,438,294	-	3,366,233	49,707,071

*Employer contributions are not less than 6.00% of payroll in accordance with G.S. 135-8(d)(1a).

Appendix E: GASB 67 Fiduciary Net Position Projection

Table E-1: Projection of Fiduciary Net Positions (in thousands) (continued)

Calendar Year	Beginning Fiduciary Position	Member Contributions	Employer Contributions*	Benefit Payments	Administrative Expenses	Investment Earnings	Ending Fiduciary Position
2072	$ 49,707,071	$ 6	$ 6	$ 3,208,275	$ -	$ 3,369,105	$ 49,867,913
2073	49,867,913	2	2	2,984,022	-	3,388,080	50,271,974
2074	50,271,974	1	1	2,766,061	-	3,423,864	50,929,779
2075	50,929,779	-	-	2,554,877	-	3,477,176	51,852,079
2076	51,852,079	-	-	2,350,918	-	3,548,755	53,049,916
2077	53,049,916	-	-	2,154,613	-	3,639,358	54,534,661
2078	54,534,661	-	-	1,966,344	-	3,749,768	56,318,085
2079	56,318,085	-	-	1,786,423	-	3,880,799	58,412,461
2080	58,412,461	-	-	1,615,122	-	4,033,299	60,830,638
2081	60,830,638	-	-	1,452,686	-	4,208,161	63,586,113
2082	63,586,113	-	-	1,299,328	-	4,406,321	66,693,106
2083	66,693,106	-	-	1,155,231	-	4,628,768	70,166,643
2084	70,166,643	-	-	1,020,539	-	4,876,550	74,022,654
2085	74,022,654	-	-	895,345	-	5,150,779	78,278,088
2086	78,278,088	-	-	779,687	-	5,452,639	82,951,039
2087	82,951,039	-	-	673,537	-	5,783,398	88,060,899
2088	88,060,899	-	-	576,805	-	6,144,416	93,628,511
2089	93,628,511	-	-	489,341	-	6,537,158	99,676,328
2090	99,676,328	-	-	410,930	-	6,963,204	106,228,602
2091	106,228,602	-	-	341,286	-	7,424,259	113,311,575
2092	113,311,575	-	-	280,056	-	7,922,174	120,953,693
2093	120,953,693	-	-	226,826	-	8,458,954	129,185,821
2094	129,185,821	-	-	181,132	-	9,036,775	138,041,464
2095	138,041,464	-	-	142,456	-	9,658,001	147,557,008
2096	147,557,008	-	-	110,224	-	10,325,198	157,771,982
2097	157,771,982	-	-	83,811	-	11,041,155	168,729,326
2098	168,729,326	-	-	62,557	-	11,808,900	180,475,670
2099	180,475,670	-	-	45,784	-	12,631,722	193,061,607
2100	193,061,607	-	-	32,823	-	13,513,183	206,541,968
2101	206,541,968	-	-	23,029	-	14,457,145	220,976,084
2102	220,976,084	-	-	15,804	-	15,467,782	236,428,061
2103	236,428,061	-	-	10,608	-	16,549,599	252,967,053
2104	252,967,053	-	-	6,969	-	17,707,454	270,667,538
2105	270,667,538	-	-	4,491	-	18,946,573	289,609,621
2106	289,609,621	-	-	2,851	-	20,272,575	309,879,345
2107	309,879,345	-	-	1,795	-	21,691,492	331,569,043
2108	331,569,043	-	-	1,133	-	23,209,794	354,777,704
2109	354,777,704	-	-	726	-	24,834,414	379,611,392
2110	379,611,392	-	-	479	-	26,572,781	406,183,694
2111	406,183,694	-	-	329	-	28,432,847	434,616,212
2112	434,616,212	-	-	235	-	30,423,127	465,039,104
2113	465,039,104	-	-	173	-	32,552,731	497,591,662
2114	497,591,662	-	-	130	-	34,831,412	532,422,944
2115	532,422,944	-	-	99	-	37,269,603	569,692,448
2116	569,692,448	-	-	75	-	39,878,469	609,570,842
2117	609,570,842	-	-	57	-	42,669,957	652,240,742
2118	652,240,742	-	-	42	-	45,656,850	697,897,550
2119	697,897,550	-	-	31	-	48,852,827	746,750,347

*Employer contributions are not less than 6.00% of payroll in accordance with G.S. 135-8(d)(1a).

