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Consolidated Judicial Retirement System Principal Results of Actuarial Valuation as of December 31, 2018

October 31, 2019 Board of Trustees Meeting

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Member Data

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

Number as of	12/31/2018	12/31/2017
Active Members	557	562
Terminated members and survivors of deceased members entitled to benefits but not yet receiving benefits	48	44
Retired members and survivors of deceased members currently receiving benefits	707	682
Total	1,312	1,288

The number of active members has decreased by 0.9% from the previous valuation date. A decrease in active members results in fewer benefits accruing but also fewer contributions supporting the system. The number of retired members and survivors of deceased members currently receiving benefits increased by 3.7% from the previous valuation date. 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.

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	12/31/2018	12/31/2017
Beginning of Year Market Value of Assets	$ 595,683,002	$ 538,766,550
Employer Contributions	24,928,691	22,814,384
Employee Contributions	5,480,146	5,196,890
Benefit Payments Other Than Refunds	(44,439,973)	(42,526,086)
Refunds	(149,814)	(119,341)
Administrative Expense	(22,945)	(28,319)
Investment Income	(8,301,197)	71,578,924
Net Increase/(Decrease)	(22,505,092)	56,916,452
End of Year Value of Assets	$ 573,177,910	$ 595,683,002
Estimated Net Investment Return	-1.41%	13.46%

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

For 2018, incoming contributions covered over 65% of the 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.

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 12/31/2017	$	95.1
Normal Cost and Administrative Expense during 2018		17.1
Reduction due to Actual Contributions during 2018		(30.4)
Interest on UAAL, Normal Cost, and Contributions		6.2
Asset (Gain) / Loss		11.0
Actuarial Accrued Liability (Gain) / Loss		1.4
Impact of Assumption Changes		-
Impact of Legislative Changes		-
Unfunded Actuarial Accrued Liability (UAAL) as of 12/31/2018	$	100.4

During 2018, the UAAL increased by $5.3 million. The loss recognized in the actuarial value of assets during the year increased the UAAL by $11.0 million. Additionally, demographic changes increased the UAAL by $1.4 million.

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

Employer Contributions

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

Fiscal year ending June 30, 2020 Preliminary ADEC (based on December 31, 2017 valuation)	33.60%
Impact of Legislative Changes	0.00%
Fiscal year ending June 30, 2020 ADEC for Reconciliation	33.60%
Change due to Anticipated Reduction in UAAL*	(0.04%)
Change Due to Demographic (Gain)/Loss	0.33%
Change Due to Investment (Gain)/Loss	1.86%
Change Due to Contributions Less (Greater) than ADEC	(0.29%)
Impact of Assumption Changes	0.00%
Impact of Direct-Rate Smoothing	0.98%
Fiscal year ending June 30, 2021 Preliminary ADEC (based on December 31, 2018 valuation)	36.44%

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

The change in rate due to demographics was mostly due to mortality experience (fewer retirees dying than expected).

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

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

Employer Contributions and Benefit Enhancements

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
12/31/2018	6/30/2021	17.43%	19.98%	N/A	N/A	N/A
12/31/2017	6/30/2020	17.28%	18.27%	0.00%	33.60%	33.60%
12/31/2016	6/30/2019	15.83%	16.52%	0.60%	32.95%	33.86%
12/31/2015	6/30/2018	15.95%	14.28%	0.82%	31.05%	31.05%
12/31/2014	6/30/2017	17.95%	7.14%	4.37%	29.46%	27.21%

*Includes Death Benefit rate

**For fiscal year ending 6/30/2017, the change due to legislation for the contribution includes a 3.44% increase in the ADEC due to the experience study and a 0.93% increase in the ADEC due to the one-time pension supplement to be paid on or before October 31, 2016. The fiscal year ending 6/30/2019 amount of 0.60% is for the one-time cost-of-living supplement paid in October 2018. The appropriated contribution rate of 33.86% was greater than the 32.95% final ADEC for the fiscal year ending June 30, 2019, by 0.91%.

The appropriated rate for the fiscal year ending 2020 is 33.60% of payroll. The preliminary ADEC after direct rate smoothing of the 12/31/2017 assumption change for the fiscal year ending 2021 is 36.44%

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

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, 2018 valuation were:
  - Market value return of -1.41% during calendar year 2018 compared to 7.00% assumed
  - Actuarial value return of 5.11% resulting in an increase of the UAAL by $11.0 million and an increase in the employer contribution rate equal to 1.86% of pay
  - Last ADEC calculation using direct rate smoothing due to change in discount rate from 7.20% to 7.00% as of December 31, 2017

Key Takeaways (continued)

- When compared to the December 31, 2017 valuation, the above resulted in:
  - Lower funded ratio (85.7% in the December 31, 2018 valuation compared to 86.1% in the December 31, 2017 valuation)
  - Higher actuarially determined employer contribution rate (36.44% for fiscal year ending June 30, 2021 compared to the 33.60% preliminary ADEC calculated in the valuation for fiscal year ending June 30, 2020)

Certification

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.

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

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

Cavanaugh Macdonald
CONSULTING, LLC
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Consolidated Judicial Retirement System of North Carolina

Report on the Actuarial Valuation Prepared as of December 31, 2018

October 2019

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Cavanaugh Macdonald
CONSULTING, LLC
The experience and dedication you deserve

October 8, 2019

Board of Trustees
Consolidated Judicial
Retirement System of North Carolina
3200 Atlantic Avenue
Raleigh, NC 27604

Members of the Board:

We submit herewith our report on the annual valuation of the Consolidated Judicial Retirement System of North Carolina (referred to as "CJRS" or the "Judicial Plan") prepared as of December 31, 2018. The report has been prepared in accordance with North Carolina General Statute 135-50 through 135-75. 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 CJRS, 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.

The assumptions used for the December 31, 2018 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, 2018, 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, 2019, RSD paid over $6.4 billion in pensions to more than 310,000 retirees. And as of June 30, 2019, RSD's defined benefit plan assets were valued at over $101 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 1985, the Consolidated Judicial Retirement System (referred to as "CJRS" or the "Judicial Plan") was established. CJRS provides benefits to the elected judges and justices, district attorneys, clerks of superior court of the general court of justice and public defenders. CJRS has approximately $573 million in assets and over 1,300 members. This actuarial valuation report is our annual analysis of the financial health of CJRS. This report, prepared as of December 31, 2018, presents the results of the actuarial valuation of CJRS.

Purpose

An actuarial valuation is performed on CJRS annually as of the end of the calendar year. The actuary determines the amount of contributions to be made to CJRS 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 on funding CJRS,
- 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.
- 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.

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, 2018 valuation were:

- Market value returns of -1.41% during calendar year 2018 compared to 7.00% assumed

When compared to the December 31, 2017 valuation, the above resulted in:

- Lower funded ratio (85.7% in the December 31, 2018 valuation compared to 86.1% in the December 31, 2017 valuation)
- Higher actuarially determined employer contribution rate (36.44% for fiscal year ending June 30, 2021 compared to the 33.60% preliminary ADEC calculated in the valuation for fiscal year ending June 30, 2020)

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

- Stakeholders working together to keep CJRS 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
- An ad hoc cost-of-living adjustment that supports the health of the system
- Modest changes in benefits when compared to peers

Continued focus on these measures will be needed to maintain the solid status of CJRS 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.

Section 1: Principal Results

This report, prepared as of December 31, 2018, presents the results of the actuarial valuation of the system. The principal results of the valuation and a comparison with the preceding year's results are summarized below.

Table 1: Summary of Principal Results

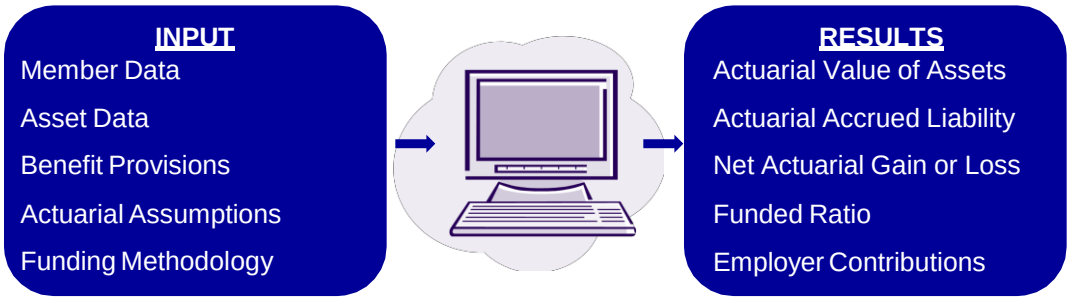
Valuation Results as of	12/31/2018	12/31/2017
Active Members		
Number	557	562
Reported Compensation	$ 70,565,420	$ 71,726,921
Valuation Compensation*	$ 75,914,294	$ 75,728,052
Retired Members and Survivors of Deceased Members Currently Receiving Benefits		
Number	707	682
Annual Allowances	$ 45,108,774	$ 42,920,238
Assets		
Actuarial Value (AVA)	$ 602,207,449	$ 586,776,499
Market Value (MVA)	$ 573,177,910	$ 595,683,002
Actuarial Accrued Liability (AAL)	$ 702,612,663	$ 681,895,087
Unfunded Accrued Liability (AAL - AVA)	$ 100,405,214	$ 95,118,588
Funded Ratio (AVA / AAL)**	85.7%	86.1%
Results for Fiscal Year Ending	**6/30/2021**	**6/30/2020**
Actuarially Determined Employer Contribution (ADEC), as a percentage of payroll		
Normal Cost	17.43%	17.28%
Accrued Liability	19.98%	18.27%
Total Preliminary ADEC	37.41%	35.55%
Total ADEC Based on Direct-Rate Smoothing	36.44%	33.60%
Impact of Legislative Changes	N/A	N/A
Final ADEC	36.44%	33.60%
Appropriation Act for Fiscal Year Ending	**6/30/2020**	**6/30/2019**
Employer Contribution Rate as a percentage of payroll		
Normal Cost	17.43%	17.28%
Accrued Liability	16.17%	16.58%
Total	33.60%	33.86%

* Reported compensation annualized for new hires and projected for valuation purposes.

** The Funded Ratio on a Market Value of Assets basis is 81.6% at December 31, 2018.

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 CJRS 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)

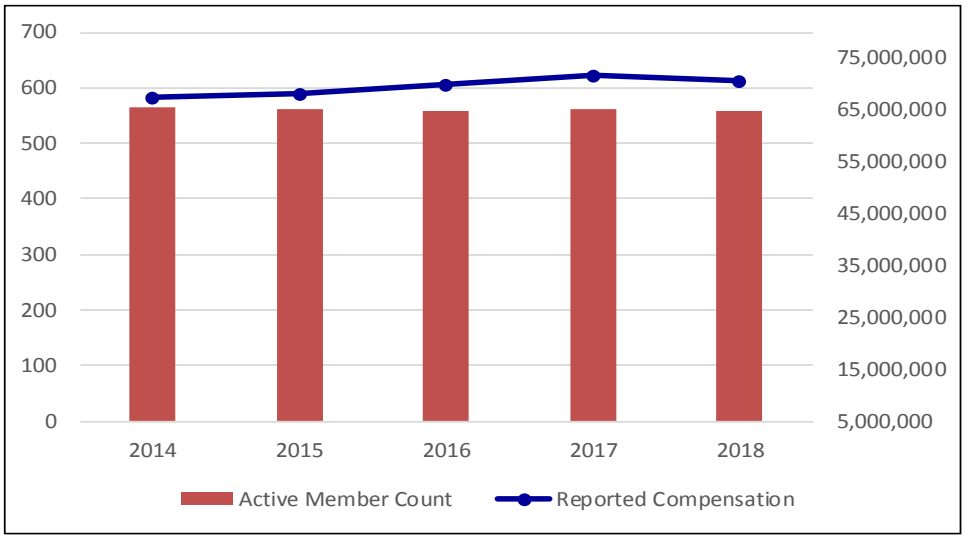
The table below provides a summary of the membership data used in this valuation compared to the prior valuation.

