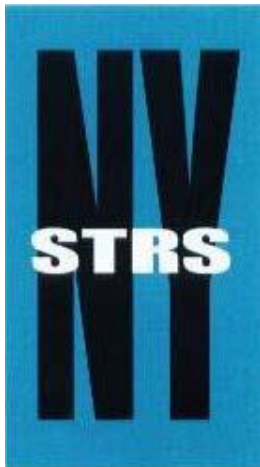


ACTUARIAL VALUATION REPORT

as of

JUNE 30, 2018



New York State Teachers' Retirement System

Office of the Actuary
July 23, 2019

NEW YORK STATE TEACHERS' RETIREMENT SYSTEM

**Actuarial Valuation Report as
of June 30, 2018**

TABLE OF CONTENTS

A. INTRODUCTION	1
B. EMPLOYER CONTRIBUTION RATE.....	1
C. GAIN/LOSS IN THE EMPLOYER CONTRIBUTION RATE	3
D. EMPLOYER CONTRIBUTION RATE HISTORY	4
E. EMPLOYER CONTRIBUTION RATE DECREASE.....	5
F. MEMBER DATA	5
G. FUNDED STATUS.....	6
H. ACTUARIAL EXPERIENCE	7
I. ASSET ALLOCATION	8
J. NEW LEGISLATION.....	8
K. SENSITIVITY ANALYSIS	9
L. FUTURE EXPECTATIONS	9
M. CERTIFICATION.....	10

APPENDICES

1.	RECONCILIATION OF THE MARKET VALUE OF ASSETS	11
2.	COMPARISON OF MARKET VALUE TO ACTUARIAL VALUE OF ASSETS	12
3.	ACTUARIAL PRESENT VALUE OF FUTURE BENEFITS.....	13
4.	FUNDING PROGRESS.....	14
5.	EMPLOYER CONTRIBUTION RATE	15
6.	LONG TERM NORMAL RATE.....	26
7.	MEMBER RECONCILIATION	27
8.	DISTRIBUTION OF ACTIVE MEMBERS	28
9.	HISTORICAL MEMBER STATISTICS.....	34
10.	RETIREMENT STATISTICS	35
11.	2014-2018 EXPERIENCE STUDY	38
12.	RATES OF RETURN	49
13.	ASSET ALLOCATION	51
14.	SENSITIVITY ANALYSIS	52
15.	HISTORY OF THE EMPLOYER CONTRIBUTION RATE	53
16.	HISTORY OF THE MEMBER CONTRIBUTION RATE	54
17.	ACTUARIAL VALUATION INFORMATION.....	56
18.	PRESENT ACTUARIAL ASSUMPTIONS.....	58
19.	SUMMARY OF BENEFIT PROVISIONS	79

NEW YORK STATE TEACHERS' RETIREMENT SYSTEM

Actuarial Valuation Report as of June 30, 2018

A. INTRODUCTION

This report presents to the New York State Teachers' Retirement System (NYSTRS or the Retirement System) Retirement Board the results of the annual actuarial valuation of assets and liabilities of the Retirement System as of June 30, 2018. The financial objective of NYSTRS is to properly fund the retirement and ancillary benefit of members in order to ensure sufficient assets are being accumulated in order to pay benefits as they become due. Employer contributions are made by participating employers in accordance with an actuarially determined employer contribution rate. The rate is determined by actuarial valuation made each June 30th. Members contribute in accordance with a fixed rate schedule as required by statute.

The purpose of this report is to summarize the determination of the Employer Contribution Rate which will be applied to member salaries earned during the July 1, 2019 to June 30, 2020 fiscal year and to review the funded status of the Retirement System. Use of the valuation results contained herein for purposes or by parties other than those stated above may not be appropriate.

B. EMPLOYER CONTRIBUTION RATE

The Employer Contribution Rate to be applied to member salaries for the July 1, 2019 to June 30, 2020 fiscal year and collected in the fiscal year ending June 30, 2021 consists of four components. These components may be described as follows:

The **Normal Rate** represents the annual cost of accruing active member benefits as well as incorporating actuarial gains and losses. The active member component includes the cost of benefits accruing on account of retirement, withdrawal, disability, death (except for the first \$50,000 of death benefits which are funded by the group life insurance rate) and the cost-of-living benefit provided during retirement. The Normal Rate is calculated in accordance with the Aggregate Actuarial Cost Method.

The **Expense Rate** is a pay-as-you-go rate representing the administrative cost of the

Retirement System for the fiscal year July 1, 2020 to June 30, 2021, and is set during the budget process.

The **Group Life Insurance Rate** is, as we understand it, prescribed to be a pay-as-you-go rate representing the expected benefit payments of the first \$50,000 of member death benefits for the fiscal year July 1, 2020 to June 30, 2021.

The **Excess Benefit Plan Rate** is a pay-as-you-go rate representing the Excess Benefit Fund's need for contributions to cover expected benefit payments in excess of the Internal Revenue Code Section 415 limits for the fiscal year July 1, 2020 to June 30, 2021.

The actuarially computed Employer Contribution Rate to be applied to the member salaries for the fiscal year ending June 30, 2020 is **8.86%**. The Employer Contribution Rates determined by the actuarial valuations as of June 30, 2018 and June 30, 2017 and the changes between the two are summarized below:

	<u>As of 6/30/2018</u>	<u>As of 6/30/2017</u>	<u>Change</u>
Normal Rate	8.47%	10.23%	-1.76%
Expense Rate	0.26	0.26	0.00
Group Life Insurance Rate	0.13	0.13	0.00
Excess Benefit Plan Rate	<u>0.00</u>	<u>0.00</u>	<u>0.00</u>
Employer Contribution Rate	8.86%	10.62%	-1.76%

The actuarial assumptions in use for the June 30, 2018 actuarial valuation were developed primarily based upon Retirement System experience and were adopted by the Retirement Board on October 29, 2015. On October 26, 2017, the Retirement Board lowered the valuation rate of interest assumption from 7.50% to 7.25%. In accordance with Sections 501, 508 and 517 of the Education Law, the Retirement Board has the authority to adopt the actuarial assumptions as recommended by the Actuary.

As in most prior years, the actual employer contributions made by participating employers during the fiscal year ending June 30, 2018 were equal to the employer contributions determined in accordance with the annual actuarial valuation.

C. GAIN/LOSS IN THE EMPLOYER CONTRIBUTION RATE

The Employer Contribution Rate of 8.86% represents a 176 basis point decrease from the prior year's rate of 10.62%.

NORMAL RATE

The Normal Rate component of the Employer Contribution Rate of 8.47% represents a 176 basis point decrease over the prior year's rate of 10.23%. This change may be broken down as follows:

<u>Salary/Service:</u>	This loss is due to salary and service data coming in higher than expected.	+0.12
<u>Net Investment Gain:</u>	The recognition of prior investment gains and losses over a five year period in accordance with the asset valuation method resulted in a net investment gain.	-1.30
<u>New Entrants:</u>	New entrants join the Retirement System as Tier 6 members with a long-term expected normal rate of approximately 4.2% which results in downward pressure on the Normal Rate.	-0.11
<u>Withdrawal:</u>	Withdrawal experience produced a gain.	-0.04
<u>Mortality:</u>	Members are living slightly longer than expected and receiving benefits for a longer period.	+0.01
<u>Retirement:</u>	There were fewer retirements than expected.	-0.16
<u>Pension Payments:</u>	Actual payments to retirees were less than expected.	-0.02
<u>Cost of Living Adjustment:</u>	The actual COLA increase of 1.2% was lower than the expected increase of 1.50%.	-0.05
<u>Miscellaneous:</u>	Decrease due to other sources of gain (e.g. overlap, disability, etc.)	<u>-0.21</u>
<u>TOTAL CHANGE IN THE NORMAL RATE</u>		-1.76%

OTHER COMPONENTS

The **Expense Rate** is set during the budget process. As of June 30, 2018, the expense rate remains at 0.26%.

The **Group Life Insurance Rate** is unchanged from the previous year. Contributions collected have generally been more than sufficient to cover payments over the past several years, resulting in an accumulated Group Life Insurance Fund of approximately \$330 million as of June 30, 2018. The Group Life Insurance Rate is being held constant, however, in anticipation of rising payouts in the future due to the Tier 2, 3, 4, 5, and 6 post-retired death benefit and the inactive death benefit.

The **Excess Benefit Plan Rate** remains equal to 0.00% this year. This rate represents the Excess Benefit Fund's need for contributions to cover retirement benefits paid in excess of the Internal Revenue Code Section 415 limits. These payments are made exclusively from the Excess Benefit Plan. This fund was established in accordance with the Excess Benefit Plan which received final IRS approval in August 2001. The fund has accumulated assets of approximately \$4.1 million as of June 30, 2018. The rate has been set to 0.00% this year in order to utilize the existing fund balance.

D. EMPLOYER CONTRIBUTION RATE HISTORY

The following chart summarizes the Employer Contribution Rate for the last 20 years:

<i>Salary Year</i>	<i>Employer Contribution Rate</i>	<i>Salary Year</i>	<i>Employer Contribution Rate</i>
2000-2001	0.43%	2010-2011	8.62%
2001-2002	0.36	2011-2012	11.11
2002-2003	0.36	2012-2013	11.84
2003-2004	2.52	2013-2014	16.25
2004-2005	5.63	2014-2015	17.53
2005-2006	7.97	2015-2016	13.26
2006-2007	8.60	2016-2017	11.72
2007-2008	8.73	2017-2018	9.80
2008-2009	7.63	2018-2019	10.62
2009-2010	6.19	2019-2020	8.86

The complete Employer Contribution Rate history is presented in Appendix 15.

E. EMPLOYER CONTRIBUTION RATE DECREASE

The Employer Contribution Rate has decreased this year from 10.62% to 8.86%, representing a decrease of approximately 17%. The Normal Rate component equals 8.47%, a decrease of approximately 17% from the prior year's Normal Rate of 10.23%. The rate of return on the System's market value of assets for the fiscal year ending June 30, 2018 was 9.0%, and the System's five-year market value rate of return now stands at 9.3%. Continued strength in the System's five-year rate of return led to an actuarial gain on investments and a decrease in the employer contribution rate.

The Normal Rate component of the Employer Contribution Rate is calculated in accordance with the Aggregate Actuarial Cost Method, as required by statute (New York State Education Law Section 517). Under the Aggregate Actuarial Cost Method gains and losses resulting from differences between actual and expected experience, as well as changes to assumptions or plan provisions, are not separately amortized but are spread as part of the normal cost calculation, over the expected future working lifetime of active members. The Aggregate Method is a reasonable and widely accepted actuarial cost method to use for ongoing plan funding purposes and is consistent with the System's goal of accumulating sufficient assets to pay benefits as they come due.

F. MEMBER DATA

The member data for the valuation was determined as of June 30, 2018. Compared with the previous year, the total number of members increased slightly from 428,579 to 430,875; the number of active members decreased from 264,761 to 264,590; the number of retired members increased from 157,703 to 160,049; and the number of beneficiaries receiving monthly benefits increased from 6,115 to 6,236.

The number of retirements increased from 6,396 during the 2016-2017 fiscal year to 6,416 during the 2017-2018 fiscal year. The number of retirements over each of the last ten years is as follows:

<i>Fiscal Year</i>	<i>Total Number of Retirements</i>	<i>Fiscal Year</i>	<i>Total Number of Retirements</i>
2008-2009	5,644	2013-2014	6,547
2009-2010	5,501	2014-2015	6,161
2010-2011*	8,423	2015-2016	6,245
2011-2012	6,033	2016-2017	6,396
2012-2013	6,330	2017-2018	6,416

*Denotes an early retirement incentive offered during that fiscal year.

Historical member statistics, including statistics specific to retired members, appear in the appendices to this report. Additional member statistics may also be found in the Retirement System's most recent Comprehensive Annual Financial Report (CAFR).

G. FUNDED STATUS

As of June 30, 2018, the actuarial value of plan assets, including GLIF assets, was equal to \$117.9 billion. The accrued pension benefit liability calculated in accordance with the Entry Age Normal Cost Method, including GLIF liabilities, was equal to \$118.9 billion. These two values produced a funded ratio of 99.2% as of June 30, 2018. If the market value of plan assets is used instead of the actuarial value of plan assets, the funded ratio as of June 30, 2018 would be equal to 100.9%.

For purposes of this funded ratio calculation, the plan liabilities have been calculated in accordance with the Entry Age Normal Cost Method as required by Governmental Accounting Standards Board (GASB) Statement No. 67. The Retirement System is funded in accordance with the Aggregate Cost Method. GASB Statement No. 67 requires that the Entry Age Normal Cost Method be used to calculate the accrued liability for purposes of presenting the funded ratio calculation for all plans, regardless of the cost method being used for funding purposes. Both Aggregate and Entry Age Normal are appropriate contribution allocation procedures for purposes of ongoing plan funding and are widely accepted actuarial cost methods.

The funded ratios provided here are an appropriate measurement of the System's funded status. While the funded ratios will fluctuate from year to year, a funded ratio of 100% is desirable and indicative of a well-funded System. The primary reason for this healthy funded ratio is that the Retirement System has collected the actuarially required contribution annually from employers. The significance of this cannot be overstated. It does not, however, imply that future contributions will not be required. The funded status measurement provided here is not appropriate for assessing the sufficiency of plan assets to cover the estimated cost of settling the System's benefit obligations such as in a plan termination situation.

A history of the Retirement System's funded status is provided in Appendix 4 of this report.

H. ACTUARIAL EXPERIENCE

Each year and quinquennially the Office of the Actuary completes an experience study in order to regularly monitor the reasonableness and appropriateness of the actuarial assumptions used in the actuarial valuation and recommends changes when warranted. Assumptions are typically revised every five years. These assumptions are used to estimate the probability a member will cease teaching due to retirement, withdrawal, disability, or death. In addition, the assumptions are used to estimate future salary increases, future investment earnings, and the probability of death for retired members and beneficiaries. A listing of the actuarial assumptions is provided in Appendix 18. A summary of the results of the most recent five year experience study is contained in Appendix 11. The current actuarial assumptions, except for the Valuation Rate of Interest, were adopted by the Retirement Board on October 29, 2015, and first effective with the actuarial valuation of the Retirement System's assets and liabilities as of June 30, 2015. Specific details regarding the development of the present actuarial assumptions can be found in the "*Report on the 2015 Recommended Actuarial Assumptions*". The Valuation Rate of Interest was adopted by the Retirement Board on October 26, 2017, and is explained in a memo from Richard Young dated October 26, 2017.

I. ASSET ALLOCATION

The Retirement Board, in consultation with Retirement System staff and the System's external investment consultant AON Hewitt, annually reviews the asset allocation to determine if any changes are appropriate. There were no changes made to the asset allocation between June 30, 2018 and the time of this report.

According to AON Hewitt, the system's adopted asset allocation produces a long-term (30 year) expected annual geometric rate of return of 7.2%, and an expected annual arithmetic rate of return of 7.8% based on their most recent report (1st quarter 2019 return assumptions).

The Retirement System's asset allocation, including targets and ranges, can be found in Appendix 13. Historical rate of return information can be found in Appendix 12. Detailed investment information is available in the System's Comprehensive Annual Financial Report (CAFR).

J. NEW LEGISLATION

The following significant legislation affecting the Retirement System was signed into law during the 2019 Legislative Session:

Reserve Bill:

Chapter 59 of the Laws of 2019 (Part YYY, Sections 52-g through 52-k) gives eligible participating employers the option of establishing a NYSTRS contribution reserve fund. The purpose of the reserve fund is to accumulate money that can be used to pay future required employer contributions. The fund can help employers in years in which the required employer contribution rate is increasing. Annual contributions to the reserve fund cannot exceed two percent of an employer's NYSTRS member payroll, and the accumulated total reserve fund cannot exceed ten percent of an employer's NYSTRS member payroll.

K. SENSITIVITY ANALYSIS

Included in Appendix 14 is a Sensitivity Analysis. The purpose of this exhibit is to illustrate what the Employer Contribution Rate would have been had various actuarial assumptions been altered. The chart also gives the reader a feel for the significance of the assumptions on the valuation results, and the potential impact of modifying them.

L. FUTURE EXPECTATIONS

Future actuarial measurements such as the funded ratio and employer contribution rate may differ significantly from the current measurements presented in this report due to such factors as: future plan experience that differs significantly from that predicted by the actuarial assumptions; changes in the actuarial assumptions or methods; and changes in plan provisions or applicable law.

The next employer contribution rate will be based upon the actuarial valuation as of June 30, 2019. The capital markets had a fairly decent year during the fiscal year ending June 30, 2019, with the System's main domestic equity index, the S&P1500, returning 9.3% for the year. The System's main international equity index, the ACWI ex-US, returned 1.3% for the fiscal year. Our fixed income index, the Barclay's US Aggregate Float Adjusted Bond index, returned 8.0% for the year. The System's finalized investment rate of return for the fiscal year ending June 30, 2019 will not be available until October of 2019. The System's five-year rate of return will decrease from last year's 9.3%, and will likely now be below the assumed rate of return of 7.25%.

M. CERTIFICATION

This actuarial valuation relies on member data provided by the participating employers to the Retirement System's administrative staff. The administrative and actuarial staff review this data for reasonability and completeness as well as reconciles it against prior data. In addition, the valuation relies on financial data provided by the Retirement System's Finance Department. Data is reviewed by the Retirement System's independent auditors as part of the annual audit. We believe the data to be reasonable and appropriate for purposes of this valuation.

The benefits recognized in this actuarial valuation are prescribed by New York State statute (Article 11 of the Education Law and Articles 11, 14, 15, 18, 19, and 20 of the Retirement and Social Security Law), and are summarized in Appendix 19. All benefits are included in the actuarial valuation.

The actuarial methods, calculations, and actuarial assumptions are in accordance with standards of practice prescribed by the Actuarial Standards Board and generally accepted actuarial principles and procedures. The actuarial assumptions, as adopted by the Retirement Board and used in determining the liabilities and costs, are internally consistent and reasonably related to actual and anticipated future experience of the Retirement System. The undersigned are members of the American Academy of Actuaries and the Society of Actuaries and meet the qualification standards of the American Academy of Actuaries to render the actuarial opinion contained in this report.