Appendix E: GASB 67 Fiduciary Net Position Projection

Table E-2: Actuarial Present Value of Projected Benefit Payments (in thousands)

Calendar Year	Beginning Fiduciary Position	Benefit Payments	Funded Benefit Payments	Unfunded Benefit Payments	Present Value of Benefit Payments: Funded Payments at 7.00%	Present Value of Benefit Payments: Unfunded Payments at 2.21%	Present Value of Benefit Payments: Using Single Discount Rate of 7.00%
2020	$ 75,486,780	$ 5,468,714	$ 5,468,714	$ -	$ 5,286,805	$ -	$ 5,286,805
2021	78,323,367	5,612,077	5,612,077	-	5,070,467	-	5,070,467
2022	81,367,241	5,756,995	5,756,995	-	4,861,121	-	4,861,121
2023	84,459,812	5,906,783	5,906,783	-	4,661,308	-	4,661,308
2024	87,438,413	6,061,474	6,061,474	-	4,470,450	-	4,470,450
2025	90,174,031	6,230,960	6,230,960	-	4,294,812	-	4,294,812
2026	92,595,010	6,416,671	6,416,671	-	4,133,474	-	4,133,474
2027	94,760,822	6,605,374	6,605,374	-	3,976,666	-	3,976,666
2028	96,745,830	6,796,885	6,796,885	-	3,824,263	-	3,824,263
2029	98,606,832	6,991,539	6,991,539	-	3,676,435	-	3,676,435
2030	100,351,658	7,186,827	7,186,827	-	3,531,893	-	3,531,893
2031	101,782,822	7,378,853	7,378,853	-	3,389,030	-	3,389,030
2032	102,729,148	7,566,246	7,566,246	-	3,247,755	-	3,247,755
2033	103,165,053	7,746,184	7,746,184	-	3,107,469	-	3,107,469
2034	103,358,394	7,915,518	7,915,518	-	2,967,663	-	2,967,663
2035	103,319,300	7,584,321	7,584,321	-	2,657,469	-	2,657,469
2036	103,550,803	7,730,749	7,730,749	-	2,531,566	-	2,531,566
2037	103,579,120	7,866,262	7,866,262	-	2,407,422	-	2,407,422
2038	103,403,338	7,982,732	7,982,732	-	2,283,241	-	2,283,241
2039	103,030,733	8,080,252	8,080,252	-	2,159,938	-	2,159,938
2040	102,471,770	8,166,924	8,166,924	-	2,040,286	-	2,040,286
2041	101,727,113	8,245,160	8,245,160	-	1,925,076	-	1,925,076
2042	100,793,518	8,315,844	8,315,844	-	1,814,560	-	1,814,560
2043	99,666,937	8,377,541	8,377,541	-	1,708,432	-	1,708,432
2044	98,343,497	8,425,396	8,425,396	-	1,605,786	-	1,605,786
2045	96,825,390	8,455,562	8,455,562	-	1,506,108	-	1,506,108
2046	95,119,756	8,465,358	8,465,358	-	1,409,208	-	1,409,208
2047	93,238,444	8,452,776	8,452,776	-	1,315,060	-	1,315,060
2048	91,196,145	8,417,505	8,417,505	-	1,223,899	-	1,223,899
2049	89,009,247	8,357,086	8,357,086	-	1,135,621	-	1,135,621
2050	86,697,245	8,260,445	8,260,445	-	1,049,055	-	1,049,055
2051	84,294,975	8,127,655	8,127,655	-	964,664	-	964,664
2052	81,842,094	7,968,628	7,968,628	-	883,916	-	883,916
2053	79,368,141	7,790,122	7,790,122	-	807,584	-	807,584
2054	76,895,242	7,595,647	7,595,647	-	735,910	-	735,910
2055	74,442,635	7,387,313	7,387,313	-	668,902	-	668,902
2056	72,028,073	7,166,342	7,166,342	-	606,443	-	606,443
2057	69,668,775	6,934,493	6,934,493	-	548,432	-	548,432
2058	67,380,993	6,690,564	6,690,564	-	494,524	-	494,524
2059	65,183,056	6,440,232	6,440,232	-	444,879	-	444,879
2060	63,088,501	6,186,374	6,186,374	-	399,386	-	399,386
2061	61,108,676	5,930,601	5,930,601	-	357,826	-	357,826
2062	59,253,926	5,674,089	5,674,089	-	319,953	-	319,953
2063	57,534,021	5,417,666	5,417,666	-	285,508	-	285,508
2064	55,958,483	5,161,965	5,161,965	-	254,236	-	254,236
2065	54,536,805	4,907,533	4,907,533	-	225,892	-	225,892
2066	53,278,542	4,654,908	4,654,908	-	200,247	-	200,247
2067	52,193,335	4,404,650	4,404,650	-	177,085	-	177,085
2068	51,290,904	4,157,289	4,157,289	-	156,206	-	156,206
2069	50,581,089	3,913,393	3,913,393	-	137,422	-	137,422
2070	50,073,814	3,673,530	3,673,530	-	120,560	-	120,560