Number as of	12/31/2018	12/31/2017
Active Members	557	562
Terminated members and survivors of deceased members entitled to benefits but not yet receiving benefits	48	44
Retired members and survivors of deceased members currently receiving benefits	707	682
Total	1,312	1,288

Commentary: The number of active members has decreased by 0.9% from the previous valuation date. A decrease in active members results in fewer benefits accruing but also fewer contributions supporting the system. The number of retired members and survivors of deceased members currently receiving benefits increased by 3.7% 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.



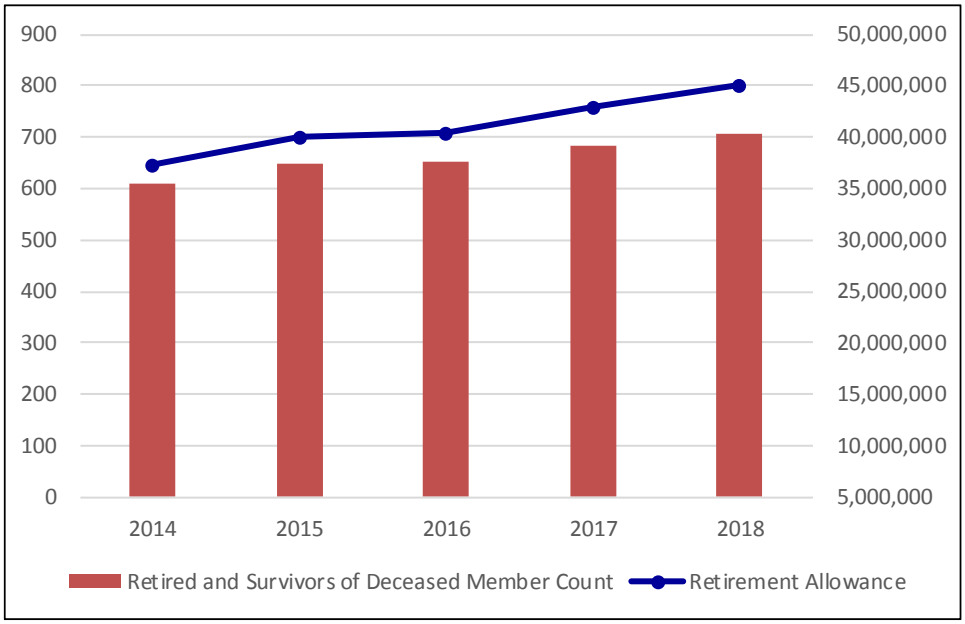
Commentary: Reported compensation has decreased by 1.6% since the last valuation and has remained relatively stable over the past five years. Covered payroll is expected to increase by approximately 3.5% annually in the future. Payroll that is not increasing as fast as assumed results in less benefits 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.

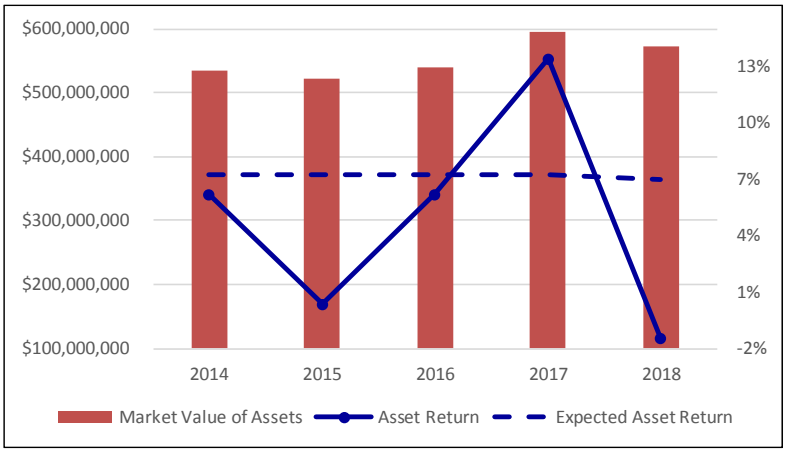
Section 2: The Valuation Process

Valuation Input: Asset Data

CJRS assets are held in trust and are invested for the exclusive benefit of plan members. The Market Value of Assets is $573 million as of December 31, 2018 and $596 million as of December 31, 2017. The investment return for the market value of assets for calendar year 2018 was -1.41%.

Graph 3: Market Value of Assets and Asset Returns

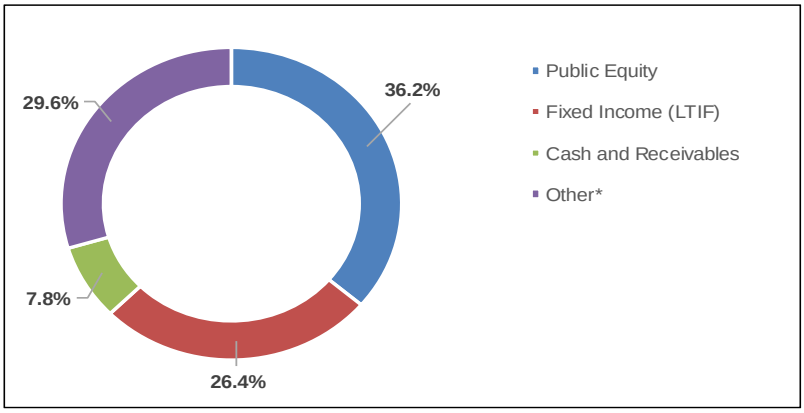
The graph below provides a history of the market value of assets and asset returns over the past five years.



Commentary: Returns were much less than the 7.00% assumed rate of return, resulting in a higher required contribution and lower funded ratio than anticipated.

Graph 4: Allocation of Investments by Category

The graph below provides the breakdown of the market value of assets at December 31, 2018 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 members who retire from service:
  - after attaining age 65 and five years of creditable service; or
  - after attaining age 50 and 24 years of creditable service
- Average final compensation is based on the four highest consecutive years of compensation
- The unreduced retirement allowance is equal to:
  - 4.02% of a member's average final compensation multiplied by the number of years of creditable service rendered as a Justice of the Supreme Court or Judge of the Court of Appeals, plus
  - 3.52% of a member's average final compensation multiplied by the number of years of creditable service rendered as a Judge of the Superior Court or as Administrative Officer of the Courts, plus
  - 3.02% of a member's average final compensation multiplied by the number of years of creditable service rendered as a Judge of the District Court, District Attorney, Public Defender, or Clerk of the Superior Court
  - The applicable formula accrual rate percentage of member's average final compensation multiplied by the number of years of creditable service transferred from the Teachers' and State Employees' Retirement System or the Local Governmental Employees' Retirement System
- Maximum unreduced retirement allowance payable from CJRS, is 75% of final compensation, less any unreduced allowances payable from other RSD Systems
- A reduced retirement allowance is payable to members who retire from service after attaining age 50 and five years of creditable service
- Ancillary benefits are also payable upon the death or disability of a member.
- CJRS 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 and/or the legislature passes a budget that provides for a cost-of-living adjustment.

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 CJRS 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. However, if North Carolina's investment policy shifts substantively, or 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.

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

Section 2: The Valuation Process

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 CJRS 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 that relate to the assets of CJRS such as the interest rate, salary increases, the real return, and payroll growth.

With the exception of the discount rate, the assumptions used for the December 31, 2018 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.

Valuation Input: Funding Methodology

The Funding Methodology is the payment plan for CJRS 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
  - Assets 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 CJRS is quite aggressive in that the policy pays down the unfunded actuarial accrued liability over a much shorter period of time (12 years) compared to most other Public Sector Retirement 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.

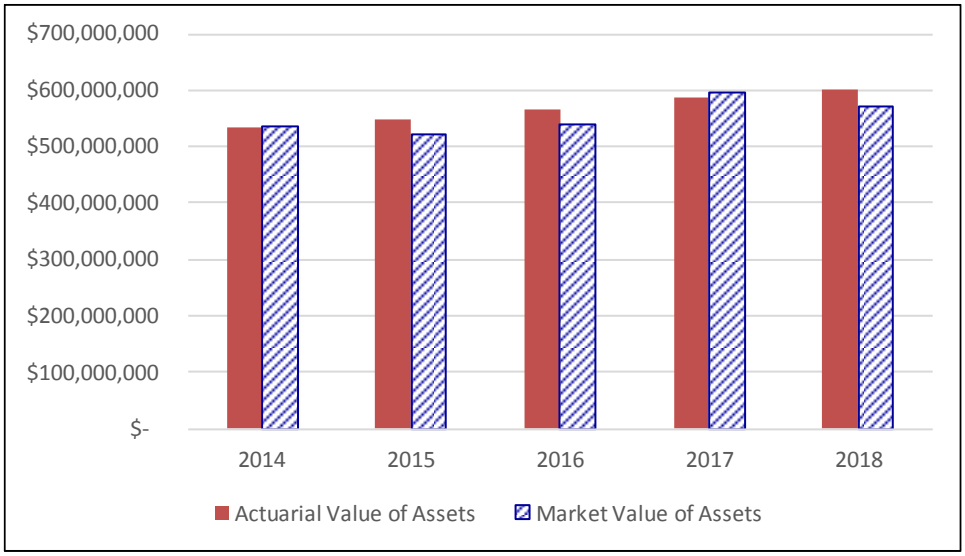
Section 2: The Valuation Process

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 CJRS, the Board adopted an asset valuation method to determine the Actuarial Value of Assets used for funding purposes. The Actuarial Value of Assets is $602.2 million as of December 31, 2018 and $586.8 million as of December 31, 2017.

Graph 5: 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.



