Segal Consulting

Boston Retirement System

Actuarial Valuation and Review as of January 1, 2018

This report has been prepared at the request of the Boston Retirement Board to assist in administering the Boston Retirement System. This valuation report may not otherwise be copied or reproduced in any form without the consent of the Retirement Board and may only be provided to other parties in its entirety. The measurements shown in this actuarial valuation may not be applicable for other purposes.

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September 21, 2018

Retirement Board
Boston Retirement System
City Hall, Room 816
Boston, MA 02201

Dear Board Members:

We are pleased to submit this Actuarial Valuation and Review as of January 1, 2018. It summarizes the actuarial data used in the valuation, analyzes the preceding two years' experience, and establishes the funding requirements for fiscal 2019 and later years.

This report shows the results for the valuation for the Boston Retirement System as a whole, and separately for the Teachers and the Boston Retirement System excluding Teachers.

This report was prepared in accordance with generally accepted actuarial principles and practices at the request of the Board to assist in administering the Retirement System. The census information and financial information on which our calculations were based was prepared by the staff of the Boston Retirement System. That assistance is gratefully acknowledged.

The actuarial calculations were directed under my supervision. I am a member of the American Academy of Actuaries and I meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion herein. To the best of my knowledge, the information supplied in this actuarial valuation is complete and accurate. Further, in my opinion, the assumptions as approved by the Board are reasonably related to the experience of and the expectations for the Boston Retirement System.

We look forward to reviewing this report at your next meeting and to answering any questions.

Sincerely,

Segal Consulting, a Member of The Segal Group, Inc.

By: 
Kathleen A. Riley, FSA, MAAA, EA
Senior Vice President and Actuary

8750611v4/03630.022

Table of Contents

Boston Retirement System Actuarial Valuation and Review as of January 1, 2018

Section 1: Actuarial Valuation Summary

Purpose and Basis

This report was prepared by Segal Consulting to present a valuation of the Boston Retirement System as of January 1, 2018. The valuation was performed to determine whether the assets and contributions are sufficient to provide the prescribed benefits. The measurements shown in this actuarial valuation may not be applicable for other purposes. In particular, the measures herein are not necessarily appropriate for assessing the sufficiency of System assets to cover the estimated cost of settling the System's benefit obligations. Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements; and changes in plan provisions or applicable law.

Certain disclosure information required by GASB Statements No. 67 and 68 as of January 1, 2018 for the Boston Retirement System is provided in a separate report.

The contribution requirements presented in this report are based on:

- The benefit provisions of Massachusetts General Law Chapter 32;
- The characteristics of covered active participants, inactive participants, and retired participants and beneficiaries as of December 31, 2017, provided by the staff of the Retirement System;
- The assets of the System as of December 31, 2017, provided by the staff of the Retirement System;
- Economic assumptions regarding future salary increases and investment earnings; and
- Other actuarial assumptions regarding employee terminations, retirement, death, etc.

Significant Issues

1. Segal Consulting ("Segal") strongly recommends an actuarial funding method that targets 100% funding of the actuarial accrued liability. Generally, this implies payments that are ultimately at least enough to cover normal cost, interest on the unfunded actuarial accrued liability and the principal balance. The funding policy adopted by the Boston Retirement System meets this standard and funds the unfunded actuarial accrued liabilities of the Boston Retirement System excluding Teachers by June 30, 2025. The funding policy for the Teachers is determined by the Commonwealth.

2. The report shows the results of the valuation for the Boston Retirement System (BRS) as a whole and separately for the Teachers and the BRS excluding Teachers.

3. In accordance with Chapter 112 of the Acts of 2010, the assets attributable to Teachers (27% of the market value of assets) were transferred to the PRIT Fund in 2010. The obligation to fund the liabilities of the Teachers and a share of the administrative cost of the BRS related to the Teachers remains an obligation of the Commonwealth. Beginning in December 2010, appropriations have been received by the BRS from the Commonwealth for the Teachers and have been transferred to the PRIT Fund. Transfers are made from the PRIT Fund on a monthly basis to cover the excess of benefit payments to the Teachers and a share of administrative expenses over the Teachers' employee contributions.

4. The funded ratio (the ratio of the actuarial value of assets to actuarial accrued liability) is 62.88% for the BRS as a whole, compared to the prior valuation's funded ratio of 61.58%. This ratio is one measure of funding status, and its history is a measure of funding progress. Using the market value of assets, the funded ratio is 63.86%, compared to 57.62% as of the prior valuation date. These measurements are not necessarily appropriate for assessing the sufficiency of assets to cover the estimated cost of settling the Boston Retirement System's benefit obligation or the need for or the amount of future contributions.

5. During the plan years ended 2016 and 2017, the market value rate of return for the BRS was 6.52% and 16.98%, respectively. The rate of return on the actuarial value of assets (which gradually recognizes market value fluctuations over a five-year period) for the plan years ended 2016 and 2017 was 6.08% and 8.11%, respectively. The actuarial value of assets as of December 31, 2017 was $6.662 billion, or 98.5% of the market value of assets of $6.766 billion (as reported in the Annual Statement). As of December 31, 2015, the actuarial value of assets was 106.9% of the market value.

6. The total unrecognized investment gain as of December 31, 2017 is $104,249,711. This investment gain will be recognized in the determination of the actuarial value of assets in the next few years, to the extent it is not offset by recognition of investment losses derived from future experience. This implies that earning the assumed rate of investment return (net of investment expenses) on a market value basis will result in investment gains on the actuarial value of assets in the next few years. The funding schedule for the BRS excluding Teachers shown in this report reflects the deferred investment gains in accordance with the asset valuation method adopted by the Board.

7. The following actuarial assumptions were changed with this valuation:

   - Mortality assumption for BRS excluding Teachers:
     - The mortality tables for non-disabled participants were updated from the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally using Scale BB2D from 2009 to the RP-2014 Blue Collar Employee and Healthy Annuitant Mortality Tables set forward one year for female participants projected generationally using Scale MP-2017.
     - The mortality tables for disabled participants were updated from the RP-2000 Healthy Annuitant Mortality Table projected generationally using Scale BB2D from 2015 to the RP-2014 Blue Collar Healthy Annuitant Mortality Table set forward one year projected generationally using Scale MP-2017.
   - Mortality assumption for Teachers:
     - The mortality tables for non-disabled participants were updated from the RP-2014 Employee and Healthy Annuitant Mortality Tables projected generationally using Scale BB2D to the RP-2014 White Collar Employee and Healthy Annuitant Mortality Tables projected generationally with Scale MP-2016.
   - Decrease the investment rate of return assumption from 7.75% to 7.50% for the BRS excluding Teachers.
   - Decrease the investment rate of return assumption from 7.50% to 7.35% for Teachers.
   - Increase the administrative expense assumption from $9,500,000 for calendar year 2016 to $11,000,000 for calendar year 2018, with 70%, or $7,700,000 assigned to the BRS excluding Teachers, and 30%, or $3,300,000, assigned to the Teachers.

   The changes in assumptions increased the unfunded liability by $200.4 million and increased the normal cost by $8.4 million for the BRS excluding Teachers. These changes increased the unfunded liability by $154.2 million and increased the normal cost by $3.5 million for the Teachers.

8. The following Plan changes are included in this valuation:

   - The COLA base was increased from $13,000 to $14,000 effective July 1, 2017.

9. The unfunded liability was expected to decrease by $108.8 million from $3,707.4 million as of January 1, 2016 to $3,598.6 million as of January 1, 2018. The actual unfunded liability of $3,933.1 million as of January 1, 2018 is $334.5 million greater than expected primarily due to the assumption and plan changes described above, partially offset by the net experience gains discussed in *Section 2* and *Section 3*.

10. The appropriation for the BRS excluding Teachers for fiscal 2019 was set to the previously budgeted amount of $283,189,199. The funding schedule included in *Section 2* fully funds the liabilities of the BRS excluding Teachers by June 30, 2025 with appropriations that increase 8.85% per year. The fiscal 2020 appropriation is $308,251,443 and the fiscal 2021 appropriation is $335,531,696. An additional payment of $12.0 million was made on September 7, 2018. This amount is reflected in the unfunded liability shown in the funding schedule beginning in fiscal 2020. The prior funding schedule also fully funded the liabilities of the BRS excluding Teachers by June 30, 2025 with appropriations that increased 8.85% per year

11. The Commonwealth appropriation for the Teachers is $143,145,563 for fiscal 2019 and is expected to increase by 8.94% for fiscal 2020.

12. *Section 2* shows participant and asset information, the experience analysis, liabilities and a funding schedule for the BRS excluding Teachers, with comparisons to 2016. *Section 3* shows the same information for the Teachers with comparisons to 2016. *Section 4* shows participant and asset information for all employees of the BRS.

13. This actuarial report as of January 1, 2018 is based on financial and demographic data as of that date. Changes subsequent to that date are not reflected and will affect future actuarial costs of the plan.

14. Since the actuarial valuation results are dependent on a given set of assumptions, there is a risk that emerging results may differ significantly as actual experience proves to be different from the assumptions. We have included a discussion of various risks that may affect the BRS excluding Teachers in *Section 2* and the Teachers in *Section 3*.

Summary of Key Valuation Results – BRS excluding Teachers

		2018	2016
Contributions:	• Actuarially Determined Contributions for fiscal year 2019 and 2017	$283,189,199	$235,770,904
	• Actuarially Determined Contributions for fiscal year 2020 and 2018	308,251,443	256,636,629
	• Actuarially Determined Contributions for fiscal year 2021 and 2019	335,531,696	279,348,971
Actuarial accrued liability for plan year beginning January 1:	• Retired participants and beneficiaries	$3,340,337,893	$3,028,967,306
	• Inactive vested participants	101,843,021	89,783,052
	• Inactive participants due a refund of employee contributions	37,968,525	31,936,931
	• Active participants	3,070,817,129	2,773,379,744
	• Total	6,550,966,568	5,924,067,033
	• Normal cost including administrative expenses for plan year beginning January 1	157,529,726	137,364,499
Assets for plan year beginning January 1:	• Market value of assets (MVA)	$5,072,440,419	$4,108,995,185
	• Actuarial value of assets (AVA)	5,038,741,926	4,440,479,851
	• Actuarial value of assets as a percentage of market value of assets	99.34%	108.07%
Funded status for plan year beginning January 1:	• Unfunded actuarial accrued liability on market value of assets	$1,478,526,149	$1,815,071,848
	• Funded percentage on MVA basis	77.43%	69.36%
	• Unfunded actuarial accrued liability on actuarial value of assets	$1,512,224,642	$1,483,587,182
	• Funded percentage on AVA basis	76.92%	74.96%
Key assumptions:	• Net investment return	7.50%	7.75%
	• Long-term inflation rate	3.25%	3.25%
Demographic data for plan year beginning January 1:	• Number of retired participants and beneficiaries	9,721	9,856
	• Number of inactive vested participants	800	765
	• Number of inactive participants entitled to a refund of employee contributions	7,500	6,784
	• Number of active participants	14,445	14,288
	• Total payroll[1]	$978,059,711	$909,132,900
	• Average payroll[1]	67,709	63,629

[1] Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. Calendar year 2015 payroll figures were increased by 14.3% for members of the Police Detectives Benevolent Society, plus a one-time $2,000 parity increase, to reflect bargaining contracts that were settled in December 2015 and first reflected in 2016 payroll.

Summary of Key Valuation Results – Teachers

		2018	2016
Actuarial accrued liability for plan year beginning January 1:	• Retired participants and beneficiaries	$2,482,365,576	$2,285,916,175
	• Inactive vested participants	61,353,783	54,304,667
	• Inactive participants due a refund of employee contributions	33,092,018	29,814,838
	• Active participants	1,467,524,023	1,354,722,557
	• Total	4,044,335,400	3,724,758,237
	• Normal cost including administrative expenses for plan year beginning January 1	77,823,376	69,488,163
Assets for plan year beginning January 1:	• Market value of assets (MVA)	$1,694,050,718	$1,450,298,185
	• Actuarial value of assets (AVA)	1,623,499,500	1,500,903,796
	• Actuarial value of assets as a percentage of market value of assets	95.84%	103.49%
Funded status for plan year beginning January 1:	• Unfunded actuarial accrued liability on market value of assets	$2,350,284,682	$2,274,460,052
	• Funded percentage on MVA basis	41.89%	38.94%
	• Unfunded actuarial accrued liability on actuarial value of assets	$2,420,835,900	$2,223,854,441
	• Funded percentage on AVA basis	40.14%	40.30%
Key assumptions:	• Net investment return	7.35%	7.50%
	• Long-term inflation rate	3.25%	4.50%
Demographic data for plan year beginning January 1:	• Number of retired participants and beneficiaries	4,727	4,629
	• Number of inactive vested participants	309	285
	• Number of inactive participants entitled to a refund of employee contributions	2,014	1,906
	• Number of active participants	6,550	6,210
	• Total payroll[1]	$562,185,195	$525,856,865
	• Average payroll[1]	85,830	84,679

[1] Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year.
Calendar year 2017 payroll figures were increased by 3.02% to reflect bargaining contracts that were settled in February 2018 and first reflected in 2018 payroll.

Summary of Key Valuation Results – All Boston Retirement System Employees

		2018	2016
Actuarial accrued liability for plan year beginning January 1:	• Retired participants and beneficiaries	$5,822,703,469	$5,314,883,481
	• Inactive vested participants	163,196,804	144,087,718
	• Inactive participants due a refund of employee contributions	71,060,543	61,751,770
	• Active participants	4,538,341,152	4,128,102,301
	• Total	10,595,301,968	9,648,825,270
	• Normal cost including administrative expenses for plan year beginning January 1	235,353,102	206,852,662
Assets for plan year beginning January 1:	• Market value of assets (MVA)	$6,766,491,137	$5,559,293,370
	• Actuarial value of assets (AVA)	6,662,241,426	5,941,383,647
	• Actuarial value of assets as a percentage of market value of assets	98.46%	106.87%
Funded status for plan year beginning January 1:	• Unfunded/(overfunded) actuarial accrued liability on market value of assets	$3,828,810,831	$4,089,531,900
	• Funded percentage on MVA basis	63.86%	57.62%
	• Unfunded/(overfunded) actuarial accrued liability on actuarial value of assets	$3,933,060,542	$3,707,441,623
	• Funded percentage on AVA basis	62.88%	61.58%
Demographic data for plan year beginning January 1:	• Number of retired participants and beneficiaries	14,448	14,485
	• Number of inactive vested participants	1,109	1,050
	• Number of inactive participants entitled to a refund of employee contributions	9,514	8,690
	• Number of active participants	20,995	20,498
	• Total payroll[1]	$1,540,244,906	$1,434,989,766
	• Average payroll[1]	73,362	70,006

[1] Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. For Boston Retirement System excluding Teachers, calendar year 2015 payroll figures were increased by 14.3% for members of the Police Detectives Benevolent Society, plus a one-time $2,000 parity increase, to reflect bargaining contracts that were settled in December 2015 and first reflected in 2016 payroll. For Teachers, calendar year 2017 payroll figures were increased by 3.02% to reflect bargaining contracts that were settled in February 2018 and first reflected in 2018 payroll.

Important Information About Actuarial Valuations

An actuarial valuation is a budgeting tool with respect to the financing of future projected obligations of a pension plan. It is an estimated forecast – the actual long-term cost of the plan will be determined by the actual benefits and expenses paid and the actual investment experience of the plan.

In order to prepare a valuation, Segal Consulting ("Segal") relies on a number of input items. These include:

Plan of benefits	Plan provisions define the rules that will be used to determine benefit payments, and those rules, or the interpretation of them, may change over time. Even where they appear precise, outside factors may change how they operate. It is important to keep Segal informed with respect to plan provisions and administrative procedures, and to review the plan summary included in our report to confirm that Segal has correctly interpreted the plan of benefits.
Participant data	An actuarial valuation for a plan is based on data provided to the actuary by the Boston Retirement System. Segal does not audit such data for completeness or accuracy, other than reviewing it for obvious inconsistencies compared to prior data and other information that appears unreasonable. It is important for Segal to receive the best possible data and to be informed about any known incomplete or inaccurate data.
Assets	The valuation is based on the market value of assets as of the valuation date, as provided by the Boston Retirement System. The Boston Retirement System uses an "actuarial value of assets" that differs from market value to gradually reflect year-to-year changes in the market value of assets in determining the contribution requirements.
Actuarial assumptions	In preparing an actuarial valuation, Segal projects the benefits to be paid to existing plan participants for the rest of their lives and the lives of their beneficiaries. This projection requires actuarial assumptions as to the probability of death, disability, withdrawal, and retirement of each participant for each year. In addition, the benefits projected to be paid for each of those events in each future year reflect actuarial assumptions as to salary increases and cost-of-living adjustments. The projected benefits are then discounted to a present value, based on the assumed rate of return that is expected to be achieved on the plan's assets. There is a reasonable range for each assumption used in the projection and the results may vary materially based on which assumptions are selected. It is important for any user of an actuarial valuation to understand this concept. Actuarial assumptions are periodically reviewed to ensure that future valuations reflect emerging plan experience. While future changes in actuarial assumptions may have a significant impact on the reported results, that does not mean that the previous assumptions were unreasonable.

