Boston Retirement System

Actuarial Valuation and Review as of January 1, 2024

Segal

Segal

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September 26, 2024

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, 2024. It summarizes the actuarial data used in the valuation, analyzes the preceding two years' experience, and establishes the funding requirements for fiscal 2025 and later years.

This report has been prepared in accordance with generally accepted actuarial principles and practices for the exclusive use and benefit of the Board, based upon information provided by the staff of the Boston Retirement System and the Boston Retirement System's other service providers.

Segal does not audit the data provided. The accuracy and comprehensiveness of the data is the responsibility of those supplying the data. To the extent we can, however, Segal does review the data for reasonableness and consistency. Based on our review of the data, we have no reason to doubt the substantial accuracy of the information on which we have based this report and we have no reason to believe there are facts or circumstances that would affect the validity of these results.

The measurements shown in this actuarial valuation may not be applicable for other purposes. 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; and changes in plan provisions or applicable law.

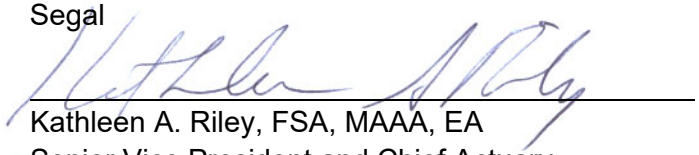
The actuarial calculations were directed under the supervision of Kathleen A. Riley, FSA, MAAA, EA. She is a member of the American Academy of Actuaries and meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion herein. To the best of her knowledge, the information supplied in this actuarial valuation is complete and accurate. The assumptions used in this actuarial valuation were selected by the Board based upon our analysis and recommendations. In her opinion, the assumptions are reasonable and take into account the experience of the Boston Retirement System and reasonable expectations. In addition, in her opinion, the combined effect of these assumptions is expected to have no significant bias.

Segal makes no representation or warranty as to the future status of the Boston Retirement System and does not guarantee any particular result. This document does not constitute legal, tax, accounting or investment advice or create or imply a fiduciary relationship. The Board is encouraged to discuss any issues raised in this report with the System's legal, tax and other advisors before taking, or refraining from taking, any action.

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

Sincerely,

Segal



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

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Section 1: Actuarial Valuation Summary

Purpose and basis

This report has been prepared by Segal to present a valuation of the Boston Retirement System as of January 1, 2024. The valuation was performed to determine whether the assets and contributions are sufficient to provide the prescribed benefits.

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, 2023, provided by the staff of the Retirement System;
- The assets of the System as of December 31, 2023, 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.

Certain disclosure information required by GASB Statements No. 67 and 68 as of December 31, 2023 for the Retirement System is provided in a separate report.

Valuation highlights

- 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 liability excluding Teachers by June 30, 2028. The funding policy for the Teachers is determined by the Commonwealth.
- 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. Section 2 shows participant and asset information, the experience analysis, liabilities and a funding schedule for the BRS excluding Teachers, with comparisons to 2022. Section 3 shows the same information for the Teachers with comparisons to 2022. Section 4 shows participant and asset information for all employees of the BRS.

  In accordance with Chapter 112 of the Acts of 2010, the assets attributable to Teachers (25% 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.
- The rate of return on the market value of assets for the BRS was 10.47% and -10.61% for the years ending December 31, 2023 and December 31, 2022, respectively. The return on the actuarial value of assets was 5.77% and 4.69% for the two years, respectively, due to the recognition of prior years' investment gains and losses.
- The actuarial value of assets is 104.5% of the market value of assets.
- The investment experience in the past years has only been partially recognized in the actuarial value of assets. As the deferred net loss is recognized in future years, the cost of the System is likely to increase unless the net loss is offset by future experience. The deferred investment losses are not recognized in the funding schedule for the BRS excluding Teachers shown in Section 2.
- With this valuation, the administrative expense assumption has been increased from $10,400,000 for calendar year 2022 (with $7,280,000 allocated to the BRS excluding Teachers and $3,120,000 allocated to the Teachers), increasing 3.25% per year to $11,700,000 for calendar year 2024 (with $8,190,000 allocated to the BRS excluding Teachers and $3,510,000 allocated to the Teachers) increasing 3.25% per year.
- The Board adopted a one-time increase in the Cost-of-Living Adjustment (COLA) from 3% to 5% effective July 1, 2022, which increased the January 1, 2024 unfunded liability by $29.4 million for the BRS excluding Teachers and by $15.1 million for the Teachers.

Section 1: Actuarial Valuation Summary

- The funded ratio (the ratio of the actuarial value of assets to actuarial accrued liability) is 72.91% for the BRS as a whole, compared to the prior valuation funded ratio of 68.91%. 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 69.75%, compared to 73.85% as of the prior valuation date. These measurements are not necessarily appropriate for assessing the sufficiency of System 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.
- The unfunded liability was expected to decrease by $570 million from $3.993 billion as of January 1, 2022 to $3.423 billion as of January 1, 2024. The actual unfunded liability as of January 1, 2024 is $3.723 billion, or $300 million more than expected primarily due to the investment loss on an actuarial basis and the one-time 5% COLA, partially offset by a net gain from other experience. Other sources of gains and losses are discussed in Sections 2 and 3.
- The fiscal 2025 appropriation for the BRS excluding Teachers has been set equal to the previously budgeted amount of $484,372,083. The funding schedule included in this report is projected to fully fund the System by June 30, 2028, if all assumptions are met and there are no changes in the plan of benefits or actuarial assumptions, with appropriations that increase 8.85% per year for two years and a smaller appropriation in fiscal 2028. The prior funding schedule fully funded the liabilities of the BRS excluding Teachers by June 30, 2027 with appropriations that also increased 8.85% per year through fiscal 2026 with a smaller appropriation in fiscal 2027.
- The Commonwealth appropriation for the Teachers is $261,107,423 for fiscal 2025. The total Commonwealth appropriation is expected to increase by 9.63% through fiscal 2028 with a 4.00% increasing amortization payment on the unfunded actuarial accrued lability thereafter, and the Commonwealth's liabilities are expected to be fully funded in 2036. The allocation of the total Commonwealth appropriation in future fiscal years to the Teachers will be determined each year.
- In December 2021, the Actuarial Standards Board issued a revision of Actuarial Standards of Practice No. 4 (ASOP 4) Measuring Pension Obligations and Determining Pension Plan Costs or Contributions. ASOP 4 requires the disclosure of a Reasonable Actuarially Determined Contribution, if one is not already calculated, the disclosure of the impact of smoothing the increases in the appropriation over the years remaining on the funding schedule and the disclosure of a Low-Default-Risk Obligation Measure (LDROM) when performing a funding valuation. This additional information is included in Sections 2 and 3.

Risk

- It is important to note that this actuarial valuation is based on plan assets as of December 31, 2023. The System's funded status does not reflect short-term fluctuations of the market, but rather is based on the market values on the last day of the plan year. Segal is available to prepare projections of potential outcomes of market conditions and other demographic experience upon request.
- 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 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 risks that may affect the System in Sections 2 and 3. A more detailed assessment would provide the Board with a better understanding of the inherent risks.