Richard A. Young, ASA, EA, MAAA, FCA
Actuary



Sandra V. Pangburn, ASA, EA, MAAA
Manager, Office of the Actuary



New York State Teachers' Retirement System
Office of the Actuary
July 23, 2019

APPENDIX 1

RECONCILIATION OF THE MARKET VALUE OF ASSETS

From June 30, 2017 to June 30, 2018

	Market Value* <u>(in thousands)</u>
1. Market Value of Assets as of June 30, 2017	\$115,468,360
2. Contributions and Transfers	
Employer contributions	1,597,139
Member contributions	131,595
Net transfers in/(out)	<u>9,278</u>
Subtotal	1,738,012
3. Net Investment Income/(Loss)	9,928,011
4. Distributions	
Benefit payments	7,108,999
Administrative expenses	<u>60,610</u>
Subtotal	7,169,609
5. Cumulative affect of change in accounting principle	49,256
6. Market Value of Assets as of June 30, 2018 (1 + 2 + 3 - 4 - 5)	\$119,915,518

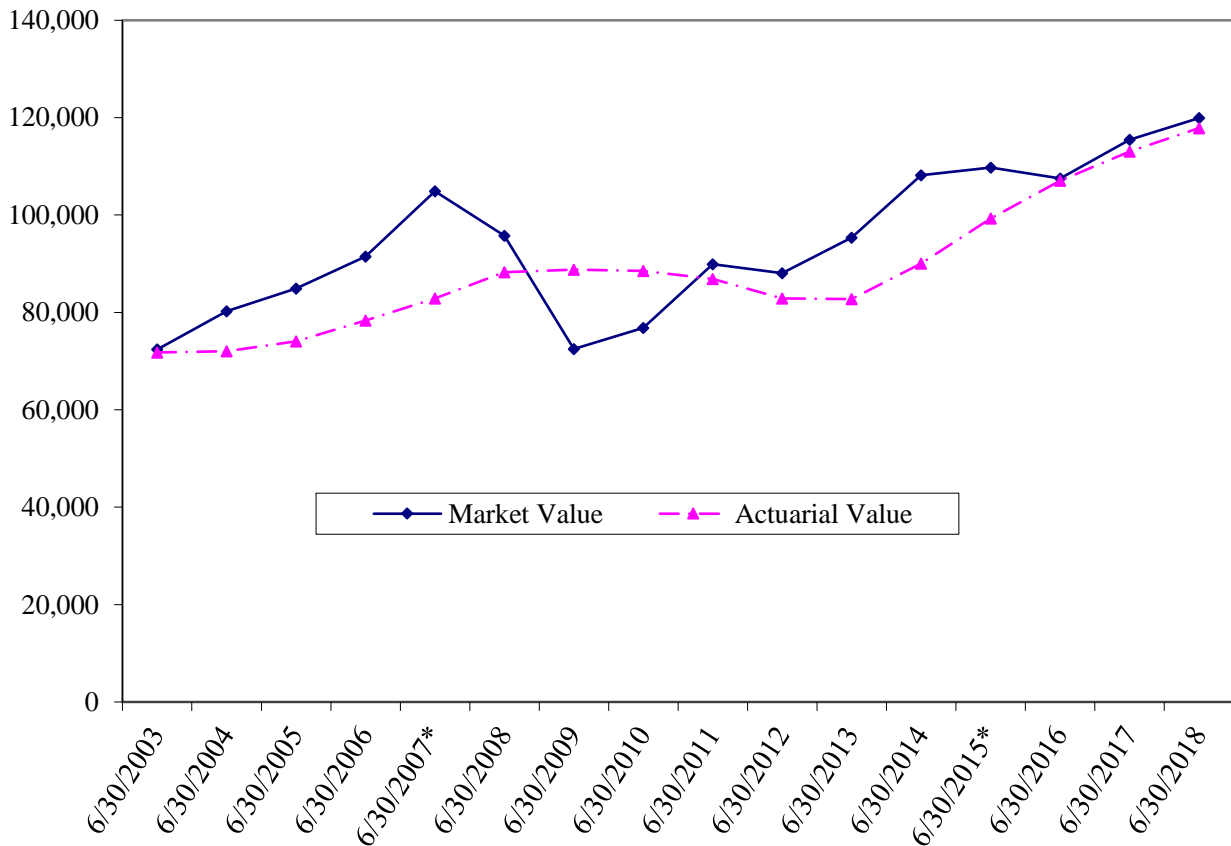
* Totals may not add due to rounding.

APPENDIX 2

COMPARISON OF MARKET VALUE TO ACTUARIAL VALUE OF ASSETS
(in Millions)

<u>Fiscal Year</u> <u>Ending</u>	<u>Market</u> <u>Value</u>	<u>Actuarial</u> <u>Value</u>	<u>Fiscal Year</u> <u>Ending</u>	<u>Market</u> <u>Value</u>	<u>Actuarial</u> <u>Value</u>
6/30/2003	72,391.5	71,780.4	6/30/2011	89,889.7	86,892.2
6/30/2004	80,276.2	72,044.4	6/30/2012	88,056.3	82,871.4
6/30/2005	84,908.5	74,074.3	6/30/2013	95,367.0	82,742.5
6/30/2006	91,492.2	78,335.8	6/30/2014	108,155.1	90,007.1
6/30/2007*	104,912.9	82,858.9	6/30/2015*	109,718.9	99,301.8
6/30/2008	95,769.3	88,254.7	6/30/2016	107,506.1	107,039.2
6/30/2009	72,471.8	88,805.5	6/30/2017	115,468.4	113,059.7
6/30/2010	76,844.9	88,544.4	6/30/2018	119,915.5	117,859.5

Market Value vs. Actuarial Value
(in Millions)



* The Retirement System's actuarial asset valuation method was changed effective with the June 30, 2007 and June 30, 2015 actuarial valuations. The assets above include the GLIF assets.

APPENDIX 3

ACTUARIAL PRESENT VALUE OF FUTURE BENEFITS

as of June 30, 2018 and June 30, 2017

(in Thousands)

Each year an actuarial valuation determines the actuarial present value of future benefits (PVB), which is the present value of retirement and ancillary benefit payments, excluding group life insurance benefits, that the Retirement System can expect to pay in the future to current retirees and members. The PVB is based upon both service and salary projected to retirement. The results of the two most recent actuarial valuations are displayed in the following table.

	2018	2017
Present Value of Benefits Currently Being Paid:		
Service Retirement Benefits.....	\$63,093,963	\$61,860,357
Disability Retirement Benefits.....	357,913	348,674
Death Benefits.....	2,287	1,892
Survivor Benefits.....	1,063,411	1,006,708
Cost-of-Living Allowance.....	<u>5,242,492</u>	<u>5,190,639</u>
Total Present Value of Benefits Presently Being Paid	69,760,066	68,408,270
Present Value of Benefits Payable in the Future to Current Active Members:		
Service Retirement Benefits.....	56,167,649	54,353,782
Disability Retirement Benefits.....	232,210	225,220
Termination Benefits.....	2,188,574	2,142,148
Death and Survivor Benefits.....	396,140	379,665
Cost-of-Living Allowance.....	<u>1,415,449</u>	<u>1,393,242</u>
Total Active Member Liabilities	60,400,022	58,494,057
Present Value of Benefits Payable in the Future to Current Inactive (Vested) Members:		
Retirement Benefits.....	377,266	368,451
Death Benefits.....	319	317
Cost-of-Living Allowance.....	<u>32,016</u>	<u>31,411</u>
Total Vested Liabilities	409,601	400,179
Unclaimed Funds.....	17,701	16,617
Total Actuarial Present Value of Future Benefits	\$130,587,390	\$127,319,123

Note: Totals may not sum due to rounding

FUNDING PROGRESS

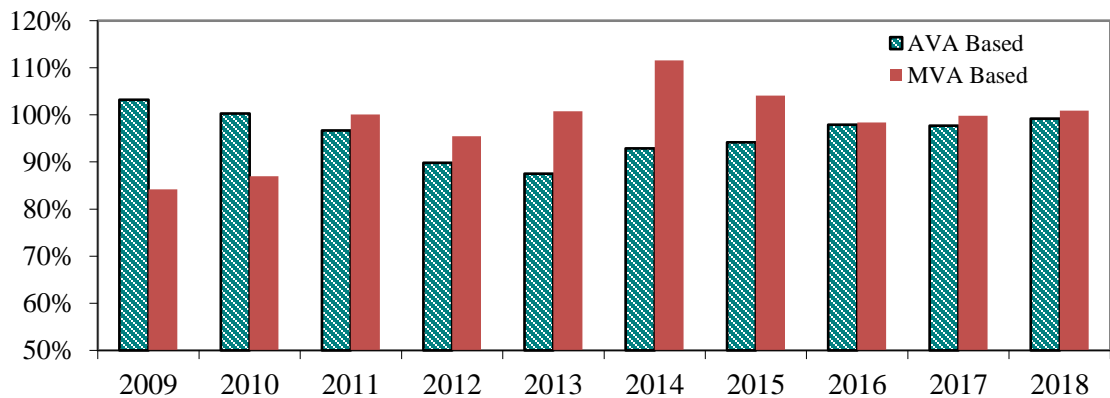
The portion of the actuarial present value of future benefits that is attributed to service rendered as of the valuation date is known as the actuarial accrued liability. In order to effectively assess the funding progress of a retirement system, it is necessary to compare the actuarial value of assets and the actuarial accrued liabilities over a period of time.

The Retirement System's funding method has allowed the accumulation of assets appropriate for the funding of its liabilities in a systematic and reasonable manner.

Analysis of Funding Progress (in Millions)

Fiscal Year Ended	Market Value of Assets (MVA)	Actuarial Value of Assets (AVA) ¹	Actuarial Accrued Liability ²	Percent Funded based on	
				MVA	AVA
2009	72,471.8	88,805.5	86,062.0	84.2%	103.2%
2010	76,844.9	88,544.4	88,318.8	87.0	100.3
2011	89,889.7	86,892.2	89,824.9	100.1	96.7
2012	88,056.3	82,871.4	92,250.9	95.5	89.8
2013	95,367.0	82,742.5	94,583.8	100.8	87.5
2014	108,155.1	90,007.1	96,904.5	111.6	92.9
2015	109,718.9	99,301.8	105,401.8	104.1	94.2
2016	107,506.1	107,039.2	109,305.1	98.4	97.9
2017	115,468.4	113,059.7	115,672.5	99.8	97.7
2018	119,915.5	117,859.5	118,861.1	100.9	99.2

Percent Funded



¹ The Retirement System's asset valuation method was changed effective with the June 30, 2007 and June 30, 2015 actuarial valuations.

² Effective June 30, 2006, the Actuarial Accrued Liability is calculated under the Entry Age Normal Cost Method, including the Group Life Insurance Fund, as was required by Governmental Accounting Standards Board (GASB) Statement No. 50 prior to its replacement by GASB Statement No. 67. The Retirement System is funded in accordance with the Aggregate Cost Method. GASB Statement No. 50 required that the Entry Age Normal Cost Method be used to calculate the accrued liability for purposes of presenting the funded percentage.

APPENDIX 5

EMPLOYER CONTRIBUTION RATE

2018 Valuation

7.25% Interest

Normal Rate	8.47%
Group Life Insurance Rate	0.13
Excess Benefit Plan Rate	0.00
Expense Rate	0.26
Computed Contribution Rate as of June 30, 2018	8.86%

APPENDIX 5 (Cont'd)
NORMAL RATE CALCULATION
 2018 Valuation
 7.25% Interest

Liabilities

Active Tier 1

Service Pension	\$225,081,744
Disability Pension	0
Vested Pension	0
Active Death over \$50,000	2,075,846
Death Benefit After 10-Yr Withdrawal over \$50,000	0
Annuity Savings Fund	2,484,312
COLA	2,445,801
Total	\$232,087,703

Active Tier 2

Service Pension	\$284,582,596
Post Retired Death over \$50,000	195,156
Disability Pension	0
Post Disabled Death over \$50,000	0
Vested Pension	0
Active Death over \$50,000	885,267
Death Benefit After 10-Yr Withdrawal over \$50,000	0
COLA	4,246,435
Total	\$289,909,454

Active Tier 3

Service Pension	\$1,759,673,371
Post Retired Death over \$50,000	989,315
Disability Pension	9,918
Post Disabled Death over \$50,000	137
Refund on Active Death	1,456,005
Active Death over \$50,000	4,274,824
Refund on Quit	40,711
Vested Pension	91,795
Death Benefit After 10-Yr Withdrawal over \$50,000	16
Refund on Death after Vested Withdrawal	8
COLA	32,527,630
Total	\$1,799,063,730

APPENDIX 5 (Cont'd)

NORMAL RATE CALCULATION (Cont'd)

2018 Valuation

7.25% Interest

Liabilities (Cont'd)

Active Tier 4

Service Pension	\$50,689,083,364
Post Retired Death over \$50,000	30,409,636
Disability Pension	208,977,055
Post Disabled Death over \$50,000	3,866,802
Refund on Active Death	37,551,202
Active Death over \$50,000	246,299,756
Refund on Quit	30,620,273
Vested Pension	1,877,623,492
Death Benefit After 10-Yr Withdrawal over \$50,000	2,447,343
Refund on Death after Vested Withdrawal	1,075,027
COLA	1,249,033,158
Total	\$54,376,987,108

Active Tier 5

Service Pension	\$932,614,794
Post Retired Death over \$50,000	677,400
Disability Pension	7,501,247
Post Disabled Death over \$50,000	140,222
Refund on Active Death	3,714,665
Active Death over \$50,000	9,571,800
Refund on Quit	29,456,974
Vested Pension	54,198,099
Death Benefit After 10-Yr Withdrawal over \$50,000	151,858
Refund on Death after Vested Withdrawal	139,559
COLA	26,819,347
Total	\$1,064,985,965

Active Tier 6

Service Pension	\$1,745,552,551
Post Retired Death over \$50,000	1,527,644
Disability Pension	15,706,198
Post Disabled Death over \$50,000	280,694
Refund on Active Death	14,383,690
Active Death over \$50,000	25,542,540
Refund on Quit	101,290,112
Vested Pension	89,580,729
Death Benefit After 10-Yr Withdrawal over \$50,000	299,694
Refund on Death after Vested Withdrawal	371,995
COLA	55,532,135
Total	\$2,050,067,982

APPENDIX 5 (Cont'd)

NORMAL RATE CALCULATION (Cont'd)

2018 Valuation

7.25% Interest

Liabilities (Cont'd)**Retirees**

Retired Pension	\$62,988,767,211
Retired Annuity	105,194,505
Disability Pension	357,363,135
Disability Annuity	550,004
Beneficiary Pension	1,051,048,183
Beneficiary Annuity	7,575,527
DBA Pension	4,523,066
DBA Annuity	263,984
Escalation	4,446,525
Post Retired Death over \$50,000	2,033,789
COLA	4,934,982,806
Catch-Up & Prior §532 Supp	303,063,122
Total	<u>\$69,759,811,857</u>

Vesteds

Inactive Vested	\$377,267,381
Death Benefit After 10-Yr Withdrawal over \$50,000	318,544
Active Vested	526,051,471
Death Benefit After 10-Yr Withdrawal over \$50,000	1,164,860
COLA	76,657,068
Total	<u>\$981,459,324</u>

TIAA

Service Pension	\$2,524,044
Disability Pension	15,616
Vested Pension	21,877
Active Death over \$50,000	2,906
COLA	203,271
Total	<u>\$2,767,714</u>

Miscellaneous

Incurred Death but not Paid	\$12,548,148
Unclaimed Non-Member Funds	17,701,267
Total	<u>\$30,249,415</u>

Total Liabilities	<u><u>\$130,587,390,252</u></u>
--------------------------	---------------------------------

APPENDIX 5 (Cont'd)

NORMAL RATE CALCULATION (Cont'd)

2018 Valuation

7.25% Interest

Assets for Valuation

Current Total Assets (excluding contributions receivable)	\$118,230,310,625
Less: Expense Fund	\$63,572,256
Less: Group Life Insurance Fund	\$330,240,954
Plus: Employer Contributions Receivable from Normal Rate in 2018-2019 Fiscal Year ¹ (2017-2018 Member Paybase)(2016 Normal Rate)(1.0725) ^{- 7/24} (16,288,883,747)(0.0940)(1.0725) ^{- 7/24}	\$1,500,214,290
Plus: Member Contributions Receivable in 2018-2019 Fiscal Year ¹	
Tier 4: (23,215,967)(1.0725) ^{- 7/24}	\$22,746,831
Tier 5: (18,701,110)(1.0725) ^{- 7/24}	\$18,323,208
Tier 6: (63,969,227)(1.0725) ^{- 7/24}	<u>\$62,676,570</u>
	Adjusted Market Value of Assets for Normal Rate
	\$119,440,458,314
Less: 5 Year Smoothing Adjustment	<u>\$1,911,171,056</u>
	Actuarial Value of Assets for Normal Rate Valuation Purposes
	\$117,529,287,258

Receivables

Employer Contributions Receivable from Normal Rate in 2019-2020 Fiscal Year ² (2018-2019 Salaries)(2017 Normal Rate)(1.0725) ^{-1 7/24} (15,739,619,328)(0.1023)(1.0725) ^{-1 7/24}	\$1,470,979,695
Present Value of Future Member Contributions ³	
(Tier 4 Present Value of Future Employee Contributions)(1.0725) ^{- 7/24} (31,658,752 - 23,215,967)(1.0725) ^{- 7/24}	\$8,272,178
(Tier 5 Present Value of Future Employee Contributions)(1.0725) ^{- 7/24} (258,897,318 - 18,701,110)(1.0725) ^{- 7/24}	\$235,342,448
(Tier 6 Present Value of Future Employee Contributions)(1.0725) ^{- 7/24} (1,042,789,968 - 63,969,227)(1.0725) ^{- 7/24}	<u>\$959,041,243</u>
	Total Receivables
	\$2,673,635,564

1. Employer and Member Contributions Receivable are based on the 2017-2018 Member Paybase and are collected in 3 installments on September 15, October 15, and November 15 of 2018. The discount represents the time value of money to the measurement date.
2. Employer Contributions Receivable are estimated based on projected 2018-2019 Member Salaries for the closed group population used to value the plan liabilities and are collected in 3 installments on September 15, October 15, and November 15 of 2019. The discount represents the time value of money to the measurement date.
3. The present value of Member Contributions are estimated based on the expected Member Contributions for the closed group population used to value the plan liabilities. These amounts are for years 2019-2020 and beyond and have an additional discount factor applied to adjust for the timing of the actual payments on September 15, October 15, and November 15 of each prospective year.