The user of Segal's actuarial valuation (or other actuarial calculations) should keep the following in mind:

- The actuarial valuation is prepared at the request of the Boston Retirement System. Segal is not responsible for the use or misuse of its report, particularly by any other party.
- An actuarial valuation is a measurement of the plan's assets and liabilities at a specific date. Accordingly, except where otherwise noted, Segal did not perform an analysis of the potential range of future financial measures. The actual long-term cost of the plan will be determined by the actual benefits and expenses paid and the actual investment experience of the plan.
- Actuarial results in this report are not rounded, but that does not imply precision.
- If the Boston Retirement System is aware of any event or trend that was not considered in this valuation that may materially change the results of the valuation, Segal should be advised, so that we can evaluate it.
- Segal does not provide investment, legal, accounting, or tax advice. Segal's valuation is based on our understanding of applicable guidance in these areas and of the plan's provisions, but they may be subject to alternative interpretations. The Boston Retirement System should look to their other advisors for expertise in these areas.

As Segal Consulting has no discretionary authority with respect to the management or assets of the System, it is not a fiduciary in its capacity as actuaries and consultants with respect to the System.

Section 2: Actuarial Valuation Results – Boston Retirement System excluding Teachers

Participant Data

The Actuarial Valuation and Review considers the number and demographic characteristics of covered participants, including active participants, inactive participants, retired participants and beneficiaries.

This section presents a summary of significant statistical data on these participant groups for the BRS excluding Teachers.

More detailed information for this valuation year and the preceding valuation can be found on the next page and in *Section 4, Exhibit A.*

PARTICIPANT POPULATION: 2007 – 2017

Year Ended December 31	Active Participants	Inactive Participants	Retired Participants and Beneficiaries	Total Non-Actives	Ratio of Non-Actives to Actives
2007	15,943	4,959	10,246	15,205	0.95
2009	14,449	6,189	10,044	16,233	1.12
2011	13,951	6,823	10,000	16,823	1.21
2013	14,235	6,751	9,925	16,676	1.17
2015	14,288	7,549	9,856	17,405	1.22
2017	14,445	8,300	9,721	18,021	1.25

TABLE OF PLAN COVERAGE

Category	Year Ended December 31		Change From Prior Year
	2017	2015	
Active participants in valuation:			
• Number	14,445	14,288	1.1%
• Average age	46.4	46.5	-0.1
• Average years of service	13.7	14.0	-0.3
• Total payroll	$978,059,711	$909,132,900	7.6%
• Average payroll	67,709	63,629	6.4%
• Member contributions	1,013,349,734	943,744,521	7.4%
• Number with unknown age	2	16	N/A
Inactive participants in valuation:			
• Inactive participants due a refund of employee contributions	7,500	6,784	10.6%
• Inactive participants with a vested right to a deferred or immediate benefit	800	765	4.6%
Retired participants:			
• Number in pay status	6,143	6,077	1.1%
• Average age	74.1	74.3	-0.2
• Average monthly benefit	$2,966	$2,727	8.8%
Disabled participants:			
• Number in pay status	1,674	1,742	-3.9%
• Average age	68.7	67.9	0.8
• Average monthly benefit	$4,193	$3,945	6.3%
Beneficiaries:			
• Number in pay status	1,904	2,037	-6.5%
• Average age	77.3	77.4	-0.1
• Average monthly benefit	$1,815	$1,650	10.0%

Notes: Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year.
Calendar year 2015 payroll figures were increased by 14.3% for members for the Police Detectives Benevolent Society, plus a one-time $2,000 parity increase, to reflect bargaining contracts that were settled in December 2015 and first reflected in 2016 payroll.

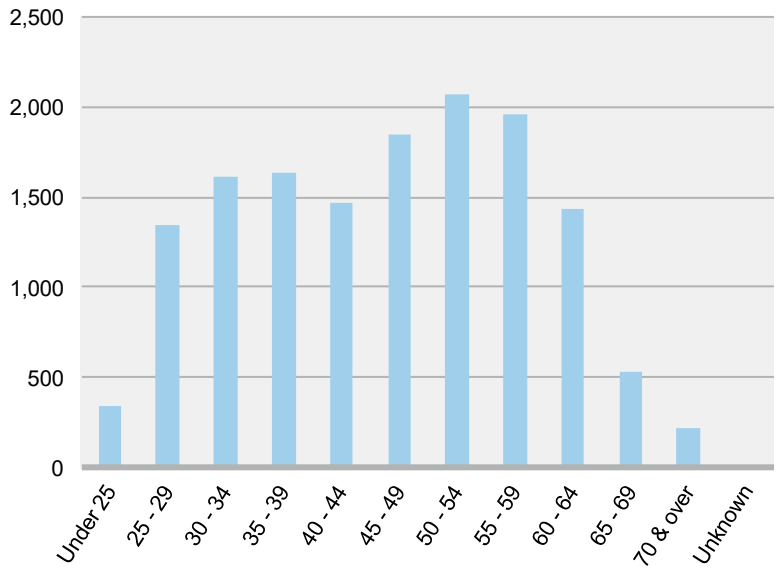
Active Participants

Plan costs are affected by the age, years of service and payroll of active participants. In this year's valuation, there were 14,445 active participants with an average age of 46.4, average service of 13.7 years and average payroll of $67,709. The 14,288 active participants in the prior valuation had an average age of 46.5, average service of 14.0 years and average payroll of $63,629.

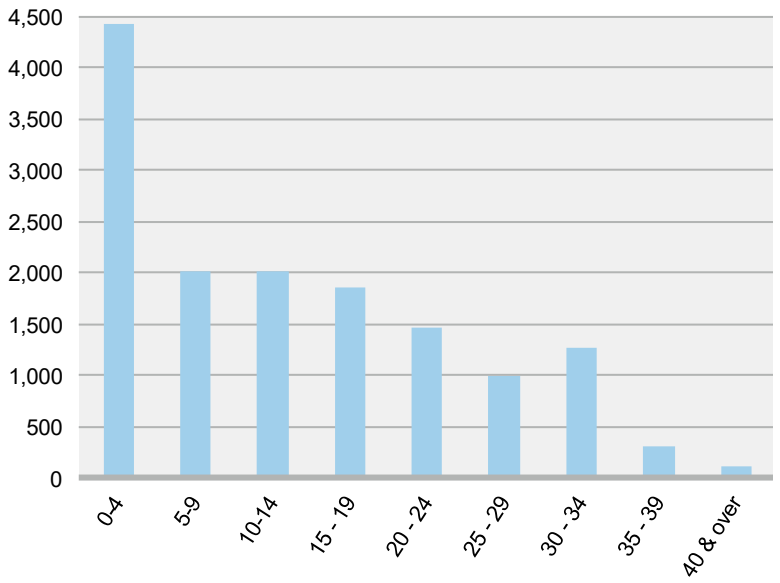
Among the active participants, there were two participants with unknown age information. The actuarial calculations were adjusted for the missing information by assuming that it was the same as information provided for other active participants with similar known characteristics.

Distribution of Active Participants as of December 31, 2017

BY AGE



BY YEARS OF SERVICE



Inactive Participants

In this year's valuation, there were 800 participants with a right to a deferred or immediate vested benefit and 7,500 participants entitled to a return of their employee contributions.

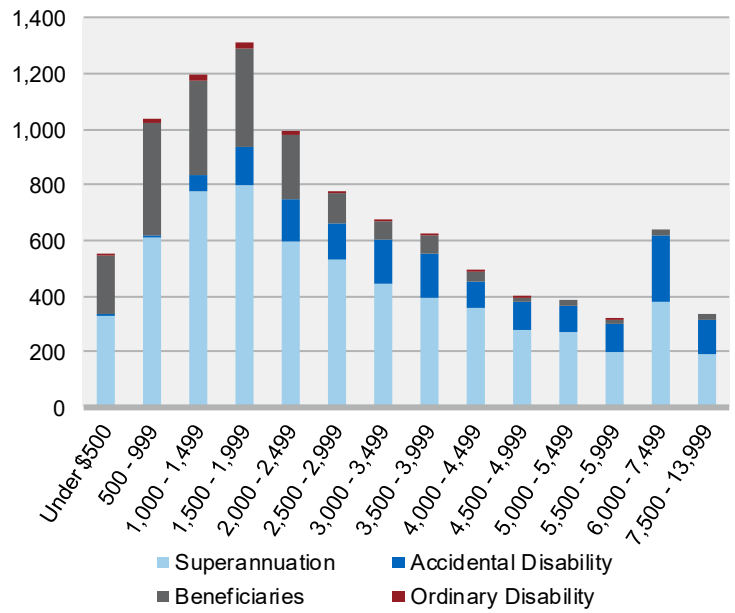
Retired Participants and Beneficiaries

As of December 31, 2017, 7,817 retired participants and 1,904 beneficiaries were receiving total monthly benefits of $28,697,014, excluding COLAs reimbursed by the Commonwealth. For comparison, in the previous valuation, there were 7,819 retired participants and 2,037 beneficiaries receiving monthly benefits of $26,805,492, excluding COLAs reimbursed by the Commonwealth..

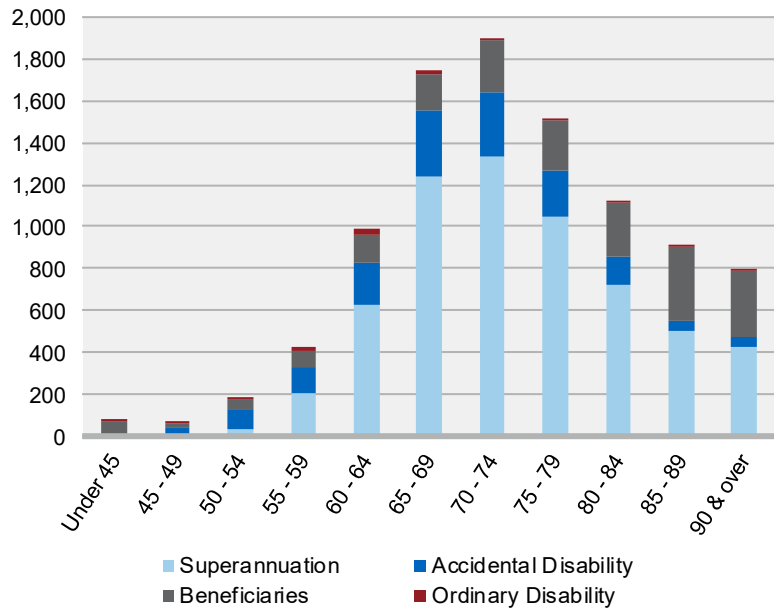
As of December 31, 2017, the average monthly benefit for retired participants and beneficiaries is $2,952, compared to $2,720 in the previous valuation. The average age for retired participants and beneficiaries is 73.8 in the current and prior valuation.

Distribution of Retired Participants and Beneficiaries as of December 31, 2017

BY TYPE AND MONTHLY AMOUNT



BY TYPE AND AGE

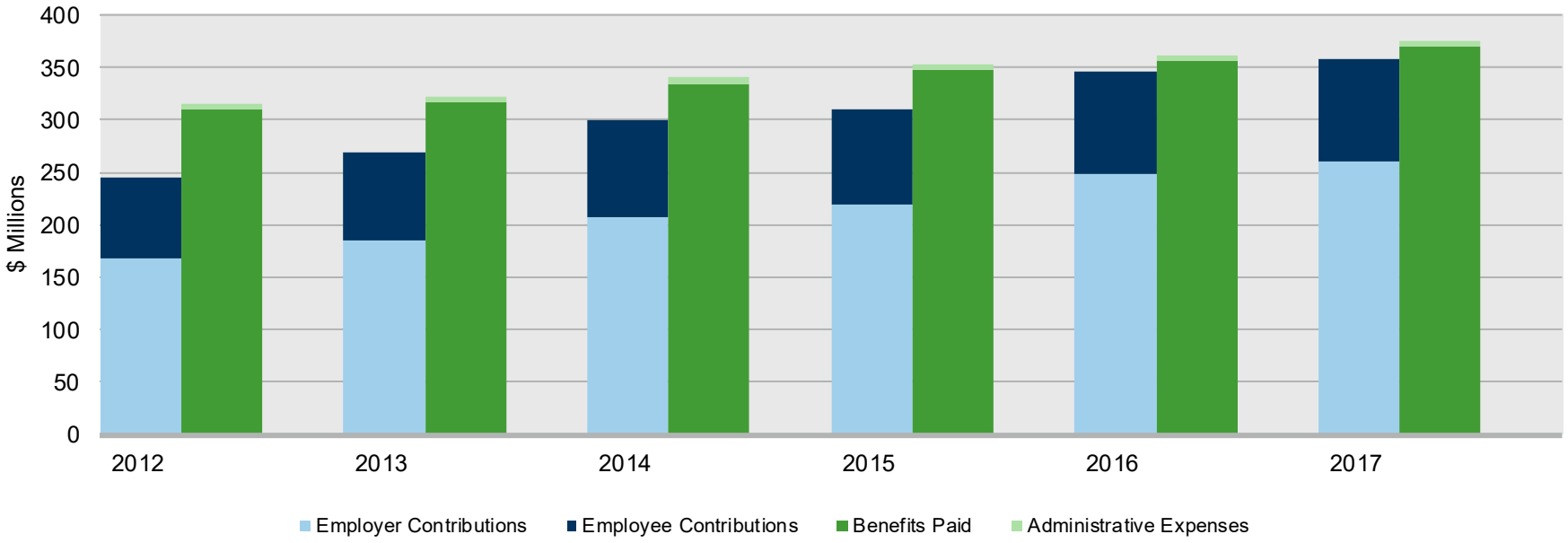


Financial Information

Retirement plan funding anticipates that, over the long term, both contributions (less administrative expenses) and investment earnings (less investment fees) will be needed to cover benefit payments. Retirement plan assets change as a result of the net impact of these income and expense components.

Additional financial information, including a summary of transactions for the valuation year, is presented in *Section 4, Exhibit B*.

COMPARISON OF CONTRIBUTIONS WITH BENEFITS AND EXPENSES FOR YEARS ENDED DECEMBER 31, 2012 – 2017



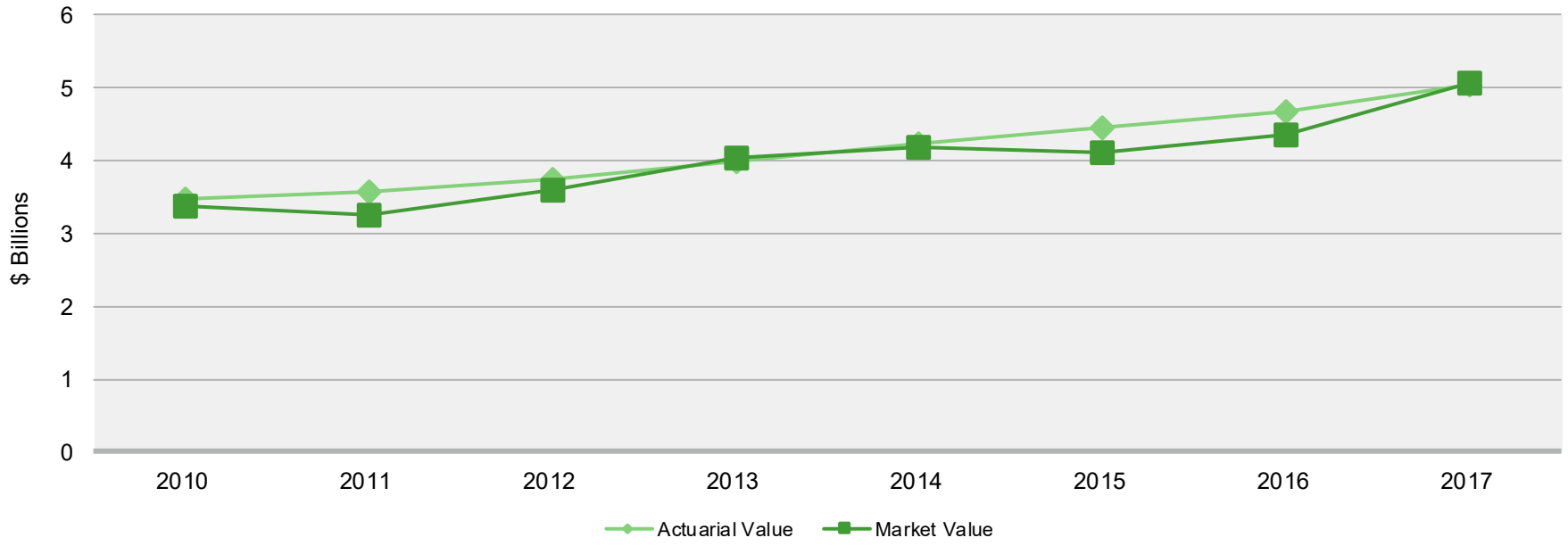
It is desirable to have level and predictable plan costs from one year to the next. For this reason, the Board has approved an asset valuation method that gradually adjusts to market value. Under this valuation method, the full value of market fluctuations is not recognized in a single year and, as a result, the asset value and the plan costs are more stable. The amount of the adjustment to recognize market value is treated as income, which may be positive or negative. Realized and unrealized gains and losses are treated equally and, therefore, the sale of assets has no immediate effect on the actuarial value.