Summary of key valuation results — BRS excluding Teachers

Valuation Result	Current	Prior
Contributions for fiscal year beginning	**July 1, 2024**	**July 1, 2022**
• Actuarially determined contributions	$484,372,083	$403,678,138
Actuarial accrued liability for plan year beginning	**January 1, 2024**	**January 1, 2022**
• Retired participants and beneficiaries	$4,789,863,646	$4,336,591,142
• Inactive vested participants	173,586,751	147,244,535
• Inactive participants due a refund of employee contributions	73,710,663	62,088,988
• Active participants	3,842,773,908	3,671,793,401
• **Total**	**$8,879,934,968**	**$8,217,718,066**
• Normal cost including administrative expense assumption for plan year beginning January 1	226,853,563	208,299,348
Assets for plan year beginning January 1		
• Market value of assets (MVA)	$7,222,830,103	$7,130,505,146
• Actuarial value of assets (AVA)	7,623,038,719	6,768,562,195
• Actuarial value of assets as a percentage of market value of assets	105.5%	94.9%
Funded status for plan year beginning January 1		
• Unfunded actuarial accrued liability on market value of assets	$1,657,104,865	$1,087,212,920
• Funded percentage on MVA basis	81.34%	86.77%
• Unfunded actuarial accrued liability on actuarial value of assets	$1,256,896,249	$1,449,155,871
• Funded percentage on AVA basis	85.85%	82.37%
Key assumptions		
• Net investment return	6.90%	6.90%
• Inflation rate	3.25%	3.25%
Demographic data for plan year beginning January 1		
• Number of retired participants and beneficiaries	10,207	9,998
• Number of inactive vested participants	934	856
• Number of inactive participants due a refund of employee contributions	10,869	9,921
• Number of active participants	14,476	14,581
• Average compensation[1]	$85,204	$77,499

[1] Compensation figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. Calendar year 2023 compensation figures were increased by 15.1% for Police to estimate unsettled contracts and TCAP impact in fiscal 2025 and decreased by 5.6% for Fire Fighters and 2.5% for Non-Teacher school employees to estimate retroactive payments made during the year. Calendar year 2021 compensation figures were increased by 3% for Police, 1% for Fire Fighters, and 2.5% for Group 1 and 2 employees to estimate unsettled contracts.

Summary of key valuation results — Teachers

Valuation Result	Current	Prior
Actuarial accrued liability for plan year beginning	**January 1, 2024**	**January 1, 2022**
• Retired participants and beneficiaries	$2,697,698,355	$2,689,353,554
• Inactive vested participants	121,490,373	92,706,424
• Inactive participants due a refund of employee contributions	70,757,591	61,603,333
• Active participants	1,973,147,817	1,781,072,106
• **Total**	**$4,863,094,136**	**$4,624,735,417**
• Normal cost including administrative expense assumption for plan year beginning January 1	101,505,181	96,966,960
Assets for plan year beginning January 1		
• Market value of assets (MVA)	$2,363,600,554	$2,353,125,177
• Actuarial value of assets (AVA)	2,396,714,185	2,080,996,195
• Actuarial value of assets as a percentage of market value of assets	101.4%	88.4%
Funded status for plan year beginning January 1		
• Unfunded actuarial accrued liability on market value of assets	$2,499,493,582	$2,271,610,240
• Funded percentage on MVA basis	48.60%	50.88%
• Unfunded actuarial accrued liability on actuarial value of assets	$2,466,379,951	$2,543,739,222
• Funded percentage on AVA basis	49.28%	45.00%
Key assumptions		
• Net investment return	7.00%	7.00%
• Inflation rate	3.25%	3.25%
Demographic data for plan year beginning January 1		
• Number of retired participants and beneficiaries	4,798	4,821
• Number of inactive vested participants	548	447
• Number of inactive participants due a refund of employee contributions	3,169	2,900
• Number of active participants	6,035	6,303
• Average compensation[1]	$114,791	$103,946

[1] Compensation figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. Calendar 2023 compensation figures were decreased by 2.5% to estimate retroactive payments made during the year. Calendar year 2021 compensation figures were increased by 1% to estimate unsettled contracts.

Summary of key valuation results — All Boston Retirement System employees

Valuation Result	Current	Prior
Actuarial accrued liability for plan year beginning	**January 1, 2024**	**January 1, 2022**
• Retired participants and beneficiaries	$7,487,562,000	$7,025,944,695
• Inactive vested participants	295,077,123	239,950,960
• Inactive participants due a refund of employee contributions	144,468,254	123,692,321
• Active participants	5,815,921,727	5,452,865,507
• **Total**	**$13,743,029,104**	**$12,842,453,483**
• Normal cost including administrative expense assumption for plan year beginning January 1	328,358,744	305,266,309
Assets for plan year beginning January 1		
• Market value of assets (MVA)	$9,586,430,657	$9,483,630,323
• Actuarial value of assets (AVA)	10,019,752,905	8,849,558,390
• Actuarial value of assets as a percentage of market value of assets	104.5%	93.3%
Funded status for plan year beginning January 1		
• Unfunded actuarial accrued liability on market value of assets	$4,156,598,447	$3,358,823,160
• Funded percentage on MVA basis	69.75%	73.85%
• Unfunded actuarial accrued liability on actuarial value of assets	$3,723,276,200	$3,992,895,093
• Funded percentage on AVA basis	72.91%	68.91%
Demographic data for plan year beginning January 1		
• Number of retired participants and beneficiaries	15,005	14,819
• Number of inactive vested participants	1,482	1,303
• Number of inactive participants due a refund of employee contributions	14,038	12,821
• Number of active participants	20,511	20,884
• Average compensation[1]	$93,910	$85,481

[1] Compensation figures are for the prior year and reflect annualized salaries for participants hired during the year. Calendar year 2023 compensation figures were increased by 15.1% for Police to estimate unsettled contracts and TCAP impact in fiscal 2025 and decreased by 5.6% for Fire Fighters and 2.5% for Teachers and Non-Teacher school employees to estimate retroactive payments made during the year. Calendar year 2021 compensation figures were increased by 3% for Police, 1% for Fire Fighters and Teachers, and 2.5% for Group 1 and Group 2 employees to estimate unsettled contracts.