NORMAL RATE CALCULATION (Cont'd)

2018 Valuation

7.25% Interest

Present Value of Future Salaries

	<u>Total PVFS*</u>	
Tier 1	\$45,619,145	
Tier 2	87,333,024	
Tier 3	550,406,706	
Tier 4	99,885,617,714	
Tier 5	6,367,109,426	
Tier 6	<u>18,237,810,104</u>	
	\$125,173,896,119	$\times (1.0725)^{-7/24} =$
		\$122,644,447,391

Normal RateTotal Liabilities - (Assets + Receivables)

Present Value of Future Salaries

$$\frac{\$10,384,467,430}{\$122,644,447,391} = 8.467132\%$$

8.47% (rounded)

* The Present Value of Future Salaries (PVFS) includes billable salaries starting with the 2019-2020 salary year. The billable salaries for the years 2017-2018 and 2018-2019 are excluded from the PVFS because a Normal Rate applicable to the 2017-2018 and 2018-2019 billable salary years has already been determined. The expected contributions thereon are included in the assets as receivables. Contributions are expected to be received on September 15, October 15, and November 15 of 2018 and 2019, respectively. Therefore, the total PVFS is discounted 3.5 months to the measurement date.

GROUP LIFE INSURANCE FUND2018 Valuation
7.25% Interest

GLIF Balance as of June 30, 2017	\$301,191,094
Benefit Payments During 2017 - 2018	\$19,113,184
Contributions During 2017 - 2018	\$20,600,717
GLIF Net Investment Income During 2017- 2018 (Based on 2017- 2018 Market Value of Assets Rate of Return of 9.0%)	\$27,562,327
GLIF Balance as of June 30, 2018	\$330,240,954
Estimated Benefit Payments During 2018 - 2019	\$20,000,000
Contributions During 2018 - 2019	\$21,175,549
GLIF Estimated Net Investment Income During 2018-2019 (Based on Estimated 2018 - 2019 Market Value of Assets Rate of Return of 7.25%)	\$24,306,454
Estimated GLIF Balance as of June 30, 2019	\$355,722,957

Calculation of the GLIF Rate for the June 30, 2018 Actuarial Valuation:

Expected Salaries for the 2018 - 2019 Fiscal Year	\$16,708,000,000
GLIF Rate	0.13%
Expected Contribution for the 2019 - 2020 Fiscal Year	\$21,720,400

Keep GLIF Rate at 0.13% as expected contribution and investment income will likely cover expected GLIF benefit payments, and once that is no longer true (as death benefits increase) GLIF balance can begin to be used.

EXCESS BENEFIT PLAN FUND*
2018 Valuation

Excess Benefit Plan Balance as of June 30, 2017	\$3,115,062
Final Adjustment for the Fiscal Year Ending June 30, 2017	\$44,345
Benefit Payments during 2017 - 2018	\$600,000
Contribution during 2017 - 2018	\$1,581,559
Net Investment Income (including miscellaneous adjustments) during 2017 - 2018 *	\$0
Excess Benefit Plan Balance as of June 30, 2018	\$4,140,966
Final Adjustment for the Fiscal Year Ending June 30, 2018	\$70,785
Estimated Benefit Payments during 2018 - 2019	\$600,000
Contribution during 2018 - 2019	\$0
Expected Net Investment Income during 2018 - 2019 *	\$0
Expected Excess Benefit Plan Balance as of June 30, 2019	\$3,611,751

Calculation of the Excess Benefit Plan Rate for the June 30, 2018 Actuarial Valuation:

Set the Excess Benefit Plan rate at 0.00% in order to use up the balance that has built up in the fund.

*Fund is in a zero-interest checking account

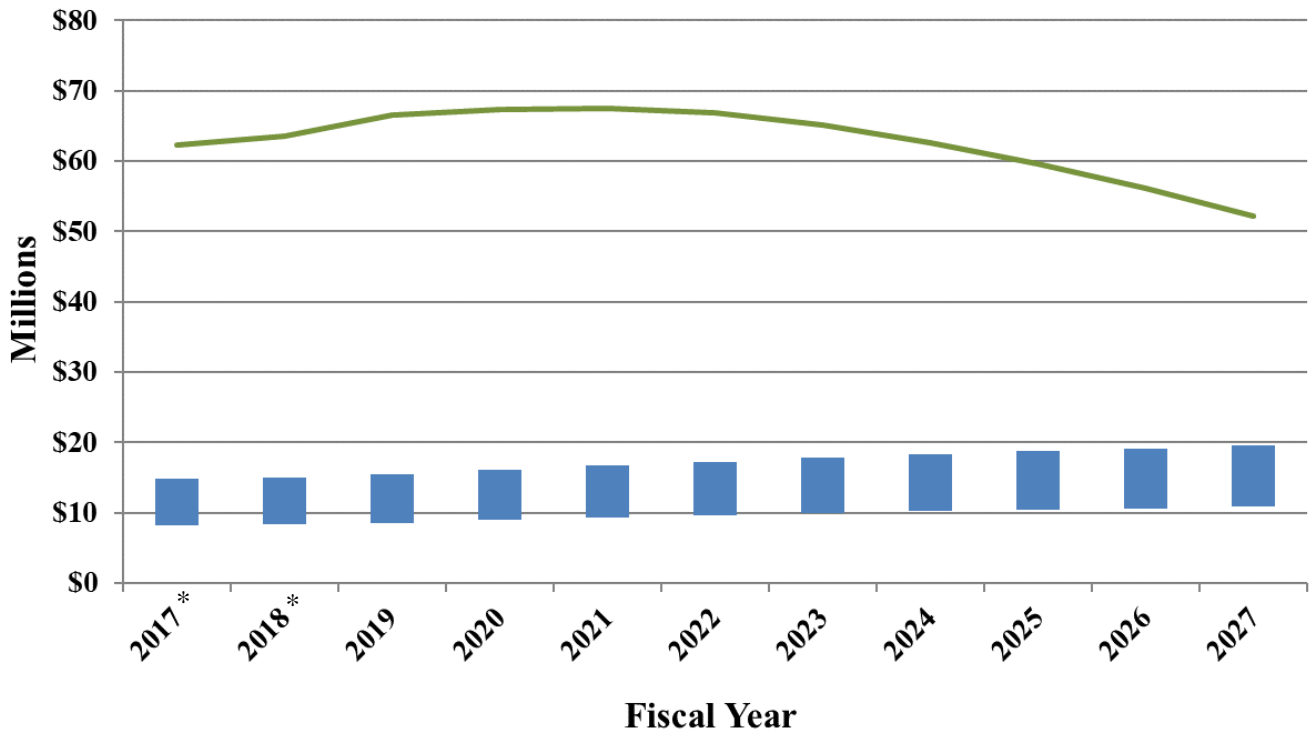
The Administrative Rate and Employer Contributions¹

The administrative portion (Rate) of the Employer Contribution Rate is adopted annually by the Retirement Board in the amount necessary to defray Retirement Administration related expenses for the following fiscal year. The first step in determining the rate is to divide the projected Retirement Administration related expenses by the projected member salary base. Consideration is also given to the overall status of the fund balance.

Based on the fall collection period for employer contributions, the preferred fund balance has been established to be 2 ½ to 4 ½ months of estimated member-related expenses. Since 2009, the fund balance has exceeded the preferred range largely due to a combination of aggressive cost saving measures immediately after the financial crisis of 2008 and additional cost containment initiatives since that time. To bring the fund balance gradually back down within the preferred range, the administrative rate was lowered from 0.27% to 0.26% during the 2018-19 fiscal year. The 2019-20 fiscal year will be the first year where collections of employer contributions will use the 0.26% rate.

A forecast analysis of expenses was performed to examine the impact of maintaining the Administrative Rate at 0.26%. Based on the analysis, staff believes the rate can remain at 0.26% without having a negative impact to the System’s mission and vision.

Administrative Fund Balance Projection – Fiscal Years 2017 - 2027



* Actual

Chart Legend

- Preferred Fund Balance Range (2 ½ to 4 ½ months of Member Expenses)
- Actual/Projected Administrative Fund Balance

APPENDIX 5 (Cont'd)

<i>(in thousands)</i>					Employer Contributions (Net of Billing Adjustments)		Increase/(Decrease) in Contributions to the Administrative Fund	
Member Salary Base					Year			
Year	Amount		Rate (%)		Collected	Amount		Percent
2020-21	\$	17,272,000 *	0.26%	*	2021-22	\$	44,907 *	1.53% *
2019-20		17,012,000 *	0.26%		2020-21		44,231 *	1.82% *
2018-19		16,708,000 *	0.26%		2019-20		43,441 *	(1.26%) *
2017-18		16,289,000	0.27%		2018-19		43,994	2.76%
2016-17		15,846,700	0.27%		2017-18		42,812	2.68%
2015-16		15,431,000	0.27%		2016-17		41,695	2.80%
2014-15		15,021,400	0.27%		2015-16		40,558	1.65%
2013-14		14,771,300	0.27%		2014-15		39,899	0.85%

* *Estimated*

Estimated Member Salary Base

The member salary base is actuarially determined; it increases as new members join the System and as members receive pay increases from their employers. Annual retirements and other forms of separation from service lessen this increase. While the member salary base is expected to continue to increase, the percentage of the increase is expected to decline in the foreseeable future.

¹This entire section comes from the NYSTRS 2019-20 Operating Budget Report

Asset Valuation Method**Development of Smoothing Adjustment**

<u>FYE</u>	<u>Market Value</u>	<u>Contributions</u>	<u>Benefit Payments</u>	<u>Average Market Value¹</u>
6/30/2013	93,531,255,172	1,765,812,556	6,194,057,011	
6/30/2014	105,671,560,226	1,858,234,634	6,399,153,913	91,647,927,748
6/30/2015	106,997,313,385	2,499,130,479	6,588,088,885	104,147,733,206
6/30/2016	105,357,811,418	2,726,314,201	6,780,291,815	105,538,306,703
6/30/2017	113,516,789,802	2,165,955,433	6,984,647,124	103,399,706,288
6/30/2018	118,230,310,625	1,994,973,683	7,169,609,705	111,345,091,308

<u>FYE</u>	<u>Actual Gain²</u>	<u>Expected Gain³</u>	<u>Unexpected Gain⁴</u>	<u>Smoothing Adjustment⁵</u>
6/30/2013	9,635,631,237			
6/30/2014	14,601,733,266	2,749,437,832	11,852,295,434	
6/30/2015	5,400,265,487	7,811,079,990	(2,410,814,503)	
6/30/2016	2,392,354,248	7,915,373,003	(5,523,018,755)	
6/30/2017	12,951,891,658	7,754,977,972	5,196,913,686	
6/30/2018	9,928,010,678	8,072,519,120	1,855,491,558	1,911,171,056

¹ Average Market Value = Market Value_(previous yr.) - (.5 x Benefit Payments) + ((8.5/12) x Contributions)

² Actual Gain = Net Appreciation for fiscal years ending prior to 6/30/2015
Actual Gain = Net Investment Income for fiscal years ending on or after 6/30/2015

³ Expected Gain = 3.0% x Average Market Value for fiscal years ending prior to 6/30/2015
Expected Gain = 7.5% x Average Market Value for fiscal years ending on or after 6/30/2015
and on or before 6/30/2017.

Expected Gain = 7.25% x Average Market Value for fiscal years ending on or after 6/30/2018

⁴ Unexpected Gain = Actual Gain - Expected Gain

⁵ Smoothing Adjustment = (.20 x Unexpected Gain 6/30/2015)
+ (.40 x Unexpected Gain 6/30/2016)
+ (.60 x Unexpected Gain 6/30/2017)
+ (.80 x Unexpected Gain 6/30/2018)

APPENDIX 6

**HYPOTHETICAL LONG TERM NORMAL RATE CALCULATION BASED ON
NEW ENTRANT NORMAL RATE AS OF JUNE 30, 2018**

The long-term expected normal rate has been determined based on the new entrant population for the year ending June 30, 2018. The new entrant population of **11,759 Tier 6 members** is defined to be members with the following characteristics:

1. a date of membership between 7/1/2017 and 6/30/2018; and
2. active as of 6/30/2018; and
3. no more than 1 year of NYS service as of 6/30/2018.

New Entrant Normal Rate as of June 30, 2018

The New Entrant Normal Rates determined under the benefit structures of Tiers 4, 5 and 6 using the member data for the current class of new entrants and the actuarial assumptions in the **June 30, 2018** actuarial valuation are as follows:

	Valued as Tier 4 Benefit Structure	Valued as Tier 5 Benefit Structure	Valued as Tier 6 Benefit Structure
Valuation Rate of Interest: 7.25%			
(1) Present Value of Future Benefits (PVB)	\$ 322,689,014	\$ 305,239,845	\$ 265,602,687
(2) Present Value of Future Member Contributions (PVFC)	49,696,530	103,897,706	138,043,336
(3) Present Value of Future Salaries (PVFS)	2,904,784,932	2,967,219,724	3,021,899,359
(4) Long Term Normal Cost of Benefit Structure as a Percent of Salary: (1) / (3)	11.1%	10.3%	8.8%
(5) Member's Share of the Normal Cost: (2) / (3)	1.7%	3.5%	4.6%
(6) Employer's Share of the Normal Cost: (4) - (5)	9.4%	6.8%	4.2%
Sensitivity Analysis¹			
Valuation Rate of Interest: 6.25%			
(1) Present Value of Future Benefits (PVB)	\$ 405,867,319	\$ 382,574,599	\$ 334,587,884
(2) Present Value of Future Member Contributions (PVFC)	50,703,783	109,200,577	144,385,242
(3) Present Value of Future Salaries (PVFS)	3,049,497,672	3,118,688,578	3,184,701,662
(4) Long Term Normal Cost of Benefit Structure as a Percent of Salary: (1) / (3)	13.3%	12.3%	10.5%
(5) Member's Share of the Normal Cost: (2) / (3)	1.7%	3.5%	4.5%
(6) Employer's Share of the Normal Cost: (4) - (5)	11.6%	8.8%	6.0%

History

As of June 30, 2018, and the 4 prior years, the long-term expected normal rates for new entrants determined under the benefit structures for Tiers 4, 5 and 6 are as follows:

Valuation Year	Employer Normal Rate from the Valuation	New Entrant Employer Normal Rate			Sensitivity Analysis ¹			Number of New Entrants ²
		Tier 4	Tier 5	Tier 6	Tier 4	Tier 5	Tier 6	
2014	12.85%	10.5%	7.5%	4.3%				8,592
2015 ³	11.31%	10.1%	7.3%	4.6%	12.4%	9.3%	6.3%	8,864
2016	9.40%	10.0%	7.2%	4.5%	12.2%	9.2%	6.3%	10,578
2017 ⁴	10.23%	10.6%	7.6%	4.7%	13.0%	9.8%	6.7%	11,061
2018 ⁵	8.47%	9.4%	6.8%	4.2%	11.6%	8.8%	6.0%	11,759

These rates represent the employers' costs only, not the total cost of the benefit structure which is in part funded by member contributions and excludes the Expense, GLIF and Excess Benefit Fund rates.

¹ New Entrant Rate determined using a Valuation Rate that is 1.0% below the Valuation Rate and the Valuation Salary Scale arithmetically reduced by 0.50%.

² Number of new entrants processed through the valuation.

³ Actuarial assumptions revised 10/29/2015, effective with the June 30, 2015 actuarial valuation.

⁴ Actuarial assumed rate of return revised from 7.50% to 7.25% and the calculation of the New Entrant Normal Rate was amended to include (rather than exclude) the current year expected member contributions as a receivable asset. No other assets are assumed to exist for the determination of these rates.

⁵ New Entrants as of 6/30/2018 exclude new members who have more than one year of service because they are transfers in from another retirement system and are older with higher salary. Also, the Present Value of Future Salaries was changed to no longer exclude the current year's salary for the purposes of the New Entrant Rate.

APPENDIX 7

**MEMBER
RECONCILIATION**

ACTIVE MEMBERS:

	<u>Male</u>	<u>Female</u>	<u>Total</u>
June 30, 2017.....	62,609	202,152	264,761
Changes During Year:			
Added.....	2,699	9,901	12,600
Withdrawn.....	1,594	4,584	6,178
Retired.....	1,393	5,023	6,416
Died.....	69	108	177
June 30, 2018.....	62,252	202,338	264,590

MEMBERS RETIRED FOR:

	<u>Service *</u>			<u>Disability</u>			<u>Total</u>		
	<u>Male</u>	<u>Female</u>	<u>Total</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>
June 30, 2017.....	49,788	105,809	155,597	459	1,647	2,106	50,247	107,456	157,703
Changes During Year:									
Retired.....	1,369	4,932	6,301	24	91	115	1,393	5,023	6,416
Died.....	1,535	2,246	3,781	25	77	102	1,560	2,323	3,883
Lump Sum.....	61	123	184	0	0	0	61	123	184
Restored to Active Membership....	0	0	0	0	3	3	0	3	3
June 30, 2018.....	49,561	108,372	157,933	458	1,658	2,116 **	50,019	110,030	160,049

BENEFICIARIES OF DECEASED:

	<u>Service Annuitants</u>			<u>Disability Annuitants</u>			<u>Active Members</u>			<u>Total</u>		
	<u>Male</u>	<u>Female</u>	<u>Total</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>
June 30, 2017.....	1,290	4,436	5,726	102	164	266	25	98	123	1,417	4,698	6,115
Changes During Year:												
Added.....	166	356	522	9	4	13	0	0	0	175	360	535
Died.....	106	288	394	4	7	11	0	9	9	110	304	414
June 30, 2018.....	1,350	4,504	5,854	107	161	268	25	89	114	1,482	4,754	6,236

SUMMARY:

	<u>Male</u>	<u>Female</u>	<u>Total</u>
Active Members.....	62,252	202,338	264,590
Retired Members.....	50,019	110,030	160,049
Beneficiaries.....	<u>1,482</u>	<u>4,754</u>	<u>6,236</u>
Total.....	113,753	317,122	430,875

*Also includes vested retirees.