Table E-2: Actuarial Present Value of Projected Benefit Payments (in thousands) (continued)

Calendar Year	Beginning Fiduciary Position	Benefit Payments	Funded Benefit Payments	Unfunded Benefit Payments	Present Value of Benefit Payments: Funded Payments at 7.00%	Present Value of Benefit Payments: Unfunded Payments at 2.21%	Present Value of Benefit Payments: Using Single Discount Rate of 7.00%
2071	$ 49,779,105	$ 3,438,294	$ 3,438,294	$ -	$ 105,458	$ -	$ 105,458
2072	49,707,071	3,208,275	3,208,275	-	91,965	-	91,965
2073	49,867,913	2,984,022	2,984,022	-	79,941	-	79,941
2074	50,271,974	2,766,061	2,766,061	-	69,254	-	69,254
2075	50,929,779	2,554,877	2,554,877	-	59,782	-	59,782
2076	51,852,079	2,350,918	2,350,918	-	51,411	-	51,411
2077	53,049,916	2,154,613	2,154,613	-	44,035	-	44,035
2078	54,534,661	1,966,344	1,966,344	-	37,559	-	37,559
2079	56,318,085	1,786,423	1,786,423	-	31,890	-	31,890
2080	58,412,461	1,615,122	1,615,122	-	26,946	-	26,946
2081	60,830,638	1,452,686	1,452,686	-	22,650	-	22,650
2082	63,586,113	1,299,328	1,299,328	-	18,934	-	18,934
2083	66,693,106	1,155,231	1,155,231	-	15,733	-	15,733
2084	70,166,643	1,020,539	1,020,539	-	12,989	-	12,989
2085	74,022,654	895,345	895,345	-	10,650	-	10,650
2086	78,278,088	779,687	779,687	-	8,668	-	8,668
2087	82,951,039	673,537	673,537	-	6,998	-	6,998
2088	88,060,899	576,805	576,805	-	5,601	-	5,601
2089	93,628,511	489,341	489,341	-	4,441	-	4,441
2090	99,676,328	410,930	410,930	-	3,485	-	3,485
2091	106,228,602	341,286	341,286	-	2,705	-	2,705
2092	113,311,575	280,056	280,056	-	2,075	-	2,075
2093	120,953,693	226,826	226,826	-	1,570	-	1,570
2094	129,185,821	181,132	181,132	-	1,172	-	1,172
2095	138,041,464	142,456	142,456	-	861	-	861
2096	147,557,008	110,224	110,224	-	623	-	623
2097	157,771,982	83,811	83,811	-	443	-	443
2098	168,729,326	62,557	62,557	-	309	-	309
2099	180,475,670	45,784	45,784	-	211	-	211
2100	193,061,607	32,823	32,823	-	142	-	142
2101	206,541,968	23,029	23,029	-	93	-	93
2102	220,976,084	15,804	15,804	-	60	-	60
2103	236,428,061	10,608	10,608	-	37	-	37
2104	252,967,053	6,969	6,969	-	23	-	23
2105	270,667,538	4,491	4,491	-	14	-	14
2106	289,609,621	2,851	2,851	-	8	-	8
2107	309,879,345	1,795	1,795	-	5	-	5
2108	331,569,043	1,133	1,133	-	3	-	3
2109	354,777,704	726	726	-	2	-	2
2110	379,611,392	479	479	-	1	-	1
2111	406,183,694	329	329	-	1	-	1
2112	434,616,212	235	235	-	-	-	-
2113	465,039,104	173	173	-	-	-	-
2114	497,591,662	130	130	-	-	-	-
2115	532,422,944	99	99	-	-	-	-
2116	569,692,448	75	75	-	-	-	-
2117	609,570,842	57	57	-	-	-	-
2118	652,240,742	42	42	-	-	-	-
2119	697,897,550	31	31	-	-	-	-