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 relies on a number of input items. These include:

Input Item	Description
Plan provisions	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 information	An actuarial valuation for a plan is based on data provided to the actuary by the 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.
Financial information	Part of the cost of a plan will be paid from existing assets — the balance will need to come from future contributions and investment income. The valuation is based on the asset values as of the valuation date, typically reported by the Retirement System. A snapshot as of a single date may not be an appropriate value for determining a single year's contribution requirement, especially in volatile markets. Plan sponsors often use 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 starts by developing a forecast of the benefits to be paid to existing plan participants for the rest of their lives and the lives of their beneficiaries. This requires actuarial assumptions as to the probability of death, disability, withdrawal, and retirement of participants in each year, as well as forecasts of the plan's benefits for each of those events. In addition, the benefits forecasted for each of those events in each future year reflect actuarial assumptions as to salary increases and cost-of-living adjustments. The forecasted benefits are then discounted to a present value, typically based on an estimate of the rate of return that will be achieved on the plan's assets. All of these factors are uncertain and unknowable. Thus, there will be a range of reasonable assumptions, and the results may vary materially based on which assumptions are selected within that range. That is, there is no right answer (except with hindsight). It is important for any user of an actuarial valuation to understand and accept this constraint. The actuarial model may use approximations and estimates that will have an immaterial impact on our results. In addition, the actuarial assumptions may change over time, and while this can have a significant impact on the reported results, it does not mean that the previous assumptions or results were unreasonable or wrong.

Section 1: Actuarial Valuation Summary

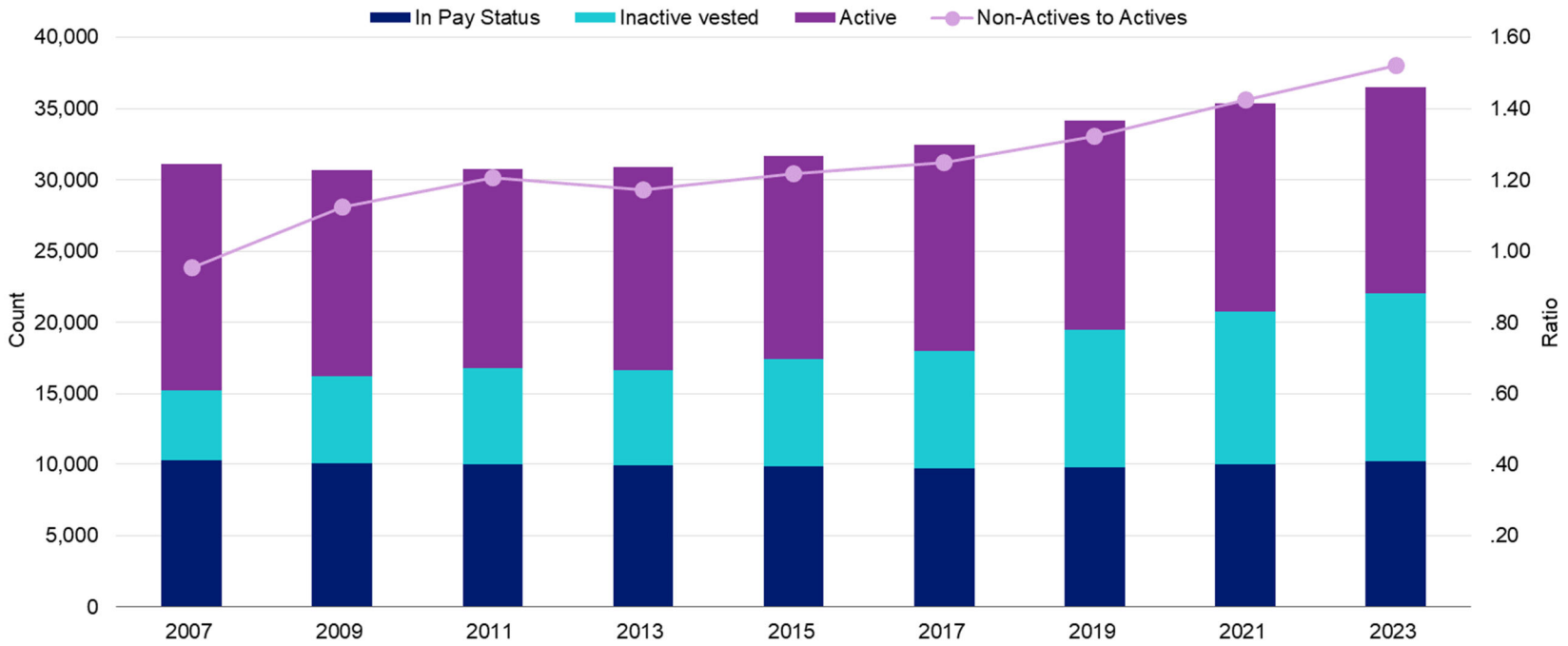
The user of Segal's actuarial valuation (or other actuarial calculations) should keep the following in mind:

- The actuarial valuation is prepared at the request of the Retirement Board. Segal is not responsible for the use or misuse of its report, particularly by any other party.
- An actuarial valuation is a measurement at a specific date — it is not a prediction of a plan's future financial condition. Accordingly, Segal did not perform an analysis of the potential range of financial measurements, except where otherwise noted.
- If the Retirement Board 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 and is not acting as a fiduciary to the Boston Retirement System. The valuation is based on Segal's understanding of applicable guidance in these areas and of the Boston Retirement System's provisions, but they may be subject to alternative interpretations. The Retirement Board should look to their other advisors for expertise in these areas.
- While Segal maintains extensive quality assurance procedures, an actuarial valuation involves complex computer models and numerous inputs. In the event that an inaccuracy is discovered after presentation of Segal's valuation, Segal may revise that valuation or make an appropriate adjustment in the next valuation.
- Segal's report shall be deemed to be final and accepted by the Retirement Board upon delivery and review. The Board should notify Segal immediately of any questions or concerns about the final content.

Section 2: Actuarial Valuation Results — BRS excluding Teachers

Participant information

Participant Population as of December 31



Legend	2007	2009	2011	2013	2015	2017	2019	2021	2023
In Pay Status	10,246	10,044	10,000	9,925	9,856	9,721	9,779	9,998	10,207
Inactive Vested[1]	4,959	6,189	6,823	6,751	7,549	8,300	9,683	10,777	11,803
Active	15,943	14,449	13,951	14,235	14,288	14,445	14,709	14,581	14,476
Ratio	0.95	1.12	1.21	1.17	1.22	1.25	1.32	1.42	1.52

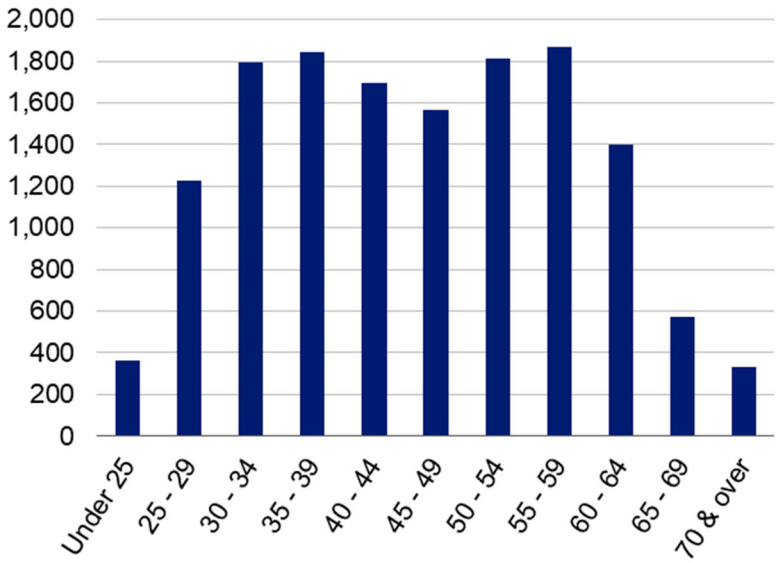
[1] Includes terminated participants due a refund of employee contributions.