DETERMINATION OF ACTUARIAL VALUE OF ASSETS

		Year Ended	
		December 31, 2017	December 31, 2016
1	Actuarial value of assets at the beginning of the year	$4,684,318,048	$4,440,479,851
2	Contributions, less benefit payments and expenses during the year	-16,399,898	-15,468,642
3	Average actuarial value of assets: **(1) + [50% of (2)]**	4,676,118,099	4,432,745,530
4	Expected investment income: **0.0775 x (3)**	362,399,153	343,537,779
5	Preliminary actuarial value of assets at the end of the year: **(1) + (2) + (4)**	5,030,317,303	4,768,548,988
6	Market value of assets at the end of the year	5,072,440,419	4,347,394,286
7	Adjustment toward market value: **20% of [(6) - (5)]**	8,424,623	-84,230,940
8	Adjustment to be within 20% of corridor	0	0
9	Final actuarial value of assets: **(5) + (7) + (8)**	5,038,741,926	4,684,318,048
10	Actuarial value as a percentage of market value: **(9) ÷ (6)**	99.34%	107.75%

Both the actuarial value and market value of assets are representations of the financial status of the Boston Retirement System. As investment gains and losses are gradually taken into account, the actuarial value of assets tracks the market value of assets. The actuarial asset value is significant because the liabilities are compared to these assets to determine what portion, if any, remains unfunded. Amortization of the unfunded actuarial accrued liability is an important element in determining the contribution requirement.

ACTUARIAL VALUE OF ASSETS VS. MARKET VALUE OF ASSETS AS OF DECEMBER 31, 2010 – 2017



Actuarial Experience

To calculate any actuarially determined contribution, assumptions are made about future events that affect the amount and timing of benefits to be paid and assets to be accumulated. Each year actual experience is measured against the assumptions. If overall experience is more favorable than anticipated (an actuarial gain), any contribution requirement will decrease from the previous year. On the other hand, any contribution requirement will increase if overall actuarial experience is less favorable than expected (an actuarial loss).

Taking account of experience gains or losses in one year without making a change in assumptions reflects the belief that the single year's experience was a short-term development and that, over the long term, experience will return to the original assumptions. For contribution requirements to remain stable, assumptions should approximate experience.

If assumptions are changed, the contribution requirement is adjusted to take into account a change in experience anticipated for all future years.

The net experience loss over the two-year period is $12,296,424, which includes $75,806,317 from investment losses and $63,509,893 in gains from all other sources. The net experience variation from individual sources other than investments was 1.0% of the actuarial accrued liability. A discussion of the major components of the actuarial experience is on the following pages.

ACTUARIAL EXPERIENCE FOR TWO-YEAR PERIOD ENDED DECEMBER 31, 2017

1	Net loss from investments	-$75,806,317
2	Net gain from administrative expenses	4,513,674
3	Net gain from other experience	58,996,219
4	Net experience loss: 1 + 2 + 3	-$12,296,424

Investment Experience

A major component of projected asset growth is the assumed rate of return. The assumed return should represent the expected long-term rate of return, based on the investment policy of the Boston Retirement System. The rate of return on the market value of assets was 17.09% and 6.19% for the years ended December 31, 2017 and December 31, 2016, respectively.

For valuation purposes, the assumed rate of return on the actuarial value of assets was 7.75% for the 2017 and 2016 plan years. The actual rate of return on an actuarial basis for the 2017 and 2016 plan years was 7.93% and 5.85%, respectively. The Boston Retirement System experienced an actuarial loss during the two-year period ending December 31, 2017 with regard to its investments.

INVESTMENT EXPERIENCE

		Year Ended December 31, 2017		Year Ended December 31, 2016	
		Market Value	Actuarial Value	Market Value	Actuarial Value
1	Net investment income	$741,446,031	$370,823,776	$253,867,742	$259,306,839
2	Average value of assets	4,339,194,337	4,676,118,099	4,101,260,865	4,432,745,530
3	Rate of return: 1 ÷ 2	17.09%	7.93%	6.19%	5.85%
4	Assumed rate of return	7.75%	7.75%	7.75%	7.75%
5	Expected investment income: 2 x 4	$336,287,561	$362,399,153	$317,847,717	$343,537,779
6	Actuarial gain/(loss): 1 – 5	405,158,470	8,424,623	-63,979,975	-84,230,940

Because actuarial planning is long term, it is useful to see how the assumed investment rate of return has followed actual experience over time. The chart below shows the rate of return on an actuarial basis compared to the actual market value investment return for the last eight years, including an eight-year average.

Based on this experience and future expectations, we have lowered the assumed rate of return from 7.75% to 7.50%.

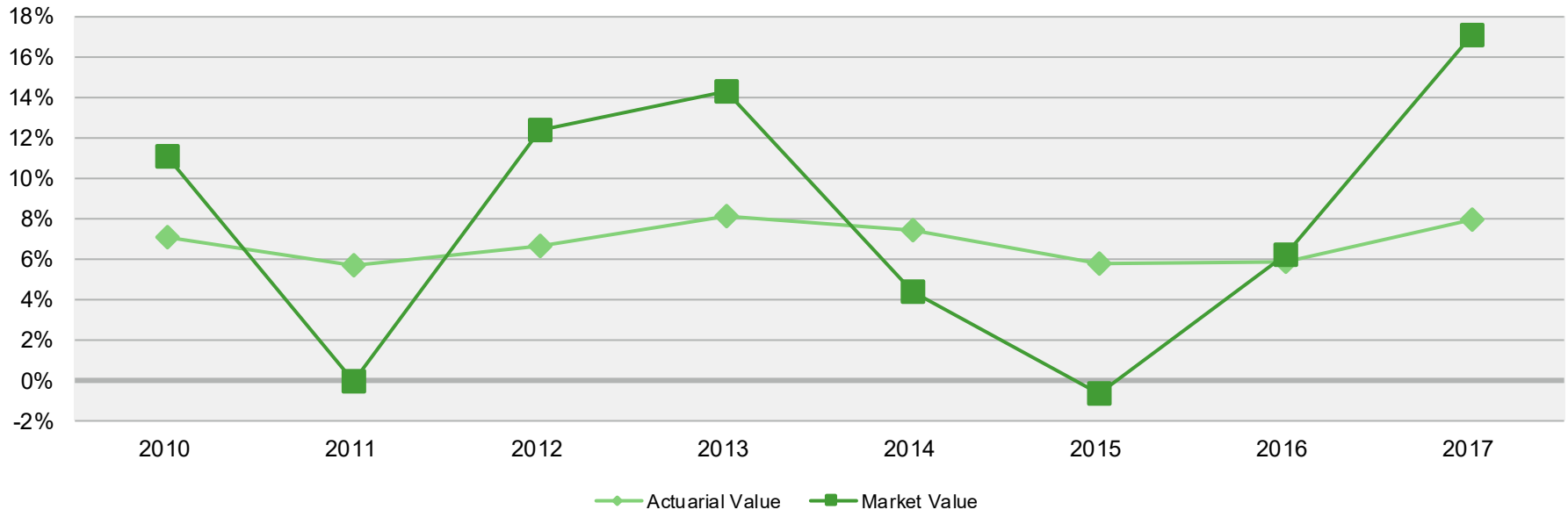
INVESTMENT RETURN – ACTUARIAL VALUE VS. MARKET VALUE: 2010 - 2017

Year Ended December 31	Actuarial Value Investment Return		Market Value Investment Return	
	Amount	Percent	Amount	Percent
2010	$227,907,602	7.08%	$331,718,631	11.07%
2011	195,775,161	5.71%	-843,146	-0.03%
2012	236,215,344	6.67%	398,647,225	12.36%
2013	301,559,400	8.12%	508,811,061	14.28%
2014	292,523,874	7.37%	177,462,844	4.41%
2015	244,055,385	5.79%	-27,167,667	-0.65%
2016	259,306,839	5.85%	253,867,742	6.19%
2017	370,823,776	7.93%	741,446,031	17.09%
Total	$2,128,167,381		$2,383,942,721	
	Eight-year average return	6.82%		8.02%

Note: Each year's yield is weighted by the average asset value in that year.

The actuarial asset valuation method gradually recognizes fluctuations in the market value rate of return. The goal of this is to stabilize the actuarial rate of return and to produce more level pension plan costs.

MARKET AND ACTUARIAL RATES OF RETURN FOR YEARS ENDED DECEMBER 31, 2010 - 2017



Administrative Expenses

Administrative expenses for the years ended December 31, 2016 and 2017 were $5,037,943 and $4,289,157, respectively, compared to the assumption of $6,650,000 for calendar 2016 and $6,866,125 for calendar 2017. This resulted in a gain of $4,513,674 for the two-year period, including an adjustment for interest. Based on discussions with the staff of the Boston Retirement System, we have increased the assumption for the Boston Retirement System from $9,500,000 for calendar 2016 to $11,000,000 for calendar 2018, with 70% or $7,700,000 assigned to the BRS excluding Teachers.

Other Experience

There are other differences between the expected and the actual experience that appear when the new valuation is compared with the projections from the previous valuation. These include:

- the extent of turnover among participants,
- retirement experience (earlier or later than projected),
- mortality (more or fewer deaths than projected),
- the number of disability retirements (more or fewer than projected), and
- salary increases (greater or smaller than projected).

The net gain from this other experience for the two-year period ending December 31, 2017 amounted to $58,996,219, which is 0.9% of the actuarial accrued liability.

LIABILITY CHANGES DUE TO DEMOGRAPHIC EXPERIENCE FOR TWO-YEAR PERIOD ENDED DECEMBER 31, 2017

Gain due to more deaths than expected among retired members and beneficiaries	$15,318,212
Loss due to salary increases greater than expected for continuing actives	-5,564,071
Miscellaneous experience gain	49,242,078
Total	**$58,996,219**

Changes in the Actuarial Accrued Liability

The actuarial accrued liability as of January 1, 2018 is $6,550,966,568, an increase of $626,899,535, or 10.6%, from the actuarial accrued liability as of the prior valuation date. The liability is expected to grow each year with normal cost and interest, and to decline due to benefit payments made. Additional fluctuations can occur due to actual experience that differs from expected (as discussed in the previous subsection) and changes in assumptions and plan provisions (as noted below).

Actuarial Assumptions

The following actuarial assumptions were changed with this valuation for BRS excluding Teachers:

- Mortality assumption:
  - The mortality tables for non-disabled participants were updated from the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally using Scale BB2D from 2009 to the RP-2014 Blue Collar Employee and Healthy Annuitant Mortality Tables set forward one year for female participants projected generationally using Scale MP-2017.
  - The mortality tables for disabled participants were updated from the RP-2000 Healthy Annuitant Mortality Table projected generationally using Scale BB2D from 2015 to the RP-2014 Blue Collar Healthy Annuitant Mortality Table set forward one year projected generationally using Scale MP-2017.
- Decrease the investment rate of return assumption from 7.75% to 7.50%.
- Increase the administrative expense assumption from $9,500,000 for calendar year 2016 to $11,000,000 for calendar year 2018, with 70%, or $7,700,000 assigned to the BRS excluding Teachers.

These changes increased the actuarial accrued liability by $200.4 million and increased the normal cost by $8.4 million.

Details on actuarial assumptions and methods are in *Section 5, Exhibit I*.

Plan Provisions

The following plan change is included in this valuation:

- The COLA base was increased from $13,000 to $14,000 effective July 1, 2017.

A summary of plan provisions is in *Section 5, Exhibit II*.

Development of Unfunded Actuarial Accrued Liability

		Year Ended	
		December 31, 2017	December 31, 2016
1	Unfunded actuarial accrued liability at beginning of year	$1,387,228,772	$1,483,587,182
2	Normal cost at beginning of year	141,828,845	137,364,499
3	Total contributions	-358,182,159	-345,941,434
4	Interest		
	For whole year on **1 + 2**	$118,501,965	$125,623,755
	For half year on **3**	-13,879,559	-13,405,231
	Total interest	104,622,406	112,218,524
5	Expected unfunded actuarial accrued liability	$1,275,497,864	$1,387,228,772
6	Changes due to:		
	New loss from investments	$75,806,317	- -
	Net gain from other experience	-63,509,893	- -
	COLA base increase	24,061,866	- -
	Assumption changes	200,368,488	- -
	Total changes	36,726,778	- -
7	Unfunded actuarial accrued liability at end of year	$1,512,224,642	- -

Actuarially Determined Contribution

The actuarially determined contribution is equal to the employer normal cost payment and a payment on the unfunded actuarial accrued liability. For fiscal 2019, the actuarially determined contribution has been set equal to the previously budgeted amount of $283,189,199 determined with the prior valuation (adjusted for the increase in the COLA base). The detail of the actuarially determined contribution is shown below.

The funding schedule included in this report fully funds the liabilities of the BRS excluding Teachers by June 30, 2025 with appropriations that increase 8.85% per year and annual recognition of the deferred investment gains. The fiscal 2020 appropriation is $308,251,443.

ACTUARIALLY DETERMINED CONTRIBUTION

		For Year Beginning January 1			
		2018		2016	
		Amount	% of Projected Payroll	Amount	% of Projected Payroll
1	Total normal cost	$149,829,726	14.73%	$130,714,499	13.82%
2	Administrative expenses	7,700,000	0.76%	6,650,000	0.70%
3	Expected employee contributions	-99,385,035	-9.77%	-91,050,581	-9.63%
4	Employer normal cost: **(1) + (2) + (3)**	$58,144,691	5.71%	$46,313,918	4.90%
5	Actuarial accrued liability	6,550,966,568		5,924,067,033	
6	Actuarial value of assets	5,038,741,926		4,440,479,851	
7	Unfunded actuarial accrued liability: **(5) - (6)**	$1,512,224,642		$1,483,587,182	
8	Employer normal cost projected to July 1, 2018 and 2016	59,081,988	5.71%	47,060,502	4.90%
9	Projected unfunded actuarial accrued liability	1,567,907,880		1,540,003,515	
10	Payment on projected unfunded actuarial accrued liability	224,107,211	21.68%	188,710,402	19.64%
11	Budgeted appropriation for fiscal 2019 and 2017: **(8) + (10)**	$283,189,199	27.39%	$235,770,904	24.53%
12	Projected payroll	$1,033,868,562		$961,060,499	

Notes: Actuarially determined contributions are assumed to be paid on July 1.
Actuarially determined contributions are set equal to the budgeted amounts determined with the prior valuation.