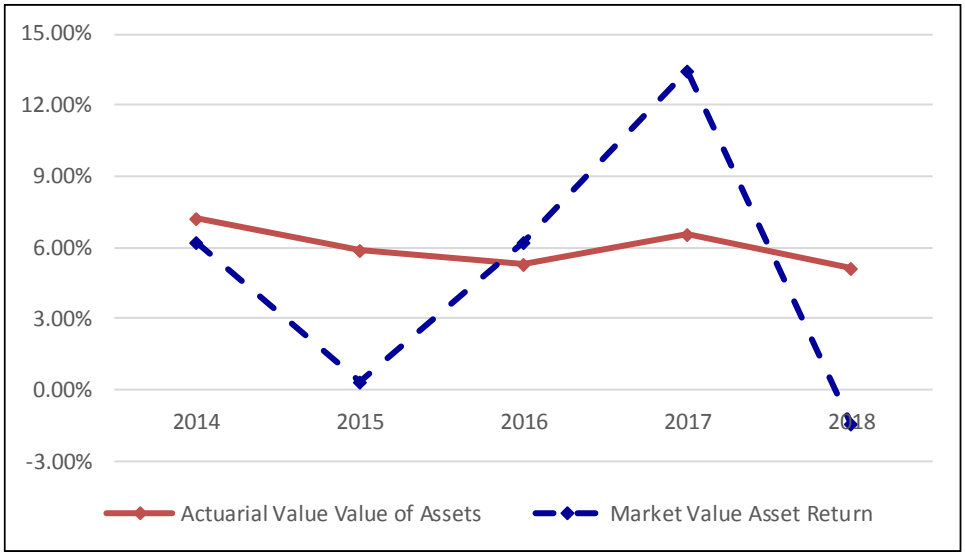
Commentary: The market value of assets is lower than the actuarial value of assets, which is used to determine employer contributions. This indicates that overall there are unrecognized asset losses to be recognized in future valuations.

Section 2: The Valuation Process

Valuation Results: Actuarial Value of Assets (continued)

Graph 6: 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 2018 was -1.41%. The actuarial value of assets smooths investment gains and losses. Lower than expected market returns in all years except 2017 resulted in an actuarial value of asset return for calendar year 2018 of 5.11% and an asset loss of $11.0 million during 2018.

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

Section 2: The Valuation Process

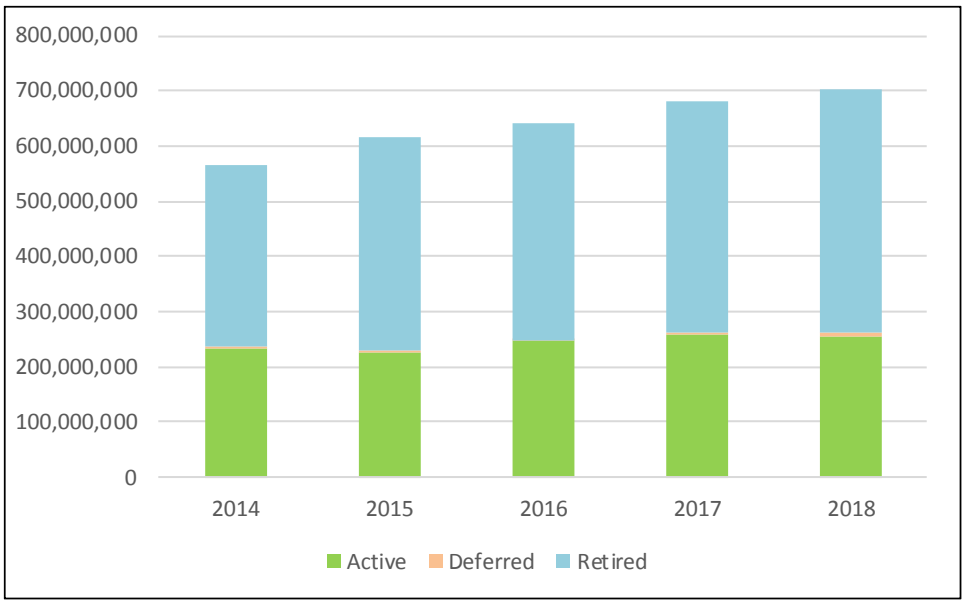
Valuation Results: Actuarial Accrued Liability

Using the provided membership data, benefit provisions, and actuarial assumptions, future benefit payments of CJRS 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 CJRS. 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 CJRS should ideally have in the trust. The NC is also referred to as the cost of benefits accruing during the year.

Graph 7: Actuarial Accrued Liability

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



Commentary: The AAL increased from $681.9 million to $702.6 million during 2018. CJRS 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 next as more benefits accrue and the membership approaches retirement. The AAL was $1.4 million higher than expected, resulting from demographic losses.

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

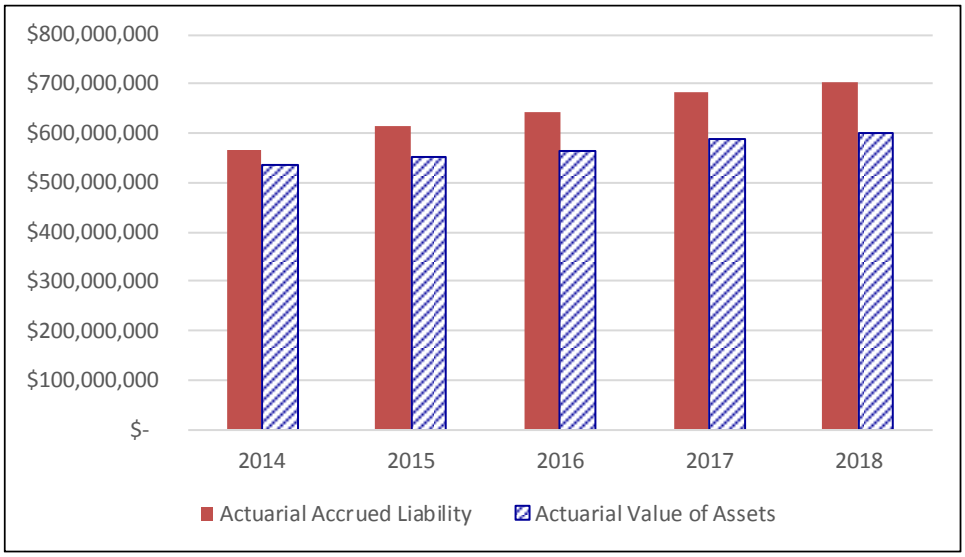
Section 2: The Valuation Process

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 CJRS actually has in the fund to the amount CJRS should have in the fund.

Graph 8: Actuarial Accrued Liability and Actuarial Value of Assets

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



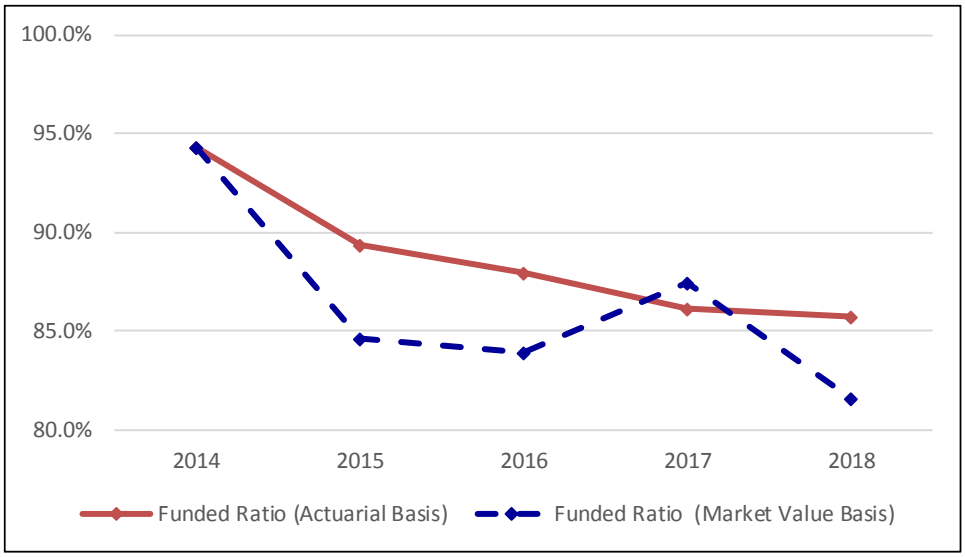
Commentary: The actuarial value of assets basis is used for computing contributions to alleviate contribution volatility. The difference in the actuarial accrued liability and the actuarial value of assets is the amount of unfunded actuarial accrued liability to be paid off in 12 years.

Section 2: The Valuation Process

Valuation Results: Funded Ratio (continued)

Graph 9: 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 decreased from 86.1% at December 31, 2017 to 85.7% at December 31, 2018.

Section 2: The Valuation Process

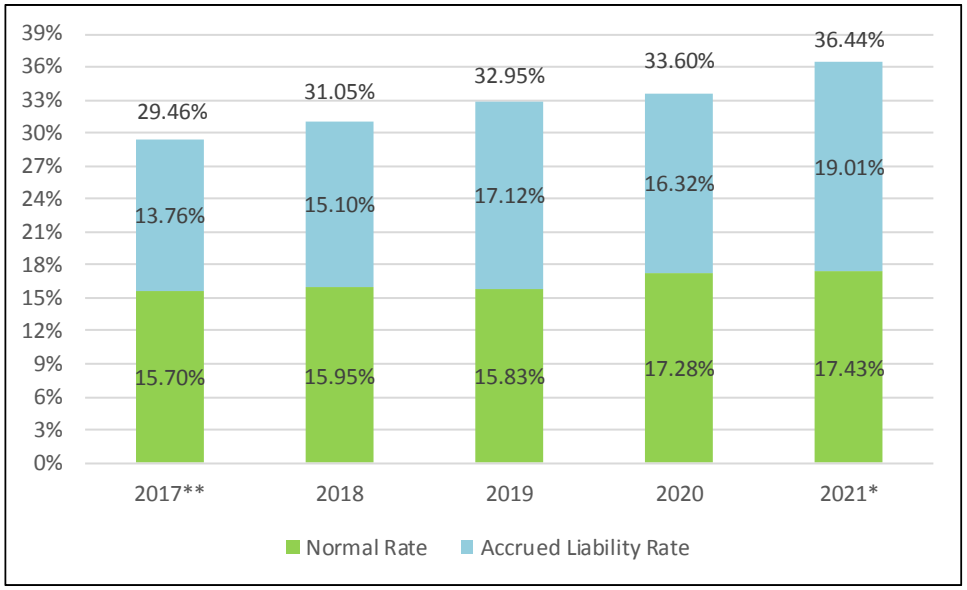
Valuation Results: Employer Contributions

G.S. 135-69 of the North Carolina General Statutes provides that the state shall make a normal contribution and an unfunded accrued liability contribution.

The December 31, 2017 valuation suggested that the preliminary total employer contribution rate be set at 33.60% of payroll for the fiscal year ending June 30, 2020. As a result of this December 31, 2018 valuation, the preliminary actuarially determined employer contribution rate is 36.44% of payroll for the fiscal year ending June 30, 2021, subject to the impact of any future legislative changes effective during that fiscal year.

Graph 10: Actuarially Determined Employer Contribution Rates

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



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

Commentary: The actuarially determined employer required 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 of most of these Systems much longer. The shorter period results in higher contributions and more benefit security.

A detailed summary of the employer required contributions rates is provided in Section 6 of this report.

Section 2: The Valuation Process

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, 2019, is $92,993,000 (compared to $95,449,000 for fiscal year ending June 30, 2018). The required financial reporting information for CJRS 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 CJRS. 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
Judges of Supreme Court and Judges of Court of Appeals	23	58.51	14.38	$ 3,658,454
Judges of the Superior Court and Administrative Officers of the Court	103	58.20	15.10	14,937,397
Judges of the District Court, District Attorneys, Clerks of the Superior Court, and Public Defenders	431	53.99	12.88	51,969,569
Total	557	54.96	13.35	$ 70,565,420

The table above includes members not in receipt of benefits who had reported compensation in 2018.