Active participants

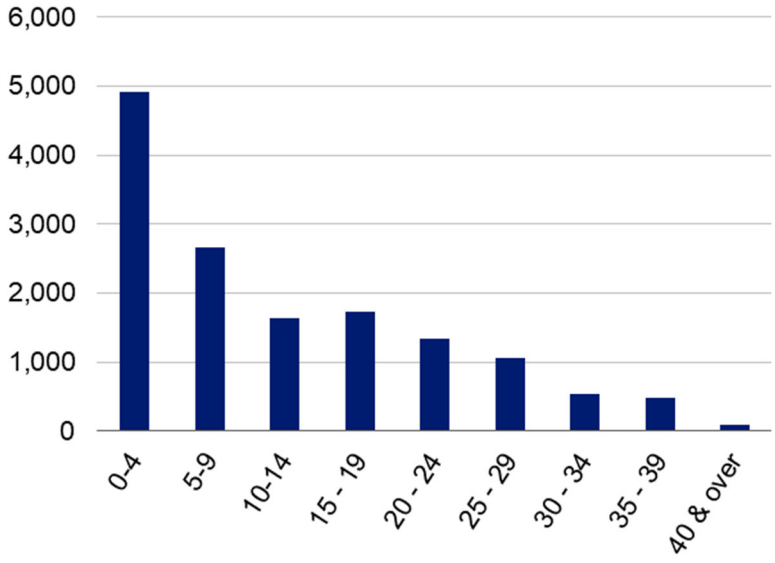
As of December 31,	2023	2021	Change
Active participants	14,476	14,581	-0.7%
Average age	46.2	46.1	0.1
Average years of service	12.3	12.6	-0.3
Average compensation	$85,204	$77,499	9.9%

Distribution of Active Participants as of December 31, 2023

Actives by Age



Actives by Years of Service



Inactive participants

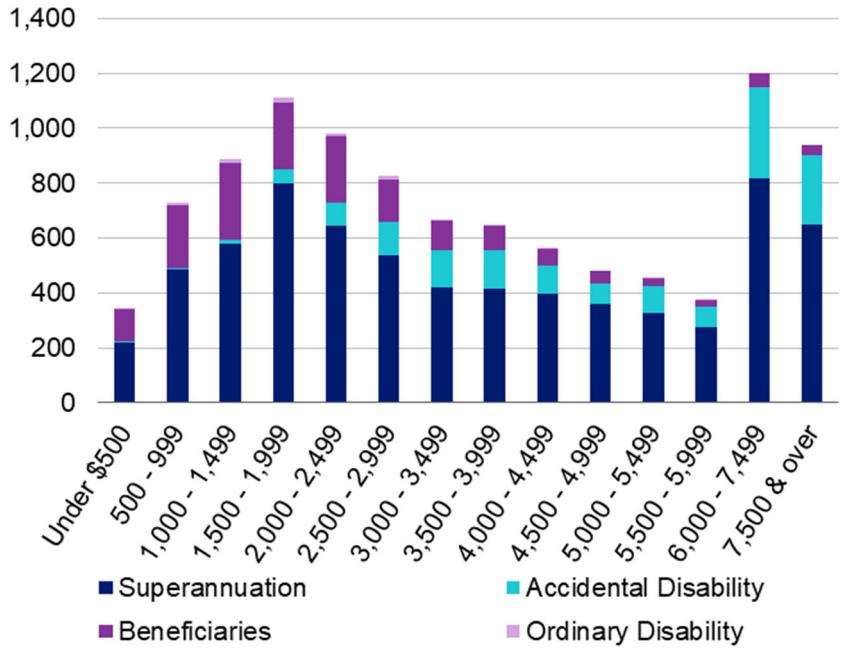
In this year's valuation, there were 934 inactive participants with a vested right to a deferred or immediate vested benefit. In addition, there were 10,869 inactive participants entitled to a return of their employee contributions.

Retired participants and beneficiaries

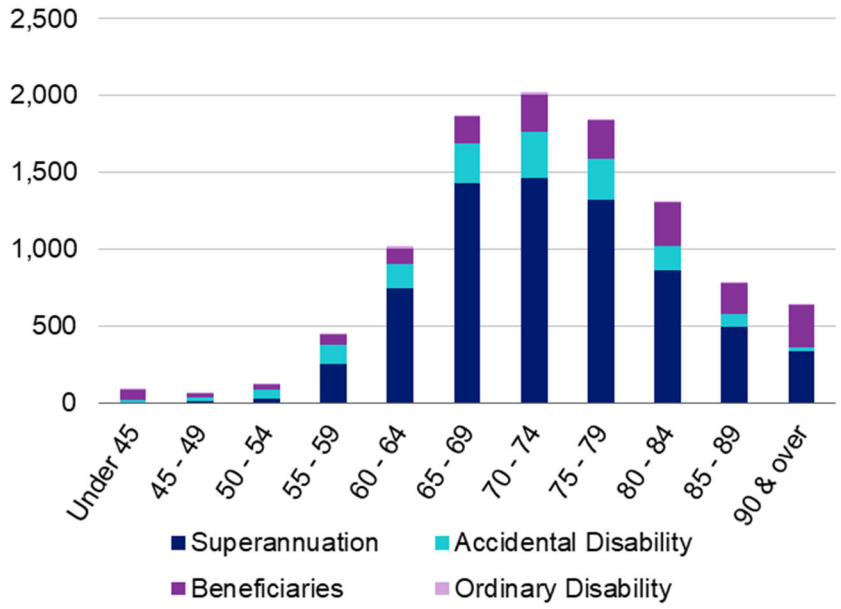
As of December 31,	2023	2021	Change
Retired participants	8,500	8,216	3.5%
Beneficiaries	1,707	1,782	-4.2%
Average age	73.5	72.8	0.7
Average amount[1]	$3,790	$3,490	8.6%
Total monthly amount[5]	38,687,326	34,890,416	10.9%