Appendix F: Additional Disclosures

Table F-1 illustrates the sensitivity of certain valuation results to changes in the discount rate on a market value of assets basis. Table F-2 provides an estimate of future market value of asset returns based on the current portfolio structure and summarized in the "TSERS Asset-Liability and Investment Strategy Project" report dated April 19th, 2016.

Section 6(c) of Session Law 2016-108 requires that the actuarial valuation report provide the valuation results using a 30-year treasury rate as of December 31 of the year of the valuation as the discount rate. This is 2.39% at December 31, 2019 and has been used as the lower bound of the sensitivity analysis presented. The range between the current discount rate (7.00%) and the 30-year treasury rate (2.39%) was used to establish an upper bound for sensitivity analysis (11.61%). The remaining rates illustrated represent mid-points between the selected rates. Table F-2 illustrates our best estimate of the plausibility of such rates. The lower bound of 2.39% falls below the 5th percentile of estimated future 30-year returns while the upper bound of 11.61% falls between the 75th and 95th percentiles of estimated future 30-year returns.

Table F-1: Sensitivity of Valuation Results as of December 31, 2019

Discount Rate	2.39%	4.70%	7.00%	9.31%	11.61%
Market Value of Assets	$ 75,486,780,473	$ 75,486,780,473	$ 75,486,780,473	$ 75,486,780,473	$ 75,486,780,473
Actuarial Accrued Liability	$149,987,223,635	$110,121,704,889	$ 84,873,315,272	$ 68,160,583,222	$ 56,771,444,974
Unfunded Accrued Liabilty (AAL)	$ 74,500,443,162	$ 34,634,924,416	$ 9,386,534,799	$ (7,326,197,251)	$ (18,715,335,499)
Funded Ratio	50.3%	68.5%	88.9%	110.7%	133.0%
20-Year Amortization of UAL	$ 4,842,503,437	$ 2,836,252,255	$ 948,036,347	N/A	N/A
(as % of general state revenue)	14.8%	8.7%	2.9%	N/A	N/A

Appendix F: Additional Disclosures

Table F-2: Statistical Likelihood of Minimum Future Asset Returns as of 12/31/2015

Horizon	95% Chance (19 out of every 20 scenarios)	75% Chance (3 out of every 4 scenarios)	50% Chance (1 out of every 2 scenarios)	25% Chance (1 out of every 4 scenarios)	5% Chance (1 out of every 20 scenarios)
10 Years (2025)	0.2%	4.0%	5.9%	8.0%	11.5%
20 Years (2035)	2.2%	4.8%	6.7%	8.5%	11.8%
30 Years (2045)	3.1%	5.3%	7.1%	8.7%	12.0%

Other than the discount rate, these results are based on the other economic and demographic assumptions presented in the report. For purposes of simplicity in this disclosure, no adjustments to the valuation assumption for inflation were reflected in the sensitivities above. The statute also requires that the actuarial valuation report show the results using a market value of assets basis. The "funded ratio" and "unfunded accrued liability" in Table F-1 are based upon the market value of assets. In order to alleviate volatility, future employer contributions are determined based on the actuarial value of assets, which smooths market value returns.