**Includes 19 males and 45 females retired for disability who receive a service benefit.

APPENDIX 8

DISTRIBUTION OF ACTIVE MEMBERS

Distribution by Age as of June 30, 2018

<u>Age*</u>	<u>Male</u>	<u>Female</u>	<u>Total Members</u>
15-19	21	74	95
20-24	1,180	4,176	5,356
25-29	5,127	17,068	22,195
30-34	7,405	24,259	31,664
35-39	9,081	28,167	37,248
40-44	10,094	29,372	39,466
45-49	10,255	31,002	41,257
50-54	8,470	27,451	35,921
55-59	5,722	22,058	27,780
60-64	3,228	13,237	16,465
65-69	1,227	4,351	5,578
70-74	330	857	1,187
75-79	81	206	287
80-84	23	52	75
85 or older	<u>8</u>	<u>8</u>	<u>16</u>
Total	62,252	202,338	264,590

Average Male age is 43 years 10 months

Average Female age is 44 years 2 months

**Age as of last birthday*

APPENDIX 8 (Cont'd)

Distribution by Age and Tier of Membership as of June 30, 2018

<u>Age*</u>	<u>Tier 1</u>	<u>Tier 2</u>	<u>Tier 3</u>	<u>Tier 4</u>	<u>Tier 5</u>	<u>Tier 6</u>	<u>Total Members</u>
15-19	0	0	0	0	0	95	95
20-24	0	0	0	2	7	5,347	5,356
25-29	0	0	0	850	2,213	19,132	22,195
30-34	0	0	0	14,186	7,170	10,308	31,664
35-39	0	0	0	28,453	2,349	6,446	37,248
40-44	0	0	0	33,356	1,236	4,874	39,466
45-49	0	0	0	35,669	1,201	4,387	41,257
50-54	0	0	12	31,731	975	3,203	35,921
55-59	0	2	677	24,357	659	2,085	27,780
60-64	8	97	1,829	12,991	423	1,117	16,465
65-69	165	399	397	4,011	201	405	5,578
70-74	185	36	58	765	46	97	1,187
75-79	62	10	17	162	14	22	287
80-84	19	2	3	41	4	6	75
85 or older	7	0	0	7	1	1	16
Total	446	546	2,993	186,581	16,499	57,525	264,590
Average Age (yrs. – mos.)	71-5	66-4	61-10	47-2	37-4	34-11	44-1

*Age as of last birthday

APPENDIX 8 (Cont'd)

Distribution of Active Members by Age and New York State Service as of June 30, 2018

Male

<u>Age*</u>	<u>Less Than 10 Years New York State Service</u>	<u>10 or More Years New York State Service</u>	<u>Total New York State Service</u>
15-19	21	0	21
20-24	1,180	0	1,180
25-29	5,126	1	5,127
30-34	6,517	888	7,405
35-39	3,994	5,087	9,081
40-44	2,432	7,662	10,094
45-49	1,849	8,406	10,255
50-54	1,487	6,983	8,470
55-59	1,098	4,624	5,722
60-64	797	2,431	3,228
65-69	424	803	1,227
70-74	160	170	330
75-79	43	38	81
80-84	15	8	23
85 or older	<u>4</u>	<u>4</u>	<u>8</u>
Total	25,147	37,105	62,252

Female

<u>Age*</u>	<u>Less Than 10 Years New York State Service</u>	<u>10 or More Years New York State Service</u>	<u>Total New York State Service</u>
15-19	74	0	74
20-24	4,176	0	4,176
25-29	17,066	2	17,068
30-34	21,491	2,768	24,259
35-39	13,097	15,070	28,167
40-44	9,231	20,141	29,372
45-49	9,069	21,933	31,002
50-54	7,348	20,103	27,451
55-59	4,772	17,286	22,058
60-64	2,469	10,768	13,237
65-69	972	3,379	4,351
70-74	253	604	857
75-79	64	142	206
80-84	21	31	52
85 or older	<u>3</u>	<u>5</u>	<u>8</u>
Total	90,106	112,232	202,338

*Age as of last birthday

APPENDIX 8 (Cont'd)

Distribution of Active Members by Total Service as of June 30, 2018

<u>Years of Service</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>
0-4	16,402	56,260	72,662
5-9	8,297	31,637	39,934
10-14	9,854	34,198	44,052
15-19	11,602	35,972	47,574
20-24	8,596	23,206	31,802
25-29	4,501	12,796	17,297
30-34	2,301	6,800	9,101
35 or more	<u>699</u>	<u>1,469</u>	<u>2,168</u>
Total	62,252	202,338	264,590

Average Male has 13 Years of Total Service

Average Female has 12 Years of Total Service

APPENDIX 8 (Cont'd)

Distribution of Active Members by Total Service and Tier of Membership as of June 30, 2018

<u>Years of Service</u>	<u>Tier 1</u>	<u>Tier 2</u>	<u>Tier 3</u>	<u>Tier 4</u>	<u>Tier 5</u>	<u>Tier 6</u>	<u>Total</u>
0-4	34	26	31	11,501	8,765	52,305	72,662
5-9	28	29	85	27,064	7,646	5,082	39,934
10-14	35	49	148	43,666	70	84	44,052
15-19	29	45	188	47,260	14	38	47,574
20-24	35	59	335	31,357	3	13	31,802
25-29	51	83	405	16,754	1	3	17,297
30-34	60	74	504	8,463	0	0	9,101
35 or more	174	181	1,297	516	0	0	2,168
Total	446	546	2,993	186,581	16,499	57,525	264,590
Average Service (yrs. – mos.)	29-5	27-5	29-6	15-8	4-0	1-8	12-3

APPENDIX 8 (Cont'd)

Total and Average Earnings by Tier of Membership
for Active Members as of June 30, 2018

	<u>Total Earnings</u>	<u>Average Earnings*</u>	<u>Average Earnings* of Full-Time Members</u>
Tier 1	\$37,880,313	\$99,685	\$111,000
Tier 2	\$47,721,567	\$100,255	\$108,645
Tier 3	\$280,566,821	\$101,471	\$105,054
Tier 4	\$13,569,235,750	\$84,317	\$88,350
Tier 5	\$534,338,875	\$53,708	\$61,763
Tier 6	<u>\$1,628,432,695</u>	<u>\$36,545</u>	<u>\$51,211</u>
Total	\$16,098,176,021	\$73,487	\$82,071

* Average earnings calculated using only those active members with earnings during the 2017-18 school year.

APPENDIX 9

HISTORICAL MEMBER STATISTICS**Active Members and Annuitants 1925-2018**

<u>As of June 30</u>	<u>Active Members</u>	<u>Retirees & Beneficiaries</u>
1925	29,057	1,815
1930	39,663	2,732
1935	45,031	3,919
1940	48,193	4,771
1945	52,359	5,637
1950	56,504	6,374
1955	71,273	7,897
1960	99,555	10,796
1965	129,543	16,043
1970	186,914	22,700
1975	227,038	35,252
1980	203,330	46,812
1985	178,516	57,366
1990	195,194	69,127
1995	199,398	82,459
2000	224,986	100,839
2005	260,356	125,325
2010	285,774	141,716
2015	267,715	158,458
2018	264,590	166,285

Number of Active Members by Tier

<u>As of June 30</u>	<u>Tier 1</u>	<u>Tier 2</u>	<u>Tier 3</u>	<u>Tier 4</u>	<u>Tier 5</u>	<u>Tier 6</u>	<u>Total</u>
1999	50,859	15,776	20,726	128,906	--	--	216,267
2000	47,234	15,700	20,159	141,893	--	--	224,986
2001	41,169	15,472	19,914	157,795	--	--	234,350
2002	35,601	15,121	19,674	172,438	--	--	242,834
2003	28,327	14,463	19,083	185,374	--	--	247,247
2004	22,986	13,947	18,835	198,747	--	--	254,515
2005	17,901	13,210	18,535	210,710	--	--	260,356
2006	13,621	12,084	18,173	220,532	--	--	264,410
2007	10,838	10,178	17,743	231,286	--	--	270,045
2008	8,630	8,171	17,007	241,093	--	--	274,901
2009	6,943	6,752	16,111	250,532	--	--	280,338
2010	5,582	5,706	14,942	255,966	3,578	--	285,774
2011	3,814	4,137	12,690	247,530	12,264	--	280,435
2012	2,756	3,253	11,180	239,199	19,969	916	277,273
2013	1,968	2,447	9,450	231,258	19,452	8,753	273,328
2014	1,439	1,810	7,753	222,545	19,124	17,368	270,039
2015	1,116	1,348	6,222	214,020	18,878	26,131	267,715
2016	832	974	4,920	204,912	18,540	36,172	266,350
2017	607	720	3,881	195,226	17,722	46,605	264,761
2018	446	546	2,993	186,581	16,499	57,525	264,590

RETIREMENT STATISTICS

RETIREMENT STATISTICS 2017-2018 MEMBERS RETIRED FOR:

	Service*	Disability
Number Retired.....	6,301	115
Age at Retirement:		
Average.....	61 yrs., 1 mo.	51 yrs., 1 mo.
Median.....	61 yrs., 3 mos.	51 yrs., 5 mos.
Years of Service:		
Average.....	25 yrs., 1 mo.	18 yrs., 6 mos.
Median.....	27 yrs., 0 mos.	17 yrs., 5 mos.
**Benefit:		
Average.....	\$45,725	\$28,241
Median.....	\$47,455	\$27,086
Final Average Salary (FAS):		
Average.....	\$86,910	\$78,641
Median.....	\$86,529	\$72,289
***Benefit as % of FAS:		
Average.....	47.26%	35.06%
Median.....	53.11%	33.33%

2017-2018 MEMBERS RETIRED FOR SERVICE* WITH:

	Less Than 10 Yrs. Svc.	10 or More Yrs. and Less Than 20 Yrs. Svc.	20 or More Yrs. and Less Than 30 Yrs. Svc.	30 or More Yrs. Svc.
Number Retired.....	511	1,001	2,046	2,743
Age at Retirement:				
Average.....	61 yrs., 3 mos.	61 yrs., 7 mos.	62 yrs., 8 mos.	59 yrs., 9 mos.
Median.....	60 yrs., 0 mos.	61 yrs., 11 mos.	62 yrs., 7 mos.	59 yrs., 2 mos.
Years of Service:				
Average.....	6 yrs., 8 mos.	14 yrs., 5 mos.	24 yrs., 1 mo.	33 yrs., 1 mo.
Median.....	7 yrs., 0 mos.	14 yrs., 4 mos.	24 yrs., 0 mos.	32 yrs., 0 mos.
**Benefit:				
Average.....	\$3,580	\$12,615	\$41,289	\$68,968
Median.....	\$3,016	\$9,841	\$39,879	\$65,167
Final Average Salary (FAS):				
Average.....	\$35,302	\$56,323	\$88,585	\$106,438
Median.....	\$32,003	\$50,459	\$86,328	\$100,034
***Benefit as % of FAS:				
Average.....	9.83%	21.73%	45.97%	64.52%
Median.....	9.63%	21.44%	45.56%	63.00%

*Also includes vested retirees.

**The Maximum, even though the member may have chosen an option.

***The average and median of individual benefits as percentages of final average salary.

APPENDIX 10 (Cont'd)

RETIREMENT STATISTICS ALL RETIREES AS OF JUNE 30, 2018 RETIRED FOR:

	Service*	Disability
Number Retired.....	157,997	2,052
Age at Retirement:		
Average.....	58 yrs., 9 mos.	49 yrs., 6 mos.
Median.....	57 yrs., 9 mos.	50 yrs., 4 mos.
Age Attained as of June 30, 2018:		
Average.....	72 yrs., 11 mos.	65 yrs., 4 mos.
Median.....	71 yrs., 7 mos.	66 yrs., 1 mo.
Years of Service:		
Average.....	28 yrs., 0 mos.	18 yrs., 4 mos.
Median.....	30 yrs., 2 mos.	17 yrs., 6 mos.
**Benefit:		
Average.....	\$42,216	\$20,780
Median.....	\$42,438	\$18,998
Final Average Salary (FAS):		
Average.....	\$72,362	\$57,221
Median.....	\$70,944	\$54,979
***Benefit as % of FAS:		
Average.....	54.08%	35.58%
Median.....	60.22%	33.33%

ALL RETIREES AS OF JUNE 30, 2018 RETIRED FOR SERVICE* WITH:

	Less Than 10 Yrs. Svc.	10 or More Yrs. and Less Than 20 Yrs. Svc.	20 or More Yrs. and Less Than 30 Yrs. Svc.	30 or More Yrs. Svc.
Number Retired.....	4,429	22,512	46,592	84,464
Age at Retirement:				
Average.....	60 yrs., 5 mos.	58 yrs., 11 mos.	59 yrs., 10 mos.	58 yrs., 1 mo.
Median.....	59 yrs., 7 mos.	57 yrs., 4 mos.	59 yrs., 9 mos.	57 yrs., 0 mos.
Years of Service:				
Average.....	7 yrs., 3 mos.	14 yrs., 5 mos.	24 yrs., 8 mos.	34 yrs., 4 mos.
Median.....	7 yrs., 4 mos.	14 yrs., 5 mos.	25 yrs., 0 mos.	34 yrs., 0 mos.
**Benefit:				
Average.....	\$4,125	\$9,316	\$32,623	\$58,274
Median.....	\$3,485	\$7,215	\$30,258	\$54,878
Final Average Salary (FAS):				
Average.....	\$39,556	\$41,436	\$67,587	\$84,959
Median.....	\$35,899	\$34,367	\$63,905	\$80,593
***Benefit as % of FAS:				
Average.....	10.45%	21.89%	47.99%	68.32%
Median.....	10.00%	20.93%	48.67%	68.00%

**Also includes vested retirees.*

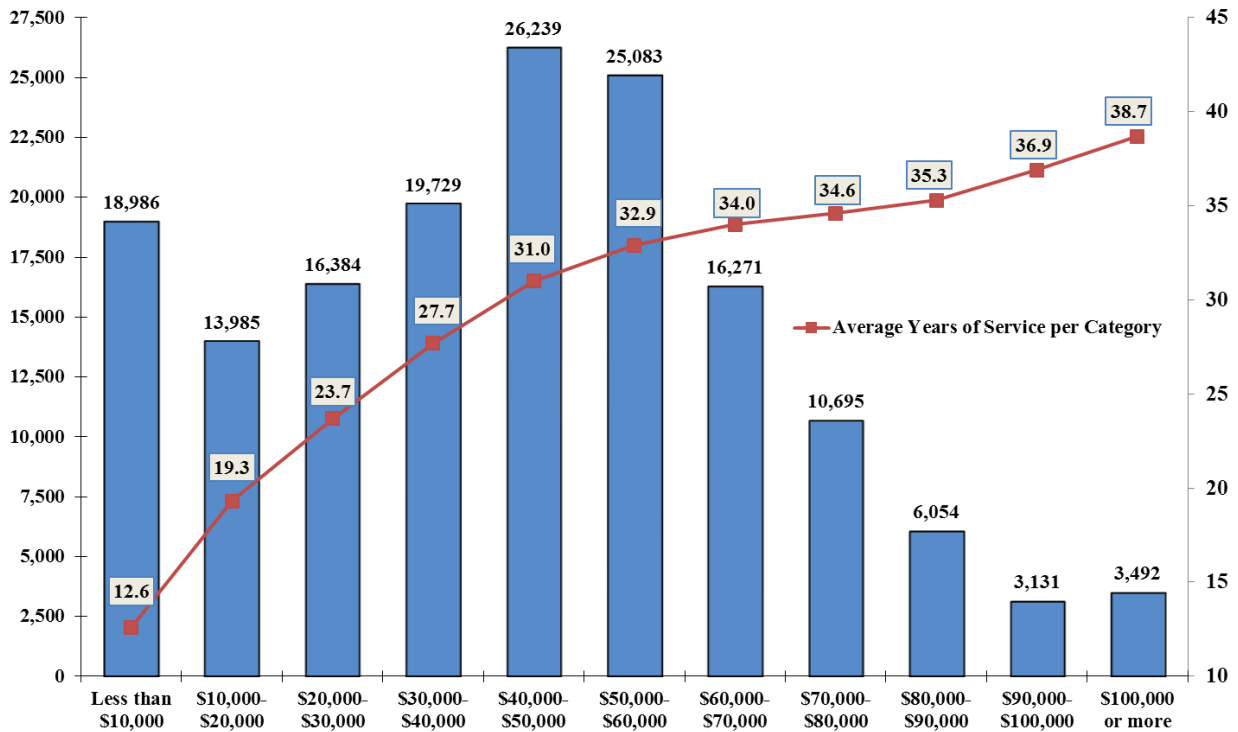
***The Maximum, even though the member may have chosen an option.*

****The average and median of individual benefits as percentages of final average salary.*

**Retired Members' Characteristics¹
By Year of Retirement**

Retired in Fiscal Year Ended	Number of Retired Members	Average Age at Retirement (yrs.- mos.)	Average Service at Retirement (yrs.- mos.)	Average Final Average Salary	Average Maximum Annual Benefit
2009	5,644	59-6	27-7	\$78,050	\$46,061
2010	5,501	60-0	27-5	79,615	46,489
2011	8,423	60-3	28-7	85,010	51,200
2012	6,033	60-9	26-3	82,461	45,759
2013	6,330	60-10	25-6	81,987	44,768
2014	6,547	61-0	25-4	84,545	44,978
2015	6,161	60-11	25-4	84,362	44,487
2016	6,245	61-2	25-0	84,308	44,215
2017	6,396	61-3	25-0	85,242	45,049
2018	6,416	61-1	25-1	86,910	45,725

**Distribution of the Annual Benefit² of All Retired
Members**



¹ Averages are for service and vested retirees.

² Maximum annual retirement benefit as of June 30, 2018 including supplementation and COLA.