Distribution of Retired Participants and Beneficiaries as of December 31, 2023

By Type and Monthly Amount



By Type and Age

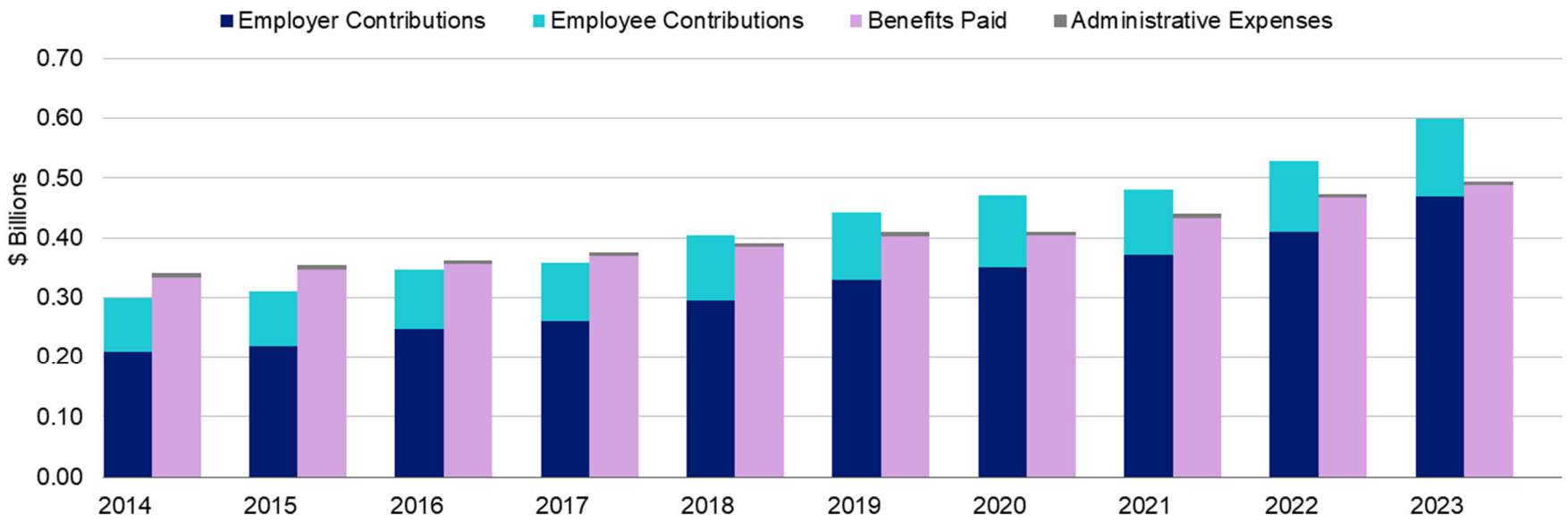


[1] Excludes COLAs reimbursed by the Commonwealth.

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.

Comparison of Contributions with Benefits and Expenses for Years Ended December 31, 2014 - 2023



Section 2: Actuarial Valuation Results — BRS Excluding Teachers

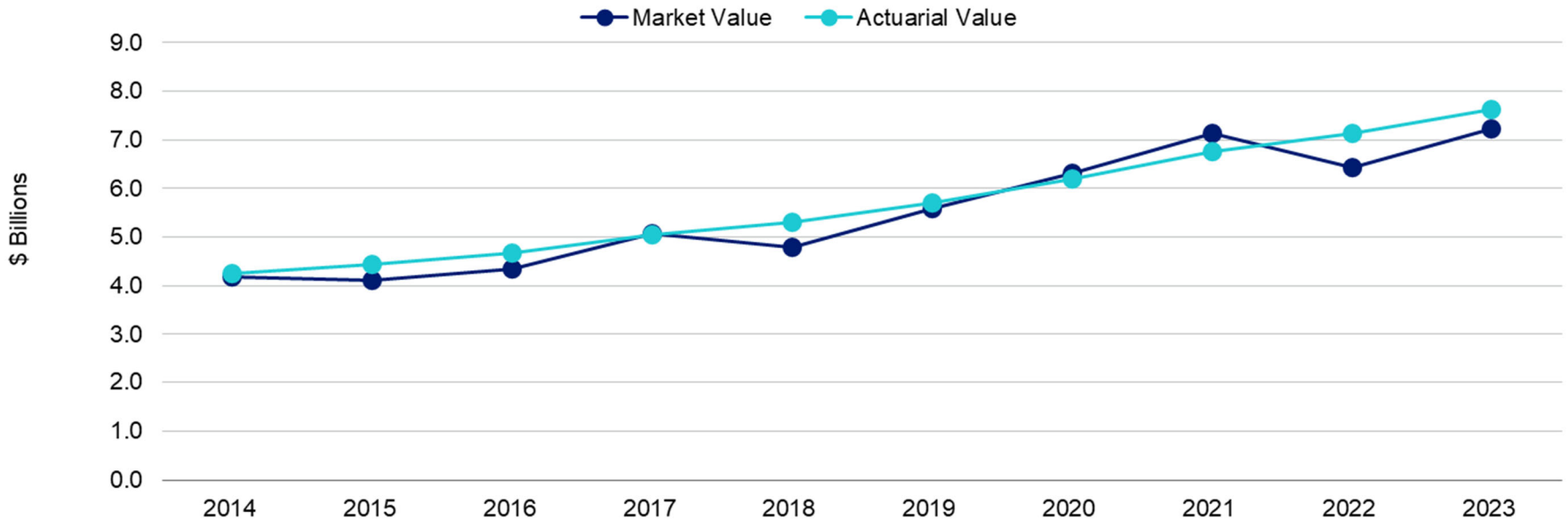
It is desirable to have level and predictable plan costs from one year to the next. For this reason, the Board has approved an asset valuation method that gradually adjusts to market value. Under this valuation method, the full value of market fluctuations is not recognized in a single year and, as a 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

	Component	Year Ended December 31, 2023	Year Ended December 31, 2022
1	Actuarial value of assets at the beginning of the year	$7,121,210,248	$6,768,562,195
2	Contributions, less benefit payments and expense during the year	106,831,433	54,623,260
3	Average actuarial value: **(1) + [50% of (2)]**	7,174,625,965	6,795,873,825
4	Expected investment income: **6.90% x (3)**	495,049,192	468,915,294
5	**Preliminary actuarial value of assets at the end of the year: (1) + (2) + (4)**	**$7,723,090,873**	**$7,292,100,749**
6	Market value of assets at the end of the year	7,222,830,103	6,437,648,248
7	Adjustment toward market value: **20% of [(6) – (5)]**	-100,052,154	-170,890,501
8	Adjustment to be within 20% corridor	0	0
9	**Final actuarial value of assets at the end of the year: (5) + (7) + (8)**	**$7,623,038,719**	**$7,121,210,248**
10	Actuarial value as a percentage of market value: **(9) ÷ (6)**	105.5%	110.6%