Funding Schedule

(1) Fiscal Year Ended June 30	(2) Employer Normal Cost	(3) Amortization of Unfunded Inactive Sheriff Liability	(4) Amortization of Remaining Unfunded Liability	(5) Crossover Payment Savings	(6) Savings from Additional Payment in Fiscal 2011	(7) Actuarially Determined Contributions: (2) + (3) + (4) + (5) + (6)	(8) Unfunded Actuarial Accrued Liability at Beginning of Fiscal Year	(9) Percent Change From Prior Year
2019	$59,081,988	$3,845,773	$244,211,085	-$14,570,160	-$9,379,487	$283,189,199	$1,567,907,880	- -
2020	61,237,942	3,845,773	267,117,374	-14,570,160	-9,379,486	308,251,443	1,429,310,772	8.85%
2021	63,471,993	3,845,773	292,163,576	-14,570,160	-9,379,486	335,531,696	1,269,711,303	8.85%
2022	65,786,952	3,845,773	319,543,172	-14,570,160	-9,379,486	365,226,251	1,072,336,611	8.85%
2023	68,185,732	3,845,773	349,466,915	-14,570,160	-9,379,486	397,548,774	831,719,675	8.85%
2024	70,671,349	3,845,773	382,164,364	-14,570,160	-9,379,486	432,731,840	541,775,507	8.85%
2025	73,246,927	3,845,773	215,834,109	-14,570,160	-9,379,486	268,977,163	195,730,232	-37.84%
2026	75,915,703	0	0	0	0	75,915,703	0	-71.78%
2027	78,681,029	0	0	0	0	78,681,029	0	3.64%
2028	81,546,377	0	0	0	0	81,546,377	0	3.64%
2029	84,515,342	0	0	0	0	84,515,342	0	3.64%
2030	87,591,651	0	0	0	0	87,591,651	0	3.64%

Notes: Actuarially determined contributions are assumed to be paid on July 1.
Actuarially determined contribution for fiscal year 2019 is set equal to the budgeted amount determined with the prior valuation (adjusted for the increase in the COLA base).
Item (2) reflects 3.25% growth in payroll and a 0.15% adjustment to total normal cost to reflect the effect of mortality improvements due to the generational mortality assumption.
Projected normal cost does not reflect the future impact of pension reform for new hires.
Projected unfunded actuarial accrued liability reflects deferred investment gains.
Payment of $12.0 million made on September 7, 2018 is reflected in the unfunded actuarial accrued liability as of July 1, 2019.

Risk

Since the actuarial valuation results depend on a single set of assumptions, there is a risk that emerging results may differ significantly as actual experience proves to be different from the current assumptions.

We have not been engaged to perform a detailed analysis of the potential range of the impact of risk relative to the System's future financial condition, but have included a brief discussion of some of the risks that may affect the System. This discussion is focused on funding-related risks, but similar concerns may apply to risks regarding the level of expense and liabilities reported for System accounting purposes as well.

We recommend a more detailed assessment of the risks to provide the Board with a better understanding of the risks inherent in the System. This assessment may include scenario testing, sensitivity testing, and/or stochastic modeling.

A detailed risk assessment is important for your System because relatively small changes in investment performance can produce large increases in the contribution requirements since the funding schedule is relatively short.

- Investment Risk (the risk that returns will be different than expected)

  The market value rate of return over the last eight years has ranged from a low of -0.65% to a high of 17.09%.

- Longevity Risk (the risk that mortality experience will be different than expected)

  The actuarial valuation includes an expectation of future improvement in life expectancy. Emerging plan experience that does not match these expectations will result in either an increase or decrease in the actuarially determined contribution.

- Contribution Risk (the risk that actual contributions will be different from actuarially determined contribution)

  Massachusetts General Law requires payment of the actuarially determined contribution. If future experience matches the current assumptions, we project the unfunded actuarial accrued liability will be paid off in 7 years.

- Demographic Risk (the risk that participant experience will be different than assumed)

  Examples of this risk include:

  - Actual retirements occurring earlier or later than assumed.
  - More or less active participant turnover than assumed.
  - Disability experience greater or less than expected
  - Salary increases greater or less than projected.

- Actual Experience in Recent Years and Implications for the Future

  Past experience can help demonstrate the sensitivity of key results to the Plan's actual experience.

  - The investment gain(loss) over the past eight years has ranged from a loss of $349,423,944 to a gain of $405,158,470.
  - The non-investment gain(loss) over the past five valuations has ranged from a loss of $57,558,907 to a gain of $189,554,895.
  - Since 2008, the funded percentage on the actuarial value of assets has ranged from a low of 69.9% as of January 1, 2010 to a high of 77.37% as of January 1, 2008.

- Maturity Measures

  As pension plans mature, the cashed need to fulfill benefit obligations will increase over time. Therefore, cash flow projections and analysis should be performed to assure that the Plan's asset allocation is aligned to meet emerging pension liabilities.

Section 3: Actuarial Valuation Results – Teachers

Participant Data

The Actuarial Valuation and Review considers the number and demographic characteristics of covered participants, including active participants, inactive participants, retired participants and beneficiaries.

This section presents a summary of significant statistical data on these participant groups for the Teachers of the Boston Retirement System.

More detailed information for this valuation year and the preceding valuation can be found on the next page and in *Section 4, Exhibit C*.

PARTICIPANT POPULATION: 2007 – 2017

Year Ended December 31	Active Participants	Inactive Participants	Retired Participants and Beneficiaries	Total Non-Actives	Ratio of Non-Actives to Actives
2007	5,805	1,281	3,693	4,974	0.86
2009	5,566	1,424	3,914	5,338	0.96
2011	5,448	1,964	4,189	6,153	1.13
2013	6,043	2,040	4,416	6,456	1.07
2015	6,210	2,191	4,629	6,820	1.10
2017	6,550	2,323	4,727	7,050	1.08

TABLE OF PLAN COVERAGE

Category	Year Ended December 31 2017	Year Ended December 31 2015	Change From Prior Year
Active participants in valuation:			
• Number	6,550	6,210	5.5%
• Average age	42.3	42.7	-0.4
• Average years of service	11.4	11.9	-0.5
• Total payroll	$562,185,195	$525,856,865	6.9%
• Average payroll	85,830	84,679	1.4%
• Member contributions	540,654,068	494,546,077	9.3
Inactive participants in valuation:			
• Inactive participants due a refund of employee contributions	2,014	1,906	5.7%
• Inactive participants with a vested right to a deferred or immediate benefit	309	285	8.4%
Retired participants:			
• Number in pay status	4,299	4,201	2.3%
• Average age	72.6	71.9	0.7
• Average monthly benefit	$4,517	$4,362	3.6%
Disabled participants:			
• Number in pay status	121	121	0.0%
• Average age	70.6	70.3	0.3
• Average monthly benefit	$3,134	$3,089	1.5%
Beneficiaries:			
• Number in pay status	307	307	0.0%
• Average age	74.6	75.0	-0.4
• Average monthly benefit	$1,963	$1,755	11.9%

Notes: Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year.
Calendar year 2017 payroll figures were increased by 3.02% to reflect bargaining contracts that were settled in February 2018 and first reflected in 2018 payroll.

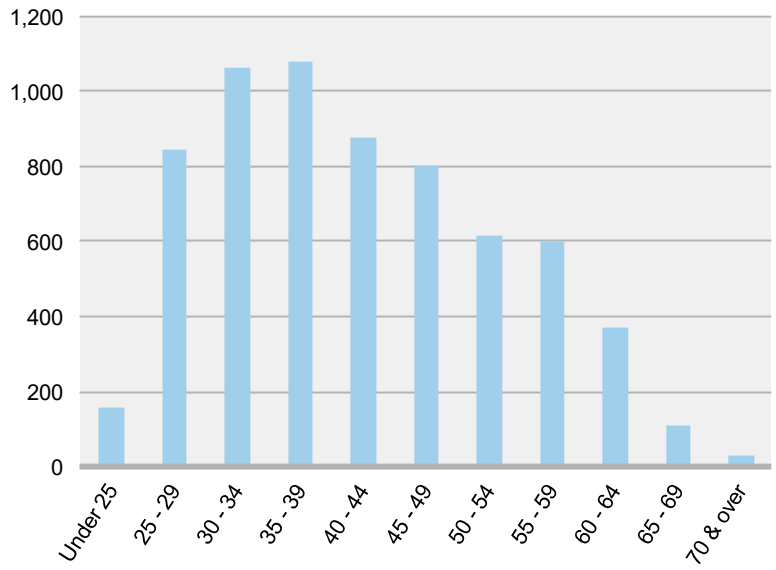
Active Participants

Plan costs are affected by the age, years of service and payroll of active participants. In this year's valuation, there were 6,550 active participants with an average age of 42.3, average service of 11.4 years and average payroll of $85,830. The 6,210 active participants in the prior valuation had an average age of 42.7, average service of 11.9 years and average payroll of $84,679.

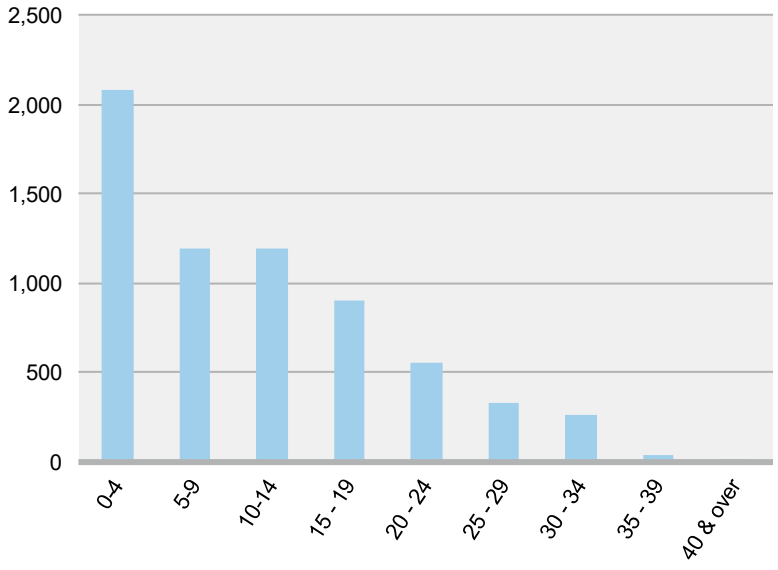
Among the active participants, there were none with unknown age information.

Distribution of Active Participants as of December 31, 2017

BY AGE



BY YEARS OF SERVICE



Inactive Participants

In this year's valuation, there were 309 participants with a right to a deferred or immediate vested benefit and 2,014 participants entitled to a return of their employee contributions.

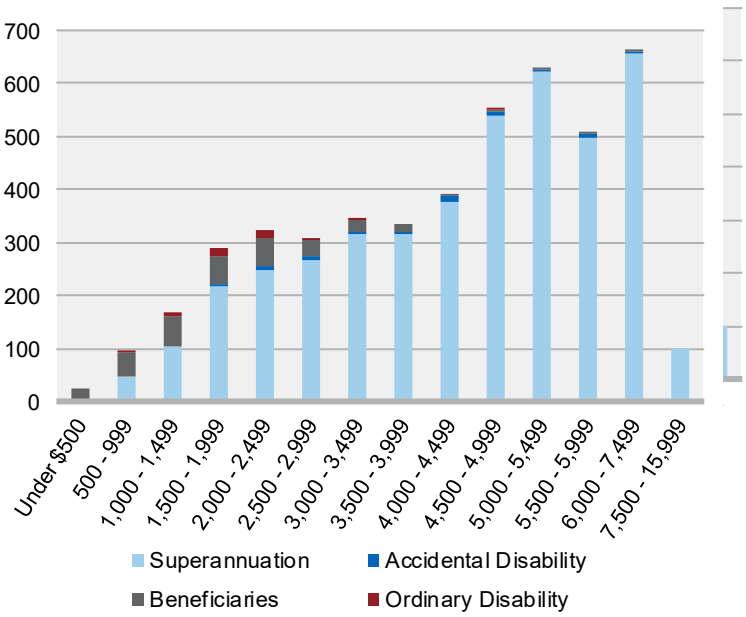
Retired Participants and Beneficiaries

As of December 31, 2017, 4,420 retired participants and 307 beneficiaries were receiving total monthly benefits of $20,399,691. For comparison, in the previous valuation, there were 4,322 retired participants and 307 beneficiaries receiving monthly benefits of $19,238,758.

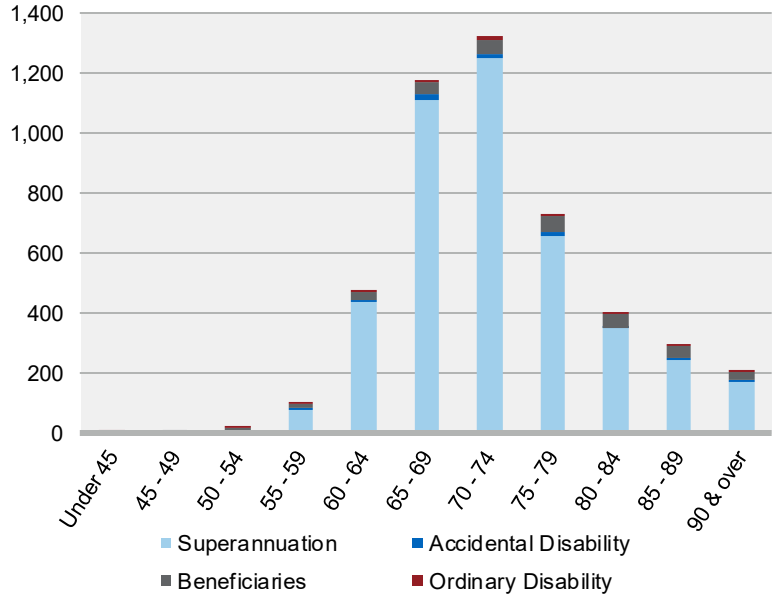
As of December 31, 2017, the average monthly benefit for retired participants and beneficiaries is $4,316, compared to $4,156 in the previous valuation. The average age for retired participants and beneficiaries is 72.7 in the current valuation, compared with 72.1 in the prior valuation.

Distribution of Retired Participants and Beneficiaries as of December 31, 2017

BY TYPE AND MONTHLY AMOUNT



BY TYPE AND AGE

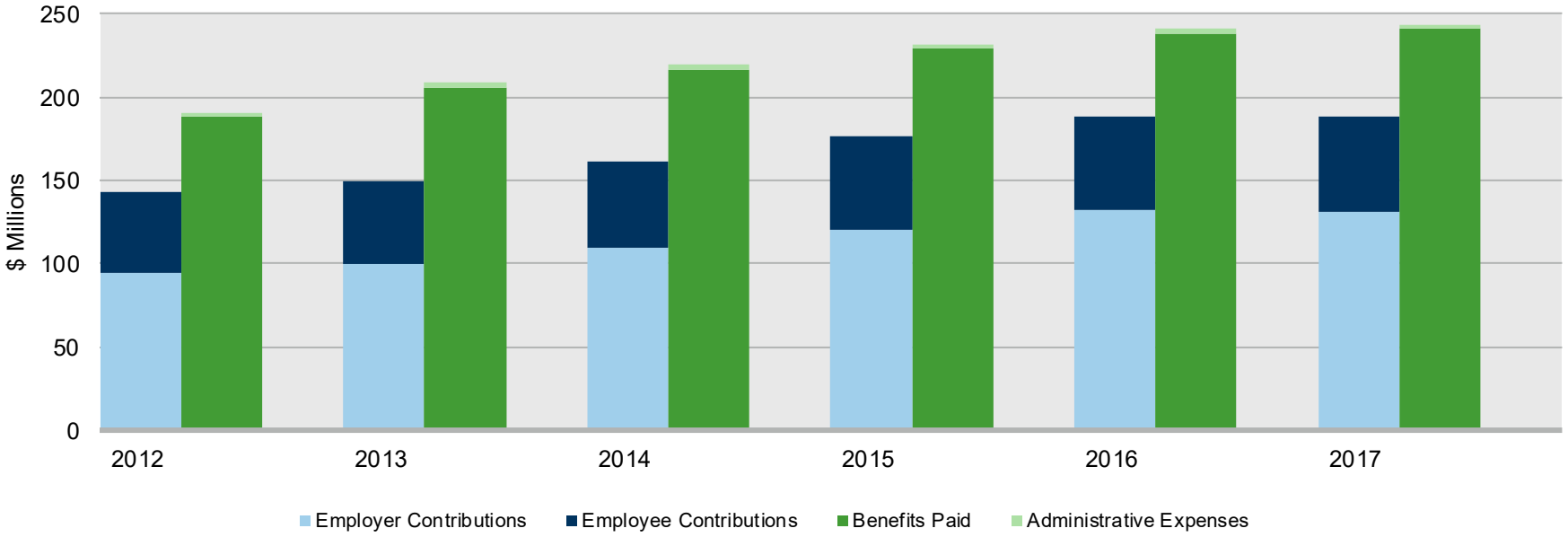


Financial Information

Retirement plan funding anticipates that, over the long term, both contributions (less administrative expenses) and investment earnings (less investment fees) will be needed to cover benefit payments. Retirement plan assets change as a result of the net impact of these income and expense components.