Section 3: Membership Data

Table 3: Terminated Vested Member Data

	Member Count	Average Age	Average Service	Accumulated Contributions
Judges of Supreme Court and Judges of Court of Appeals	0	0.00	0.00	$ -
Judges of the Superior Court and Administrative Officers of the Court	7	52.10	10.88	748,014
Judges of the District Court, District Attorneys, Clerks of the Superior Court, and Public Defenders	41	55.43	4.75	1,721,003
Total	48	54.94	5.64	$ 2,469,017

The table above includes members not in receipt of benefits who did not have reported compensation in 2018.

Section 3: Membership Data

Table 4: Data for Members Currently Receiving Benefits

	Member Count	Average Age	Annual Retirement Allowances
Retired Members (Healthy at Retirement)			
Male	393	73.11	$ 29,567,894
Female	153	69.82	9,423,456
Total	546	72.19	$ 38,991,350
Retired Members (Disabled at Retirement)*			
Male	1	61.75	$ 69,696
Female	1	69.67	53,015
Total	2	65.71	$ 122,711
Survivors of Deceased Members			
Male	12	76.13	$ 353,904
Female	147	77.20	5,640,809
Total	159	77.12	$ 5,994,713
Grand Total	707	73.28	$ 45,108,774

*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 CJRS members. The tables below provide the details of the Market Value of Assets for the current and prior years' valuations.

Table 5: Market Value of Assets

Asset Data as of	12/31/2018	12/31/2017
Beginning of Year Market Value of Assets	$ 595,683,002	$ 538,766,550
Employer Contributions	24,928,691	22,814,384
Employee Contributions	5,480,146	5,196,890
Benefit Payments Other Than Refunds	(44,439,973)	(42,526,086)
Refunds	(149,814)	(119,341)
Administrative Expense	(22,945)	(28,319)
Investment Income	(8,301,197)	71,578,924
Net Increase/(Decrease)	(22,505,092)	56,916,452
End of Year Value of Assets	$ 573,177,910	$ 595,683,002
Estimated Net Investment Return	-1.41%	13.46%

Table 6: Allocation of Investments by Category of the Market Value of Assets

Asset Data as of	12/31/2018	12/31/2017
Allocation by Dollar Amount		
Public Equity	$ 207,608,197	$ 235,434,181
Fixed Income (LTIF)	150,976,071	155,704,922
Cash and Receivables	44,875,219	22,088,284
Other*	169,718,423	182,455,615
Total Market Value of Assets	$ 573,177,910	$ 595,683,002
Allocation by Percentage of Asset Value		
Public Equity	36.2%	39.6%
Fixed Income (LTIF)	26.4%	26.1%
Cash and Receivables	7.8%	3.7%
Other*	29.6%	30.6%
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 CJRS, 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 7: Actuarial Value of Assets

Asset Data as of	12/31/2018
Beginning of Year Actuarial Value of Assets	$ 586,776,499
Beginning of Year Market Value of Assets	595,683,002
Contributions	30,408,837
Benefit Payments, Refunds and Administrative Expenses	(44,612,732)
Net Cash Flow	(14,203,895)
Expected Investment Return	41,209,082
Expected End of Year Market Value of Assets	622,688,189
End of Year Market Value of Assets	573,177,910
Excess of Market Value over Expected Market Value of Assets	(49,510,279)
80% of 2018 Asset Gain/(Loss)	(39,608,223)
60% of 2017 Asset Gain/(Loss)	19,966,252
40% of 2016 Asset Gain/(Loss)	(2,119,937)
20% of 2015 Asset Gain/(Loss)	(7,267,631)
Total Deferred Asset Gain/(Loss)	(29,029,539)
Preliminary End of Year Actuarial Value of Assets	602,207,449
Final End of Year Actuarial Value of Asset (not less than 80% and not greater than 120% of Market Value)	602,207,449
Estimated Net Investment Return on Actuarial Value	5.11%

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

Lower than expected market returns in all years except 2017 resulted in an actuarial value of asset return for calendar year 2018 of 5.11% and a recognized actuarial asset loss of $11.0 million during 2018.

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 8: Historical Asset Returns

Calendar Year	Actuarial Value of Asset Return	Market Value of Asset Return
1999	15.74%	10.03%
2000	12.37%	2.60%
2001	9.07%	-1.74%
2002	6.13%	-4.84%
2003	8.44%	18.33%
2004	8.95%	10.73%
2005	8.56%	6.94%
2006	9.17%	11.35%
2007	9.04%	8.35%
2008	3.01%	-19.39%
2009	4.88%	14.83%
2010	6.01%	11.49%
2011	5.25%	2.18%
2012	6.42%	11.79%
2013	7.52%	12.19%
2014	7.26%	6.19%
2015	5.87%	0.35%
2016	5.33%	6.22%
2017	6.57%	13.46%
2018	5.11%	-1.41%
Average	7.50%	5.63%
Range	12.73%	37.72%

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 last 20 years of 7.50% compares with an average market return of 5.63%. The difference is primarily due to asset gains of the late 1990's being included in the actuarial value and not the market value as well as the 2018 market loss only being partially recognized in the actuarial value of assets. But the range of returns on market value of assets is markedly more volatile, 12.73% versus 37.72%. This results in much lower employer contribution volatility using the actuarial value of assets versus market, while ensuring that the actuarial needs of CJRS are met.

Section 5: Liability Results

Using the provided membership data, benefit provisions, and actuarial assumptions, future benefit payments of CJRS 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 9: Liability Summary

Valuation Results as of	12/31/2018	12/31/2017
(a) Present Value of Future Benefits		
(1) Active Members	$ 409,330,900	$ 409,938,370
(2) Terminated Members	7,657,518	4,174,484
(3) Members Currently Receiving Benefits	438,826,119	420,408,179
(4) Total	$ 855,814,537	$ 834,521,033
(b) Present Value of Future Normal Costs	$ 153,201,874	$ 152,625,946
(c) Actuarial Accrued Liability: (a4) - (b3)	$ 702,612,663	$ 681,895,087
(d) Actuarial Value of Assets	$ 602,207,449	$ 586,776,499
(e) Unfunded Actuarial Accrued Liability: (c) - (d)	$ 100,405,214	$ 95,118,588

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 10: Reconciliation of Unfunded Actuarial Accrued Liability

(in millions)	
Unfunded Actuarial Accrued Liability (UAAL) as of 12/31/2017	$ 95.1
Normal Cost and Administrative Expense during 2018	17.1
Reduction due to Actual Contributions during 2018	(30.4)
Interest on UAAL, Normal Cost, and Contributions	6.2
Asset (Gain) / Loss	11.0
Actuarial Accrued Liability (Gain) / Loss	1.4
Impact of Assumption Changes	-
Impact of Legislative Changes	-
Unfunded Actuarial Accrued Liability (UAAL) as of 12/31/2018	$ 100.4

Commentary: The loss recognized in the actuarial value of assets during the year increased the UAAL by $11.0 million. Additionally, demographic changes increased the UAAL by $1.4 million.

Section 6: Actuarially Determined Employer Contribution

The actuarially determined employer contribution consists of a normal cost rate and an accrued liability 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 table below provides the calculation of the actuarially determined employer contribution for the current and prior years' valuations.

TABLE 11: Calculation of the Actuarially Determined Employer Contribution (ADEC)

Valuation Date ADEC for Fiscal Year Ending	12/31/2018 6/30/2021	12/31/2017 6/30/2020
Normal Cost Rate Calculation		
(a) Normal Cost Rate*	23.43%	23.28%
(b) Employee Contribution Rate	6.00%	6.00%
(c) Total Normal Cost Rate: (a) - (b)	17.43%	17.28%
Accrued Liability Rate Calculation		
(d) Total Annual Amortization Payments**	$ 15,826,291	$ 14,433,684
(e) Valuation Compensation***	79,200,415	79,014,246
(f) Accrued Liability Rate: (d) / (e)	19.98%	18.27%
Preliminary ADEC (c) + (f)	37.41%	35.55%
ADEC With Direct-Rate Smoothing	36.44%	33.60%
Impact of Legislative Changes	N/A	0.00%
Final ADEC	N/A	33.60%

*Includes assumed administrative expenses.
**See Table 14 for more detail
***Beginning with the December 31, 2017 valuation, compensation is projected to the fiscal year over which contributions will occur.

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Section 6: Actuarially Determined Employer Contribution

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

Table 12: Reconciliation of the Change in the ADEC

Fiscal year ending June 30, 2020 Preliminary ADEC (based on December 31, 2017 valuation)	33.60%
Impact of Legislative Changes	0.00%
Fiscal year ending June 30, 2020 ADEC for Reconciliation	33.60%
Change due to Anticipated Reduction in UAAL*	(0.04%)
Change Due to Demographic (Gain)/Loss	0.33%
Change Due to Investment (Gain)/Loss	1.86%
Change Due to Contributions Less (Greater) than ADEC	(0.29%)
Impact of Assumption Changes	0.00%
Impact of Direct-Rate Smoothing	0.98%
Fiscal year ending June 30, 2021 Preliminary ADEC (based on December 31, 2018 valuation)	36.44%

*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.

Section 6: Actuarially Determined Employer Contribution

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

Table 13: Calculation of the New Amortization Base

Calculation as of	12/31/2018	12/31/2017
(a) Unfunded Actuarial Accrued Liability*	$ 100,405,214	$ 94,709,956
(b) Prior Years' Outstanding Bases	$ 90,067,665	$ 75,520,807
(c) New Amortization Base: (a) - (b)	$ 10,337,549	$ 19,189,149
(d) New Amortization Payment	$ 1,392,607	$ 2,585,036

* The unfunded actuarial accrued liability at December 31, 2017 does not reflect the cost of the one-time pension supplement to be paid in October 2018, as the entire cost of this supplement was funded in the appropriated contribution for fiscal year ending June 30, 2019.

Table 14: Amortization Schedule for Unfunded Accrued Liability

Date Established	Original Balance	12/31/2018 Outstanding Balance	FYE 6/30/2021 Payment
December 31, 2009	$ 34,962,037	$ 18,440,836	$ 4,754,253
December 31, 2010	3,913,729	2,441,312	531,669
December 31, 2011	10,017,079	7,148,237	1,359,464
December 31, 2012	(4,239,030)	(3,380,047)	(574,752)
December 31, 2013	(892,665)	(781,495)	(120,921)
December 31, 2014	(6,478,378)	(6,143,413)	(876,777)
December 31, 2015	36,271,204	36,853,557	4,903,895
December 31, 2016	13,868,882	14,956,289	1,871,817
December 31, 2017	19,189,149	20,532,389	2,585,036
December 31, 2018	10,337,549	10,337,549	1,392,607
Total		$ 100,405,214	$ 15,826,290

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

Section 6: Actuarially Determined Employer Contribution

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

Table 15: History of Actuarially Determined Employer Contributions and Appropriated Rates

Valuation Date	Fiscal Year Ending	Normal Rate*	Accrued Liability Rate	Change due to Legislation**	Final ADEC	Appropriated Rate
12/31/2018	6/30/2021	17.43%	19.98%	N/A	N/A	N/A
12/31/2017	6/30/2020	17.28%	18.27%	0.00%	33.60%	33.60%
12/31/2016	6/30/2019	15.83%	16.52%	0.60%	32.95%	33.86%
12/31/2015	6/30/2018	15.95%	14.28%	0.82%	31.05%	31.05%
12/31/2014	6/30/2017	17.95%	7.14%	4.37%	29.46%	27.21%

*Includes Death Benefit rate

**For fiscal year ending 6/30/2017, the change due to legislation for the contribution includes a 3.44% increase in the ADEC due to the experience study and a 0.93% increase in the ADEC due to the one-time pension supplement to be paid on or before October 31, 2016. The fiscal year ending 6/30/2019 amount of 0.60% is for the one-time cost-of-living supplement paid in October 2018. The appropriated contribution rate of 33.86% was greater than the 32.95% final ADEC for the fiscal year ending June 30, 2019, by 0.91%.