APPENDIX 11

2014-2018 EXPERIENCE STUDY
 NUMBER OF SERVICE RETIREMENTS
 TIER 1 AND TIERS 2, 3, 4 AT LEAST AGE 62 OR WITH 30 YEARS OF SERVICE
 AND TIER 5 AT LEAST AGE 62
 EXPOSURE BASED ON ACTIVE TEACHERS
 ASSUMPTIONS ADOPTED OCTOBER 2015

AGE	EXPOSURES	MALE			FEMALE			RATIO OF ACTUAL TO EXPECTED
		ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	
50	9	0	0.00	N/A	20	0	0.00	N/A
51	27	0	0.00	N/A	87	0	0.00	N/A
52	304	0	0.00	N/A	762	0	0.00	N/A
53	720	0	0.00	N/A	1,900	0	0.00	N/A
54	1,115	58	0.00	N/A	3,011	120	0.00	N/A
55	1,448	518	444.09	1.166	3,761	1,343	1,180.92	1.137
56	1,240	355	348.17	1.020	3,241	1,086	933.78	1.163
57	1,174	299	296.37	1.009	2,820	758	759.91	0.997
58	1,168	312	303.02	1.030	2,695	697	703.44	0.991
59	1,088	291	311.76	0.933	2,560	736	688.09	1.070
60	1,010	301	314.12	0.958	2,346	754	655.50	1.150
61	946	277	302.94	0.914	2,133	679	591.20	1.149
62	2,808	711	759.01	0.937	12,556	3,425	3,228.87	1.061
63	2,104	453	482.56	0.939	9,128	2,023	2,126.34	0.951
64	1,658	329	342.98	0.959	6,909	1,377	1,514.62	0.909
65	1,319	289	276.57	1.045	5,283	1,291	1,258.79	1.026
66	1,037	303	225.48	1.344	3,812	1,059	932.12	1.136
67	689	177	149.47	1.184	2,547	636	603.11	1.055
68	511	121	106.44	1.137	1,718	409	378.59	1.080
69	380	83	71.09	1.168	1,176	260	271.58	0.957
70	280	72	45.79	1.572	852	192	195.36	0.983
71	187	39	27.44	1.421	597	139	126.60	1.098
72	148	35	25.10	1.394	429	93	77.41	1.201
73	107	31	17.91	1.731	313	65	57.32	1.134
74	74	13	12.15	1.070	247	43	47.45	0.906
75	55	9	7.36	1.223	184	29	35.08	0.827
76	232	54	232.00	0.233	512	106	512.00	0.207
TOTAL	21,838	5,130	5,101.82	1.006	71,599	17,320	16,878.08	1.026

APPENDIX 11 (Cont'd)
 2014-2018 EXPERIENCE STUDY
 NUMBER OF SERVICE RETIREMENTS
 TIERS 2,3,4 LESS THAN AGE 62 AND WITH LESS THAN 30 YEARS OF SERVICE
 EXPOSURE BASED ON ACTIVE TEACHERS
 ASSUMPTIONS ADOPTED OCTOBER 2015

<u>AGE</u>	<u>EXPOSURES</u>	MALE			FEMALE			RATIO OF ACTUAL TO EXPECTED	
		<u>ACTUAL</u>	<u>EXPECTED</u>	<u>EXPECTED</u>	<u>ACTUAL</u>	<u>EXPECTED</u>	<u>EXPECTED</u>	<u>EXPECTED</u>	
50	6,575	0	0.00	N/A	20,034	0	0.00	N/A	
51	6,298	0	0.00	N/A	20,145	0	0.00	N/A	
52	5,823	0	0.00	N/A	19,785	0	0.00	N/A	
53	5,247	0	0.00	N/A	18,926	0	0.00	N/A	
54	4,596	29	0.00	N/A	17,845	131	0.00	N/A	
55	4,095	125	130.90	0.955	16,920	578	584.84	0.988	
56	3,642	109	115.75	0.942	15,884	499	568.03	0.878	
57	3,274	89	118.72	0.750	14,899	450	622.03	0.723	
58	2,950	98	129.50	0.757	14,062	549	651.76	0.842	
59	2,724	99	153.63	0.644	13,418	592	809.63	0.731	
60	2,443	111	155.32	0.715	12,760	803	898.50	0.894	
61	2,212	177	159.74	1.108	11,827	933	976.79	0.955	
TOTAL	49,879	837	963.56	0.869	196,505	4,535	5,111.58	0.887	

APPENDIX 11 (Cont'd)
 2014-2018 EXPERIENCE STUDY
 NUMBER OF SERVICE RETIREMENTS
 TIER 5 LESS THAN AGE 62 AND WITH LESS THAN 30 YEARS OF SERVICE
 EXPOSURE BASED ON ACTIVE TEACHERS
 ASSUMPTIONS ADOPTED OCTOBER 2015

AGE	EXPOSURES*	MALE				FEMALE			
		ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	EXPOSURES*	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	EXPOSURES*
50	1	0	0.00	N/A	7	0	0.00	N/A	
51	1	0	0.00	N/A	7	0	0.00	N/A	
52	2	0	0.00	N/A	5	0	0.00	N/A	
53	1	0	0.00	N/A	4	0	0.00	N/A	
54	0	0	0.00	N/A	7	0	0.00	N/A	
55	0	0	0.00	N/A	11	0	0.19	0.000	
56	1	0	0.02	0.000	11	1	0.20	5.000	
57	1	0	0.02	0.000	7	0	0.15	0.000	
58	1	0	0.02	0.000	9	1	0.21	4.762	
59	2	0	0.06	0.000	6	0	0.18	0.000	
60	2	0	0.06	0.000	7	1	0.25	4.000	
61	1	0	0.04	0.000	4	2	0.17	11.765	
TOTAL	13	0	0.22	0.000	85	5	1.35	3.704	

* Exposures have at least 10 years of service.

APPENDIX 11 (Cont'd)

2014-2018 EXPERIENCE STUDY
 NUMBER OF SERVICE RETIREMENTS
 TIER 6
 EXPOSURE BASED ON ACTIVE TEACHERS
 ASSUMPTIONS ADOPTED OCTOBER 2015

AGE	EXPOSURES*	MALE				FEMALE			
		ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	EXPOSURES*	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	
50	1	0	0.00	N/A	3	0	0.00	N/A	
51	0	0	0.00	N/A	3	0	0.00	N/A	
52	0	0	0.00	N/A	8	0	0.00	N/A	
53	0	0	0.00	N/A	7	0	0.00	N/A	
54	0	0	0.00	N/A	5	0	0.00	N/A	
55	0	0	0.00	N/A	3	0	0.05	0.000	
56	0	0	0.00	N/A	1	0	0.02	0.000	
57	0	0	0.00	N/A	4	0	0.08	0.000	
58	0	0	0.00	N/A	1	0	0.02	0.000	
59	0	0	0.00	N/A	1	0	0.03	0.000	
60	0	0	0.00	N/A	4	0	0.14	0.000	
61	0	0	0.00	N/A	2	0	0.08	0.000	
62	0	0	0.00	N/A	6	0	0.28	0.000	
63	0	0	0.00	N/A	2	0	0.63	0.000	
64	0	0	0.00	N/A	2	0	0.58	0.000	
65	1	1	0.25	4.000	2	0	0.54	0.000	
66	0	0	0.00	N/A	2	1	0.52	1.923	
67	1	1	0.29	3.448	0	0	0.00	N/A	
68	0	0	0.00	N/A	1	0	0.28	0.000	
69	0	0	0.00	N/A	0	0	0.00	N/A	
70	0	0	0.00	N/A	0	0	0.00	N/A	
71	0	0	0.00	N/A	0	0	0.00	N/A	
72	0	0	0.00	N/A	0	0	0.00	N/A	
73	1	0	0.21	0.000	0	0	0.00	N/A	
74	1	0	0.22	0.000	0	0	0.00	N/A	
75	1	0	0.22	0.000	0	0	0.00	N/A	
76	0	0	0.00	N/A	1	0	1.00	0.000	
TOTAL	6	2	1.19	1.681	58	1	4.25	0.235	

* Exposures have at least 10 years of service.

APPENDIX 11 (Cont'd)

2014-2018 EXPERIENCE STUDY
 NUMBER OF DEATHS AMONG ACTIVE MEMBERS
 EXPOSURE BASED ON ACTIVE TEACHERS
 ASSUMPTIONS ADOPTED OCTOBER 2015

CENTRAL AGE	MALE			FEMALE		
	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
20	0	0.20	0.000	1	0.36	2.778
25	5	4.22	1.185	3	5.74	0.523
30	10	7.73	1.294	11	10.73	1.025
35	9	13.11	0.686	15	16.02	0.936
40	16	20.64	0.775	20	25.39	0.788
45	25	28.93	0.864	46	46.68	0.985
50	33	29.74	1.110	55	63.30	0.869
55	38	32.91	1.155	87	80.97	1.074
60	32	38.84	0.824	88	81.95	1.074
65	16	30.61	0.523	41	42.88	0.956
70	7	13.56	0.516	14	12.72	1.101
75	7	3.91	1.790	5	3.41	1.466
TOTAL	198	224.40	0.882	386	390.15	0.989

APPENDIX 11 (Cont'd)

2014-2018 EXPERIENCE STUDY
 NUMBER OF DISABILITY RETIREMENTS
 EXPOSURE BASED ON ACTIVE TEACHERS
 ASSUMPTIONS ADOPTED OCTOBER 2015

CENTRAL AGE	MALE			FEMALE		
	<u>ACTUAL</u>	<u>EXPECTED</u>	<u>RATIO OF ACTUAL TO EXPECTED</u>	<u>ACTUAL</u>	<u>EXPECTED</u>	<u>RATIO OF ACTUAL TO EXPECTED</u>
30	0	0.01	0.000	0	0.02	0.000
35	2	1.60	1.250	8	5.05	1.584
40	8	7.62	1.050	44	18.92	2.326
45	17	17.17	0.990	61	45.88	1.330
50	22	27.28	0.806	124	88.03	1.409
54	19	13.55	1.402	59	51.17	1.153
TOTAL	68	67.23	1.011	296	209.07	1.416

APPENDIX 11 (Cont'd)
 2014-2018 EXPERIENCE STUDY
 COMPARISON OF SALARY SCALE TO ACTUAL SALARY INCREASES
 ASSUMPTIONS ADOPTED OCTOBER 2015

MALE

PREVIOUS YEAR'S SERVICE	PREVIOUS YEAR'S DURATION*	PREVIOUS YEAR'S SALARIES	ACTUAL SALARIES	EXPECTED SALARIES**	RATIO OF ACTUAL TO EXPECTED
0-0 to 0-4	0	150,327,278	187,122,499	165,360,006	1.132
0-5 to 1-4	1	399,705,667	446,671,546	439,676,234	1.016
1-5 to 2-4	2	359,715,069	390,608,140	384,895,124	1.015
2-5 to 3-4	3	337,422,650	360,502,895	357,870,463	1.007
3-5 to 4-4	4	341,092,058	361,188,018	358,897,063	1.006
4-5 to 5-4	5	360,586,624	379,304,083	377,606,313	1.004
5-5 to 6-4	6	418,930,061	438,402,731	437,572,449	1.002
6-5 to 7-4	7	489,013,544	508,656,699	510,090,028	0.997
7-5 to 8-4	8	552,143,439	574,369,524	575,443,892	0.998
8-5 to 9-4	9	637,830,776	662,829,180	664,300,753	0.998
9-5 to 10-4	10	720,973,938	747,492,033	750,317,577	0.996
10-5 to 11-4	11	806,250,833	834,429,799	838,339,616	0.995
11-5 to 12-4	12	874,049,372	903,092,299	907,875,083	0.995
12-5 to 13-4	13	962,976,857	994,096,797	999,088,489	0.995
13-5 to 14-4	14	1,014,819,109	1,046,973,947	1,051,454,079	0.996
14-5 to 15-4	15	1,052,528,787	1,085,766,567	1,088,946,283	0.997
15-5 to 16-4	16	1,045,236,074	1,076,321,607	1,079,833,388	0.997
16-5 to 17-4	17	1,021,021,713	1,048,997,741	1,053,388,101	0.996
17-5 to 18-4	18	947,360,280	972,850,433	976,160,033	0.997
18-5 to 19-4	19	877,587,311	901,557,190	903,300,619	0.998
19-5 to 20-4	20	782,282,715	801,848,435	804,343,088	0.997
20-5 to 21-4	21	696,602,431	712,957,174	715,550,017	0.996
21-5 to 22-4	22	600,278,694	614,302,239	616,066,024	0.997
22-5 to 23-4	23	542,709,675	554,482,392	556,494,501	0.996
23-5 to 24-4	24	500,677,138	512,419,184	512,943,728	0.999
24-5 to 25-4	25	469,628,032	479,053,111	480,758,216	0.996
25-5 to 26-4	26	431,813,682	440,636,850	441,702,215	0.998
26-5 to 27-4	27	427,161,427	434,770,505	436,644,411	0.996
27-5 to 28-4	28	408,291,821	415,598,725	417,070,095	0.996
28-5 to 29-4	29	391,534,616	399,174,680	399,756,843	0.999
29-5 to 30-4	30	302,173,180	305,439,837	308,397,948	0.990
30-5 to 31-4	31	236,951,470	240,466,839	241,737,890	0.995
31-5 to 32-4	32	181,478,634	182,321,125	185,108,207	0.985
32-5 to 33-4	33	137,783,758	138,335,595	140,470,541	0.985
33-5 to 34-4	34	105,973,955	106,956,311	108,019,252	0.990
34-5 to 35-4	35	90,184,620	90,535,438	91,898,128	0.985
35-5 to 36-4	36	73,872,273	74,338,984	75,246,297	0.988
36-5 to 37-4	37	55,770,424	55,948,044	56,774,292	0.985
37-5 to 38-4	38	43,560,876	43,155,812	44,327,547	0.974
38-5 or more	39	147,345,086	146,073,186	149,938,360	0.974
TOTAL		19,995,645,947	20,670,048,194	20,703,663,191	0.998

*For service less than 5 months duration is set to one.

**Totals may not add due to rounding.

APPENDIX 11 (Cont'd)
 2014-2018 EXPERIENCE STUDY
 COMPARISON OF SALARY SCALE TO ACTUAL SALARY INCREASES
 ASSUMPTIONS ADOPTED OCTOBER 2015

FEMALE

<u>PREVIOUS YEAR'S SERVICE</u>	<u>PREVIOUS YEAR'S DURATION*</u>	<u>PREVIOUS YEAR'S SALARIES</u>	<u>ACTUAL SALARIES</u>	<u>EXPECTED SALARIES**</u>	<u>RATIO OF ACTUAL TO EXPECTED</u>
0-0 to 0-4	0	455,762,634	576,949,000	501,338,897	1.151
0-5 to 1-4	1	1,283,392,056	1,450,204,344	1,411,731,262	1.027
1-5 to 2-4	2	1,149,381,582	1,251,211,773	1,229,838,293	1.017
2-5 to 3-4	3	1,076,993,057	1,149,960,743	1,142,258,836	1.007
3-5 to 4-4	4	1,061,136,167	1,122,606,069	1,116,527,475	1.005
4-5 to 5-4	5	1,135,812,409	1,195,085,199	1,189,422,755	1.005
5-5 to 6-4	6	1,311,815,378	1,371,664,383	1,370,191,162	1.001
6-5 to 7-4	7	1,512,352,273	1,579,510,767	1,577,534,656	1.001
7-5 to 8-4	8	1,716,776,137	1,787,862,609	1,789,224,090	0.999
8-5 to 9-4	9	1,948,096,328	2,024,107,179	2,028,942,326	0.998
9-5 to 10-4	10	2,139,299,000	2,222,186,041	2,226,368,469	0.998
10-5 to 11-4	11	2,327,661,639	2,415,230,208	2,420,302,572	0.998
11-5 to 12-4	12	2,505,908,773	2,594,875,204	2,602,887,443	0.997
12-5 to 13-4	13	2,704,003,914	2,799,420,212	2,805,404,061	0.998
13-5 to 14-4	14	2,826,484,285	2,923,938,680	2,928,520,368	0.998
14-5 to 15-4	15	2,867,934,855	2,961,073,236	2,967,165,401	0.998
15-5 to 16-4	16	2,798,616,846	2,884,672,045	2,891,251,064	0.998
16-5 to 17-4	17	2,647,468,802	2,725,224,449	2,731,393,563	0.998
17-5 to 18-4	18	2,402,426,284	2,470,765,661	2,475,460,043	0.998
18-5 to 19-4	19	2,204,185,774	2,265,200,571	2,268,768,417	0.998
19-5 to 20-4	20	1,974,433,818	2,026,290,414	2,030,112,852	0.998
20-5 to 21-4	21	1,740,688,530	1,782,362,316	1,788,035,258	0.997
21-5 to 22-4	22	1,563,266,196	1,599,653,768	1,604,380,097	0.997
22-5 to 23-4	23	1,456,479,866	1,488,338,205	1,493,474,455	0.997
23-5 to 24-4	24	1,359,402,968	1,389,351,108	1,392,708,341	0.998
24-5 to 25-4	25	1,288,295,719	1,316,048,885	1,318,828,328	0.998
25-5 to 26-4	26	1,248,393,946	1,273,102,828	1,276,982,167	0.997
26-5 to 27-4	27	1,220,349,006	1,243,639,126	1,247,440,754	0.997
27-5 to 28-4	28	1,158,311,898	1,180,626,124	1,183,215,604	0.998
28-5 to 29-4	29	1,083,308,031	1,103,270,045	1,106,057,500	0.997
29-5 to 30-4	30	830,064,106	838,073,943	847,163,427	0.989
30-5 to 31-4	31	596,184,383	603,790,819	608,227,308	0.993
31-5 to 32-4	32	444,220,616	448,682,675	453,105,028	0.990
32-5 to 33-4	33	315,049,615	317,780,362	321,193,082	0.989
33-5 to 34-4	34	223,293,996	224,646,534	227,603,570	0.987
34-5 to 35-4	35	167,214,244	168,889,616	170,391,315	0.991
35-5 to 36-4	36	131,403,007	132,257,662	133,847,103	0.988
36-5 to 37-4	37	96,874,194	97,551,010	98,617,929	0.989
37-5 to 38-4	38	61,749,833	62,614,406	62,836,630	0.996
38-5 or more	39	184,292,233	184,749,179	187,535,776	0.985
TOTAL		55,218,784,398	57,253,467,398	57,226,287,675	1.000

*For service less than 5 months duration is set to one.