Additional financial information, including a summary of transactions for the valuation year, is presented in *Section 4, Exhibit D*.

COMPARISON OF CONTRIBUTIONS WITH BENEFITS AND EXPENSES FOR YEARS ENDED DECEMBER 31, 2012 – 2017



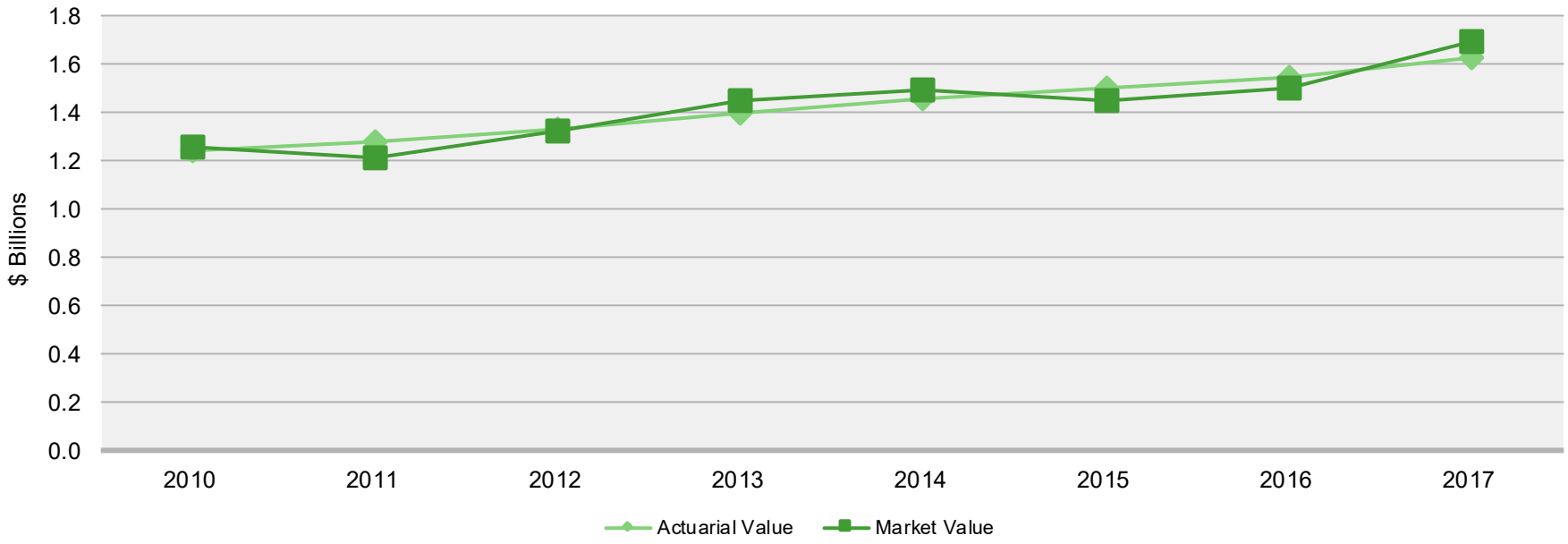
It is desirable to have level and predictable plan costs from one year to the next. For this reason, the Board has approved an asset valuation method that gradually adjusts to market value. Under this valuation method, the full value of market fluctuations is not recognized in a single year and, as a result, the asset value and the plan costs are more stable. The amount of the adjustment to recognize market value is treated as income, which may be positive or negative. Realized and unrealized gains and losses are treated equally and, therefore, the sale of assets has no immediate effect on the actuarial value.

DETERMINATION OF ACTUARIAL VALUE OF ASSETS

	Year Ended	
	December 31, 2017	December 31, 2016
1. Actuarial value of assets at the beginning of the year	$1,547,462,925	$1,500,903,796
2. Contributions, less benefit payments and expenses during the year	-55,576,818	-53,074,839
3. Average actuarial value of assets: **(1) + [50% of (2)]**	1,519,674,516	1,474,366,376
4. Expected investment income: **0.075 x (3)**	113,975,589	110,577,478
5. Preliminary actuarial value of assets at the end of the year: **(1) + (2) + (4)**	1,605,861,696	1,558,406,435
6. Market value of assets at the end of the year	1,694,050,718	1,503,688,884
7. Adjustment toward market value: **20% of [(6) - (5)]**	17,637,804	-10,943,510
8. Adjustment to be within 20% of corridor	0	0
9. Final actuarial value of assets: **(5) + (7) + (8)**	1,623,499,500	1,547,462,925
10. Actuarial value as a percentage of market value: **(9) ÷ (6)**	95.84%	102.91%

Both the actuarial value and market value of assets are representations the financial status of the Boston Retirement System. As investment gains and losses are gradually taken into account, the actuarial value of assets tracks the market value of assets. The actuarial asset value is significant because the liabilities are compared to these assets to determine what portion, if any, remains unfunded. Amortization of the unfunded actuarial accrued liability is an important element in determining the contribution requirement.

ACTUARIAL VALUE OF ASSETS VS. MARKET VALUE OF ASSETS AS OF DECEMBER 31, 2010 – 2017



Actuarial Experience

To calculate any actuarially determined contribution, assumptions are made about future events that affect the amount and timing of benefits to be paid and assets to be accumulated. Each year actual experience is measured against the assumptions. If overall experience is more favorable than anticipated (an actuarial gain), any contribution requirement will decrease from the previous year. On the other hand, any contribution requirement will increase if overall actuarial experience is less favorable than expected (an actuarial loss).

Taking account of experience gains or losses in one year without making a change in assumptions reflects the belief that the single year's experience was a short-term development and that, over the long term, experience will return to the original assumptions. For contribution requirements to remain stable, assumptions should approximate experience.

If assumptions are changed, the contribution requirement is adjusted to take into account a change in experience anticipated for all future years.

The experience gain over the two-year period is $70,479,967, which includes $6,694,294 from investment gains and $63,785,673 in gains from all other sources. The net experience variation from individual sources other than investments was 1.6% of the actuarial accrued liability. A discussion of the major components of the actuarial experience is on the following pages.

ACTUARIAL EXPERIENCE FOR TWO-YEAR PERIOD ENDED DECEMBER 31, 2017

1	Net gain from investments	$6,694,294
2	Net gain from administrative expenses	598,341
4	Net gain from other experience	63,187,332
5	Net experience gain: 1 + 2 + 3	$70,479,967

Investment Experience

A major component of projected asset growth is the assumed rate of return. The assumed return should represent the expected long-term rate of return, based on the investment policy of the PRIM Board. The rate of return on the market value of assets was 16.66% and 7.48% for the years ended December 31, 2017 and December 31, 2016, respectively.

For valuation purposes, the assumed rate of return on the actuarial value of assets is 7.50% for the 2017 and 2016 plan years. The actual rate of return on an actuarial basis for the 2017 and 2016 plan year was 8.66% and 6.76%, respectively. There was an actuarial gain during the two-year period ending December 31, 2017 with regard to its investments.

INVESTMENT EXPERIENCE

		Year Ended December 31, 2017		Year Ended December 31, 2016	
		Market Value	Actuarial Value	Market Value	Actuarial Value
1	Net investment income	$245,938,652	$131,613,393	$106,465,538	$99,633,968
2	Average value of assets	1,475,900,475	1,519,674,516	1,423,760,766	1,474,366,376
3	Rate of return: 1 ÷ 2	16.66%	8.66%	7.48%	6.76%
4	Assumed rate of return	7.50%	7.50%	7.50%	7.50%
5	Expected investment income: 2 x 4	$110,692,536	$113,975,589	$106,782,057	$110,577,478
6	Actuarial gain/(loss): 1 – 5	$135,246,116	$17,637,804	-$316,519	-$10,943,510

Because actuarial planning is long term, it is useful to see how the assumed investment rate of return has followed actual experience over time. The chart below shows the rate of return on an actuarial basis compared to the actual market value investment return for the last eight years, including an eight-year average.

We have decreased the assumed rate of return assumption from 7.50% to 7.35% for the Teachers of the Boston Retirement System to be consistent with the assumptions used in the January 1, 2018 Actuarial Valuation Report of the Massachusetts Teachers' Retirement System.

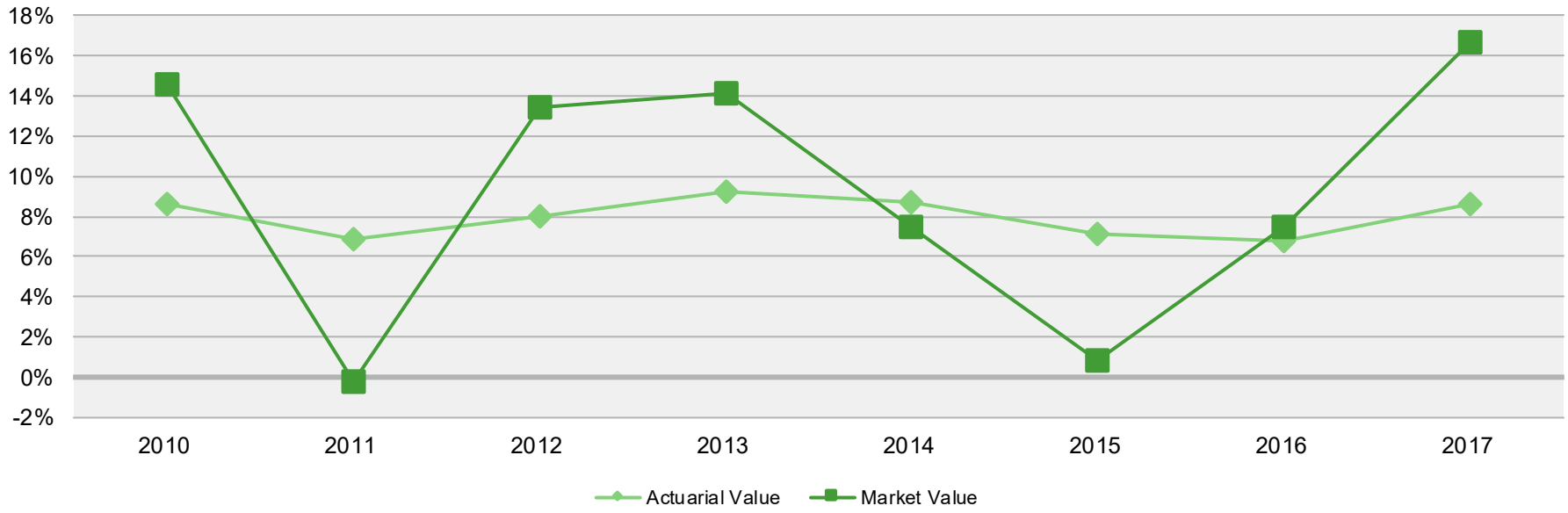
INVESTMENT RETURN – ACTUARIAL VALUE VS. MARKET VALUE: 2010 - 2017

Year Ended December 31	Actuarial Value Investment Return		Market Value Investment Return	
	Amount	Percent	Amount	Percent
2010	$95,270,615	8.64%	$154,709,657	14.59%
2011	83,285,518	6.84%	-2,647,747	-0.21%
2012	101,068,635	8.05%	159,649,908	13.45%
2013	120,630,899	9.26%	183,271,929	14.17%
2014	119,024,449	8.72%	105,879,526	7.47%
2015	101,510,620	7.11%	11,543,574	0.79%
2016	99,633,968	6.76%	106,465,538	7.48%
2017	131,613,393	8.66%	245,938,652	16.66%
Total	$852,038,097		$964,811,037	
	Eight-year average return	7.99%		9.14%

Note: Each year's yield is weighted by the average asset value in that year.

The actuarial asset valuation method gradually recognizes fluctuations in the market value rate of return. The goal of this is to stabilize the actuarial rate of return and to produce more level pension plan costs.

MARKET AND ACTUARIAL RATES OF RETURN FOR YEARS ENDED DECEMBER 31, 2010 - 2017



Administrative Expenses

Administrative expenses for the years ended December 31, 2016 and 2017 were $2,682,577 and $2,783,190, respectively, compared to the assumption of $2,850,000 for calendar 2016 and $2,978,250 for calendar 2017. This resulted in a gain of $598,341 for the two-year period, including an adjustment for interest. Based on discussions with the staff of the Boston Retirement System, we have increased the assumption for the Boston Retirement System from $9,500,000 for calendar 2016 to $11,000,000 for calendar 2018, with 30% or $3,300,000 assigned to the Teachers.

Other Experience

There are other differences between the expected and the actual experience that appear when the new valuation is compared with the projections from the previous valuation. These include:

- the extent of turnover among participants,
- retirement experience (earlier or later than projected),
- mortality (more or fewer deaths than projected),
- the number of disability retirements (more or fewer than projected), and
- salary increases (greater or smaller than projected).

The net gain from this other experience for the two-year period ending December 31, 2017 amounted to $63,187,332, which is 1.6% of the actuarial accrued liability.

LIABILITY CHANGES DUE TO DEMOGRAPHIC EXPERIENCE FOR TWO-YEAR PERIOD ENDED DECEMBER 31, 2017

Loss due to fewer deaths than expected among retired members and beneficiaries	-$10,129,851
Gain due to salary increases less than expected for continuing actives	58,367,261
Miscellaneous experience gain	14,949,922
Total	**$63,187,332**

Changes in the Actuarial Accrued Liability

The actuarial accrued liability as of January 1, 2018 is $4,044,335,400, an increase of $319,577,163, or 8.6%, from the actuarial accrued liability as of the prior valuation date. The liability is expected to grow each year with normal cost and interest, and to decline due to benefit payments made. Additional fluctuations can occur due to actual experience that differs from expected (as discussed in the previous subsection) and changes in assumptions and plan provisions as noted below.

Actuarial Assumptions

The following actuarial assumptions were changed with this valuation for Teachers:

- The mortality tables for non-disabled participants were updated from the RP-2014 Employee and Healthy Annuitant Mortality Tables projected generationally using Scale BB2D to the RP-2014 White Collar Employee and Healthy Annuitant Mortality Tables projected generationally with Scale MP-2016.
- Decrease the investment rate of return assumption from 7.50% to 7.35%.
- Increase the administrative expense assumption from $9,500,000 for calendar year 2016 to $11,000,000 for calendar year 2018, with 30%, or $3,300,000, assigned to the Teachers.

These changes increased the unfunded actuarial accrued liability by $154.2 million and increased the normal cost by $3.5 million.

Details on actuarial assumptions and methods are in *Section 5, Exhibit I*.

Plan Provisions

The following plan change is included in this valuation:

- The COLA base was increased from $13,000 to $14,000 effective July 1, 2017.

A summary of plan provisions is in *Section 5, Exhibit II*.

Development of Unfunded Actuarial Accrued Liability

		Year Ended	
		December 31, 2017	December 31, 2017
1	Unfunded actuarial accrued liability at beginning of year	$2,270,100,027	$2,223,854,441
2	Normal cost at beginning of year	72,615,130	69,488,163
3	Total contributions	-188,217,486	-188,186,287
4	Interest		
	• For whole year on **1 + 2**	$175,703,637	$172,000,695
	• For half year on **3**	-7,058,156	-7,056,985
	Total interest	168,645,481	164,943,710
5	Expected unfunded actuarial accrued liability	$2,323,143,152	$2,270,100,027
6	Changes due to:		
	• Net gain on investments	-$6,694,294	- -
	• Net gain from other experience	-63,785,673	- -
	• COLA base increase	13,967,197	- -
	• Assumption changes	154,205,518	- -
	Total changes	97,692,748	- -
7	Unfunded actuarial accrued liability at end of year	$2,420,835,900	- -

Actuarially Determined Contribution

The actuarially determined contribution is equal to the employer normal cost payment and a payment on the unfunded actuarial accrued liability.

The fiscal 2019 appropriation for the Teachers has already been budgeted at $143,145,563 by the Commonwealth. The fiscal 2020 appropriation is expected to increase by 8.94% and the pension obligations of the Commonwealth are expected to be fully funded by June 30, 2036.