Table 16: Cost of Benefit Enhancements

Valuation Date	12/31/2018	12/31/2017
Increase in UAAL for a 1% COLA	$ 4,820,000	$ 4,662,000
Increase in ADEC for a 1% COLA	0.82%	0.79%

* The 1% COLA in the 12/31/2018 column would be effective July 1, 2020 and includes expected costs of COLAs paid for retirements after 12/31/2018 and before June 30, 2020. The COLA would be paid in full to retired members and survivors of deceased members on the retirement roll on July 1, 2019 and would be prorated for retired members and survivors of deceased members who commence benefits after July 1, 2019 but before June 30, 2020.

Section 7: Valuation Balance Sheet

The valuation balance sheet shows the assets and liabilities of CJRS. 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 17: Valuation Balance Sheet

Balance Sheet as of	12/31/2018	12/31/2017
Assets		
Current Actuarial Value of Assets		
Annuity Savings Fund	$ 66,049,642	$ 64,311,122
Pension Accumulation Fund	536,157,807	522,465,377
Total	$ 602,207,449	$ 586,776,499
Future Member Contributions to the Annuity Savings Fund	$ 38,764,645	$ 39,016,822
Prospective Contributions to the Pension Accumulation Fund		
Normal Contributions	$ 114,437,229	$ 114,017,756
Unfunded Accrued Liability Contributions	100,405,214	95,118,588
Total	$ 214,842,443	$ 209,136,344
Total Assets	$ 855,814,537	$ 834,929,665
Liabilities		
Annuity Savings Fund		
Past Member Contributions	$ 66,049,642	$ 64,311,122
Future Member Contributions	38,764,645	39,016,822
Total Contributions	$ 104,814,287	$ 103,327,944
Pension Accumulaton Fund		
Benefits Currently in Payment	$ 438,826,119	$ 420,408,179
Benefits to be Paid to Current Active Members and Inactive Members Not in Receipt of a Benefit	312,174,131	310,784,910
Reserve for Increases in Retirement Allowances	-	408,632
Total Benefits Payable	$ 751,000,250	$ 731,601,721
Total Liabilities	$ 855,814,537	$ 834,929,665

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, 2019 based on a valuation date of December 31, 2018.

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

The June 30, 2019 total pension liability presented in this section was determined by an actuarial valuation as of December 31, 2018, 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 18: Number of Active and Retired Members as of December 31, 2018

Number of Active and Retired Participants as of December 31, 2018	
Group	**Number**
Retired members and survivors of deceased members currently receiving benefits	707
Terminated members and survivors of deceased members entitled to benefits but not yet receiving benefits	48
Active members	557
Total	1,312

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 19: Schedule of Changes in Net Pension Liability (Asset)

Schedule of Changes in Net Pension Liability as of June 30, 2019	
Plan Fiduciary Net Position	
Service Cost	$ 18,710,000
Interest	46,838,000
Changes of Benefit Terms*	0
Difference between Expected and Actual Experience	845,000
Change of Assumptions	0
Benefit Payments, including Refund of Member Contributions	(46,451,000)
Net Change in Total Pension Liability	19,942,000
Total Pension Liability - Beginning of Year	$ 691,953,000
Total Pension Liability - End of Year	$ 711,895,000
Plan Fiduciary Net Position	
Employer Contributions	$ 25,636,000
Member Contributions	5,151,000
Net Investment Income	38,211,000
Benefit Payments, including Refund of Member Contributions	(46,451,000)
Administrative Expenses	(30,000)
Other	(119,000)
Net Change in Plan Fiduciary Net Position	22,398,000
Plan Fiduciary Net Position - Beginning of Year	$ 596,504,000
Plan Fiduciary Net Position - End of Year	$ 618,902,000

Table 20: Net Pension Liability (Asset)

Net Pension Liability (Asset)	June 30, 2019	June 30, 2018
Total Pension Liability	$ 711,895,000	$ 691,953,000
Plan Fiduciary Net Position	618,902,000	596,504,000
Net Pension Liability (Asset)	$ 92,993,000	$ 95,449,000
Plan Fiduciary Net Position as a Percentage of the Total Pension Liability (Asset)	86.94%	86.21%

Section 8: Accounting Results

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

Table 21: Sensitivity of the Net Pension Liability at June 30, 2019 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)	$165,042,000	$92,993,000	$31,298,000

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 System contributions will continue to follow the current funding policy, including "direct-rate smoothing" as adopted by the Board on April 26, 2018. Based on those assumptions, 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 detail.

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

Table 22: Additional Information for GASB Statement No. 67

Valuation Date	12/31/2018
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% - 5.50%
*Includes Inflation of	3.00%
**Includes Inflation and Productivity of	3.50%
Cost-of-living Adjustments	N/A

Appendix A: Valuation Process and Glossary of Actuarial Terms

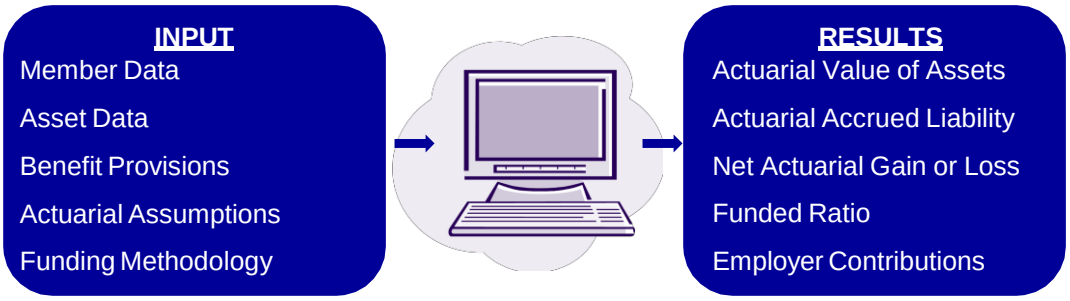
Purpose of an Actuarial Valuation

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") 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.

Appendix A: Valuation Process and Glossary of Actuarial Terms

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 12 years. 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.

Appendix A: Valuation Process and Glossary of Actuarial Terms

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.

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 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. The actuary 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.*

Appendix A: Valuation Process and Glossary of Actuarial Terms

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 includes:

- Amortization Period Length – Generally amortization periods of 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.

Asset Valuation Method. The components of how the actuarial value of assets is to be developed CJRS 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.*

Appendix A: Valuation Process and Glossary of Actuarial Terms

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 Tabulations of Member Data

Table B-1: The Number and Average Reported Compensation of Active Members Distributed by Age and Service as of December 31, 2018

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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
25 to 29	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
30 to 34	1	11	0	0	0	0	0	0	0	0	12
	42,430	109,169	0	0	0	0	0	0	0	0	103,607
35 to 39	1	11	4	1	0	0	0	0	0	0	17
	9,391	120,417	125,273	128,308	0	0	0	0	0	0	115,493
40 to 44	4	24	13	4	0	0	0	0	0	0	45
	25,028	115,545	127,468	130,505	0	0	0	0	0	0	112,273
45 to 49	2	22	18	23	7	6	0	0	0	0	78
	9,429	126,627	123,629	131,485	134,278	130,370	0	0	0	0	125,337
50 to 54	2	21	21	16	20	16	12	4	0	0	112
	7,751	105,423	125,055	131,969	139,661	138,520	138,002	100,892	0	0	125,323
55 to 59	2	17	17	22	12	10	15	10	1	0	106
	15,074	122,751	127,054	132,386	124,955	137,739	145,799	130,685	103,052	0	128,897
60 to 64	4	21	12	12	11	16	6	10	4	1	97
	25,881	118,421	128,140	139,441	139,654	139,138	158,489	137,581	142,250	111,698	129,600
65 to 69	1	5	6	14	11	10	5	6	4	4	66
	7,581	136,446	121,696	130,927	144,289	147,194	147,612	149,472	146,616	119,596	136,543
70 & Over	1	0	4	8	1	1	2	2	1	4	24
	8,944	0	131,774	134,466	153,194	168,720	163,009	167,637	139,221	128,424	135,329
Total	18	132	95	100	62	59	40	32	10	9	557
	18,694	117,834	125,942	132,805	137,245	139,708	146,451	134,948	139,774	122,642	126,688

Appendix B: Detailed Tabulations of Member Data

Table B-2: The Number and Reported Compensation of Active Members Distributed by Age as of December 31, 2018

Age	Men		Women	
	Number	Compensation	Number	Compensation
31	1	64,616	1	117,877
32	1	117,877	2	235,754
33	1	103,151	2	207,957
34	3	278,184	1	117,877
35	1	117,877	1	117,877
36	2	207,957	1	117,877
37	2	254,022	0	0
38	6	752,621	1	9,391
39	3	385,753	0	0
40	5	605,618	5	495,336
41	3	377,683	6	524,730
42	6	656,206	3	354,092
43	3	331,492	6	759,168
44	5	617,812	3	330,160
45	0	0	3	382,264
46	8	1,001,243	6	726,672
47	16	1,970,167	3	411,570
48	13	1,694,208	10	1,235,830
49	10	1,191,272	9	1,163,075
50	12	1,513,632	14	1,694,603
51	10	1,177,046	7	773,196
52	13	1,819,842	9	1,136,560
53	15	2,034,026	12	1,477,329
54	9	1,205,493	11	1,204,475
55	7	809,387	9	1,103,429
56	13	1,860,860	11	1,385,506
57	8	998,031	10	1,380,123
58	15	1,865,636	9	1,167,916
59	15	2,034,611	9	1,057,560
60	8	896,208	9	989,496
61	13	1,670,633	6	692,238
62	17	2,423,496	8	978,037
63	13	1,672,768	5	671,238
64	15	2,152,548	3	424,527
65	11	1,546,979	2	210,430
66	18	2,410,045	3	376,103
67	10	1,368,313	1	168,911
68	7	1,038,496	0	0
69	11	1,484,082	3	408,450
70	8	1,153,100	4	446,059
71	4	530,450	1	168,720
72	4	593,830	0	0
73	0	0	1	111,698
74	2	244,038	0	0
Total	347	45,231,309	210	25,334,111

Appendix B: Detailed Tabulations of Member Data

Table B-3: The Number and Reported Compensation of Active Members Distributed by Service as of December 31, 2018