Asset history for years ended December 31

Market Value of Assets vs Actuarial Value of Assets

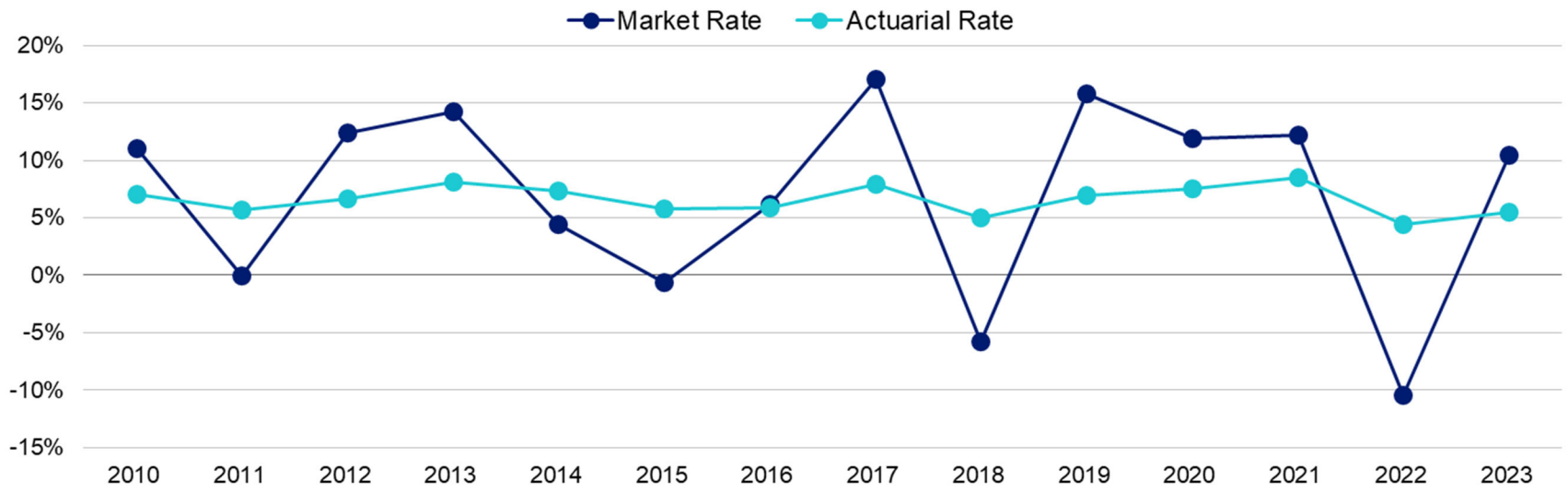


Legend	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Market value[1]	$4.18	$4.11	$4.35	$5.07	$4.79	$5.58	$6.31	$7.13	$6.44	$7.22
Actuarial value[6]	4.24	4.44	4.68	5.04	5.30	5.70	6.20	6.77	7.12	7.62

[1] In $ billions

Historical investment returns

Market and Actuarial Rates of Return for Years Ended December 31



Legend	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Market rate	11.07%	-0.03%	12.36%	14.28%	4.41%	-0.65%	6.19%	17.09%	-5.78%	15.78%	11.94%	12.22%	-10.44%	10.45%
Actuarial rate	7.08%	5.71%	6.67%	8.12%	7.37%	5.79%	5.85%	7.93%	4.97%	6.93%	7.56%	8.50%	4.39%	5.51%
Assumed rate	8.00%	8.00%	7.75%	7.75%	7.75%	7.75%	7.75%	7.75%	7.50%	7.50%	7.05%	7.05%	6.90%	6.90%

Average Rates of Return	Market Value	Actuarial Value
Most recent five-year average return:	7.02%	6.48%
Most recent ten-year average return:	5.73%	6.42%
14-year average return	6.48%	6.52%

Actuarial experience

Assumptions should consider experience and should be based on reasonable expectations for the future.

Each year actual experience is compared to that projected by the assumptions. Differences are reflected in the actuarial valuation.

Assumptions are not changed if experience is believed to be a short-term development that will not continue over the long term. On the other hand, if experience is expected to continue, assumptions are changed.

Actuarial Experience for Two-Year Period Ended December 31, 2023

	Source of Gain/(Loss)	Amount
1.	(Loss) from investments[1]	-$270,942,654
2.	Gain from administrative expenses	2,739,890
3.	(Loss) from other experience	-40,271,461
4.	**Net experience (loss): 1 + 2 + 3**	**-$308,474,225**

[1] Details on next page

Investment experience

Actuarial planning is long term. The obligations of a pension plan are expected to continue for the lifetime of all its participants.

The assumed long-term rate of return of 6.90% considers past experience, the asset allocation policy of the Board and future expectations.

Investment Experience for Years Ended December 31, 2023 and December 31, 2022

	Investment	2023 Market Value	2023 Actuarial Value	2022 Market Value	2022 Actuarial Value
1.	Net investment income	$678,350,422	$394,997,038	-$747,480,158	$298,024,794
2.	Average value of assets	6,491,063,965	7,174,625,965	7,157,816,776	6,795,873,825
3.	Rate of return: **1 ÷ 2**	10.45%	5.51%	-10.44%	4.39%
4.	Assumed rate of return	6.90%	6.90%	6.90%	6.90%
5.	Expected investment income: **2 x 4**	$447,883,414	$495,049,192	$493,889,358	$468,915,294
6.	**Net investment gain/(loss): 1 – 5**	**$230,467,008**	**-$100,052,154**	**-$1,241,369,516**	**-$170,890,500**

Non-investment experience

Administrative expenses

Administrative expenses for the year ended December 31, 2023 and 2022 totaled $5,861,288 and $6,430,862, respectively, as compared to the assumption of $7,280,000 for calendar year 2022 and $7,516,600 for calendar year 2023. This resulted in an experience gain of $2,739,890 for the two-year period, including an adjustment for interest.

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:

- Mortality experience (more or fewer than expected deaths)
- The extent of turnover among participants
- Retirement experience (earlier or later than projected)
- The number of disability retirements (more or fewer than projected)
- Salary increases (greater or smaller than projected)

The net loss from this other experience for the two-year period ending December 31, 2023 amounted to $40,271,461, which is 0.5% of the actuarial accrued liability.

Liability Changes Due to Demographic Experience for Two-Year Period Ended December 31, 2023

Other Experience	Gain or (Loss)
(Loss) due to transfers from Teachers	-$23,405,722
Gain due to mortality experience	58,891,995
(Loss) due to salaries increasing more than expected	-96,744,742
Miscellaneous experience gain	20,987,008
Net (loss)	**-$40,271,461**

Actuarial assumptions

Based on information on expenses provided by the Retirement System, we have increased the assumption from $10,400,000 to $11,700,000 for the Boston Retirement System for calendar year 2024, with 70% or $8,190,000 assigned to the BRS excluding Teachers.

Plan provisions

Pursuant to Chapter 269 of the Acts of 2022, the Board approved a one-time increase in the COLA from 3% to 5% effective July 1, 2022, which increased the January 1, 2024 unfunded liability by $29.4 million.

Unfunded actuarial accrued liability

Development of Unfunded Actuarial Accrued Liability

	Unfunded Actuarial Accrued Liability	Amount for Year Ended December 31, 2023	Amount for Year Ended December 31, 2022
1.	Unfunded actuarial accrued liability at beginning of year	$1,225,242,241	$1,449,155,871
2.	Normal cost at beginning of year	215,069,077	208,299,348
3.	Total contributions	-599,989,124	-528,349,337
4.	Interest on **1, 2 & 3**	78,681,855	96,136,359
5.	**Expected unfunded actuarial accrued liability**	**$919,004,049**	**$1,225,242,241**
6.	Changes due to:		
	a. Net experience loss	$308,474,225	
	b. Adoption of 5% COLA	29,417,975	
	c. Total changes	**$337,892,200**	
7.	**Unfunded actuarial accrued liability at end of year**	**$1,256,896,249**	

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 2025, the actuarially determined contribution has been set equal to the previously budgeted amount of $484,372,083 determined with the prior valuation, updated to reflect the 5% COLA.