ACTUARIALLY DETERMINED CONTRIBUTION

		For Year Beginning January 1 2018		For Year Beginning January 1 2016	
		Amount	% of Projected Payroll	Amount	% of Projected Payroll
1	Total normal cost	$74,523,376	12.61%	$66,638,163	12.05%
2	Administrative expenses	3,300,000	0.56%	$2,850,000	0.52%
3	Expected employee contributions	-63,410,670	-10.73%	-58,977,399	-10.67%
4	Employer normal cost: **(1) + (2) + (3)**	$14,412,706	2.44%	$10,510,764	1.90%
5	Actuarial accrued liability	4,044,335,400		3,724,758,237	
6	Actuarial value of assets	1,623,499,500		1,500,903,796	
7	Unfunded actuarial accrued liability: **(5) - (6)**	$2,420,835,900		$2,223,854,441	
8	Employer normal cost projected to July 1, 2018 and 2016, adjusted for timing	15,173,703	2.53%	11,140,294	1.97%
9	Projected unfunded actuarial accrued liability, adjusted for timing	2,508,224,326		2,305,741,360	
10	Payment on projected unfunded actuarial accrued liability, adjusted for timing	127,971,860	21.31%	121,336,706	21.47%
11	Budgeted appropriation for fiscal 2019 and 2017: **(8) + (10)**	$143,145,563	23.83%	$132,477,000	23.44%
12	Projected payroll as of July 1	$600,605,514		$565,259,211	

Note: Actuarially determined contributions are assumed to be paid on December 31.

Risk

Since the actuarial valuation results depend on a single set of assumptions, there is a risk that emerging results may differ significantly as actual experience proves to be different from the current assumptions.

We have not been engaged to perform a detailed analysis of the potential range of the impact of risk relative to the System's future financial condition, but have included a brief discussion of some of the risks that may affect the System. This discussion is focused on funding-related risks, but similar concerns may apply to risks regarding the level of expense and liabilities reported for System accounting purposes as well.

We recommend a more detailed assessment of the risks to provide the Board with a better understanding of the risks inherent in the System. This assessment may include scenario testing, sensitivity testing, and/or stochastic modeling.

A detailed risk assessment is important for your System because relatively small changes in investment performance can produce large increases in the contribution requirements since the funding schedule is relatively short.

- Investment Risk (the risk that returns will be different than expected)

  The market value rate of return over the last eight years has ranged from a low of -0.21% to a high of 16.66%.

- Longevity Risk (the risk that mortality experience will be different than expected)

  The actuarial valuation includes an expectation of future improvement in life expectancy. Emerging plan experience that does not match these expectations will result in either an increase or decrease in the actuarially determined contribution.

- Contribution Risk (the risk that actual contributions will be different from actuarially determined contribution)

  Massachusetts General Law requires payment of the actuarially determined contribution. If future experience matches the current assumptions, we project the unfunded actuarial accrued liability will be paid off in 18 years.

- Demographic Risk (the risk that participant experience will be different than assumed)

  Examples of this risk include:

  - Actual retirements occurring earlier or later than assumed.
  - More or less active participant turnover than assumed.

- Disability experience greater or less than expected
- Salary increases greater or less than projected.

➢ Actual Experience in Recent Years and Implications for the Future

Past experience can help demonstrate the sensitivity of key results to the Plan's actual experience.

- The investment gain(loss) over the past eight years has ranged from a loss of $105,767,364 to a gain of $135,246,116.
- The non-investment gain(loss) over the past five valuations has ranged from a loss of $159,093,818 to a gain of $122,688,672.
- Since 2008, the funded percentage on the actuarial value of assets has ranged from a low of 40.1% as of January 1, 2018 to a high of 50.36% as of January 1, 2008.

➢ Maturity Measures

As pension plans mature, the cashed need to fulfill benefit obligations will increase over time. Therefore, cash flow projections and analysis should be performed to assure that the Plan's asset allocation is aligned to meet emerging pension liabilities.

Section 4: Supplemental Information

EXHIBIT A – PARTICIPANTS IN ACTIVE SERVICE AS OF DECEMBER 31, 2017 – BRS EXCLUDING TEACHERS BY AGE, YEARS OF SERVICE, AND AVERAGE PAYROLL

	Years of Service									
Age	Total	0-4	5-9	10-14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 & over
Under 25	346	345	1	- -	- -	- -	- -	- -	- -	- -
	$35,791	$35,781	$39,048	- -	- -	- -	- -	- -	- -	- -
25 - 29	1,344	1,163	175	6	- -	- -	- -	- -	- -	- -
	$51,070	$49,946	$58,630	$48,262	- -	- -	- -	- -	- -	- -
30 - 34	1,608	870	518	213	7	- -	- -	- -	- -	- -
	$63,295	$54,954	$73,765	$71,872	$64,154	- -	- -	- -	- -	- -
35 - 39	1,632	571	371	519	163	8	- -	- -	- -	- -
	$68,734	$48,929	$71,242	$85,670	$78,370	$71,016	- -	- -	- -	- -
40 - 44	1,472	360	216	344	375	169	8	- -	- -	- -
	$70,736	$44,864	$61,570	$79,120	$85,211	$88,106	$76,524	- -	- -	- -
45 - 49	1,843	378	195	248	388	418	146	70	- -	- -
	$72,913	$42,051	$57,123	$61,770	$79,337	$98,283	$92,157	$95,802	- -	- -
50 - 54	2,064	325	190	226	292	322	337	354	17	1
	$75,278	$42,484	$49,818	$52,683	$67,279	$89,158	$102,033	$100,767	$99,485	$91,526
55 - 59	1,953	197	173	203	273	248	259	463	127	10
	$75,780	$44,008	$51,254	$49,758	$55,108	$77,277	$92,780	$104,344	$100,862	$100,149
60 - 64	1,431	112	115	141	230	184	170	294	136	49
	$71,944	$41,218	$53,080	$48,499	$57,038	$62,545	$74,862	$98,384	$104,141	$101,040
65 - 69	531	73	54	78	93	76	59	54	18	26
	$52,796	$34,232	$45,208	$50,488	$50,100	$54,437	$52,992	$62,684	$78,291	$93,821
70 & over	219	24	14	31	40	34	22	28	6	20
	$46,367	$26,213	$35,503	$34,966	$49,012	$49,876	$59,040	$52,825	$46,978	$61,406
Unknown	2	2	- -	- -	- -	- -	- -	- -	- -	- -
	$35,000	$35,000	- -	- -	- -	- -	- -	- -	- -	- -
Total	14,445	4,420	2,022	2,009	1,861	1,459	1,001	1,263	304	106
	$67,709	$47,176	$62,687	$67,926	$70,064	$83,451	$89,545	$98,557	$99,852	$91,617

Note: Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year.

EXHIBIT B – SUMMARY STATEMENT OF INCOME AND EXPENSES ON A MARKET VALUE BASIS – BRS EXCLUDING TEACHERS

	Year Ended December 31, 2017		Year Ended December 31, 2016	
Net assets at market value at the beginning of the year		$4,347,394,286		$4,108,995,185
Contribution income:				
• Employer contributions	$260,164,621		$247,770,904	
• Employee contributions	98,017,538		98,170,530	
• Less administrative expenses	-4,289,157		-5,037,943	
Net contribution income		353,893,002		340,903,491
Net investment income		741,446,031		253,867,742
Total income available for benefits		$1,095,339,033		$594,771,233
Less benefit payments		-$370,292,900		-$356,372,132
Change in reserve for future benefits		$725,046,133		$238,399,101
Net assets at market value at the end of the year		$5,072,440,419		$4,347,394,286

EXHIBIT C – PARTICIPANTS IN ACTIVE SERVICE AS OF DECEMBER 31, 2017 - TEACHERS BY AGE, YEARS OF SERVICE, AND AVERAGE PAYROLL

		Years of Service								
Age	Total	0-4	5-9	10-14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 & over
Under 25	159	159	- -	- -	- -	- -	- -	- -	- -	- -
	$57,840	$57,840	- -	- -	- -	- -	- -	- -	- -	- -
25 - 29	843	758	84	1	- -	- -	- -	- -	- -	- -
	$64,439	$63,161	$76,254	$41,286	- -	- -	- -	- -	- -	- -
30 - 34	1,065	543	425	97	- -	- -	- -	- -	- -	- -
	$77,797	$68,861	$84,877	$96,802	- -	- -	- -	- -	- -	- -
35 - 39	1,077	231	316	439	87	4	- -	- -	- -	- -
	$87,607	$68,408	$85,086	$96,820	$100,597	$101,876	- -	- -	- -	- -
40 - 44	879	123	133	282	283	53	5	- -	- -	- -
	$92,984	$72,866	$87,011	$97,260	$98,052	$105,111	$90,239	- -	- -	- -
45 - 49	800	122	98	130	202	197	44	7	- -	- -
	$93,082	$70,950	$85,199	$92,921	$98,332	$101,299	$110,983	$96,924	- -	- -
50 - 54	618	65	54	86	121	106	130	56	- -	- -
	$94,512	$68,624	$91,939	$88,760	$95,043	$101,590	$103,900	$99,539	- -	- -
55 - 59	600	52	54	89	101	99	80	111	12	2
	$96,118	$73,112	$85,291	$94,792	$95,281	$97,616	$103,980	$107,305	$94,559	87,718
60 - 64	371	18	19	46	72	73	54	64	19	6
	$97,178	$65,685	$85,485	$90,085	$95,439	$98,136	$99,744	$108,165	$107,922	117,933
65 - 69	111	7	14	13	27	17	14	12	1	6
	$95,851	$44,382	$93,772	$101,582	$93,593	$99,487	$104,910	$104,227	$109,592	108,019
70 & over	27	2	- -	4	6	4	3	4	1	3
	$92,176	$91,223	- -	$48,760	$95,020	$88,353	$106,484	$108,976	$108,011	108,121
Total	6,550	2,080	1,197	1,187	899	553	330	254	33	17
	$85,830	$66,261	$85,041	$95,343	$97,281	$100,498	$104,043	$105,404	$103,116	$109,147

Note: Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. Calendar year payroll figures were increased by 3.02% to reflect bargaining contracts that were settled in February 2018 and first reflected in 2018 payroll.

EXHIBIT D – SUMMARY STATEMENT OF INCOME AND EXPENSES ON A MARKET VALUE BASIS – TEACHERS

	Year Ended December 31, 2017		Year Ended December 31, 2015	
Net assets at market value at the beginning of the year		$1,503,688,884		$1,450,298,185
Contribution income:				
• Employer contributions	$131,297,926		$132,477,000	
• Employee contributions	56,919,560		55,709,287	
• Less administrative expenses	-2,783,190		-2,682,577	
Net contribution income		185,434,296		185,503,710
Net investment income:		245,938,652		106,465,538
Total income available for benefits		$431,372,948		$291,969,248
Less benefit payments		-$241,011,114		-$238,578,549
Change in reserve for future benefits		$190,361,834		$53,390,699
Net assets at market value at the end of the year		$1,694,050,718		$1,503,688,884

EXHIBIT E – PARTICIPANT POPULATION – ALL EMPLOYEES: 1999 – 2017

Year Ended December 31	Active Participants	Inactive Participants	Retired Participants and Beneficiaries	Total Non-Actives	Ratio of Non-Actives to Actives
1999	19,953	1,459	13,381	14,840	0.74
2001	22,003	3,560	13,144	16,704	0.76
2003	20,456	5,294	14,034	19,328	0.94
2005	20,917	6,178	13,783	19,961	0.95
2007	21,748	6,240	13,939	20,179	0.93
2009	20,015	7,613	13,958	21,571	1.08
2011	19,399	8,787	14,189	22,976	1.18
2013	20,278	8,791	14,341	23,132	1.14
2015	20,498	9,740	14,485	24,225	1.18
2017	20,995	10,623	14,448	25,071	1.19

EXHIBIT F – TABLE OF PLAN COVERAGE – ALL EMPLOYEES

Category	Year Ended December 31		Change From Prior Year
	2017	2015	
Active participants in valuation:			
• Number	20,995	20,498	2.4%
• Average age	45.1	45.3	-0.2
• Average years of service	13.0	13.3	-0.3
• Total payroll[1]	$1,540,244,906	$1,434,989,765	7.3%
• Average payroll[1]	73,362	70,006	4.8%
• Member contributions	1,554,003,803	1,438,290,598	8.0%
• Number with unknown age	2	43	N/A
Inactive participants in valuation:			
• Inactive participants due a refund of employee contributions	1,109	1,050	5.6%
• Inactive participants with a vested right to a deferred or immediate benefit	9,514	8,690	9.5%
Retired participants:			
• Number in pay status	10,442	10,278	1.6%
• Average age	73.5	73.3	0.2
• Average monthly benefit	$3,605	$3,395	6.2%
Disabled participants:			
• Number in pay status	1,795	1,863	-3.7%
• Average age	68.9	68.1	0.8
• Average monthly benefit	$4,121	$3,889	6.0%
Beneficiaries:			
• Number in pay status	2,211	2,344	-5.7%
• Average age	76.9	77.1	-0.2
• Average monthly benefit	$1,836	$1,664	10.3%

[1] Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. For Boston Retirement System excluding Teachers, calendar year 2015 payroll figures were increased by 14.3% for members of the Police Detectives Benevolent Society, plus a one-time $2,000 parity increase, to reflect bargaining contracts that were settled in December 2015 and first reflected in 2016 payroll. For Teachers, calendar year 2017 payroll figures were increased by 3.02% to reflect bargaining contracts that were settled in February 2018 and first reflected in 2018 payroll.

EXHIBIT G – INVESTMENT RETURN – ACTUARIAL VALUE VS. MARKET VALUE – ALL ASSETS: 2006 - 2017

Year Ended December 31	Actuarial Value Investment Return		Market Value Investment Return	
	Amount	Percent	Amount	Percent
2006	$335,622,622	8.79%	$506,115,642	13.43%
2007	368,013,791	8.95%	403,369,820	9.53%
2008	-330,344,896	-7.44%	-1,167,563,433	-25.41%
2009	251,082,864	6.17%	635,296,107	18.76%
2010	323,178,217	7.48%	486,428,288	11.99%
2011	279,060,679	6.00%	-3,490,893	-0.08%
2012	337,283,979	7.03%	558,297,133	12.65%
2013	422,190,300	8.41%	692,082,990	14.26%
2014	411,548,325	7.72%	283,342,371	5.21%
2015	345,566,005	6.12%	-15,624,093	-0.28%
2016	358,940,806	6.08%	360,333,280	6.52%
2017	502,437,169	8.11%	987,384,683	16.98%
Total	$3,604,579,861		$3,725,971,895	
Most recent five-year average return		7.26%		8.46%
Most recent ten-year average return		5.76%		5.84%
12-year average return		6.18%		6.62%

Note: Each year's yield is weighted by the average asset value in that year.