Service	Men		Women	
	Number	Compensation	Number	Compensation
0	10	186,561	8	149,931
1	13	1,176,437	8	662,259
2	19	2,359,448	22	2,642,831
3	12	1,544,267	1	117,877
4	39	4,907,695	18	2,143,225
5	12	1,490,659	5	553,528
6	16	2,033,081	14	1,667,008
7	1	123,535	2	247,070
8	19	2,454,665	13	1,621,972
9	9	1,237,511	4	535,512
10	13	1,761,451	14	1,747,473
11	10	1,360,687	5	648,504
12	21	2,773,511	7	889,854
13	9	1,255,749	1	129,193
14	13	1,755,563	7	958,482
15	2	227,925	2	228,289
16	10	1,424,006	9	1,156,035
17	4	596,352	3	397,427
18	14	1,956,127	8	1,124,120
19	8	1,127,232	2	271,696
20	10	1,323,186	4	564,776
21	4	550,354	4	501,482
22	7	984,367	5	677,078
23	2	275,365	6	874,749
24	16	2,318,225	1	173,217
25	9	1,424,902	5	653,136
26	3	467,887	4	631,022
27	1	150,903	1	94,406
28	8	1,283,597	3	409,592
29	5	607,725	1	134,857
30	8	1,225,435	5	608,109
31	0	0	1	129,193
32	4	550,728	1	125,498
33	3	433,614	2	233,589
34	2	340,003	6	672,162
35	1	170,782	0	0
36	0	0	1	139,221
37	1	103,052	2	274,214
38	0	0	1	111,698
39	3	500,037	1	98,732
41	1	160,577	0	0
42	1	107,378	0	0
43	1	98,732	2	223,396
44	1	160,577	0	0
46	2	241,421	0	0
47	0	0	1	111,698
Total	347	45,231,309	210	25,334,111

Appendix B: Detailed Tabulations of Member Data

Table B-4: The Number and Accumulated Contributions of Terminated Vested Members Distributed by Age as of December 31, 2018

Age	Men		Women	
	Number	Contributions	Number	Contributions
36	1	3,434	0	0
42	0	0	1	11,482
44	0	0	1	4,721
45	0	0	1	124,649
47	1	44,015	1	76,061
48	3	27,766	1	90,544
49	1	48,001	1	49,643
50	1	100,436	1	58,524
51	4	183,923	0	0
52	1	7,124	1	4,583
53	1	6,014	1	5,083
54	1	35,323	1	49,895
55	1	15,180	1	5,446
56	1	37,503	0	0
57	1	80,825	2	348,985
58	2	101,237	0	0
59	1	42,918	0	0
60	1	20,546	1	46,786
61	4	408,187	2	270,953
65	1	32,873	1	1,512
66	1	49,972	0	0
68	3	29,363	1	45,510
Total	30	1,274,640	18	1,194,377

Appendix B: Detailed Tabulations of Member Data

Table B-5: The Number and Annual Retirement Allowances of Retired Members (Healthy at Retirement) and Survivors of Deceased Members Distributed by Age as of December 31, 2018

Age	Men		Women	
	Number	Allowances	Number	Allowances
51	0	0	2	53,973
52	0	0	4	200,917
54	0	0	5	205,301
55	2	81,621	0	0
56	3	245,792	5	208,307
57	2	125,050	4	153,882
58	1	21,469	2	99,301
59	3	232,172	0	0
60	3	295,225	3	208,654
61	1	50,416	5	286,699
62	7	567,858	13	814,680
63	4	340,789	9	610,653
64	14	1,007,724	13	731,768
65	12	772,608	11	686,537
66	12	807,214	9	425,943
67	22	1,669,920	14	777,339
68	15	1,109,749	15	971,700
69	28	2,066,514	12	719,353
70	24	1,824,663	8	518,105
71	24	1,778,689	6	433,055
72	31	2,486,316	8	404,771
73	31	2,198,681	16	893,984
74	17	1,199,362	6	294,679
75	20	1,435,920	6	260,198
76	21	1,455,753	7	538,460
77	11	836,262	16	583,398
78	10	872,877	2	13,994
79	11	1,041,001	9	523,400
80	8	691,518	8	332,663
81	9	631,562	10	314,177

Appendix B: Detailed Tabulations of Member Data

Table B-5: The Number and Annual Retirement Allowances of Retired Members (Healthy at Retirement) and Survivors of Deceased Members Distributed by Age as of December 31, 2018 (continued)

Age	Men		Women	
	Number	Allowances	Number	Allowances
82	9	746,975	8	343,398
83	8	480,549	5	198,120
84	5	229,660	8	322,502
85	7	515,775	3	91,827
86	3	270,492	9	358,152
87	4	328,440	5	355,117
88	4	292,289	3	210,127
89	5	321,939	4	202,061
90	5	328,890	6	100,713
91	1	10,973	6	148,015
92	0	0	4	158,666
93	3	227,399	2	55,637
94	1	105,024	2	36,649
95	1	100,757	1	11,951
96	2	91,633	2	38,131
98	1	24,278	1	20,263
100	0	0	2	97,292
101	0	0	1	49,753
Total	405	29,921,798	300	15,064,265

Appendix B: Detailed Tabulations 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 Annuity Type as of December 31, 2018

Annuity Type	Men		Women	
	Number	Allowances	Number	Allowances
Maximum	226	17,364,665	121	7,407,318
Option 1	3	271,138	0	0
Option 2	40	2,209,923	4	220,716
Option 3	45	3,964,560	5	359,673
Option 4	3	196,984	8	352,950
Option 5-2	0	0	0	0
Option 5-3	0	0	0	0
Option 6-2	23	1,330,679	1	91,263
Option 6-3	50	4,149,628	14	991,536
Other	3	80,317	0	0
Survivors of Deceased Members	12	353,904	147	5,640,809
Total	405	29,921,798	300	15,064,265

Appendix B: Detailed Tabulations of Member Data

Table B-7: The Number and Annual Retirement Allowances of Retired Members (Disabled at Retirement) Distributed by Age as of December 31, 2018

Age	Men		Women	
	Number	Allowances	Number	Allowances
62	1	69,696	0	0
70	0	0	1	53,015
Total	1	69,696	1	53,015

Appendix B: Detailed Tabulations of Member Data

Table B-8: The Number and Annual Retirement Allowances of Retired Members (Disabled at Retirement) Distributed by Annuity Type as of December 31, 2018

Annuity Type	Men		Women	
	Number	Allowances	Number	Allowances
Maximum	1	69,696		
Option 1				
Option 2				
Option 3			1	53,015
Option 4				
Option 5-2				
Option 5-3				
Option 6-2				
Option 6-3				
Other				
Total	1	69,696	1	53,015

Appendix C: Summary of Main Benefits & Contribution Provisions

All justices, judges, district attorneys, and public defenders of the General Court of Justice, and clerks of the Superior Court are eligible for membership.

"Final compensation" as used in the summary means the annual rate of compensation of the member at his date of termination or death. “Average final compensation” means the average annual compensation during the 48 consecutive calendar months of membership producing the highest average. "Creditable service" includes all service rendered as a justice of the Supreme Court, judge of the Court of Appeals, judge of the Superior Court, judge of the District Court Division of the General Court of Justice, Administrative Officer of the Courts, District Attorney, Public Defender or as a Clerk of the Superior Court.

BENEFITS

Service Retirement Allowance

Conditions for Allowance

A service retirement allowance is payable to any member who retires from service and:

(a) had attained age 50 and was in service on October 8, 1981; or

(b) has attained age 50 and completed five or more years of creditable service; or

Retirement is compulsory at age 72 if the member is a justice or judge of the Appellate, Superior, or District Divisions of the General Court of Justice and at age 70 for each other member.

Unreduced Allowance

An unreduced annual service retirement allowance is payable to a member who:

(a) has attained age 65 and completed five years of creditable service; or

(b) has attained age 50 and completed 24 years of creditable service.

The Service Retirement Allowance is equal to:

(i) 4.02% of final compensation multiplied by the number of years of creditable service rendered as a justice of the Supreme Court or judge of the Court of Appeals, plus

(ii) 3.52% of final compensation multiplied by the number of years of creditable service rendered as a judge of the Superior Court or as Administrative Officer of the Courts, plus

(iii) 3.02% of final compensation multiplied by the number of years of creditable service rendered as a judge of the District Court, District Attorney, Public Defender, or Clerk of the Superior Court, plus

(iv) A service retirement allowance computed on average final compensation, service transferred from the Teachers' and State Employees' Retirement System or the Local Governmental Employees' Retirement System and the applicable formula accrual rate from the previous system.

Reduced Allowance

A reduced annual service retirement allowance is payable to a member who retires:

(a) prior to the earlier of attainment of age 65 and completion of five years of creditable service;

(b) prior to attainment of age 50 or the completion of 24 years of creditable service.

The reduced amount is an allowance as computed above reduced by 3% for each year that the member's retirement date precedes the date upon which the member would have attained age 65 or completed 24 years of service had he or she remained in service, whichever is earlier.

Maximum Amount

The maximum annual service retirement allowance (on an unreduced basis) is the amount which, when added to the member's benefit payable from the Teachers' and State Employees' Retirement System, Local Governmental Employees' Retirement System, or Legislative Retirement System (all on an unreduced basis) would total 75% of the member's final compensation.

Minimum Amount

In no event will a member whose creditable service commenced prior to January 1, 1974 as a justice of the Supreme Court, as a judge of the Court of Appeals, as an Administrative Officer of the courts, or as a judge of the Superior Court, receive a smaller retirement allowance than he or she would have received under Chapter 7-A of the General Statutes.

Appendix C: Summary of Main Benefits & Contribution Provisions

Disability Retirement Allowance

Condition for Allowance	Any member who becomes permanently and totally disabled prior to the attainment of age 65 and who has completed at least five years of creditable service may be retired by the Board of Trustees on a disability retirement allowance. Any retired member may also apply for a disability retirement allowance within the first three years of retirement.
Amount of Allowance	The disability retirement allowance is computed as a Service Retirement Allowance based on the number of years of creditable service the member would have had had he or she remained in service to the earliest date he could have retired on an unreduced service retirement allowance.
Deferred Allowance	Any member who separates from service prior to age 50 and completion of five years of creditable service and who leaves his total accumulated contributions in the system may receive a deferred allowance, beginning at age 50, computed in the same way as a service retirement allowance on the basis of creditable service and compensation to the date of separation.

Spouse Benefit

Conditions for Benefit	Upon the death of a member in active service after attainment of age 50 and completion of five years of creditable service a death benefit is payable to his or her surviving spouse.
Amount of Benefit	The surviving spouse receives a lump sum payment equal to the member's final compensation. In addition the surviving spouse receives an annual retirement allowance, until death or remarriage, equal to 50% of the service retirement allowance to which the member would have been entitled had retirement occurred on the first day of the calendar month coincident with or next following his or her date of death reduced by 2% for each year that the member's age exceeds that of the spouse.

Lump Sum Death Benefit	Upon the death of a member in active service prior to attainment of age 50 a lump sum payment equal to the member's accumulated contributions plus his or her final compensation is made to the designated beneficiary or estate.