None of the liability amounts shown are intended to imply the amount that might represent the cost of any settlement of the plan's obligations. The various caveats, constraints, and discussions presented earlier in the report apply to these results as well.

Appendix G: Data for Section 2 Graphs

The tables below provide the numbers associated with the graphs in Section 2 of this report.

Graph 1: Active Members

	Active Member Count	Reported Compensation
2015	305,291	$ 13,145,602,154
2016	305,013	13,497,815,754
2017	304,554	13,914,085,325
2018	304,575	14,436,435,848
2019	305,962	14,886,467,797

Graph 2: Retired Members and Survivors of Deceased Members

	Retired and Survivors of Deceased Member Count	Retirement Allowance
2015	201,522	$ 4,202,371,724
2016	208,443	4,343,259,132
2017	215,008	4,521,393,822
2018	222,084	4,668,925,869
2019	228,291	4,804,178,473

Graph 3: Market Value of Assets and Asset Returns

	Market Value of Assets	Asset Return
2015	$ 62,669,341,716	0.36%
2016	64,246,523,614	6.22%
2017	70,607,887,248	13.49%
2018	67,536,480,309	-1.39%
2019	75,486,780,473	14.85%

Appendix G: Data for Section 2 Graphs

Graph 5: Cost-of-Living Increase and CPI-U History

	Total Allowance Increase	National CPI-U
1989	6.70%	4.60%
1990	0.00%	6.10%
1991	5.20%	3.10%
1992	2.20%	2.90%
1993	4.70%	2.70%
1994	3.20%	2.70%
1995	4.40%	2.50%
1996	6.20%	3.30%
1997	2.50%	1.70%
1998	2.30%	1.60%
1999	4.20%	2.70%
2000	2.00%	3.40%
2001	2.00%	2.60%
2002	1.30%	2.40%
2003	1.70%	1.90%
2004	2.00%	3.30%
2005	3.00%	3.40%
2006	2.20%	2.50%
2007	2.20%	4.10%
2008	0.00%	0.10%
2009	0.00%	2.70%
2010	0.00%	1.50%
2011	1.00%	3.00%
2012	0.00%	1.70%
2013	1.00%	1.50%
2014	0.00%	0.80%
2015	0.00%	0.70%
2016	1.00%	2.10%
2017	0.00%	2.10%
2018	0.00%	1.90%
2019	0.00%	2.30%

* Allowance increases are effective at July 1 the following year

Appendix G: Data for Section 2 Graphs

Graph 6: Actuarial Value and Market Value of Assets

	Actuarial Value of Assets	Market Value of Assets
2015	$ 66,169,352,203	$ 62,669,341,716
2016	67,376,892,466	64,246,523,614
2017	69,568,450,606	70,607,887,248
2018	70,959,093,440	67,536,480,309
2019	73,353,759,963	75,486,780,473

Graph 7: Asset Returns

	Actuarial Value Value of Assets	Market Value Asset Return
2015	5.87%	0.36%
2016	5.32%	6.22%
2017	6.56%	13.49%
2018	5.10%	-1.39%
2019	6.18%	14.85%

Graph 8: Actuarial Accrued Liability

Fiscal Year Ending	Active	Deferred	Retired	Total
2015	$ 27,630,686,237	$ 3,482,641,054	$ 40,408,588,106	$ 71,521,915,397
2016	28,548,308,913	3,764,216,305	42,235,329,807	74,547,855,025
2017	30,943,761,739	4,053,311,655	44,212,274,274	79,209,347,668
2018	32,234,081,882	4,337,483,404	45,534,377,845	82,105,943,131
2019	33,527,838,928	4,621,814,392	46,723,661,952	84,873,315,272

Appendix G: Data for Section 2 Graphs

Graph 9: Present Value of Future Benefits, Actuarial Accrued Liability and Actuarial Value of Assets

	Actuarial Accrued Liability	Actuarial Value of Assets
2015	$ 71,521,915,397	$ 66,169,352,203
2016	74,547,855,025	67,376,892,466
2017	79,209,347,668	69,568,450,606
2018	82,105,943,131	70,959,093,440
2019	84,873,315,272	73,353,759,963