EXHIBIT H – MARKET AND ACTUARIAL RATES OF RETURN
FOR YEARS ENDED DECEMBER 31, 2006 – 2017 – ALL ASSETS

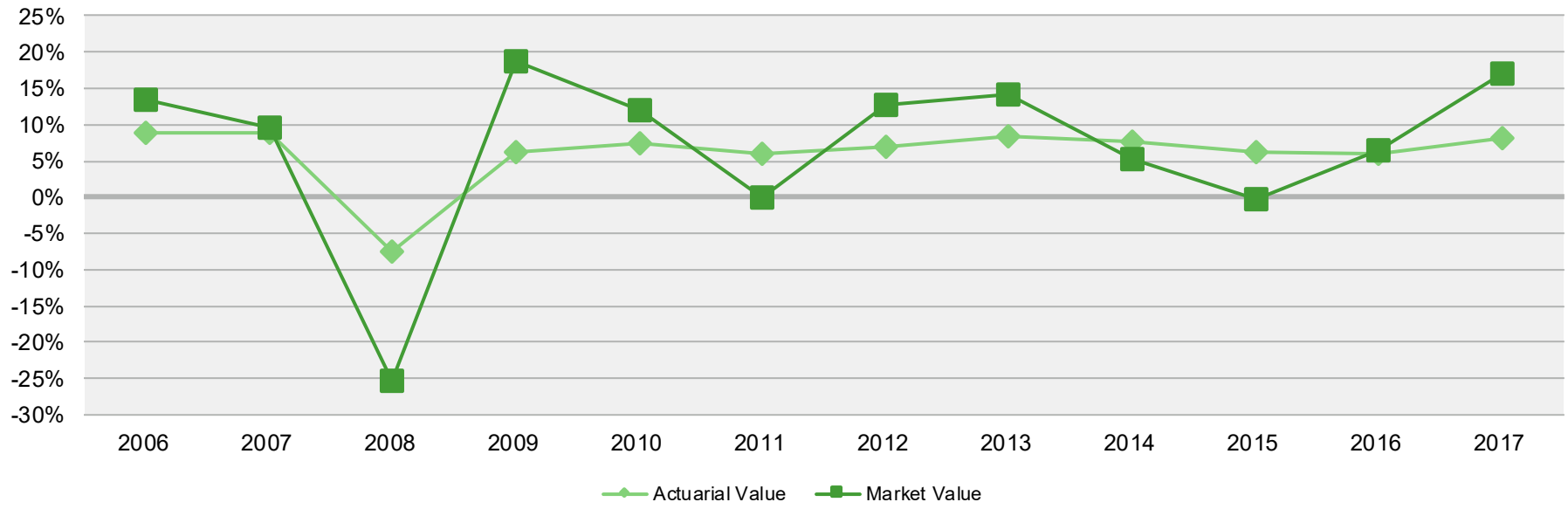


EXHIBIT I – DEFINITIONS OF PENSION TERMS

The following list defines certain technical terms for the convenience of the reader:

Actuarial Accrued Liability for Actives:	The equivalent of the accumulated normal costs allocated to the years before the valuation date.
Actuarial Accrued Liability for Pensioners and Beneficiaries:	The single-sum value of lifetime benefits to existing pensioners and beneficiaries. This sum takes account of life expectancies appropriate to the ages of the annuitants and the interest that the sum is expected to earn before it is entirely paid out in benefits.
Actuarial Cost Method:	A procedure allocating the Actuarial Present Value of Future Benefits to various time periods; a method used to determine the Normal Cost and the Actuarial Accrued Liability that are used to determine the actuarially determined contribution.
Actuarial Gain or Loss:	A measure of the difference between actual experience and that expected based upon a set of Actuarial Assumptions, during the period between two Actuarial Valuation dates. Through the actuarial assumptions, rates of decrements, rates of salary increases, and rates of fund earnings have been forecasted. To the extent that actual experience differs from that assumed, Actuarial Accrued Liabilities emerge which may be the same as forecasted, or may be larger or smaller than projected. Actuarial gains are due to favorable experience, e.g., assets earn more than projected, salary increases are less than assumed, members retire later than assumed, etc. Favorable experience means actual results produce actuarial liabilities not as large as projected by the actuarial assumptions. On the other hand, actuarial losses are the result of unfavorable experience, i.e., actual results yield in actuarial liabilities that are larger than projected. Actuarial gains will shorten the time required for funding of the actuarial balance sheet deficiency while actuarial losses will lengthen the funding period.
Actuarially Equivalent:	Of equal actuarial present value, determined as of a given date and based on a given set of Actuarial Assumptions.
Actuarial Present Value (APV):	The value of an amount or series of amounts payable or receivable at various times, determined as of a given date by the application of a particular set of Actuarial Assumptions. Each such amount or series of amounts is: Adjusted for the probable financial effect of certain intervening events (such as changes in compensation levels, marital status, etc.) Multiplied by the probability of the occurrence of an event (such as survival, death, disability, withdrawal, etc.) on which the payment is conditioned, and Discounted according to an assumed rate (or rates) of return to reflect the time value of money.

Actuarial Present Value of Future Plan Benefits:	The Actuarial Present Value of benefit amounts expected to be paid at various future times under a particular set of Actuarial Assumptions, taking into account such items as the effect of advancement in age, anticipated future compensation, and future service credits. The Actuarial Present Value of Future Plan Benefits includes the liabilities for active members, retired members, beneficiaries receiving benefits, and inactive members entitled to either a refund or a future retirement benefit. Expressed another way, it is the value that would have to be invested on the valuation date so that the amount invested plus investment earnings would provide sufficient assets to pay all projected benefits and expenses when due.
Actuarial Valuation:	The determination, as of a valuation date, of the Normal Cost, Actuarial Accrued Liability, Actuarial Value of Assets, and related Actuarial Present Values for a plan. An Actuarial Valuation for a governmental retirement system typically also includes calculations of items needed for compliance with GASB, such as the Actuarially Determined Contribution (ADC) and the Net Pension Liability (NPL).
Actuarial Value of Assets (AVA):	The value of the Fund's assets as of a given date, used by the actuary for valuation purposes. This may be the market or fair value of plan assets, but commonly plans use a smoothed value in order to reduce the year-to-year volatility of calculated results, such as the funded ratio and the ADC.
Actuarially Determined:	Values that have been determined utilizing the principles of actuarial science. An actuarially determined value is derived by application of the appropriate actuarial assumptions to specified values determined by provisions of the law.
Actuarially Determined Contribution (ADC):	The employer's periodic required contributions, expressed as a dollar amount or a percentage of covered plan compensation, determined under the Plan's funding policy. The ADC consists of the Employer Normal Cost and the Amortization Payment.
Amortization Method:	A method for determining the Amortization Payment. The most common methods used are level dollar and level percentage of payroll. Under the Level Dollar method, the Amortization Payment is one of a stream of payments, all equal, whose Actuarial Present Value is equal to the UAAL. Under the Level Percentage of Pay method, the Amortization Payment is one of a stream of increasing payments, whose Actuarial Present Value is equal to the UAAL. Under the Level Percentage of Pay method, the stream of payments increases at the assumed rate at which total covered payroll of all active members will increase.
Amortization Payment:	The portion of the pension plan contribution, or ADC, that is designed to pay interest on and to amortize the Unfunded Actuarial Accrued Liability.

Assumptions or Actuarial Assumptions:	The estimates upon which the cost of the Fund is calculated, including: Investment return - the rate of investment yield that the Fund will earn over the long-term future; Mortality rates - the death rates of employees and pensioners; life expectancy is based on these rates; Retirement rates - the rate or probability of retirement at a given age or service; Disability rates – the probability of disability retirement at a given age; Withdrawal rates - the rates at which employees of various ages are expected to leave employment for reasons other than death, disability, or retirement; Salary increase rates - the rates of salary increase due to inflation and productivity growth.
Closed Amortization Period:	A specific number of years that is counted down by one each year, and therefore declines to zero with the passage of time. For example, if the amortization period is initially set at 30 years, it is 29 years at the end of one year, 28 years at the end of two years, etc. See Open Amortization Period.
Decrements:	Those causes/events due to which a member's status (active-inactive-retiree-beneficiary) changes, that is: death, retirement, disability, or withdrawal.
Defined Benefit Plan:	A retirement plan in which benefits are defined by a formula applied to the member's compensation and/or years of service.
Defined Contribution Plan:	A retirement plan, such as a 401(k) plan, a 403(b) plan, or a 457 plan, in which the contributions to the plan are assigned to an account for each member, the plan's earnings are allocated to each account, and each member's benefits are a direct function of the account balance.
Employer Normal Cost:	The portion of the Normal Cost to be paid by the employer. This is equal to the Normal Cost less expected member contributions.
Experience Study:	A periodic review and analysis of the actual experience of the Fund that may lead to a revision of one or more actuarial assumptions. Actual rates of decrement and salary increases are compared to the actuarially assumed values and modified as deemed appropriate by the Actuary.
Funded Ratio:	The ratio of the actuarial value of assets (AVA) to the actuarial accrued liability (AAL). Plans sometimes calculate a market funded ratio, using the market value of assets (MVA), rather than the AVA.
GASB 67 and GASB 68:	Governmental Accounting Standards Board (GASB) Statements No. 67 and No. 68. These are the governmental accounting standards that set the accounting rules for public retirement systems and the employers that sponsor or contribute to them. Statement No. 68 sets the accounting rules for the employers that sponsor or contribute to public retirement systems, while Statement No. 67 sets the rules for the systems themselves.

Investment Return:	The rate of earnings of the Fund from its investments, including interest, dividends and capital gain and loss adjustments, computed as a percentage of the average value of the fund. For actuarial purposes, the investment return often reflects a smoothing of the capital gains and losses to avoid significant swings in the value of assets from one year to the next.
Net Pension Liability (NPL):	The Net Pension Liability is equal to the Total Pension Liability minus the Plan Fiduciary Net Position.
Normal Cost:	That portion of the Actuarial Present Value of pension plan benefits and expenses allocated to a valuation year by the Actuarial Cost Method. Any payment in respect of an Unfunded Actuarial Accrued Liability is not part of Normal Cost (see Amortization Payment). For pension plan benefits that are provided in part by employee contributions, Normal Cost refers to the total of employee contributions and employer Normal Cost unless otherwise specifically stated.
Open Amortization Period:	An open amortization period is one which is used to determine the Amortization Payment but which does not change over time. If the initial period is set as 30 years, the same 30-year period is used in determining the Amortization Period each year. In theory, if an Open Amortization Period with level percentage of payroll is used to amortize the Unfunded Actuarial Accrued Liability, the UAAL will never decrease, but will become smaller each year, in relation to covered payroll, if the actuarial assumptions are realized.
Plan Fiduciary Net Position:	Market value of assets.
Total Pension Liability (TPL):	The actuarial accrued liability under the entry age normal cost method and based on the blended discount rate as described in GASB 67 and 68.
Unfunded Actuarial Accrued Liability:	The excess of the Actuarial Accrued Liability over the Actuarial Value of Assets. This value may be negative, in which case it may be expressed as a negative Unfunded Actuarial Accrued Liability, also called the Funding Surplus.
Valuation Date or Actuarial Valuation Date:	The date as of which the value of assets is determined and as of which the Actuarial Present Value of Future Plan Benefits is determined. The expected benefits to be paid in the future are discounted to this date.

Section 5: Actuarial Valuation Basis

EXHIBIT I – ACTUARIAL ASSUMPTIONS AND ACTUARIAL COST METHOD

Rationale for Demographic and Noneconomic Assumptions for Teachers:	The assumptions for the Teachers are the same as used in the Massachusetts Teachers' Retirement System Actuarial Valuation Report as of January 1, 2018. These assumptions were used because there is a larger experience base to rely on and because the liabilities of the Boston Teachers are funded by the Commonwealth of Massachusetts. We have reviewed these demographic assumptions and have no reason to doubt their reasonableness.
Net Investment Return:	7.50% for BRS excluding Teachers and 7.35% for Teachers (previously, 7.75% for BRS excluding Teachers and 7.50% for Teachers) The net investment return assumption for BRS excluding Teachers is a long-term estimate derived from historical data, current and recent market expectations, and professional judgment. As part of the analysis, a building block approach was used that reflects inflation expectations and anticipated risk premiums for each of the portfolio's asset classes, as well as the Plan's target asset allocation.

Salary Increases:

Years of Service	Teachers	BRS Excluding Teachers		
		Group 1	Group 2	Group 4
0	7.50%	4.00%	4.25%	4.50%
1	7.10%	4.00%	4.25%	4.50%
2	7.00%	4.00%	4.25%	4.50%
3	6.90%	4.00%	4.25%	4.50%
4	6.80%	4.00%	4.25%	4.50%
5	6.70%	4.00%	4.25%	4.50%
6	6.60%	4.00%	4.25%	4.50%
7	6.50%	4.00%	4.25%	4.50%
8	6.30%	4.00%	4.25%	4.50%
9	6.10%	4.00%	4.25%	4.50%
10	5.90%	4.00%	4.25%	4.50%
11	5.70%	4.00%	4.25%	4.50%
12	5.20%	4.00%	4.25%	4.50%
13	4.70%	4.00%	4.25%	4.50%
14	4.35%	4.00%	4.25%	4.50%
15-16	4.20%	4.00%	4.25%	4.50%
17-19	4.10%	4.00%	4.25%	4.50%
20 and later	4.00%	4.00%	4.25%	4.50%

Includes allowance for inflation of 3.25%.

The salary scale assumption for BRS excluding Teachers is a long-term estimate derived from historical data, current and recent market expectations, and professional judgment.

Interest on Employee Contributions:

3.5%

Administrative Expenses:

$11,000,000 for calendar year 2018, with 70%, or $7,700,000 assigned to the BRS excluding Teachers, and 30%, or $3,300,000, assigned to the Teachers (previously, $9,500,000 for calendar 2016, with 70%, or $6,650,000, assigned to the BRS excluding Teachers and 30%, or $2,850,000, assigned to Teachers).

The administrative expense assumption is based on information on expenses provided by the Retirement System.

Mortality Rates:	<u>BRS excluding Teachers</u> *Healthy:* RP-2014 Blue Collar Employee and Healthy Annuitant Mortality Tables set forward one year for female participants projected generationally using Scale MP-2017 (previously, RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale BB2D from 2009) *Disabled:* RP-2014 Blue Collar Healthy Annuitant Mortality Table set forward one year projected generationally using Scale MP-2017 (previously, RP-2000 Healthy Annuitant Mortality Table projected generationally with Scale BB2D from 2015) The underlying tables with generational projection to the ages of the participants as of the measurement date reasonably reflect the projected mortality experience of the Plan as of the measurement date based on historical and current demographic data. As part of the analysis, a comparison was made between the actual number of retiree deaths and the projected number based on the prior years' assumptions over the four most recent valuations. The mortality tables were then adjusted to future years using a generational projection under Scale MP-2017 to reflect future mortality improvement. <u>Teachers</u> *Healthy:* RP-2014 White Collar Employee and Healthy Annuitant Mortality Tables projected generationally with Scale MP-2016 (previously, RP-2014 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale BB2D from 2014) *Disabled:* RP-2014 Healthy Annuitant Mortality Table set forward four years projected generationally with Scale BB2D from 2014

Termination Rates before Retirement:

Groups 1 and 2 Rate (%) – BRS Excluding Teachers						
	Mortality					
	Current		Previous			
Age	Male	Female	Male	Female	Disability	Withdrawal
20	0.05	0.02	0.03	0.02	0.03	6.58
25	0.06	0.02	0.04	0.02	0.04	5.27
30	0.06	0.03	0.04	0.03	0.06	4.83
35	0.07	0.03	0.08	0.05	0.07	4.47
40	0.08	0.05	0.11	0.07	0.11	3.84
45	0.13	0.08	0.15	0.11	0.18	3.21
50	0.22	0.14	0.21	0.17	0.30	1.52
55	0.36	0.20	0.30	0.25	0.50	0.33
60	0.61	0.30	0.49	0.39	0.81	0.00

Notes: Mortality rates do not reflect generational projection.
50% of the disability rates shown represent accidental disability.
20% of the accidental disabilities will die from the same cause as the disability.
20% of the death rates shown represent accidental death.

	Group 4 Rate (%) – BRS Excluding Teachers					
	Mortality					
	Current		Previous			
Age	Male	Female	Male	Female	Disability	Withdrawal
20	0.05	0.02	0.03	0.02	0.15	0.00
25	0.06	0.02	0.04	0.02	0.21	0.00
30	0.06	0.03	0.04	0.03	0.28	0.00
35	0.07	0.03	0.08	0.05	0.37	0.00
40	0.08	0.05	0.11	0.07	0.55	0.00
45	0.13	0.08	0.15	0.11	0.90	0.00
50	0.22	0.14	0.21	0.17	1.51	0.00
55	0.36	0.20	0.30	0.25	2.52	0.00
60	0.61	0.30	0.49	0.39	0.00	0.00

Notes: Mortality rates do not reflect generational projection.
90% of the disability rates shown represent accidental disability.
60% of the accidental disabilities will die from the same cause as the disability.
50% of the death rates shown represent accidental death.

The termination rates and disability rates for the BRS excluding Teachers were based on historical and current demographic data, adjusted to reflect economic conditions of the area and estimated future experience and professional judgment. As part of the analysis, a comparison was made between the actual number of terminations and disability retirements and the projected number based on the prior years' assumptions over the four most recent valuations.

Age	Rate (%) – Teachers				
	Mortality				
	Current		Previous		
	Male	Female	Male	Female	Disability
20	0.03	0.01	0.04	0.02	0.04
25	0.03	0.01	0.05	0.02	0.05
30	0.03	0.02	0.05	0.02	0.06
35	0.04	0.02	0.05	0.03	0.06
40	0.04	0.03	0.06	0.04	0.10
45	0.07	0.06	0.10	0.07	0.30
50	0.12	0.09	0.17	0.11	0.50
55	0.20	0.14	0.28	0.17	0.70
60	0.33	0.21	0.47	0.24	0.70

Notes: Mortality rates do not reflect generational projection.
35% of the disability rates shown represent accidental disability.
40% of the accidental disabilities will die from the same cause as the disability.
75% of the death rates shown represent accidental death.