The funding schedule included in this report fully funds the liabilities of the BRS excluding Teachers by 2028 with appropriations that increase 8.85% per year for two years and a smaller appropriation in fiscal 2028. The actuarially determined contribution shown in the funding schedule can be considered a “Reasonable Actuarially Determined Contribution” as required under ASOP 4.

The prior funding schedule fully funded the liabilities of the BRS excluding Teachers by June 30, 2027 with appropriations that also increased 8.85% per year through fiscal 2026 with a smaller appropriation in fiscal 2027.

Actuarially Determined Contribution for Years beginning July 1, 2024 and July 1, 2022

	Component	2024 Amount	2024 Percent of Projected Payroll	2022 Amount	2022 Percent of Projected Payroll
1.	Total normal cost	$218,663,563	17.05%	$201,019,348	17.11%
2.	Administrative expense assumption	8,190,000	0.64%	7,280,000	0.62%
3.	Expected employee contributions	-130,390,399	-10.17%	-117,816,039	-10.03%
4.	**Employer normal cost: (1) + (2) + (3)**	**$96,463,164**	**7.52%**	**$90,483,309**	**7.70%**
5.	Actuarial accrued liability	$8,879,934,968		$8,217,718,066	
6.	Actuarial value of assets	7,623,038,719		6,768,562,195	
7.	**Unfunded actuarial accrued liability: (5) - (6)**	**$1,256,896,249**		**$1,449,155,871**	
8.	Employer normal cost projected to July 1, 2024 and 2022	$98,018,157	7.52%	$91,941,906	7.70%
9.	Projected unfunded actuarial accrued liability	1,299,535,904		1,498,317,850	
10.	Payment on projected unfunded actuarial accrued liability	386,353,926	29.64%	316,868,778	26.54%
11.	**Actuarially determined contribution: (8) + (10)**	**$484,372,083**	**37.16%**	**$408,810,684**	**34.24%**
12.	Projected payroll as of July 1	1,303,324,167		1,193,858,301	

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, updated to reflect the 5% COLA.

Section 2: Actuarial Valuation Results — BRS Excluding Teachers

The funding schedule adopted by the Board is designed to reduce the volatility of the actuarially determined contribution by increasing the total contribution by a fixed percentage per year. As noted in Section 1, ASOP 4 requires the disclosure of the impact of smoothing the increases in the appropriation over the funding schedule. If the actuarially determined contribution were determined by amortizing the projected July 1, 2024 unfunded actuarial accrued liability in amortization payments that increase 3.25% per year for four years, plus payment of the fiscal 2025 employer normal cost, the actuarially determined contribution for fiscal 2025 would decrease from $484,372,083 to $440,022,971 and increase by approximately 3.25% per year through 2028. Although the initial employer contribution would be lower than the current funding schedule, the employer contribution in fiscal 2028 would be higher.

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) Actuarially Determined Contribution (ADC): (2) + (3) + (4)	(6) Unfunded Actuarial Accrued Liability at Beginning of Fiscal Year	(7) Percent Increase in ADC over Prior Year
2025	$98,018,157	$2,237,070	$384,116,856	$484,372,083	$1,299,535,904	- -
2026	101,547,862	2,237,070	423,454,080	527,239,012	976,191,534	8.85%
2027	105,203,998	2,237,070	466,458,597	573,899,665	588,484,910	8.85%
2028	108,991,074	2,237,070	125,817,631	237,045,775	128,054,701	-58.70%
2029	112,913,759	0	0	112,913,759	0	-52.37%
2030	116,976,887	0	0	116,976,887	0	3.60%

Notes:
Actuarially determined contribution for fiscal year 2025 is set equal to the amount determined with the prior valuation, updated to reflect the 5% COLA.
Actuarially determined contributions are assumed to be paid on July 1.
Item (2) reflects 3.25% growth in payroll and a 0.15% adjustment to total normal cost to reflect the effect of morality 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 does not reflect the recognition of deferred investment gains or losses.

Low-Default-Risk Obligation Measure (LDROM)

As noted in Section 1, ASOP 4 requires the disclosure of a Low-Default-Risk Obligation Measure (LDROM) when performing a funding valuation. The LDROM presented in this report is calculated using the same methodology and assumptions used to determine the Actuarial Accrued Liability (AAL) used for funding, except for the discount rate. The LDROM is required to be calculated using "a discount rate…derived from low-default-risk fixed income securities whose cash flows are reasonably consistent with the pattern of benefits expected to be paid in the future."

The LDROM is a calculation assuming a plan's assets are invested in an all-bond portfolio, generally lowering expected long-term investment returns. The discount rate selected and used for this purpose is the Bond Buyer General Obligation 20-year Municipal Bond Index Rate, published at the end of each week. The last published rate in December of the measurement period, by The Bond Buyer (www.bondbuyer.com), is 3.26% for use effective December 31, 2023. This is the rate used to determine the discount rate for valuing reported public pension plan liabilities in accordance with Governmental Accounting Standards when plan assets are projected to be insufficient to make projected benefit payments, and the 20-year period reasonably approximates the duration of plan liabilities. The LDROM is not used to determine a plan's funded status or Actuarially Determined Contribution. The plan's expected return on assets, currently 6.90%, is used for these calculations.

As of December 31, 2023, the LDROM for the System, excluding Teachers, is $13,729,272,616. The difference between the plan's AAL of $8,879,934,968 and the LDROM can be thought of as the increase in the AAL if the entire portfolio were invested in low-default-risk securities. Alternatively, this difference could also be viewed as representing the expected savings from investing in the plan's diversified portfolio compared to investing only in low-default-risk securities.

ASOP 4 requires commentary to help the intended user understand the significance of the LDROM with respect to the funded status of the plan, plan contributions, and the security of participant benefits. In general, if plan assets were invested exclusively in low-default-risk securities, the funded status would be lower and the Actuarially Determined Contribution would be higher. While investing in a portfolio with low-default-risk securities may be more likely to reduce investment volatility and the volatility of employer contributions, it also may be more likely to result in higher employer contributions or lower benefits.

Risk

The actuarial valuation results are dependent on a single set of assumptions; however, 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 risks that may affect the System.

- Economic and Other Related Risks. Potential implications for the System due to the following economic effects (that were not reflected as of the valuation date) include:
  - Volatile financial markets and investment returns lower than assumed
  - High inflationary environment impacting salary increases
- Investment Risk (the risk that returns will be different than expected)

  If the actual return on market value for the prior plan year were 1% different (either higher or lower), the unfunded actuarial liability would change by 5.16%, or about $64,910,640, disregarding the asset smoothing method.

  The market value rate of return over the last 14 years has ranged from a low of -10.44% 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 Chapter 32 requires payment of the actuarially determined contribution. If future experience matches current assumptions, we project the unfunded actuarial accrued liability will be paid off in four 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.