Graph 10: Funded Ratios

	Funded Ratio (Actuarial Basis)	Funded Ratio (Market Value Basis)
2015	92.5%	87.6%
2016	90.4%	86.2%
2017	87.8%	89.1%
2018	86.4%	82.3%
2019	86.4%	88.9%

Graph 11: Actuarially Determined Employer Contribution Rates

Fiscal Year Ending	Normal Rate	Accrued Liability Rate	Total ADEC
2018	4.31%	6.22%	10.53%
2019	4.48%	7.81%	12.29%
2020	5.17%	7.80%	12.97%
2021	5.18%	9.60%	14.78%
2022*	5.16%	10.58%	15.74%

* Subject to the impact of future legislative changes effective during that fiscal year

Appendix G: Data for Section 2 Graphs

Graph 12: Projected Actuarially Determined Employer Contribution Rates

	Alternate #1 (0.0% 2020 Return)	Baseline Projection	Alternate #2 (14.0% 2020 Return)
2020	12.97%	12.97%	12.97%
2021	14.78%	14.78%	14.78%
2022	15.74%	15.74%	15.74%
2023	15.91%	15.09%	14.27%
2024	14.28%	12.45%	10.62%
2025	14.86%	12.13%	9.41%
2026	14.00%	10.48%	6.96%
2027	14.54%	10.32%	6.09%
2028	14.39%	10.28%	6.17%
2029	14.31%	10.32%	6.32%
2030	12.40%	8.51%	6.00%
2031	10.97%	7.19%	6.00%
2032	9.26%	6.00%	6.00%
2033	8.08%	6.00%	6.00%
2034	7.54%	6.00%	6.00%
2035	7.23%	6.00%	6.00%
2036	6.88%	6.00%	6.00%
2037	6.15%	6.00%	6.00%

Graph 13: Projected Funded Ratio

	Alternate #1 (0.0% 2020 Return)	Baseline Projection	Alternate #2 (14.0% 2020 Return)
2019	86.43%	86.43%	86.43%
2020	87.09%	88.28%	89.48%
2021	87.81%	90.56%	93.30%
2022	87.85%	92.01%	96.18%
2023	89.12%	94.48%	99.84%
2024	89.24%	95.57%	101.90%
2025	90.51%	96.52%	102.53%
2026	91.80%	97.33%	102.88%
2027	93.18%	98.17%	103.16%
2028	94.61%	99.04%	103.48%
2029	95.91%	99.78%	103.79%
2030	96.95%	100.26%	104.09%
2031	97.74%	100.50%	104.40%
2032	98.28%	100.65%	104.73%
2033	98.68%	100.79%	105.07%
2034	99.01%	100.95%	105.43%

Appendix H: Participating Employers

Employer	Employer Code
A Childs Garden Charter (Aka Cross Creek Charter)	33501
Academy of Moore County	36301
Administrative Office of the Courts	10800
Alamance Community College	30105
Alamance County Schools	30100
Alexander County Schools	30200
Alleghany County Schools	30300
American Renaissance Middle School	34901
Anson County Schools	30400
Appalachian State University	20100
Arapahoe Charter School	36901
Arts Based Elementary Charter	33402
Ashe County Schools	30500
Asheboro City Schools	37610
Asheville City Schools	31110
Asheville-Buncombe Technical College	31105
Avery County Schools	30600
Barber Examiners, State Board of	18600
Bear Grass Charter School	33206
Beaufort County Community College	30705
Beaufort County Schools	30700
Bertie County Schools	30800
Bethany Community Middle School	37901
Bladen Community College	30905
Bladen County Schools	30900
Blue Ridge Community College	34505
Brevard Academy Charter School	38801
Bridges Charter Schools	38601
Brunswick Community College	31005
Brunswick County Schools	31000
Buncombe County Schools	31100
Burke County Schools	31200
Cabarrus County Schools	31300
Caldwell Community College	31405
Caldwell County Schools	31400
Camden County Schools	31500
Cape Fear Community College	36505
Cape Fear Center For Inquiry	36501
Carolina International School	31301
Carteret Community College	31605
Carteret County Schools	31600
Casa Esperanza Montessori	39209
Caswell County Schools	31700
Catawba County Schools	31800
Catawba Valley Community College	31805
Central Carolina Community College	35305
Central Park School For Children	33202
Central Piedmont Community College	36005
Chapel Hill - Carboro City Schools	36810
Charlotte Secondary Charter	36009
Charlotte-Mecklenburg County Schools	36000
Chatham County Schools	31900
Cherokee County Schools	32000
Childrens Village Academy	35401
Clay County Schools	32200
Cleveland County Schools	32300
Cleveland Technical College	32305
Clinton City Schools	38210
Clover Garden Charter School	30102
Coastal Carolina Community College	36705
College of the Albemarle	37005
Columbus County Schools	32400
Community Colleges Administration	19005
Community School of Davidson	36003
Cornerstone Academy	33027
Corvian Community School	36004
Craven Community College	32505
Cumberland County Schools	32600
Currituck County Schools	32700
Dare County Schools	32800
Davidson County Community College	32905
Davidson County Schools	32900
Davie County Schools	33000
Department of Administration	10900
Department of Agriculture	18400
Department of Commerce	12510
Department of Cultural Resources	10700
Department of Justice	10400
Department of Public Instruction	22000
Department of Public Safety	19100