Withdrawal Rates:

	Rate (%) - Teachers									
	Years of Service									
	0 - 1		2		3		4		5	
Age	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
20	13.0	10.0	11.5	10.5	8.3	7.5	6.6	7.3	5.5	7.0
30	15.0	15.0	11.0	11.5	8.9	10.0	7.0	10.0	5.4	8.8
40	13.3	10.5	13.0	8.5	7.1	6.6	7.5	5.2	5.2	5.0
50	16.2	9.8	12.2	12.0	8.8	7.0	9.0	6.6	7.0	5.0

	Rate (%) - Teachers									
	Years of Service									
	6		7		8		9		10+	
Age	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
20	4.0	5.0	4.0	6.0	3.3	7.0	1.5	7.0	1.5	5.0
30	4.5	7.3	4.0	6.0	3.3	7.0	1.5	6.0	1.5	4.5
40	5.5	5.0	3.0	4.5	3.4	3.5	2.5	3.0	1.7	2.2
50	6.5	3.0	5.0	4.0	2.2	2.4	2.5	3.0	2.3	2.0

Retirement Rates:

Rate (%) – BRS excluding Teachers			
Age	Groups 1 and 2	Age	Group 4
55	3.0	50	1.0
56	3.0	51	1.0
57	3.0	52	1.0
58	3.0	53	1.0
59	3.0	54	1.0
60	8.0	55	10.0
61	8.0	56	5.0
62	15.0	57	5.0
63	10.0	58	5.0
64	10.0	59	5.0
65	35.0	60	10.0
66	20.0	61	15.0
67	20.0	62	15.0
68	20.0	63	15.0
69	20.0	64	25.0
70	100.0	65	100.0

The retirement rates for the BRS excluding Teachers were based on historical and current demographic data, adjusted to reflect economic conditions of the area and estimated future experience and professional judgment. As part of the analysis, a comparison was made between the actual number of retirements by age and the projected number based on the prior years' assumptions over the four most recent valuations.

Age	Rate (%) – Non-TARP Teachers			
	Years of Service			
	Less than 20		20 or more	
	Male	Female	Male	Female
50	0.0	0.0	2.0	1.0
51	0.0	0.0	2.0	1.0
52	0.0	0.0	2.0	1.5
53	0.0	0.0	2.0	2.0
54	0.0	0.0	3.0	2.0
55	3.5	3.5	3.0	4.0
56	3.5	3.5	3.5	4.0
57	5.0	3.5	4.0	4.0
58	5.5	5.0	5.0	6.0
59	6.0	6.5	6.0	8.0
60	7.5	8.5	15.0	15.0
61	12.0	10.0	25.0	20.0
62	14.0	12.0	30.0	20.0
63	14.0	12.0	30.0	25.0
64	14.0	20.0	30.0	30.0
65	30.0	30.0	30.0	40.0
66	30.0	30.0	25.0	30.0
67	30.0	30.0	25.0	30.0
68	30.0	30.0	25.0	30.0
69	30.0	30.0	25.0	30.0
70	100.0	100.0	100.0	100.0

Age	Rate (%) – TARP Teachers					
	Years of Service					
	Less than 20		20 – 29		30 or more	
	Male	Female	Male	Female	Male	Female
50	0.0	0.0	1.0	1.0	2.0	1.5
51	0.0	0.0	1.0	1.0	2.0	1.5
52	0.0	0.0	1.0	1.0	2.0	1.5
53	0.0	0.0	1.5	1.0	2.0	1.5
54	0.0	0.0	2.5	1.0	2.0	2.0
55	5.0	3.0	3.0	3.0	6.0	5.0
56	5.0	3.0	6.0	5.0	20.0	15.0
57	5.0	4.0	10.0	8.0	40.0	35.0
58	5.0	8.0	15.0	10.0	50.0	35.0
59	10.0	8.0	20.0	15.0	50.0	35.0
60	10.0	10.0	25.0	20.0	40.0	35.0
61	20.0	12.0	30.0	25.0	40.0	35.0
62	20.0	12.0	35.0	30.0	35.0	35.0
63	25.0	15.0	40.0	30.0	35.0	35.0
64	25.0	20.0	40.0	30.0	35.0	35.0
65	25.0	25.0	40.0	40.0	35.0	35.0
66	30.0	25.0	30.0	30.0	40.0	35.0
67	30.0	30.0	30.0	30.0	40.0	30.0
68	30.0	30.0	30.0	30.0	40.0	30.0
69	30.0	30.0	30.0	30.0	40.0	30.0
70	100.0	100.0	100.0	100.0	100.0	100.0

Retirement Age for Inactive Vested Participants:	Age 60 for Group 1 and Group 2 members and age 55 for Group 4 members hired prior to April 2, 2012. For members hired April 2, 2012 or later, age 60 for Group 1 members, age 55 for Group 2 members and age 50 for Group 4 members. The retirement age for inactive vested participants was based on historical and current demographic data, adjusted to reflect economic conditions of the area and estimated future experience and professional judgment.
Inactive Vested Participants:	Inactive vested participants whose present value of future benefits is less than their member contributions balance, including those for whom no final average salary information has been reported, are assumed to elect to receive an immediate refund of their member contributions.
Loading:	For the Teachers, the total normal cost was increased by 2% and the actuarial accrued liability of active members by 1% to account for buybacks at retirement and other unvalued benefits.
Unknown Data for Participants:	Same as those exhibited by participants with similar known characteristics.
Family Composition:	75% of participants are assumed to be married for BRS excluding Teachers, 80% for Teachers. None are assumed to have dependent children. Females are assumed to be three years younger than their male spouses.
Benefit Election:	All participants are assumed to elect Option A. Benefit elections reflect the fact that all benefit options are actuarially equivalent.
2017 Salary:	2017 salary equal to salaries provided in the data, except salaries for new hires were annualized. Calendar year 2017 payroll figures were increased by 3.02% for Teachers to reflect bargaining contracts that were settled in February 2018 and first reflected in 2018 payroll. For participants hired in December 2017, salaries were set equal to $35,000 for Group 1 and $50,000 for Group 4 and Teachers.
Total Service:	Total creditable service reported in the data.
Net 3(8)(c) Liability:	No liability is valued for benefits paid or received from other municipal systems.
Actuarial Value of Assets:	A preliminary actuarial value is first determined by taking the actuarial value of assets at the beginning of the year and adding assumed investment earnings (at the assumed actuarial rate of return) and the net new money during the year (contributions less benefit payments and administrative expenses). Twenty percent of the difference between the market value of assets and the preliminary actuarial value of assets is added to the preliminary actuarial value. In order that the actuarial value not differ too significantly from the market value of assets, the final actuarial value of assets must be within 20% of the market value of assets.
Actuarial Cost Method:	Entry Age Normal Actuarial Cost Method. Entry Age is the age of the participant less total creditable service. Normal Cost and Actuarial Accrued Liability are calculated on an individual basis and are allocated by salary. Normal Cost is determined by using the plan of benefits applicable to each participant.

Justification for Change in Actuarial Assumptions:	Based on past experience and future expectations, the following actuarial assumptions were changed for BRS excluding Teachers: • The investment return assumption was lowered from 7.75% to 7.50%. • The mortality assumption for healthy participants was changed from the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale BB2D from 2009 to the RP-2014 Blue Collar Employee and Healthy Annuitant Mortality Tables set forward one year for female participants projected generationally using Scale MP-2017. • The mortality assumption for disabled participants was changed from the RP-2000 Healthy Annuitant Mortality Table projected generationally using Scale BB2D from 2015 to the RP-2014 Blue Collar Healthy Annuitant Mortality Table set forward one year projected generationally using Scale MP-2017. • The administrative expense assumption was changed from $9,500,000 for calendar year 2016 to $11,000,000 for calendar year 2018, with 70%, or $7,700,000 assigned to the BRS excluding Teachers. The following changes in actuarial assumptions were made to be consistent with the assumptions used in the January 1, 2018 Actuarial Valuation Report of the Massachusetts Teachers' Retirement System: • The investment return assumption was lowered from 7.50% to 7.35%. • The mortality assumption for healthy participants was changed from the RP-2014 Employee and Healthy Annuitant Mortality Tables projected generationally using Scale BB2D to the RP-2014 White Collar Employee and Healthy Annuitant Mortality Tables projected generationally with Scale MP-2016. • The administrative expense assumption was changed from $9,500,000 for calendar 2016 to $11,000,000, with 30%, or $3,300,000, assigned to the Teachers.

EXHIBIT II – SUMMARY OF PLAN PROVISIONS

This exhibit summarizes the major provisions of the Plan included in the valuation. It is not intended to be, nor should it be interpreted as, a complete statement of all plan provisions.

Plan Year: January 1 through December 31

Plan Status: Ongoing

Retirement Benefits:

Employees covered by the Contributory Retirement Law are classified into one of four groups depending on job classification. Group 1 comprises most positions in state and local government. It is the general category of public employees. Group 4 comprises mainly police and firefighters. Group 2 is for other specified hazardous occupations. (Officers and inspectors of the State Police are classified as Group 3.)

For employees hired prior to April 2, 2012, the annual amount of the retirement allowance is based on the member's final three-year average salary multiplied by the number of years and full months of creditable service at the time of retirement and multiplied by a percentage according to the following table based on the age of the member at retirement:

	Age Last Birthday at Date of Retirement		
Percent	Group 1	Group 2	Group 4
2.5	65 or over	60 or over	55 or over
2.4	64	59	54
2.3	63	58	53
2.2	62	57	52
2.1	61	56	51
2.0	60	55	50
1.9	59	--	49
1.8	58	--	48
1.7	57	--	47
1.6	56	--	46
1.5	55	--	45

TARP – Chapter 114 of the Acts of 2000 provides enhanced retirement benefits to teachers who elect to participate in the program and to all teachers hired on or after July 1, 2001. The retirement allowance of a participating teacher with 30 or more years of service is increased by an additional 2 percent for each full year of creditable service in excess of 24 years, up to the statutory maximum of 80 percent of the member's three-year salary average.

A member's final three-year average salary is defined as the greater of the highest consecutive three-year average annual rate of regular compensation and the average annual rate of regular compensation received during the last three years of creditable service prior to retirement.

For employees hired on April 2, 2012 or later, the annual amount of the retirement allowance is based on the member's final five-year average salary multiplied by the number of years and full months of creditable service at the time of retirement and multiplied by a percentage according to the following tables based on the age and years of creditable service of the member at retirement:

For members with less than 30 years of creditable service: Age Last Birthday at Date of Retirement			
Percent	**Group 1**	**Group 2**	**Group 4**
2.50	67 or over	62 or over	57 or over
2.35	66	61	56
2.20	65	60	55
2.05	64	59	54
1.90	63	58	53
1.75	62	57	52
1.60	61	56	51
1.45	60	55	50

For members with 30 years of creditable service or greater: Age Last Birthday at Date of Retirement			
Percent	**Group 1**	**Group 2**	**Group 4**
2.500	67 or over	62 or over	57 or over
2.375	66	61	56
2.250	65	60	55
2.125	64	59	54
2.000	63	58	53
1.875	62	57	52
1.750	61	56	51
1.625	60	55	50

A member's final five-year average salary is defined as the greater of the highest consecutive five-year average annual rate of regular compensation and the average annual rate of regular compensation received during the last five years of creditable service prior to retirement.

	For employees who became members after January 1, 2011, regular compensation is limited to 64% of the federal limit found in 26 U.S.C. 401(a)(17). In addition, regular compensation for members who retire after April 2, 2012 will be limited to prohibit "spiking" of a member's salary to increase the retirement benefit. For all employees, the maximum annual amount of the retirement allowance is 80 percent of the member's final average salary. Any member who is a veteran also receives an additional yearly retirement allowance of $15 per year of creditable service, not exceeding $300. The veteran allowance is paid in addition to the 80 percent maximum.
Employee Contributions:	<table><tr><th>Date of Hire</th><th>Contribution Rate</th></tr><tr><td>Prior to January 1, 1975</td><td>5%</td></tr><tr><td>January 1, 1975 – December 31, 1983</td><td>7%</td></tr><tr><td>January 1, 1984 – June 30, 1996</td><td>8%</td></tr><tr><td>July 1, 1996 onward</td><td>9%</td></tr></table> In addition, employees hired after December 31, 1978 contribute an additional 2 percent of salary in excess of $30,000. Employees hired after 1983 who voluntarily withdraw their contributions with less than 10 ten years of credited service receive 3% interest on their contributions. Employees in Group 1 hired on or after April 2, 2012 with 30 years of creditable service or greater will pay a base contribution rate of 6%.
Retirement Benefits (Superannuation):	Members of Group 1, 2 or 4 hired prior to April 2, 2012 may retire upon the attainment of age 55. For retirement at ages below 55, twenty years of creditable service is required. Members hired prior to April 2, 2012 who terminate before age 55 with ten or more years of creditable service are eligible for a retirement allowance upon the attainment of age 55 (provided they have not withdrawn their accumulated deductions from the Annuity Savings Fund of the System). Members of Group 1 hired April 2, 2012 or later may retire upon the attainment of age 60. Members of Group 2 or 4 hired April 2, 2012 or later may retire upon the attainment of age 55. Members of Group 4 may retire upon attainment of age 50 with ten years of creditable service. Members hired April 2, 2012 or later who terminate before age 55 (60 for members of Group 1) with ten or more years of creditable service are eligible for a retirement allowance upon the attainment of age 55 (60 for members of Group 1) provided they have not withdrawn their accumulated deductions from the Annuity Savings Fund of the System.
Ordinary Disability Benefit:	A member who is unable to perform his or her job due to a non-occupational disability will receive a retirement allowance if he or she has ten or more years of creditable service and has not reached age 55. The annual amount of such allowance shall be determined as if the member retired for superannuation at age 55 (age 60 for Group 1 members hired on or after April 2, 2012), based on the amount of creditable service at the date of disability. For veterans, there is a minimum benefit of 50 percent of the member's most recent year's pay plus an annuity based on his or her own contributions.

Accidental Disability Benefit:	For a job-connected disability, the benefit is 72 percent of the member's most recent annual pay plus an annuity based on his or her own contributions, plus additional amounts for surviving children. Benefits are capped at 75 percent of annual rate of regular compensation for employees who become members after January 1, 1988.
Death Benefits:	In general, the beneficiary of an employee who dies in active service will receive a refund of the employee's own contributions. Alternatively, if the employee were eligible to retire on the date of death, a spouse's benefit will be paid equal to the amount the employee would have received under Option C. The surviving spouse of a member who dies with two or more years of credited service has the option of a refund of the employee's contributions or a monthly benefit regardless of eligibility to retire, if they were married for at least one year. There is also a minimum widow's pension of $500 per month, and there are additional amounts for surviving children. If an employee's death is job-connected, the spouse will receive 72 percent of the member's most recent annual pay, in addition to a refund of the member's accumulated deductions, plus additional amounts for surviving children. However, in accordance with Section 100 of Chapter 32, the surviving spouse of a police officer, firefighter or corrections officer is killed in the line of duty will be eligible to receive an annual benefit equal to the maximum salary held by the member at the time of death. Upon the death of a job-connected disability retiree who retired prior to November 7, 1996 and could not elect an Option C benefit, a surviving spouse will receive an allowance of $12,000 per year if the member dies for a reason unrelated to cause of disability.
"Heart And Lung Law" And Cancer Presumption:	Any case of hypertension or heart disease resulting in total or partial disability or death to a uniformed fireman, permanent member of a police department, or certain employees of a county correctional facility is presumed to have been suffered in the line of duty, unless the contrary is shown by competent evidence. Any case of disease of the lungs or respiratory tract resulting in total disability or death to a uniformed fireman is presumed to have been suffered in the line of duty, unless the contrary is shown by competent evidence. There is an additional presumption for uniformed firemen that certain types of cancer are job-related if onset occurs while actively employed or within five years of retirement.
Options:	Members may elect to receive a full retirement allowance payable for life under Option A. Under Option B a member may elect to receive a lower monthly allowance in exchange for a guarantee that at the time of death any contributions not expended for annuity payments will be refunded to the beneficiary. Option C allows the member to take a lesser retirement allowance in exchange for providing a survivor with two-thirds of the lesser amount. Option C pensioners will have benefits converted from a reduced to a full retirement if the beneficiary predeceases the retiree.
Post-Retirement Benefits:	The Board has adopted the provisions of Section 51 of Chapter 127 of the Acts of 1999, which provide that the Retirement Board may approve an annual COLA in excess of the Consumer Price Index but not to exceed a 3% COLA on the first $14,000 (previously, $13,000) of a retirement allowance. Cost-of-living increases granted prior to July 1, 1998 are reimbursed by the Commonwealth and not reflected in this report.
Changes in Plan Provisions:	The COLA base was increased from $13,000 to $14,000 effective July 1, 2017.