Appendix C: Summary of Main Benefits & Contribution Provisions

Death after Retirement	Upon the death of a retired member while in receipt of a service retirement allowance or after age 65 if in receipt of a disability retirement allowance an allowance is paid to his or her spouse, until death or remarriage, equal to one-half the allowance which was payable to the member prior to death reduced by 2% for each year that the member's age exceeds that of the spouse. Upon the death of a member in receipt of a disability retirement allowance prior to age 65, an allowance is paid to his or her spouse, until death or remarriage, equal to one-half the service retirement allowance the member would have received had he or she remained in service up to the date of death reduced by 2% for each year that the member's age exceeds that of the spouse. 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.
Other Death Benefits	Upon the death of a member in service, other benefits may be provided by the Death Benefit Plan.
Return of Contributions	Any member who terminates service other than by retirement or death is entitled to the return of accumulated contributions. If the total retirement allowance payments to a retired member, spouse and/or beneficiary under option are less than the member's accumulated contributions at retirement, the excess is paid to the designated beneficiary or legal representatives. The current interest rate on member contributions is 4%.

Appendix C: Summary of Main Benefits & Contribution Provisions

Optional Allowances

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 - At the death of the member within 10 years from retirement date, an amount equal to his or her accumulated contributions at retirement, less 1/120 for each month he or she has received a retirement allowance payment, is paid to the estate, or to a person 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, or

Option 4 - At retirement, any member may elect to receive a retirement allowance in such amount that, together with his or her Social Security benefit, the member 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. A member who elects to receive his or her allowance under this option is deemed to have elected Option 1 also, or

Option 5 - At retirement, the member may elect to receive a reduced retirement allowance during his or her life with some other benefit approved by the Board of Trustees payable after death, or the member 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, or

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.

Appendix C: Summary of Main Benefits & Contribution Provisions

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.
Post-Retirement Increases in Allowance	Future increases in allowances may be granted at the discretion of the State.
Contributions	
Member Contributions	Each member contributes 6% of annual compensation.
Employer Contributions	The State makes 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.
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.

Withdrawal: No termination of employment is assumed to occur prior to retirement, other than death or disability.

Separations Before Retirement: Representative values of the assumed annual rates of separation are as follows:

	Annual Rate of		
	Disability	Base Mortality*	
Age	Male & Female	Male	Female
25	.0001	.0005	.0002
30	.0001	.0005	.0002
35	.0003	.0005	.0003
40	.0007	.0006	.0004
45	.0014	.0010	.0007
50	.0023	.0017	.0011
55	.0047	.0028	.0017
60	.0077	.0047	.0024
64	.0098	.0074	.0034

* Base mortality rates as of 2014.

Service Retirement: Representative values of the assumed annual rates of service retirement are as follows:

	Service				
Age*	5	10	15	20	25 +
50					.150
55	.025	.025	.025	.025	.150
60	.025	.025	.025	.025	.125
65	.100	.100	.100	.100	.100
70	.500	.500	.500	.500	.500

*All members are assumed to retire no later than age 72.

Appendix D: Actuarial Assumptions and Methods

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

Annual Rate of Salary Increase

Service	
0	.0550
5	.0500
10	.0450
15	.0405
20	.0375
25	.0350
30	.0350
35	.0350
40	.0350

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

Annual Rate of Death after Retirement
(Retired Members and Survivors of Deceased Members)

	Retirees (Healthy at Retirement)		Survivors of Deceased Members		Retirees (Disabled at Retirement)	
Age	Male	Female	Male	Female	Male	Female
55	.0057	.0036	.0057	.0036	.0234	.0145
60	.0078	.0052	.0078	.0052	.0266	.0170
65	.0110	.0080	.0110	.0080	.0317	.0209
70	.0168	.0129	.0168	.0129	.0403	.0282
75	.0268	.0209	.0268	.0209	.0543	.0410
80	.0447	.0348	.0447	.0348	.0766	.0610

Deaths After Retirement (Healthy Members at Retirement and Survivors of Deceased Members): 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.

Deaths After Retirement (Disabled Members at Retirement): Mortality rates are based on the RP-2014 Total Data Set for Disabled Annuitants Mortality Table.

Deaths Prior to Retirement: Mortality rates are based on the RP-2014 Total Data Set Employee Mortality Table.

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

Appendix D: Actuarial Assumptions and Methods

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

Liability for Inactive Members: The liability for members who terminated prior to five years of creditable service is estimated to be 100% of the member's accumulated contributions. The liability for members who terminated after completing five years of creditable service is estimated based on the member's current age and the service and reported compensation at termination of employment.

Administrative Expenses: 0.75% of payroll added to the normal cost rate.

Marriage Assumption: 90% of male members married and 50% of female members married with the male spouses four years older than female spouses.

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 7. 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 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: Calculation of investment return no longer net of administrative expenses.

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
2019	$ 573,178	$ 4,555	$ 25,470	$ 47,588	$ 127	$ 39,514	$ 595,002
2020	595,002	4,399	26,680	49,759	123	41,003	617,202
2021	617,202	4,276	28,555	51,816	120	42,547	640,644
2022	640,644	4,168	29,969	53,628	117	44,170	665,206
2023	665,206	4,057	27,993	55,283	113	45,761	687,621
2024	687,621	3,921	26,135	56,985	109	47,203	707,786
2025	707,786	3,793	25,602	58,644	105	48,535	726,967
2026	726,967	3,653	24,821	60,162	101	49,794	744,972
2027	744,972	3,510	24,690	61,728	97	50,991	762,338
2028	762,338	3,353	24,708	63,164	92	52,153	779,296
2029	779,296	3,196	22,196	64,429	87	53,205	793,377
2030	793,377	3,043	18,339	65,570	82	54,013	803,120
2031	803,120	2,886	15,607	66,734	77	54,556	809,357
2032	809,357	2,720	13,111	67,894	72	54,861	812,083
2033	812,083	2,554	10,793	68,993	67	54,929	811,299
2034	811,299	2,376	8,788	69,871	62	54,769	807,300
2035	807,300	2,217	7,531	70,590	57	54,416	800,816
2036	800,816	2,057	5,899	71,118	53	53,882	791,483
2037	791,483	1,890	4,574	71,617	48	53,160	779,443
2038	779,443	1,727	4,083	72,074	43	52,279	765,415
2039	765,415	1,551	3,625	72,384	39	51,265	749,433
2040	749,433	1,378	3,158	72,586	34	50,118	731,467
2041	731,467	1,197	2,630	72,875	28	48,826	711,217
2042	711,217	1,004	2,148	72,945	23	47,383	688,784
2043	688,784	826	1,736	72,634	19	45,803	664,496
2044	664,496	676	1,442	71,727	16	44,119	638,990
2045	638,990	572	1,208	70,386	13	42,368	612,739
2046	612,739	480	1,039	68,727	11	40,579	586,099
2047	586,099	406	837	67,063	9	38,762	559,032
2048	559,032	330	664	65,274	7	36,920	531,666
2049	531,666	262	499	63,397	6	35,061	504,085
2050	504,085	199	377	61,339	4	33,195	476,513
2051	476,513	156	272	59,142	3	31,336	449,132
2052	449,132	114	221	56,760	2	29,498	422,203
2053	422,203	91	156	54,383	2	27,691	395,756
2054	395,756	68	127	51,897	1	25,924	369,977
2055	369,977	53	92	49,435	1	24,202	344,889
2056	344,889	37	63	46,978	1	22,529	320,539
2057	320,539	25	33	44,548	-	20,907	296,956
2058	296,956	13	14	42,112	-	19,339	274,210
2059	274,210	5	2	39,674	-	17,830	252,374
2060	252,374	2	-	37,243	-	16,385	231,518
2061	231,518	-	-	34,837	-	15,008	211,688
2062	211,688	-	-	32,491	-	13,700	192,898
2063	192,898	-	-	30,208	-	12,463	175,153
2064	175,153	-	-	27,993	-	11,298	158,457
2065	158,457	-	-	25,852	-	10,202	142,808
2066	142,808	-	-	23,789	-	9,178	128,196
2067	128,196	-	-	21,808	-	8,223	114,611
2068	114,611	-	-	19,913	-	7,338	102,035

Appendix E: GASB 67 Fiduciary Net Position Projection

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

(in thousands)

Calendar Year	Beginning Fiduciary Position	Member Contributions	Employer Contributions	Benefit Payments	Administrative Expenses	Investment Earnings	Ending Fiduciary Position
2069	$ 102,035	$ -	$ -	$ 18,108	$ -	$ 6,519	$ 90,447
2070	90,447	-	-	16,397	-	5,767	79,817
2071	79,817	-	-	14,783	-	5,079	70,113
2072	70,113	-	-	13,268	-	4,451	61,297
2073	61,297	-	-	11,853	-	3,883	53,327
2074	53,327	-	-	10,537	-	3,370	46,160
2075	46,160	-	-	9,320	-	2,911	39,751
2076	39,751	-	-	8,199	-	2,500	34,052
2077	34,052	-	-	7,172	-	2,137	29,017
2078	29,017	-	-	6,236	-	1,817	24,597
2079	24,597	-	-	5,388	-	1,536	20,746
2080	20,746	-	-	4,624	-	1,293	17,415
2081	17,415	-	-	3,939	-	1,084	14,560
2082	14,560	-	-	3,329	-	905	12,136
2083	12,136	-	-	2,789	-	754	10,100
2084	10,100	-	-	2,314	-	627	8,414
2085	8,414	-	-	1,900	-	524	7,037
2086	7,037	-	-	1,542	-	440	5,935
2087	5,935	-	-	1,236	-	373	5,072
2088	5,072	-	-	977	-	321	4,417
2089	4,417	-	-	760	-	283	3,940
2090	3,940	-	-	582	-	256	3,614
2091	3,614	-	-	438	-	238	3,414
2092	3,414	-	-	323	-	228	3,318
2093	3,318	-	-	234	-	224	3,308
2094	3,308	-	-	166	-	226	3,369
2095	3,369	-	-	115	-	232	3,486
2096	3,486	-	-	77	-	241	3,650
2097	3,650	-	-	51	-	254	3,853
2098	3,853	-	-	33	-	269	4,089
2099	4,089	-	-	20	-	286	4,354
2100	4,354	-	-	12	-	304	4,646
2101	4,646	-	-	7	-	325	4,964
2102	4,964	-	-	4	-	347	5,307
2103	5,307	-	-	2	-	371	5,677
2104	5,677	-	-	1	-	397	6,073
2105	6,073	-	-	1	-	425	6,497
2106	6,497	-	-	-	-	455	6,952
2107	6,952	-	-	-	-	487	7,438
2108	7,438	-	-	-	-	521	7,959
2109	7,959	-	-	-	-	557	8,516
2110	8,516	-	-	-	-	596	9,112
2111	9,112	-	-	-	-	638	9,750
2112	9,750	-	-	-	-	682	10,432
2113	10,432	-	-	-	-	730	11,162
2114	11,162	-	-	-	-	781	11,944
2115	11,944	-	-	-	-	836	12,780
2116	12,780	-	-	-	-	895	13,674
2117	13,674	-	-	-	-	957	14,632
2118	14,632	-	-	-	-	1,024	15,656