Appendix H: Participating Employers

Employer	Employer Code
Discovery Charter	32904
Duplin County Schools	33100
Durham Public Schools	33200
Durham Technical Institute	33205
East Carolina University	20300
East Wake Academy	39208
Edenton-Chowan County Schools	32100
Edgecombe County Schools	33300
Edgecombe Technical College	33305
Elizabeth City and Pasquotank County Schools	37000
Elizabeth City State University	20400
Elkin City Schools	38620
Endeavor Charter School	39201
Environment and Natural Resources	11300
Evergreen Community Charter School	31102
F Delany New School For Children	31101
Fayetteville State University	20600
Fayetteville Technical Community College	32605
Forsyth Technical Institute	33405
Franklin County Schools	33500
Gaston College	33605
Gaston College Preparatory Charter	36601
Gaston County Schools	33600
Gates County Schools	33700
General Assembly	12160
Governor's Office	12100
Graham County Schools	33800
Grandfather Academy	30601
Granville County Schools and Oxford Orphanage	33900
Gray Stone Day School	38402
Greene County Schools	34000
Guilford County Schools	34100
Guilford Technical Community College	34105
Halifax Community College	34205
Halifax County Schools	34200
Haliwa-Saponi Tribal Charter	39301
Harnett County Schools	34300
Haywood County Schools	34400
Haywood Technical College	34405
Health & Human Svcs	12220

Employer	Employer Code
Healthy Start Academy	33203
Henderson Collegiate Charter School	39401
Henderson County Schools	34500
Hertford County Schools	34600
Hickory City Schools	31810
Highway - Administrative	51000
Hoke County Schools	34700
Hyde County Schools	34800
Information Technology Services	10930
Insurance Department	12600
Invest Collegiate Charter (Buncombe)	33207
Invest Collegiate Charter School	32901
Iredell County Schools	34900
Isothermal Community College	38105
Jackson County Schools	35000
James Sprunt Technical College	33105
Johnston County Schools	35100
Johnston Technical College	35105
Jones County Schools	35200
Kannapolis City Schools	31320
Kipp Charlotte Charter	36102
Labor Department	12700
Lake Norman Charter School	36006
Lenoir County Community College	35405
Lenoir County Schools	35400
Lexington City Schools	32910
Lincoln County Schools	35500
Lt Governor's Office	12150
Macon County Schools	35600
Madison County Schools	35700
Martin Community College	35805
Martin County Schools	35800
Mayland Technical College	36105
Mcdowell County Schools	35900
Mcdowell Technical College	35905
Millennium Charter Academy	38602
Mitchell Community College	34905
Mitchell County Schools	36100
Montgomery Community College	36205
Montgomery County Schools	36200