**Totals may not add due to rounding.

APPENDIX 11 (Cont'd)

2014-2018 EXPERIENCE STUDY
 NUMBER OF WITHDRAWALS
 EXPOSURE BASED ON ACTIVE TEACHERS
 ASSUMPTIONS ADOPTED OCTOBER 2015

CENTRAL AGE	MALE			FEMALE		
	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
20	186	220.71	0.843	549	689.05	0.797
25	2,433	2,473.80	0.984	7,599	8,007.74	0.949
30	2,169	1,992.26	1.089	6,536	7,041.34	0.928
35	1,351	1,298.58	1.040	5,023	5,149.35	0.975
40	973	946.14	1.028	3,523	3,558.37	0.990
45	881	859.97	1.024	3,317	3,382.87	0.981
50	718	717.61	1.001	3,134	2,883.27	1.087
54	247	262.71	0.940	1,053	1,012.78	1.040
TOTAL	8,958	8,771.78	1.021	30,734	31,724.77	0.969

APPENDIX 11 (Cont'd)

2014-2018 EXPERIENCE STUDY
 NUMBER OF DEATHS AMONG MEMBERS RETIRED FOR DISABILITY
 MORTALITY ADOPTED OCTOBER 2015

CENTRAL AGE	MALE			FEMALE		
	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
30	0	0.00	0.000	0	0.00	0.000
35	1	0.31	3.226	3	2.06	1.456
40	3	3.46	0.867	9	12.84	0.701
45	7	9.41	0.744	17	21.26	0.800
50	8	8.84	0.905	34	35.74	0.951
55	15	15.36	0.977	52	53.00	0.981
60	15	10.53	1.425	48	47.07	1.020
65	18	17.80	1.011	51	51.68	0.987
70	13	20.32	0.640	49	45.27	1.082
75	16	17.20	0.930	32	29.84	1.072
80	14	12.72	1.101	31	25.73	1.205
85	11	14.76	0.745	21	23.61	0.889
90	12	5.95	2.017	21	21.79	0.964
95	0	0.00	0.000	4	8.44	0.474
100	0	0.00	0.000	3	2.05	1.463
105	0	0.00	0.000	0	0.00	0.000
110	0	0.00	0.000	0	0.00	0.000
TOTAL	133	136.66	0.973	375	380.38	0.986

APPENDIX 11 (Cont'd)

2014-2018 EXPERIENCE STUDY
 NUMBER OF DEATHS AMONG BENEFICIARIES AND MEMBERS RETIRED FOR SERVICE
 MORTALITY ADOPTED OCTOBER 2015

CENTRAL AGE	MALE			FEMALE		RATIO OF ACTUAL TO EXPECTED
	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	ACTUAL	EXPECTED	
5	0	0.00	N/A	0	0.00	N/A
10	0	0.00	N/A	0	0.00	N/A
15	0	0.00	N/A	0	0.00	N/A
20	0	0.00	N/A	0	0.00	N/A
25	0	0.00	N/A	0	0.00	N/A
30	0	0.00	N/A	0	0.00	N/A
35	0	0.00	N/A	0	0.00	N/A
40	0	0.01	0.000	0	0.00	N/A
45	0	0.04	0.000	0	0.05	0.000
50	0	0.10	0.000	0	0.14	0.000
55	14	13.16	1.064	48	29.46	1.629
60	91	80.01	1.137	182	178.04	1.022
65	362	352.74	1.026	569	634.42	0.897
70	755	787.03	0.959	870	993.89	0.875
75	930	977.60	0.951	1,066	1,138.54	0.936
80	1,324	1,372.60	0.965	1,486	1,475.83	1.007
85	1,869	1,858.15	1.006	2,216	2,279.06	0.972
90	1,526	1,565.91	0.975	2,514	2,591.71	0.970
95	658	602.91	1.091	1,887	1,877.64	1.005
100	121	115.13	1.051	669	618.25	1.082
105	7	9.97	0.702	100	95.24	1.050
110	0	0.00	0.000	8	6.37	1.256
TOTAL	7,657	7,735.36	0.990	11,615	11,918.64	0.975

APPENDIX 12

RATES OF RETURN

Investment Rate of Return
on
Market and Actuarial Value of Assets

as of June 30, 2018

Annualized rates of return over the last:

	<u>Based Upon Market Value of Assets</u>	<u>Based Upon Actuarial Value of Assets¹</u>
1 Year:	9.0%	8.7%
3 Years:	7.9%	9.6%
5 Years:	9.3%	11.7%
10 Years:	7.2%	7.6%
15 Years:	8.1%	8.4%
20 Years:	6.6%	
25 Years:	8.5%	
30 Years:	9.2%	

Annualized inflation over the last:

	<u>Inflation Assumption</u>		<u>COLA Benefit</u>	
	<u>Actual</u>	<u>Expected</u>	<u>Actual</u>	<u>Expected²</u>
1 Year:	2.36%	2.25%	1.2 %	1.5%
3 Years:	1.86%	2.25%	1.1%	1.5%
5 Years:	1.40%	2.25%	1.1%	1.5%

¹ The Retirement System's asset valuation method was changed effective with the June 30, 2007 and June 30, 2015 actuarial valuations.

² The annual percentage for estimating future COLA benefit payments is 1.5%. The COLA percentage is one-half of the increase in the CPI with a floor of 1.0% and a cap of 3.0%. Therefore the estimate of inflation for the COLA benefit is the result of analyzing available CPI data with percentages bounded between 2.0% and 6.0%, and reduced by 50%. The COLA benefit was first initiated in 2001.

APPENDIX 12 (Cont'd)

RATES OF RETURN

Annual Rates of Return through June 30, 2018

<u>Year Ending June 30th</u>	<u>Annual Rate of Return</u>	<u>Year Ending June 30th</u>	<u>Annual Rate of Return</u>
1983	37.1%	2006	11.8%
1984	-4.8%	2007	19.4%
1985	31.3%	2008	-6.3%
1986	28.4%	2009	-20.5%
1987	14.6%	2010	12.1%
1988	-1.5%	2011	23.2%
1989	16.8%	2012	2.8%
1990	11.4%	2013	13.7%
1991	8.3%	2014	18.2%
1992	13.0%	2015	5.2%
1993	13.6%	2016	2.3%
1994	1.8%	2017	12.5%
1995	19.3%	2018	9.0%
1996	18.8%		
1997	22.0%		
1998	21.5%		
1999	14.0%		
2000	6.8%		
2001	-5.7%		
2002	-6.8%		
2003	4.0%		
2004	16.1%		
2005	10.6%		

APPENDIX 13

ASSET ALLOCATION

The table below displays the Retirement System’s asset allocation targets, actual allocation percentages, and ranges as of June 30, 2018. No changes have been made between June 30, 2018 and the time of this report.

	Target	Actual	Range
Domestic Equity	33%	37.2%	29-37%
International Equity	16%	18.8%	12-20%
Global Equity	4%	0.9%	0-8%
Real Estate Equity	11%	10.0%	6-16%
Private Equity	8%	7.1%	3-13%
<i>Total Equities</i>	72%	74.0%	
Domestic Fixed Income	16%	15.9%	12-20%
High Yield Bonds	1%	0.1%	0-3%
Global Bonds	2%	2.2%	0-3%
Real Estate Debt	7%	5.1%	3-11%
Private Debt	1%	0.4%	0-5%
Cash Equivalents	1%	2.3%	0-4%
<i>Total Debt</i>	28%	26.0%	

Changes to the Asset Allocation between June 30, 2017 and June 30, 2018

On August 2, 2017 the Retirement Board approved two changes to the asset allocation as follows: 1) An allocation of 1% to a new asset class Private Debt; and 2) A reduction of 1% in the System’s allocation to Real Estate Debt, bringing its target allocation to 7%.

Additionally, on April 26, 2018 the Retirement Board approved three changes to the asset allocation as follows: 1) An allocation of 4% to a new asset class Global Equity; 2) A reduction of 2% in the System’s allocation to Domestic Equity, bringing its target allocation to 33%; and 3) A reduction of 2% in the System’s allocation to International Equity, bringing its target allocation to 16%.

APPENDIX 14

SENSITIVITY ANALYSIS

Valuation results are highly dependent on the actuarial assumptions used to project future events. If actual experience emerges differently from the assumptions used in the valuation process, actuarial gains or losses will result, and future Employer Contribution Rates will be higher or lower. In this section, results of a sensitivity analysis are presented in order to illustrate how deviations in specific assumptions would have changed the current Employer Contribution Rate of 8.86%.

It is important to note that the results displayed here, with the exception of those for the investment return, are the consequence of altering each assumption individually without accounting for possible correlation between assumptions. Therefore, these results are presented in order to provide an illustration as to the order of magnitude that a variation in key assumptions could have on valuation results. There is no guarantee that future experience will be consistent with either our current or the following alternative set of assumptions.

<u>Assumption</u>	<u>Adjustment Made</u>	<u>Calculated Employer Contribution Rate</u>
Current Assumptions		8.86%
Valuation Rate of Interest¹	Decrease from 7.25% to 7.00%	11.79%
Valuation Rate of Interest¹	Decrease from 7.25% to 6.75%	14.76%
Valuation Rate of Interest¹	Decrease from 7.25% to 6.25%	21.02%
Salary Scale	Decrease of 10%	7.93%
Salary Scale	Increase of 10%	9.78%
Service Retirement Rates	Decrease of 10%	8.03%
Service Retirement Rates	Increase of 10%	9.57%
Healthy Annuitant Mortality	Decrease of 10%	10.60%
Healthy Annuitant Mortality	Increase of 10%	7.25%
Active Mortality	Decrease of 10%	8.88%
Active Mortality	Increase of 10%	8.84%

¹ In the event that a change to the long term investment return assumption would be warranted, it is likely that a related change to the salary scale assumption would also be necessary in order for these assumptions to remain consistent with overall inflation. Therefore, for the results presented here, the salary scale assumption was decreased by one-half of the reduction in the investment return assumption.

APPENDIX 15

HISTORY OF THE EMPLOYER CONTRIBUTION RATE

<u>Salary Year</u>	<u>Employer Contribution Rate</u>	<u>Salary Year</u>	<u>Employer Contribution Rate</u>	<u>Salary Year</u>	<u>Employer Contribution Rate</u>
1921-22	5.10 %	1956-57	10.90 %	1991-92	6.64 %
1922-23	5.10	1957-58	11.20	1992-93	8.00
1923-24	5.20	1958-59	13.40	1993-94	8.41
1924-25	5.20	1959-60	14.00	1994-95	7.24
1925-26	5.20	1960-61	18.35	1995-96	6.37
1926-27	5.20	1961-62	18.55	1996-97	3.57
1927-28	5.20	1962-63	19.55	1997-98	1.25
1928-29	5.30	1963-64	21.13	1998-99	1.42
1929-30	5.50	1964-65	17.67	1999-00	1.43
1930-31	5.50	1965-66	17.70	2000-01	0.43
1931-32	5.50	1966-67	17.72	2001-02	0.36
1932-33	5.50	1967-68	18.50	2002-03	0.36
1933-34	5.50	1968-69	18.80	2003-04	2.52
1934-35	5.60	1969-70	18.60	2004-05	5.63
1935-36	5.70	1970-71	18.80	2005-06	7.97
1936-37	5.80	1971-72	18.80	2006-07	8.60
1937-38	5.93	1972-73	18.80	2007-08	8.73
1938-39	6.03	1973-74	18.80	2008-09	7.63
1939-40	6.13	1974-75	18.80	2009-10	6.19
1940-41	6.23	1975-76	19.40	2010-11	8.62
1941-42	6.33	1976-77	19.40	2011-12	11.11
1942-43	6.43	1977-78	20.40	2012-13	11.84
1943-44	6.53	1978-79	21.40	2013-14	16.25
1944-45	7.10	1979-80	22.49	2014-15	17.53
1945-46	7.20	1980-81	23.49	2015-16	13.26
1946-47	7.50	1981-82	23.49	2016-17	11.72
1947-48	7.80	1982-83	23.49	2017-18	9.80
1948-49	8.00	1983-84	22.90	2018-19	10.62
1949-50	8.40	1984-85	22.80	2019-20	8.86
1950-51	8.80	1985-86	21.40		
1951-52	9.60	1986-87	18.80	Average	10.93 %
1952-53	9.90	1987-88	16.83		
1953-54	9.90	1988-89	14.79		
1954-55	10.30	1989-90	6.87		
1955-56	10.40	1990-91	6.84		

APPENDIX 16

HISTORY OF THE MEMBER CONTRIBUTION RATE

<u>Year of Membership</u>	<u>Required Contribution</u>
1921	4%
1948	5% (new members - 1948 and after)
1948	Voluntary 4% <u>could</u> be contributed (all members eligible)
1951	If member elected special retirement allowance: 4% went to 6.5%, 5% went to 8% (all members eligible)
1957	If member elected 1/120th plan: 6.5% went to 9%, 8% went to 11% (all members eligible)
1968	0%
1976	3% (new members - 1976 and after)
2000	3% employee contribution ceases after ten years of service or membership
2010	3.5% throughout career for members joining 1/1/2010 – 3/31/2012
2012	Throughout career for members joining on or after 4/1/2012: <ul style="list-style-type: none"> - 3.0% if salary less than or equal to \$45,000 - 3.5% if salary greater than \$45,000 and less than or equal to \$55,000 - 4.5% if salary greater than \$55,000 and less than or equal to \$75,000 - 5.75% if salary greater than \$75,000 and less than or equal to \$100,000 - 6.0% if salary greater than \$100,000 and less than or equal to \$179,000

As of August 1, 1921, when the Retirement System was established, members contributed 4% of salary. These contributions were used to fund a separate annuity, over and above the regular pension. New members on or after July 1, 1948 were required to contribute 5% of salary. Additional contributions, not in excess of 4% of salary, were permitted during the five-year period beginning July 1, 1948.

Under the provisions of a law passed in 1950, members could elect before July 1, 1951, or within one year of their date of membership, if later, to contribute towards a special service retirement allowance that would allow them to retire up to five years earlier. If their rate of contribution had been 4%, their new rate would be 6.5%. If their rate of contribution had been 5%, their new rate would be 8%. In 1956, an amendment was passed which provided additional benefits for service in excess of 25 years, but not in excess of 35 years, for those members who elected to contribute an additional 2.5% or 3% of their salaries. This increased the rate of contribution to 9% or 11% depending on whether the member's rate of contribution had been 6.5% or 8%.

Throughout the 1960's the advent of the "take-home pay" program effectively reduced the required contribution rate to zero for many members. As of July 1, 1968, all members were no longer required to make contributions, nor permitted to make voluntary contributions unless they had been making them previously.

HISTORY OF THE MEMBER CONTRIBUTION RATE (Cont'd)

The law that created Tier 3 in 1976 reinstated member contributions and required members who joined the System after July 26, 1976 to contribute 3% of their annual salary. This money, however, helps fund the member's pension and does not fund a separate annuity as before. Effective October 1, 2000, however, in accordance with Chapter 126 of the Laws of 2000, the 3% required member contribution ceases upon the attainment of the earlier of 10 years of service credit or 10 years of membership.

In accordance with Tier 5, enacted in 2009, members joining on or after January 1, 2010 and prior to April 1, 2012 must contribute 3.5% of salary throughout their working career towards the funding of their pension. Tier 6, enacted in 2012, requires members joining on or after April 1, 2012 to contribute between 3.0% and 6.0% of salary throughout their working career towards the funding of their pension. The contribution percentage for Tier 6 members can vary during their working career depending on the salary received.

ACTUARIAL VALUATION INFORMATION**1. Actuarial Cost Method**

The cost method used to determine the liabilities and normal cost in this valuation is the Aggregate Cost Method. This funding method is required by statute, specifically Section 517 of the New York State Education Law.

Each year a normal rate percentage is developed as a level percentage of total member compensation. This percentage equals the portion of the actuarial present value of projected benefits which exceeds the actuarial value of assets divided by one percent of the present value of future compensation of the active members, as of the valuation date.

The cost of death benefits up to \$50,000, Retirement System administrative expenses, and benefits in excess of the IRC §415 limits are each determined using the pay-as-you-go method which is not considered to be an actuarial cost method.

Each year, actuarial gains and losses will occur because actual experience will vary from the actuarial assumptions. All gains and losses are automatically amortized as part of the normal rate, over the expected future working lifetime of active members.

The average expected future working lifetime for our active population as determined by the actuarial valuation as of June 30, 2018 is 13.09 years.

2. Asset Valuation Method

The actuarial value of assets for the normal rate is determined by recognizing each year's net investment income/loss in excess of (or less than) 7.25% at a rate of 20% per year, until fully recognized after five years. For fiscal years ending prior to June 30, 2015, realized and unrealized appreciation in excess of (or less than) the assumed inflationary rate of 3% is recognized at a rate of 20% per year, until fully recognized after five years.

The actuarial value of assets for the expense, group life insurance, and excess benefit plan rates is equal to the fair market value of assets, excluding contributions receivable.

3. Actuarial Assumptions

The valuation rate of interest of 7.25% was adopted by the Board on October 26, 2017 and was effective starting with the June 30, 2017 actuarial valuation. The remaining actuarial assumptions were adopted by the Retirement Board on October 29, 2015 and were effective with the June 30, 2015 actuarial valuation. Specific details regarding the development of the present actuarial assumptions can be found in the "*Report on the 2015 Recommended Actuarial Assumptions.*"

APPENDIX 17 (Cont'd)

ACTUARIAL VALUATION INFORMATION (Cont'd)

The withdrawal rates are the assumed rates of termination of employment from all causes other than death, disability or retirement. The withdrawal rates vary by gender, age and service. The withdrawal rates for active members age 55 or older are set to the age 54 withdrawal rates.

The healthy annuitant mortality rates are the assumed rates of death for service and deferred retired members and beneficiaries. The healthy annuitant mortality rates vary by gender and age. Future mortality improvement was projected on a generational basis using the Society of Actuaries Mortality Projection Scale MP-2014. For determining the present value of future COLA and supplementation for current retirees and vested, an approximation is made to estimate the impact of future mortality improvement.

The salary scale is the assumed annual rate of increase in compensation. The rates are based upon salary experience for members, vary by service and are independent of the member's gender. Cost-of-living, merit and productivity increases are included in these rates.

PRESENT ACTUARIAL ASSUMPTIONS

Actuarial assumptions have been developed based upon actual member experience. Various actuarial and graduation techniques are applied to experience data and tables are developed. An experience study is performed annually and assumptions are revised when warranted. The current actuarial assumptions were adopted by the Retirement Board on October 29, 2015. Specific details regarding the development of the present actuarial assumptions can be found in the “*Report on the 2015 Recommended Actuarial Assumptions*”.