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%	Unfunded Payments at 3.50%	Using Single Discount Rate of 7.00%
2019	$ 573,178	$ 47,588	$ 47,588	$ -	$ 46,005	$ -	$ 46,005
2020	595,002	49,759	49,759	-	44,957	-	44,957
2021	617,202	51,816	51,816	-	43,753	-	43,753
2022	640,644	53,628	53,628	-	42,320	-	42,320
2023	665,206	55,283	55,283	-	40,772	-	40,772
2024	687,621	56,985	56,985	-	39,278	-	39,278
2025	707,786	58,644	58,644	-	37,777	-	37,777
2026	726,967	60,162	60,162	-	36,220	-	36,220
2027	744,972	61,728	61,728	-	34,732	-	34,732
2028	762,338	63,164	63,164	-	33,214	-	33,214
2029	779,296	64,429	64,429	-	31,663	-	31,663
2030	793,377	65,570	65,570	-	30,115	-	30,115
2031	803,120	66,734	66,734	-	28,645	-	28,645
2032	809,357	67,894	67,894	-	27,237	-	27,237
2033	812,083	68,993	68,993	-	25,867	-	25,867
2034	811,299	69,871	69,871	-	24,482	-	24,482
2035	807,300	70,590	70,590	-	23,116	-	23,116
2036	800,816	71,118	71,118	-	21,765	-	21,765
2037	791,483	71,617	71,617	-	20,484	-	20,484
2038	779,443	72,074	72,074	-	19,266	-	19,266
2039	765,415	72,384	72,384	-	18,083	-	18,083
2040	749,433	72,586	72,586	-	16,947	-	16,947
2041	731,467	72,875	72,875	-	15,902	-	15,902
2042	711,217	72,945	72,945	-	14,876	-	14,876
2043	688,784	72,634	72,634	-	13,843	-	13,843
2044	664,496	71,727	71,727	-	12,776	-	12,776
2045	638,990	70,386	70,386	-	11,717	-	11,717
2046	612,739	68,727	68,727	-	10,692	-	10,692
2047	586,099	67,063	67,063	-	9,751	-	9,751
2048	559,032	65,274	65,274	-	8,870	-	8,870
2049	531,666	63,397	63,397	-	8,051	-	8,051
2050	504,085	61,339	61,339	-	7,280	-	7,280
2051	476,513	59,142	59,142	-	6,560	-	6,560
2052	449,132	56,760	56,760	-	5,884	-	5,884
2053	422,203	54,383	54,383	-	5,269	-	5,269
2054	395,756	51,897	51,897	-	4,699	-	4,699
2055	369,977	49,435	49,435	-	4,183	-	4,183
2056	344,889	46,978	46,978	-	3,715	-	3,715
2057	320,539	44,548	44,548	-	3,293	-	3,293
2058	296,956	42,112	42,112	-	2,909	-	2,909
2059	274,210	39,674	39,674	-	2,561	-	2,561
2060	252,374	37,243	37,243	-	2,247	-	2,247
2061	231,518	34,837	34,837	-	1,964	-	1,964
2062	211,688	32,491	32,491	-	1,712	-	1,712
2063	192,898	30,208	30,208	-	1,488	-	1,488
2064	175,153	27,993	27,993	-	1,289	-	1,289
2065	158,457	25,852	25,852	-	1,112	-	1,112
2066	142,808	23,789	23,789	-	956	-	956
2067	128,196	21,808	21,808	-	819	-	819
2068	114,611	19,913	19,913	-	699	-	699

Appendix E: GASB 67 Fiduciary Net Position Projection

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

(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%	Unfunded Payments at 3.50%	Using Single Discount Rate of 7.00%
2069	$ 102,035	$ 18,108	$ 18,108	$ -	$ 594	$ -	$ 594
2070	90,447	16,397	16,397	-	503	-	503
2071	79,817	14,783	14,783	-	424	-	424
2072	70,113	13,268	13,268	-	355	-	355
2073	61,297	11,853	11,853	-	297	-	297
2074	53,327	10,537	10,537	-	247	-	247
2075	46,160	9,320	9,320	-	204	-	204
2076	39,751	8,199	8,199	-	168	-	168
2077	34,052	7,172	7,172	-	137	-	137
2078	29,017	6,236	6,236	-	111	-	111
2079	24,597	5,388	5,388	-	90	-	90
2080	20,746	4,624	4,624	-	72	-	72
2081	17,415	3,939	3,939	-	57	-	57
2082	14,560	3,329	3,329	-	45	-	45
2083	12,136	2,789	2,789	-	35	-	35
2084	10,100	2,314	2,314	-	28	-	28
2085	8,414	1,900	1,900	-	21	-	21
2086	7,037	1,542	1,542	-	16	-	16
2087	5,935	1,236	1,236	-	12	-	12
2088	5,072	977	977	-	9	-	9
2089	4,417	760	760	-	6	-	6
2090	3,940	582	582	-	5	-	5
2091	3,614	438	438	-	3	-	3
2092	3,414	323	323	-	2	-	2
2093	3,318	234	234	-	2	-	2
2094	3,308	166	166	-	1	-	1
2095	3,369	115	115	-	1	-	1
2096	3,486	77	77	-	-	-	-
2097	3,650	51	51	-	-	-	-
2098	3,853	33	33	-	-	-	-
2099	4,089	20	20	-	-	-	-
2100	4,354	12	12	-	-	-	-
2101	4,646	7	7	-	-	-	-
2102	4,964	4	4	-	-	-	-
2103	5,307	2	2	-	-	-	-
2104	5,677	1	1	-	-	-	-
2105	6,073	1	1	-	-	-	-
2106	6,497	-	-	-	-	-	-
2107	6,952	-	-	-	-	-	-
2108	7,438	-	-	-	-	-	-
2109	7,959	-	-	-	-	-	-
2110	8,516	-	-	-	-	-	-
2111	9,112	-	-	-	-	-	-
2112	9,750	-	-	-	-	-	-
2113	10,432	-	-	-	-	-	-
2114	11,162	-	-	-	-	-	-
2115	11,944	-	-	-	-	-	-
2116	12,780	-	-	-	-	-	-
2117	13,674	-	-	-	-	-	-
2118	14,632	-	-	-	-	-	-

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 summarizes historical actuarial value and market value asset returns. Table F-3 provides an estimate of future market value of asset returns based on the current portfolio structure and summarized in our "TSERS Asset-Liability and Investment Strategy Project" report dated April 19, 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 3.02% at December 31, 2018 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 (3.02%) was used to establish an upper bound for sensitivity analysis (10.98%). The remaining rates illustrated represent mid-points between the selected rates. Table F-3 illustrates our best estimate of the plausibility of such rates. The lower bound of 3.02% falls below the 5th percentile of estimated future 30-year returns while the upper bound of 10.98% falls between the 75th and 95th percentiles of estimated future 30-year returns.

Table F-1: Sensitivity of Valuation Results as of December 31, 2018

Discount Rate	3.02%	5.01%	7.00%	8.99%	10.98%
Market Value of Assets	$ 573,177,910	$ 573,177,910	$ 573,177,910	$ 573,177,910	$ 573,177,910
Actuarial Accrued Liability	$ 1,074,116,092	$ 857,125,350	$ 702,612,663	$ 589,287,731	$ 503,979,511
Unfunded Accrued Liability (UAL)	$ 500,938,182	$ 283,947,440	$ 129,434,753	$ 16,109,821	$ (69,198,399)
Funded Ratio	53.40%	66.90%	81.60%	97.30%	113.70%
20-Year Amortization of UAL	$ 34,751,899	$ 23,946,385	$ 13,072,859	$ 1,922,030	N/A
(as % of general state revenue)	0.11%	0.08%	0.04%	0.01%	N/A

Table F-2: Historical Asset Returns

Calendar Year	Actuarial Value of Asset Return	Market Value of Asset Return	Calendar Year	Actuarial Value of Asset Return	Market Value of Asset Return	Calendar Year	Actuarial Value of Asset Return	Market Value of Asset Return
1998	9.92%	16.61%	2005	8.56%	6.94%	2012	6.42%	11.79%
1999	15.74%	10.03%	2006	9.17%	11.35%	2013	7.52%	12.19%
2000	12.37%	2.60%	2007	9.04%	8.35%	2014	7.26%	6.19%
2001	9.07%	-1.74%	2008	3.01%	-19.39%	2015	5.87%	0.35%
2002	6.13%	-4.84%	2009	4.88%	14.83%	2016	5.33%	6.22%
2003	8.44%	18.33%	2010	6.01%	11.49%	2017	6.57%	13.46%
2004	8.95%	10.73%	2011	5.25%	2.18%	2018	5.11%	-1.41%

The average investment return recognized for the purposes of determining the annual change in contribution each year is the Actuarial Value of Asset Return. The Actuarial Value of Assets smooths investment gains and losses over a five-year period and is used to reduce volatility that investment gains and losses can have on required contributions and the funded status of the Plan.

Appendix F: Additional Disclosures

Table F-3: Estimate of Future Asset Returns

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
2014	566	$ 67,562,225
2015	561	68,245,416
2016	560	70,112,652
2017	562	71,726,921
2018	557	70,565,420

Graph 2: Retired Members and Survivors of Deceased Members

	Retired and Survivors of Deceased Member Count	Retirement Allowance
2014	610	$ 37,376,920
2015	647	40,036,451
2016	654	40,501,250
2017	682	42,920,238
2018	707	45,108,774

Graph 3: Market Value of Assets and Asset Returns

	Market Value of Assets	Asset Return
2014	$ 534,452,795	6.19%
2015	520,979,678	0.35%
2016	538,766,550	6.22%
2017	595,683,002	13.46%
2018	573,177,910	-1.41%

Appendix G: Data for Section 2 Graphs

Graph 5: Actuarial Value and Market Value of Assets

	Actuarial Value of Assets	Market Value of Assets
2014	$ 534,299,602	$ 534,452,795
2015	550,050,200	520,979,678
2016	564,809,316	538,766,550
2017	586,776,499	595,683,002
2018	602,207,449	573,177,910

Graph 6: Asset Returns

	Actuarial Value Value of Assets	Market Value Asset Return
2014	7.26%	6.19%
2015	5.87%	0.35%
2016	5.33%	6.22%
2017	6.57%	13.46%
2018	5.11%	-1.41%

Graph 7: Actuarial Accrued Liability

	Active	Deferred	Retired	Total
2014	$ 234,280,897	$ 3,507,279	$ 329,042,332	$ 566,830,508
2015	227,098,381	2,403,740	386,097,159	615,599,280
2016	246,147,229	2,404,005	393,976,711	642,527,945
2017	256,903,792	4,174,484	420,816,811	681,895,087
2018	256,129,026	7,657,518	438,826,119	702,612,663

Appendix G: Data for Section 2 Graphs

Graph 8: Actuarial Accrued Liability and Actuarial Value of Assets

	Actuarial Accrued Liability	Actuarial Value of Assets
2014	$ 566,830,508	$ 534,299,602
2015	615,599,280	550,050,200
2016	642,527,945	564,809,316
2017	681,895,087	586,776,499
2018	702,612,663	602,207,449

Graph 9: Funded Ratios

	Funded Ratio (Actuarial Basis)	Funded Ratio (Market Value Basis)
2014	94.3%	94.3%
2015	89.4%	84.6%
2016	87.9%	83.9%
2017	86.1%	87.4%
2018	85.7%	81.6%

Graph 10: Actuarially Determined Employer Contribution Rates

Fiscal Year Ending	Normal Rate	Accrued Liability Rate	Total ADEC
2017**	15.70%	13.76%	29.46%
2018	15.95%	15.10%	31.05%
2019	15.83%	17.12%	32.95%
2020	17.28%	16.32%	33.60%
2021*	17.43%	19.01%	36.44%

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

** Includes impact of the experience study