Appendix H: Participating Employers

Employer	Employer Code
Moore County Schools	36300
Mooresville City Schools	34910
Mount Airy City Schools	38610
Mountain Community School	34501
Mtn Discovery Charter	38701
NC Auctioneers Licensing Board	18740
NC Central University	20800
NC Innovative School District	39220
NC School of Science & Mathematics	10950
NC School of the Arts	20200
NC State Board of Examiners of Practicing Psychology	18780
NC State University	21300
N.E. Academy of Aerospace & Adv.Tech	37001
N.E. Regional School For Biotechnology	33001
Nash-Rocky Mount Schools	36400
Nash Technical College	36405
NC A&T University	20700
NC Department of Military & Veterans Affairs	11050
NC Housing Finance Agency	11310
Neuse Charter School	35106
New Bern/Craven County Board of Education	32500
New Hanover County Schools	36500
Newton-Conover City Schools	31820
North Carolina Board of Opticians	18640
North Carolina Education Lottery	10200
Northampton County Schools	36600
Office of Administrative Hearing	10850
Office of State Budget & Management	10910
Office of State Controller	10940
Onslow County Schools	36700
Orange Charter School	36802
Orange County Schools	36800
Pamlico Community College	36905
Pamlico County Schools	36900
Pender County Schools	37100
Perquimans County Schools	37200
Person County Schools	37300
Piedmont Community College	37305
Pine Lake Prep Charter	36008
Pinnacle Classical Academy	39703

Employer	Employer Code
Pitt Community College	37405
Pitt County Schools	37400
Polk County Schools	37500
Randolph Community College	37605
Randolph County Schools	37600
Revenue Department	13500
Richmond County Schools	37700
Richmond Technical College	37705
River Mill Academy Charter	30103
Roanoke Rapids City Schools	34220
Roanoke-Chowan Community College	34605
Robeson Community College	37805
Robeson County Schools	37800
Rockingham Community College	37905
Rockingham County Schools	37900
Rowan-Cabarrus Community College	38005
Rowan-Salisbury School System	38000
Roxboro Community School	37301
Rutherford County Schools	38100
Sampson Community College	38205
Sampson County Schools	38200
Sandhills Community College	36305
Sanford-Lee County Board of Education	35300
Scotland County Schools	38300
Secretary of State	13700
Socrates Academy	36007
South Piedmont Community College	30405
Southeastern Academy Charter School	37801
Southeastern Community College	32405
Southern Wake Academy	39204
Southwestern Community College	35005
Stanly Community College	38405
Stanly County Schools	38400
Stars Charter School	36302
State Auditor	10500
State Board of Elections	11900
State Division of Health Services	12200
State Treasurer	14300
Stokes County Schools	38500
Success Institute	34903

Appendix H: Participating Employers

Employer	Employer Code
Surry Community College	38605
Surry County Schools	38600
Swain County Schools	38700
The Hawbridge School	30104
The North Carolina Leadership Academy	36303
Thomasville City Schools	32920
Transylvania County Schools	38800
Tri-County Community College	32005
Two Rivers Comm School	39501
Tyrrell County Schools	38900
UNC - Pembroke	21200
UNC Health Care System	21550
UNC-Ch Cb 1260	21520
UNC-General Administration	21525
Union County Schools	39000
University of North Carolina at Asheville	23000
University of North Carolina at Charlotte	23100
University of North Carolina at Greensboro	20900
University of North Carolina at Wilmington	23200
University of North Carolina Press	21570
Uwharrie Charter Academy	37601
Vance Charter School	39101
Vance County Schools	39100
Vance-Granville Community College	39105
Voyager Academy	33204
Wake County Schools	39200
Wake Technical College	39205
Warren County Schools	39300
Washington County Schools	39400
Watauga County Schools	39500
Wayne Community College	39605
Wayne County Schools	39600
Weldon City Schools	34230
Western Carolina University	21800
Western Piedmont Community College	31205
Whiteville City Schools	32410
Wildlife Resources Commission	11600
Wilkes Community College	39705
Wilkes County Schools	39700
Wilmington Prep Academy	36502
Wilson Community College	39805
Wilson County Schools	39800
Winston-Salem State University	21900
Winston-Salem-Forsyth County Schools	33400
Yadkin County Schools	39900
Wilson Community College	39805
Zeca School of the Arts and Technology	39800