Table of Contents

- I. Active Member Mortality Rates
- II. Disability Retirement Rates
- III. Withdrawal Rates
 - a) Males
 - b) Females
- IV. Retirement Rates
 - a) Tier 1 Members and Tier 2, 3 and 4 Members at Least Age 62 or with at Least 30 Years of Service and Tier 5 Members at Least Age 62
 - b) Tier 2, 3 and 4 Members Less Than Age 62 and with Less Than 30 Years of Service
 - c) Tier 5 Members Less Than Age 62 and with Less Than 30 Years of Service
 - d) Tier 5 Members Less Than Age 62 and with at Least 30 Years of Service
 - e) Tier 6 Members
- V. Service and Deferred Annuitant and Beneficiary Base Mortality Rates
- VI. Disabled Annuitant Base Mortality Rates
- VII. Salary Scale
- VIII. Valuation Rate of Interest Assumption
- IX. Other Assumptions

APPENDIX 18 (Cont'd)

I. Active Member
Mortality Rates

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
20	0.000189	20	0.000108
21	0.000212	21	0.000112
22	0.000233	22	0.000112
23	0.000258	23	0.000112
24	0.000281	24	0.000112
25	0.000286	25	0.000112
26	0.000286	26	0.000112
27	0.000287	27	0.000112
28	0.000288	28	0.000119
29	0.000290	29	0.000124
30	0.000293	30	0.000129
31	0.000298	31	0.000132
32	0.000305	32	0.000135
33	0.000314	33	0.000137
34	0.000326	34	0.000140
35	0.000342	35	0.000144
36	0.000361	36	0.000151
37	0.000384	37	0.000160
38	0.000410	38	0.000174
39	0.000441	39	0.000191
40	0.000474	40	0.000213
41	0.000510	41	0.000239
42	0.000548	42	0.000269
43	0.000586	43	0.000302
44	0.000624	44	0.000338
45	0.000661	45	0.000374
46	0.000697	46	0.000412
47	0.000732	47	0.000450
48	0.000765	48	0.000487
49	0.000800	49	0.000523
50	0.000836	50	0.000559
51	0.000876	51	0.000595
52	0.000923	52	0.000632
53	0.000979	53	0.000671
54	0.001050	54	0.000711

APPENDIX 18 (Cont'd)

I. Active Member
Mortality Rates
(cont'd)

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
55	0.001139	55	0.000755
56	0.001251	56	0.000802
57	0.001391	57	0.000854
58	0.001565	58	0.000911
59	0.001779	59	0.000973
60	0.002039	60	0.001042
61	0.002349	61	0.001117
62	0.002716	62	0.001199
63	0.003143	63	0.001291
64	0.003636	64	0.001393
65	0.004197	65	0.001509
66	0.004828	66	0.001642
67	0.005370	67	0.001797
68	0.006058	68	0.001981
69	0.006834	69	0.002350
70	0.007709	70	0.002550
71	0.008696	71	0.002864
72	0.009810	72	0.003217
73	0.011066	73	0.003613
74	0.012483	74	0.004058
75	0.014082	75	0.004558

APPENDIX 18 (Cont'd)

II. Disability Retirement Rates

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
30	0.000003	30	0.000005
31	0.000008	31	0.000008
32	0.000015	32	0.000010
33	0.000024	33	0.000037
34	0.000040	34	0.000076
35	0.000062	35	0.000098
36	0.000091	36	0.000102
37	0.000126	37	0.000105
38	0.000164	38	0.000126
39	0.000196	39	0.000159
40	0.000226	40	0.000214
41	0.000245	41	0.000274
42	0.000278	42	0.000310
43	0.000330	43	0.000376
44	0.000398	44	0.000452
45	0.000470	45	0.000501
46	0.000530	46	0.000522
47	0.000569	47	0.000568
48	0.000611	48	0.000666
49	0.000707	49	0.000818
50	0.000889	50	0.000986
51	0.001091	51	0.001187
52	0.001190	52	0.001325
53	0.001250	53	0.001380
54	0.001225	54	0.001375

APPENDIX 18 (Cont'd)

III. Withdrawal Rates

a) Males

<u>Age</u>	<u>0 Years of Service</u>	<u>1 Year of Service</u>	<u>2 Years of Service</u>	<u>3 Years of Service</u>	<u>4 Years of Service</u>	<u>5 Years of Service</u>	<u>6 Years of Service</u>	<u>7 Years of Service</u>	<u>8 Years of Service</u>	<u>9 Years of Service</u>	<u>10 or more Years of Service</u>
20	0.254275	0.165892	0.116327	0.094647	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
21	0.254275	0.139607	0.116327	0.094647	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
22	0.258777	0.126464	0.116327	0.094647	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
23	0.267780	0.124274	0.116327	0.094647	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
24	0.281285	0.133035	0.119082	0.088647	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
25	0.294790	0.168083	0.124171	0.081761	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
26	0.308295	0.185606	0.128845	0.077761	0.057858	0.036379	0.020319	0.011763	0.011922	0.007796	0.008873
27	0.319549	0.194368	0.131962	0.080715	0.059296	0.036635	0.020319	0.011763	0.012975	0.007796	0.008873
28	0.325176	0.196558	0.134039	0.083668	0.061071	0.036892	0.020319	0.011763	0.013931	0.007796	0.008873
29	0.328927	0.194368	0.135424	0.086621	0.064622	0.037533	0.021368	0.012912	0.014537	0.007796	0.008873
30	0.330803	0.190091	0.136168	0.089575	0.068227	0.040481	0.025825	0.019809	0.015106	0.007796	0.008873
31	0.322070	0.187568	0.131286	0.093049	0.069540	0.043533	0.031397	0.022317	0.015955	0.007796	0.008873
32	0.313337	0.185045	0.125654	0.096523	0.070854	0.046585	0.036969	0.023571	0.018078	0.007796	0.008873
33	0.304605	0.182523	0.123777	0.099997	0.072167	0.049638	0.039754	0.023884	0.020201	0.008513	0.008873
34	0.295872	0.180000	0.126812	0.103470	0.073481	0.052690	0.041147	0.023963	0.022323	0.011216	0.008873
35	0.287140	0.177477	0.133047	0.105207	0.074794	0.055742	0.041993	0.023963	0.023738	0.015946	0.008508
36	0.286690	0.171821	0.138075	0.104196	0.077092	0.060321	0.041209	0.023963	0.024021	0.019585	0.008299
37	0.286241	0.166165	0.135561	0.101447	0.076326	0.064899	0.040425	0.023963	0.024163	0.020908	0.008091
38	0.285791	0.160509	0.130616	0.098699	0.075560	0.067189	0.039641	0.025293	0.024233	0.021664	0.007882
39	0.285342	0.154853	0.130202	0.095950	0.074219	0.067761	0.038857	0.034440	0.024269	0.021916	0.007673
40	0.284892	0.152025	0.129787	0.093202	0.069959	0.067904	0.038073	0.037085	0.025711	0.021664	0.007464
41	0.289068	0.152732	0.132358	0.094006	0.067933	0.064863	0.035133	0.037747	0.027438	0.021286	0.007534
42	0.293244	0.156266	0.134928	0.094810	0.066920	0.057260	0.033664	0.037747	0.029166	0.020625	0.007638
43	0.297420	0.159800	0.137499	0.095614	0.065907	0.053458	0.035133	0.037747	0.030893	0.018971	0.007795
44	0.301596	0.163334	0.140070	0.096418	0.064894	0.052983	0.038073	0.037747	0.032620	0.016781	0.008147
45	0.303684	0.166868	0.142640	0.086769	0.063881	0.052698	0.045610	0.037747	0.033484	0.015314	0.008659
46	0.297917	0.169216	0.142902	0.077120	0.064110	0.054366	0.053147	0.037747	0.032404	0.014047	0.008915
47	0.290062	0.171564	0.143164	0.073904	0.067541	0.055072	0.060684	0.037747	0.029166	0.014943	0.009043
48	0.282207	0.173912	0.143426	0.077120	0.070973	0.057785	0.064453	0.038438	0.027546	0.020435	0.009106
49	0.274352	0.176260	0.143687	0.092398	0.072689	0.059956	0.065709	0.042311	0.028356	0.022630	0.009170
50	0.266497	0.178609	0.143949	0.099585	0.072689	0.061041	0.065709	0.044893	0.032404	0.023728	0.009227
51	0.258643	0.178609	0.144211	0.106772	0.072689	0.061041	0.065709	0.045754	0.036452	0.023728	0.009227
52	0.250788	0.178609	0.144211	0.110366	0.072689	0.061041	0.065709	0.047475	0.037465	0.023728	0.009227
53	0.246860	0.178609	0.144211	0.110366	0.072689	0.061041	0.065709	0.048336	0.037754	0.023728	0.009227
54+	0.246860	0.178609	0.144211	0.110366	0.072689	0.061041	0.065709	0.051133	0.037754	0.023728	0.009227

APPENDIX 18 (Cont'd)

III. Withdrawal Rates

b) Females

<u>Age</u>	<u>0 Years Of Service</u>	<u>1 Year of Service</u>	<u>2 Years of Service</u>	<u>3 Years of Service</u>	<u>4 Years of Service</u>	<u>5 Years of Service</u>	<u>6 Years of Service</u>	<u>7 Years of Service</u>	<u>8 Years of Service</u>	<u>9 Years of Service</u>	<u>10 or more Years of Service</u>
20	0.221624	0.111743	0.100290	0.059871	0.079156	0.057015	0.041279	0.030151	0.037037	0.022766	0.019527
21	0.222584	0.102302	0.100290	0.059871	0.079156	0.057015	0.041279	0.030151	0.037037	0.022766	0.019527
22	0.227539	0.100414	0.100290	0.059871	0.079156	0.057015	0.041279	0.030151	0.037037	0.022766	0.019527
23	0.241991	0.107967	0.100290	0.059871	0.079156	0.057015	0.041279	0.030151	0.037037	0.022766	0.019527
24	0.306350	0.130625	0.100290	0.059474	0.079156	0.057015	0.041279	0.030151	0.037037	0.022766	0.019527
25	0.332325	0.175943	0.102290	0.064680	0.042156	0.051015	0.040469	0.030151	0.037037	0.022766	0.019527
26	0.353217	0.189852	0.106684	0.072489	0.048382	0.047684	0.039012	0.030151	0.037037	0.022766	0.019527
27	0.360933	0.198520	0.127538	0.080297	0.051495	0.039255	0.037846	0.030151	0.037037	0.022766	0.019527
28	0.360817	0.202853	0.141441	0.088106	0.054608	0.042029	0.037458	0.030151	0.035810	0.022766	0.019527
29	0.354235	0.205020	0.141602	0.095915	0.057721	0.048963	0.039012	0.031232	0.032407	0.022766	0.019527
30	0.346747	0.202316	0.139988	0.099819	0.073286	0.053123	0.042120	0.033722	0.029005	0.022766	0.019527
31	0.343752	0.199612	0.136830	0.106115	0.076094	0.060404	0.051611	0.036984	0.029725	0.024035	0.019527
32	0.335848	0.195888	0.133673	0.109263	0.078901	0.067684	0.056356	0.040686	0.032607	0.026574	0.019527
33	0.327944	0.192164	0.130516	0.112411	0.081709	0.071845	0.058505	0.043387	0.035489	0.027589	0.019527
34	0.320040	0.188440	0.127358	0.113290	0.084516	0.072885	0.060654	0.045088	0.038371	0.030635	0.019527
35	0.312137	0.181656	0.124201	0.113729	0.087323	0.073130	0.061088	0.046793	0.039811	0.033681	0.018793
36	0.304496	0.174543	0.122312	0.110640	0.086076	0.070552	0.058894	0.048497	0.040833	0.035204	0.017327
37	0.296856	0.167429	0.120422	0.105598	0.084828	0.067974	0.056701	0.048838	0.040413	0.034443	0.015860
38	0.289215	0.160316	0.118533	0.100557	0.082956	0.065396	0.054507	0.049179	0.039994	0.033681	0.014393
39	0.281575	0.153202	0.116644	0.095515	0.080149	0.062819	0.052314	0.049213	0.039574	0.031777	0.012192
40	0.273935	0.146089	0.114754	0.092994	0.073750	0.060241	0.050120	0.049359	0.039155	0.030254	0.011459
41	0.269779	0.144793	0.111172	0.091252	0.074162	0.059860	0.048675	0.044929	0.037437	0.030242	0.011182
42	0.265623	0.143498	0.107590	0.092030	0.074575	0.059479	0.047230	0.040499	0.035718	0.030230	0.010905
43	0.261467	0.142203	0.104009	0.092809	0.074987	0.059098	0.045785	0.036070	0.034000	0.030218	0.010628
44	0.257311	0.140908	0.100427	0.093587	0.075400	0.058717	0.044339	0.035516	0.032282	0.030207	0.010351
45	0.253155	0.140260	0.098636	0.094366	0.075812	0.058336	0.043617	0.038284	0.030564	0.030195	0.010074
46	0.257124	0.142616	0.099349	0.095174	0.074383	0.058048	0.044604	0.038381	0.030284	0.029256	0.009941
47	0.267047	0.143794	0.101854	0.095983	0.072954	0.057761	0.046315	0.038478	0.030004	0.028317	0.009808
48	0.276970	0.147033	0.104358	0.096791	0.071525	0.057474	0.048025	0.038574	0.029724	0.027377	0.009675
49	0.286893	0.151626	0.106862	0.097600	0.070096	0.057187	0.049735	0.038671	0.029444	0.026438	0.009542
50	0.296815	0.154630	0.109367	0.098408	0.068667	0.056900	0.051446	0.038767	0.029164	0.025499	0.009409
51	0.299296	0.157633	0.111871	0.098408	0.067238	0.056900	0.051446	0.038767	0.029164	0.025499	0.009409
52	0.299296	0.160636	0.111871	0.098408	0.067238	0.056900	0.051446	0.038767	0.029164	0.025499	0.009409
53	0.299296	0.162138	0.111871	0.098408	0.067238	0.056900	0.051446	0.038767	0.029164	0.025499	0.009409
54+	0.299296	0.162138	0.111871	0.098408	0.067238	0.056900	0.051446	0.038767	0.029164	0.025499	0.009409

APPENDIX 18 (Cont'd)

IV. Retirement Rates

- a) Tier 1 Members and Tier 2, 3, and 4 Members
at Least Age 62 or with at Least 30 Years of
Service and Tier 5 Members at Least Age 62

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
55	0.306695	55	0.313992
56	0.280779	56	0.288116
57	0.252448	57	0.269473
58	0.259437	58	0.261016
59	0.286545	59	0.268785
60	0.311011	60	0.279410
61	0.320232	61	0.277166
62	0.270303	62	0.257157
63	0.229352	63	0.232947
64	0.206863	64	0.219224
65	0.209678	65	0.238272
66	0.217437	66	0.244523
67	0.216934	67	0.236791
68	0.208294	68	0.220367
69	0.187086	69	0.230935
70	0.163555	70	0.229295
71	0.146721	71	0.212056
72	0.169602	72	0.180451
73	0.167377	73	0.183107
74	0.164226	74	0.192125
75	0.133890	75	0.190633
76+	1.000000	76+	1.000000

APPENDIX 18 (Cont'd)

IV. Retirement Rates

b) Tier 2, 3, and 4 Members Less Than Age 62
and with Less Than 30 Years of Service

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
55	0.031965	55	0.034565
56	0.031782	56	0.035761
57	0.036262	57	0.041750
58	0.043899	58	0.046349
59	0.056398	59	0.060339
60	0.063578	60	0.070415
61	0.072217	61	0.082590

APPENDIX 18 (Cont'd)

IV. Retirement Rates

c) Tier 5 Members Less Than Age 62
and with Less Than 30 Years of Service

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
55	0.015983	55	0.017283
56	0.015891	56	0.017881
57	0.018131	57	0.020875
58	0.021950	58	0.023175
59	0.028199	59	0.030170
60	0.031789	60	0.035208
61	0.036109	61	0.041295

APPENDIX 18 (Cont'd)

IV. Retirement Rates

d) Tier 5 Members Less Than Age 62
and with at Least 30 Years of Service

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
55	0.015983	55	0.017283
56	0.015891	56	0.017881
57	0.306695	57	0.313992
58	0.280779	58	0.288116
59	0.252448	59	0.269473
60	0.259437	60	0.261016
61	0.286545	61	0.268785

APPENDIX 18 (Cont'd)

IV. Retirement Rates

e) Tier 6 Members

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
55	0.015983	55	0.017283
56	0.015891	56	0.017881
57	0.018131	57	0.020875
58	0.021950	58	0.023175
59	0.028199	59	0.030170
60	0.031789	60	0.035208
61	0.036109	61	0.041295
62	0.039942	62	0.046683
63	0.306695	63	0.313992
64	0.280779	64	0.288116
65	0.252448	65	0.269473
66	0.259437	66	0.261016
67	0.286545	67	0.268785
68	0.311011	68	0.279410
69	0.320232	69	0.277166
70	0.270303	70	0.257157
71	0.229352	71	0.232947
72	0.206863	72	0.219224
73	0.209678	73	0.238272
74	0.217437	74	0.244523
75	0.216934	75	0.236791
76+	1.000000	76+	1.000000

APPENDIX 18 (Cont'd)

V. Service and Deferred Annuitant and
Beneficiary Base Mortality Rates

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
1	0.000410	1	0.000361
2	0.000277	2	0.000236
3	0.000230	3	0.000176
4	0.000179	4	0.000132
5	0.000157	5	0.000119
6	0.000141	6	0.000110
7	0.000124	7	0.000102
8	0.000105	8	0.000094
9	0.000085	9	0.000087
10	0.000072	10	0.000082
11	0.000076	11	0.000084
12	0.000113	12	0.000097
13	0.000149	13	0.000110
14	0.000183	14	0.000121
15	0.000218	15	0.000132
16	0.000253	16	0.000142
17	0.000290	17	0.000150
18	0.000256	18	0.000144
19	0.000288	19	0.000148
20	0.000317	20	0.000148
21	0.000351	21	0.000148
22	0.000381	22	0.000148
23	0.000397	23	0.000152
24	0.000403	24	0.000155
25	0.000378	25	0.000158
26	0.000361	26	0.000164
27	0.000351	27	0.000171
28	0.000347	28	0.000179
29	0.000348	29	0.000189
30	0.000353	30	0.000199

Society of Actuaries Mortality Improvement Scale MP-2014 will be applied on a generational basis to base table rates.

APPENDIX 18 (Cont'd)

V. Service and Deferred Annuitant and
Beneficiary Base Mortality Rates
(cont'd)

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
31	0.000361	31	0.000211
32	0.000372	32	0.000223
33	0.000384	33	0.000236
34	0.000397	34	0.000249
35	0.000408	35	0.000262
36	0.000418	36	0.000275
37	0.000430	37	0.000291
38	0.000445	38	0.000310
39	0.000464	39	0.000334
40	0.000490	40	0.000362
41	0.000524	41	0.000396
42	0.000566	42	0.000436
43	0.000619	43	0.000484
44	0.000684	44	0.000539
45	0.000760	45	0.000601
46	0.000849	46	0.000671
47	0.000949	47	0.000747
48	0.001060	48	0.000829
49	0.001183	49	0.000916
50	0.001316	50	0.001008
51	0.001461	51	0.001104
52	0.001618	52	0.001203
53	0.001951	53	0.001419
54	0.002311	54	0.001645
55	0.002522	55	0.001805
56	0.002753	56	0.001980
57	0.003004	57	0.002172
58	0.003279	58	0.002382
59	0.003579	59	0.002613
60	0.003906	60	0.002866

Society of Actuaries Mortality Improvement Scale MP-2014 will be applied on a generational basis to base table rates.

APPENDIX 18 (Cont'd)

V. Service and Deferred Annuitant and
Beneficiary Base Mortality Rates
(cont'd)

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
61	0.004264	61	0.003053
62	0.004654	62	0.003298
63	0.005050	63	0.003604
64	0.005564	64	0.003976
65	0.006204	65	0.004417
66	0.006976	66	0.004931
67	0.007886	67	0.005524
68	0.008942	68	0.006203
69	0.010151	69	0.006979
70	0.011524	70	0.007864
71	0.013074	71	0.008874
72	0.014821	72	0.010029
73	0.016788	73	0.011349
74	0.019009	74	0.012863
75	0.021524	75	0.014602
76	0.024380	76	0.016603
77	0.027633	77	0.018909
78	0.031346	78	0.021567
79	0.035590	79	0.024631
80	0.040445	80	0.028162
81	0.045997	81	0.032228
82	0.052342	82	0.036904
83	0.059585	83	0.042268
84	0.067844	84	0.048410
85	0.077246	85	0.055421
86	0.087929	86	0.063404
87	0.100040	87	0.072465
88	0.113741	88	0.082724
89	0.129208	89	0.094308
90	0.141713	90	0.107360

Society of Actuaries Mortality Improvement Scale MP-2014 will be applied on a generational basis to base table rates.

APPENDIX 18 (Cont'd)

V. Service and Deferred Annuitant and
Beneficiary Base Mortality Rates
(cont'd)

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
91	0.158130	91	0.122037
92	0.175288	92	0.138518
93	0.193131	93	0.157000
94	0.211674	94	0.177701
95	0.230976	95	0.191477
96	0.251106	96	0.210235
97	0.272113	97	0.229998
98	0.293848	98	0.250723
99	0.313988	99	0.270858
100	0.334365	100	0.291040
101	0.354599	101	0.311444
102	0.374524	102	0.331900
103	0.393982	103	0.352232
104	0.412831	104	0.372273
105	0.430946	105	0.391860
106	0.448227	106	0.410849
107	0.464592	107	0.429112
108	0.479987	108	0.446544
109	0.494376	109	0.463061
110	0.500000	110	0.478604

Society of Actuaries Mortality Improvement Scale MP-2014 will be applied on a generational basis to base table rates.

APPENDIX 18 (Cont'd)

VI. Disabled Annuitant
Base Mortality Rates

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
30	0.180013	30	0.106487
31	0.180013	31	0.106487
32	0.180013	32	0.106487
33	0.180013	33	0.103280
34	0.173269	34	0.100083
35	0.166522	35	0.096905
36	0.159773	36	0.093763
37	0.153024	37	0.090676
38	0.146284	38	0.087665
39	0.139576	39	0.084746
40	0.132936	40	0.081925
41	0.126401	41	0.079198
42	0.120012	42	0.076550
43	0.113802	43	0.073965
44	0.107801	44	0.071430
45	0.102029	45	0.068936
46	0.096503	46	0.066480
47	0.091236	47	0.064061
48	0.086231	48	0.061677
49	0.081479	49	0.059314
50	0.076958	50	0.056949
51	0.072640	51	0.054543
52	0.068494	52	0.052046
53	0.064498	53	0.049422
54	0.060638	54	0.046664
55	0.056938	55	0.043813
56	0.053442	56	0.040949
57	0.050216	57	0.038174
58	0.047308	58	0.035582
59	0.044759	59	0.033251

Society of Actuaries Mortality Improvement Scale MP-2014 will be applied on a generational basis to base table rates.

APPENDIX 18 (Cont'd)

VI. Disabled Annuitant
Base Mortality Rates
(cont'd)

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
60	0.042595	60	0.031256
61	0.040829	61	0.029665
62	0.039455	62	0.028522
63	0.038461	63	0.027851
64	0.037830	64	0.027664
65	0.037550	65	0.027957
66	0.037620	66	0.028701
67	0.038040	67	0.029851
68	0.038798	68	0.031348
69	0.039890	69	0.033140
70	0.041328	70	0.035196
71	0.043137	71	0.037505
72	0.045337	72	0.040079
73	0.047925	73	0.042938
74	0.050890	74	0.046105
75	0.054216	75	0.049628
76	0.057882	76	0.053557
77	0.061871	77	0.057934
78	0.066162	78	0.062794
79	0.070742	79	0.068155
80	0.075602	80	0.074002
81	0.080733	81	0.080289
82	0.086134	82	0.086960
83	0.087929	83	0.093972
84	0.100040	84	0.101322
85	0.113741	85	0.109018
86	0.129208	86	0.117066
87	0.141713	87	0.122037
88	0.158130	88	0.138518
89	0.175288	89	0.157000

Society of Actuaries Mortality Improvement Scale MP-2014 will be applied on a generational basis to base table rates.

APPENDIX 18 (Cont'd)

VI. Disabled Annuitant
Base Mortality Rates
(cont'd)

<u>Males</u>		<u>Females</u>	
<u>Age</u>	<u>Rate</u>	<u>Age</u>	<u>Rate</u>
90	0.193131	90	0.177701
91	0.211674	91	0.191477
92	0.230976	92	0.210235
93	0.251106	93	0.229998
94	0.272113	94	0.250723
95	0.293848	95	0.270858
96	0.313988	96	0.291040
97	0.334365	97	0.311444
98	0.354599	98	0.331900
99	0.374524	99	0.352232
100	0.393982	100	0.372273
101	0.412831	101	0.391860
102	0.430946	102	0.410849
103	0.448227	103	0.429112
104	0.464592	104	0.446544
105	0.479987	105	0.463061
106	0.494376	106	0.478604
107	0.500000	107	0.478604
108	0.500000	108	0.478604
109	0.500000	109	0.478604
110	0.500000	110	0.478604

Society of Actuaries Mortality Improvement Scale MP-2014 will be applied on a generational basis to base table rates.

APPENDIX 18 (Cont'd)

VII. Salary Scale

<u>Duration</u>	<u>Rate</u>	<u>Duration</u>	<u>Rate</u>
1	1.1000	21	1.0272
2	1.0700	22	1.0263
3	1.0606	23	1.0254
4	1.0522	24	1.0245
5	1.0472	25	1.0237
6	1.0445	26	1.0229
7	1.0431	27	1.0222
8	1.0422	28	1.0215
9	1.0415	29	1.0210
10	1.0407	30	1.0206
11	1.0398	31	1.0202
12	1.0387	32	1.0200
13	1.0375	33	1.0195
14	1.0361	34	1.0193
15	1.0346	35	1.0190
16	1.0331	36	1.0186
17	1.0317	37	1.0180
18	1.0304	38	1.0176
19	1.0293	39	1.0176
20	1.0282		

VIII. Valuation Rate of Interest Assumption

The interest rate for valuation purposes is a level 7.25%. This valuation rate of interest is made up of a 2.25%¹ annual rate of inflation and a 5.0% real rate of return.

The valuation rate of interest assumption represents our best estimate of the anticipated annual rate of return on plan assets over a very long-term horizon.

The valuation rate of interest assumption is developed based upon the Retirement System's specific asset allocation, and capital market assumptions, based upon recommendations from AON Hewitt, the System's investment consultant. Using expected returns and standard deviations for each asset class, and including anticipated correlation between the classes, a long-term anticipated rate of return is developed. Based on their 1st quarter 2019 capital market return assumptions, AON Hewitt has estimated the geometric annual rate of return to be 7.2%, and the arithmetic annual rate of return to be 7.8%, given the System's asset allocation. This analysis is performed annually, and intended to be over a 30-year time horizon.

For a complete explanation of the rationale behind the System's valuation rate of interest assumption, please see pages 28 through 33 of the "*Report on the 2015 Recommended Actuarial Assumptions*" and a memo from R. Young dated October 26, 2017.

IX. Other Assumptions

Projected COLA Assumption

The annual percentage for estimating future COLA benefit payments is 1.5%.²

IRC Section 415(b) and 401(a)(17)

For purposes of the normal rate, the limitations under IRC Section 415(b) were not reflected due to immateriality. The IRC Section 401(a)(17) limit for the fiscal year ending June 30, 2018 was reflected for members with a membership date on or after July 1, 1996.

Retirement Rates

Retirement Rates for terminated vested members (no earnings in the fiscal year and entitled to a vested benefit, not yet retired): 100% at the age of 55 or current age if later.

Marriage Assumptions

None

¹ The average annual rate of increase in the Consumer Price Index (CPI) for 1925 – 2018 was 2.91%.

² The COLA percentage is one-half of the increase in the CPI with a floor of 1.0% and a cap of 3.0%. Therefore the estimate of inflation for the COLA benefit is the result of analyzing available CPI data with percentages bounded between 2.0% and 6.0%, and reduced by 50%.

APPENDIX 18 (Cont'd)

Tier 6 Pensionable Salary Limit

Tier 6 Pensionable earnings are limited to the Governor's salary of \$179,000 per year which is assumed to increase annually by the assumed rate of inflation 2.25%.

Maximum Salary for Tier 2-5 Death Benefits

The Tier 2 to Tier 5 maximum Salary allowable under Section 130 of the Civil Service Law as of June 30th, 2018 is \$180,922. It is assumed to increase annually by the assumed annual rate of inflation 2.25%.

SUMMARY OF BENEFIT PROVISIONS1. Membership

With certain very limited exceptions, membership is mandatory for all full-time New York State public school teachers and administrators, outside New York City. Membership is optional for certain teachers/administrators eligible for the Optional Retirement Program and teachers employed on other than a full-time basis and for certain employees of the State University of New York, community colleges, and the State Education Department. Generally, the membership of any non-vested person will terminate when seven years have elapsed since (s)he last rendered at least 20 days of credited service in a school year.

Tiers are determined by a member's most recent date of membership in the Retirement System as follows:

Tier 1:	Membership prior to 7/1/1973;
Tier 2:	Membership 7/1/1973 – 7/26/1976*;
Tier 3:	Membership 7/27/1976* – 8/31/1983;
Tier 4:	Membership 9/1/1983 – 12/31/2009;
Tier 5:	Membership 1/1/2010 – 3/31/2012;
Tier 6:	Membership on or after 4/1/2012.

*The end date for Tier 2 and the start date for Tier 3 differs from what is in the law due to a court case known as the Oliver decision, making the start date of the new tier the date that it was signed into law.

Tier 3 members are entitled to receive the benefits of either Tier 3 or Tier 4, however, they may not mix the provisions of the two tiers. For valuation purposes, Tier 3 members are assumed to receive the Tier 4 benefit at retirement, as that is generally always the larger benefit.

2. Final Average Salary (FAS)

For Tiers 1-5, FAS is generally the average of the three highest consecutive full years of regular salary, whenever they occurred in the salary history, for duties involving the supervision and instruction of students.

For Tier 6 members, FAS calculation is based on 5 years. Pensionable earnings can be no more than the Governor's salary, which is \$179,000 as of 6/30/2018.

Certain other restrictions apply to pensionable earnings that can be used in the FAS calculation. There are also limits on the year percentage increase in salary used in calculating FAS.

3. Service Retirement

The service retirement benefits are payable for life generally as follows:

APPENDIX 19 (Cont'd)

Tier 1:

Non-Contributory Plan

For Tier 1 members with a date of membership prior to July 1, 1970 the benefit is generally calculated as:

For New York State service prior to 7/1/1959 and all out-of-state service:

1/100th of final average salary (FAS) per year for each of the first 25 years of service, plus 1/120th of FAS per year for each of the next 10 years of service, plus 1/140th of FAS per year for each year of NYS service in excess of 35, *plus*

For New York State service subsequent to 7/1/1959:

1/50th of final average salary (FAS) per year for each of the first 25 years of NYS service, plus 1/60th of FAS per year for each of the next 10 years of NYS service, plus 1/70th of FAS per year for each year of NYS service in excess of 35.

Non-Contributory Plan members generally may retire at:

- Age 55 with 20 years of total service or
- Any age with 35 years of total service.

Career Plan

If 20 or more years of NYS service: 2% of final average salary (FAS) per year of NYS service after July 1, 1959, plus 1.8% of FAS per year of NYS service prior to that date, plus 1% of FAS per year of out-of-state service. Out-of-state service is allowed only up to a maximum of 10 years, and only to the extent that it does not raise the total service credit to greater than 35 years. The maximum pension permitted is 75% of FAS.

If less than 20 years of NYS service, the above formula is used except the benefit is reduced by 5% for each year of service less than 20, subject to a maximum reduction of 50%.

Career Plan members generally may retire at:

- Age 55 with 2 years of NYS service or
- Any age with 35 years of total service.

The provisions of Article 19 of the Retirement and Social Security Law, effective July 11, 2000, provides to eligible Tier 1 and 2 members additional service credit of one-twelfth of a year of service for each year of retirement credit as of the date of retirement or death, up to a maximum of two additional years. The maximum pension, as a result of Article 19, can be 79% of FAS.

Tier 2: Computed under the Tier 1 Career Plan formula, but may be reduced for early retirement, as noted below.

Tier 2 members generally may retire at:

- Age 62 with 5 years of service,
- Age 55 with 30 years of service, or

APPENDIX 19 (Cont'd)

- Age 55 with 5 years of service, with benefit reduced by 6% for each of the first 2 years under age 62 and 3% for each of the next 5 years.

Tier 3: $1\frac{2}{3}\%$ of FAS per year of NYS service (if less than 20 years) or 2% of FAS per year of NYS service (if 20 to 30 years). There is no additional benefit for more than 30 years of service. At age 62 the benefit is reduced by 50% of the primary Social Security benefit accrued while in NYS public employment. A member may be eligible for automatic cost-of-living adjustments.

Tier 3 members generally may retire at:

- Age 62 with 5 years of service,
- Age 55 with 30 years of service, or
- Age 55 with 5 years of service, with benefit reduced by $\frac{1}{15}$ th for each of the first 2 years under age 62 and $\frac{1}{30}$ th for each of the next 5 years.

Tier 4: $1\frac{2}{3}\%$ of FAS per year of NYS service (if less than 20 years), or 2% of FAS per year of NYS service (if 20 to 30 years), plus $1\frac{1}{2}\%$ of FAS per year of NYS service in excess of 30 years.

Tier 4 members generally may retire at:

- Age 62 with 5 years of service,
- Age 55 with 30 years of service, or
- Age 55 with 5 years of service, with benefit reduced by 6% for each of the first 2 years under age 62 and 3% for each of the next 5 years.

Tier 5: $1\frac{2}{3}\%$ of FAS per year of NYS service (if less than 25 years), or 2% of FAS per year of NYS service (if 25 to 30 years), plus $1\frac{1}{2}\%$ of FAS per year of NYS service in excess of 30 years.

Tier 5 members generally may retire at:

- Age 62 with 10 years of service,
- Age 57 with 30 years of service, or
- Age 55 with 10 years of service, with benefit reduced by $6\frac{2}{3}\%$ for each of the first 2 years under age 62 and 5% for each of the next 5 years.

Tier 6: $1\frac{2}{3}\%$ of FAS per year of NYS service (if less than 20 years), 1.75% of FAS per year of NYS service (if credited with 20 years) or 35% plus 2% per year of NYS service in excess of 20 years (if beyond 20 years).

Tier 6 members generally may retire at:

- Age 63 with 10 years of service,
- Age 55 with 10 years of service, with benefit reduced by 6.5% for each year under age 63.

4. Disability Retirement

Generally a member with at least 10 years of service may qualify for a disability retirement benefit of the smaller of 1) $1\frac{2}{3}\%$ of FAS per year of projected service to age

APPENDIX 19 (Cont'd)

60 or 2) $\frac{1}{3}$ of FAS; but the benefit shall not be less than $1\frac{2}{3}\%$ of FAS per year of completed service.

5. Death Benefits

a) Active Service

The Tier 1 death benefit is generally equal to the greater of 1) 3 times annual salary after 36 years of service (proportionately reduced for less than 36 years) or 2) for members who are at least age 55 with 20 years of service, the pension reserve calculated under a prior, lower service retirement formula.

Under legislation enacted in 2000, all Tier 2-6 members will be covered by the Paragraph 2 Death Benefit, unless they selected Paragraph 1 (see Tier 1 Calculation above) and it is greater than Paragraph 2. All members joining on or after Jan. 1, 2001, will be covered by the Paragraph 2 Death Benefit. The benefit is one year's salary¹ after a year of service, increasing to a maximum of three years' salary after three years or more of service. The benefit is reduced after age 60 by 4% per year, up to a maximum reduction of 40% at age 70. (Reductions begin at age 61; age is not rounded and the reduction is not prorated.) Under Paragraph 2, if the in-service death benefit is in effect when a member retires, coverage may continue after retirement. The benefit would be:

- 1st Year: 50% of the death benefit in effect at retirement;
- 2nd Year: 25% of the benefit at retirement; and,
- 3rd & Ensuing Years: 10% of the benefit in effect at retirement (or at age 60, if the member retires after age 59). To be eligible for the continued coverage in retirement, the member must retire within one year of leaving the payroll and not be employed (other than NYSTRS service) between the member's cease-teaching date and retirement date.

b) Not in Active Service

The death benefit for members of all tiers with at least ten years of service credit who die when not in active service is equal to one-half the active member death benefit.

6. Deferred Retirement

Tiers 1-4:

A member with at least 5 years of credited service who ceases teaching has a vested right to receive a deferred service retirement benefit. A member with at least five, but less than ten years of service credit, has the choice of receiving a refund of their member contributions with interest or a deferred service retirement benefit. A member with ten or more years of service credit will receive the deferred service retirement benefit.

¹ The law limits the amount of salary that can be used in the calculation of the Paragraph 2 Death Benefit.

APPENDIX 19 (Cont'd)

Tiers 5 and 6:

A member with at least 10 years of credited service who ceases teaching has a vested right to receive a deferred service retirement benefit. Members with less than 10 years of credited service who cease teaching may receive a refund of their contributions with interest.

7. Member Contributions

Certain Tier 1 and 2 members may elect to contribute in order to receive an additional benefit upon retirement. Tier 3 and 4 members are required to contribute 3% of pay to fund a portion of their benefit. Effective October 1, 2000, such contributions cease upon the attainment of the earlier of 10 years of service credit or 10 years of membership. Tier 5 members are required to contribute 3.5% of their salary throughout their active membership.

Tier 6 members are required to contribute throughout their active membership. From 4/1/2012 through 3/31/2013, all Tier 6 members were required to contribute 3.5%. Beginning 4/1/2013 members are required to contribute in accordance with the following schedule:

<u>Salary</u>	<u>Contribution Rate</u>
\$45,000 and less	3.00%
More than \$45,000 to \$55,000	3.50%
More than \$55,000 to \$75,000	4.50%
More than \$75,000 to \$100,000	5.75%
More than \$100,000 to \$179,000 (the limit currently equal to the NYS governor's salary)	6.00%

For purposes of administration, a Tier 6 member's contribution rate in any given year is based on regular compensation earned two years prior. During the member's first three years of membership, he/she will contribute a percentage based on a salary projection provided by the employer.

8. Cost-of-Living Adjustment (COLA)

A permanent, annually-adjusted cost-of-living benefit is provided to both current and future retired members. This benefit was first paid commencing September 2001, and is increased every September thereafter, to retired members who meet one of the following eligibility criteria:

APPENDIX 19 (Cont'd)

- Age 62 and retired for 5 years,
- Age 55 and retired for 10 years, or
- Retired for 5 years under a disability retirement.

The annual COLA percentage is equal to 50% of the increase in the annual CPI; not to exceed 3% nor be lower than 1%. It is applied to the first \$18,000 of annual benefit. Additionally, commencing September 2000, members retired before 1997 are eligible for a “Catch-Up” supplemental benefit upon satisfaction of the above eligibility criteria.