Section 2: Actuarial Valuation Results — BRS Excluding Teachers

- Actual Experience Over the Last Ten Years

  Past experience can help demonstrate the sensitivity of key results to the System's actual experience. Over the past ten years:

  – The investment gain/(loss) for a year has ranged from a loss of $1,241,369,516 to a gain of $405,158,470 and the non-investment gain(loss) for a year has ranged from a loss of $37,531,571 to a gain of $189,554,895.

Plan Year Ended	Investment Gain/(Loss)	All Other Gains and (Losses)
2014	-$134,373,389	N/A
2015	-349,423,944	$189,554,895
2016	-63,979,975	N/A
2017	405,158,470	63,509,893
2018	-674,451,689	N/A
2019	398,284,471	-23,700,187
2020	274,760,722	N/A
2021	327,569,270	60,575,664
2022	-1,241,369,516	N/A
2023	230,467,008	-37,531,571

  – The funded percentage on the actuarial value of assets has ranged from a low of 75.0% as of January 1, 2016 to a high of 85.9% as of January 1, 2024.

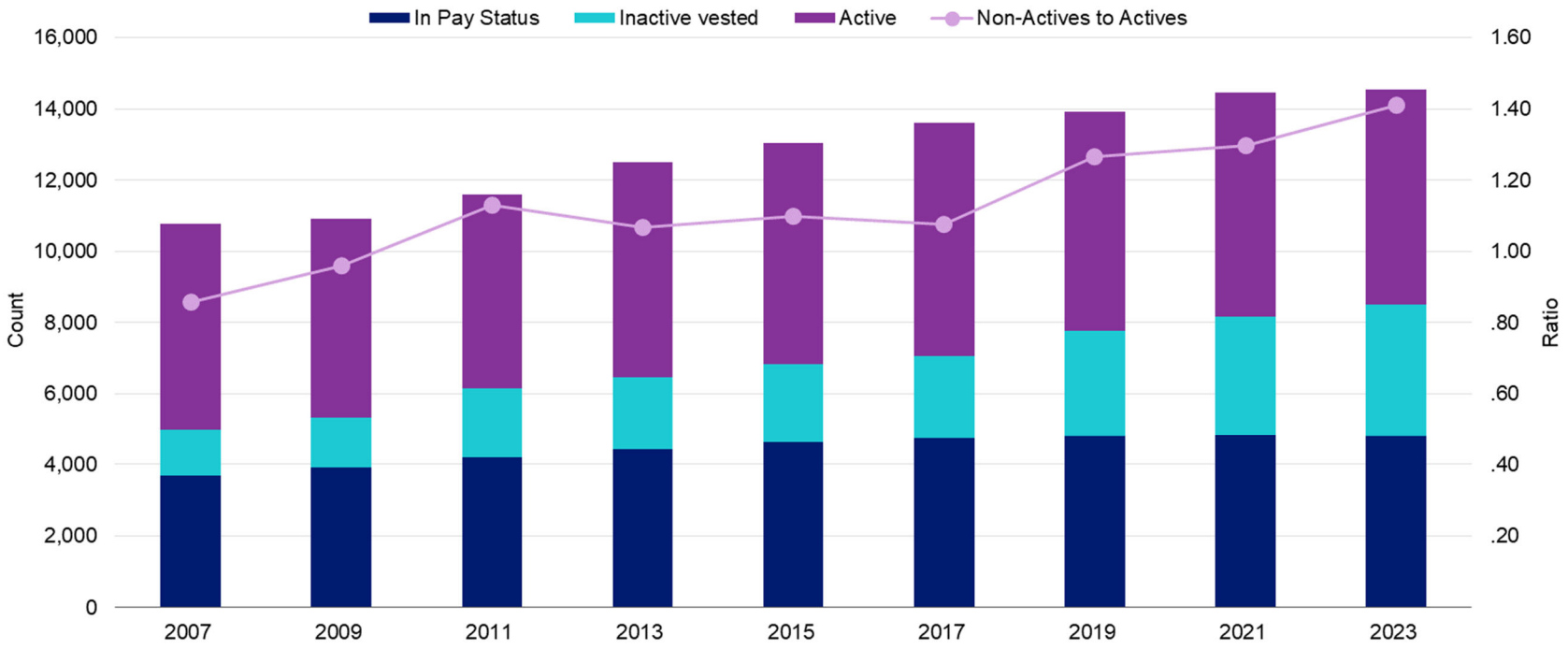
Maturity Measures

- As pension plans mature, the cash needed to fulfill benefit obligations will increase over time. Therefore, cash flow projections and analysis should be performed to assure that the System's asset allocation is aligned to meet emerging pension liabilities.
- Currently the System has a non-active to active participant ratio of 1.52.
- For the prior year, benefits paid and expenses were $106,831,433 less than contributions received. While this excess continues, the System is not dependent on investment returns to pay benefits. In future years, cash may be needed from the investment portfolio to pay benefits.

Section 3: Actuarial Valuation Results — Teachers

Participant information

Participant Population as of December 31



Legend	2007	2009	2011	2013	2015	2017	2019	2021	2023
In Pay Status	3,693	3,914	4,189	4,416	4,629	4,727	4,780	4,821	4,798
Inactive Vested[1]	1,281	1,424	1,964	2,040	2,191	2,323	2,995	3,347	3,717
Active	5,805	5,566	5,448	6,043	6,210	6,550	6,147	6,303	6,035
Ratio	0.86	0.96	1.13	1.07	1.10	1.08	1.26	1.30	1.41

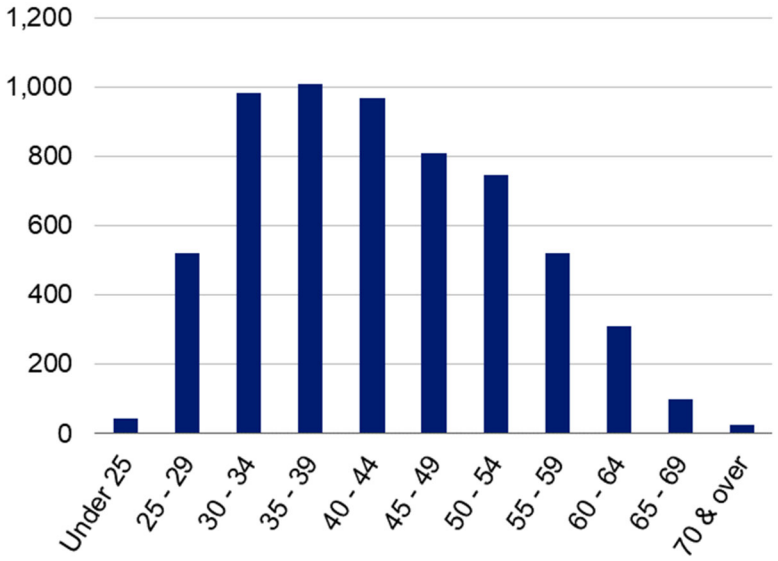
[1] Includes terminated participants due a refund of employee contributions.

Active participants

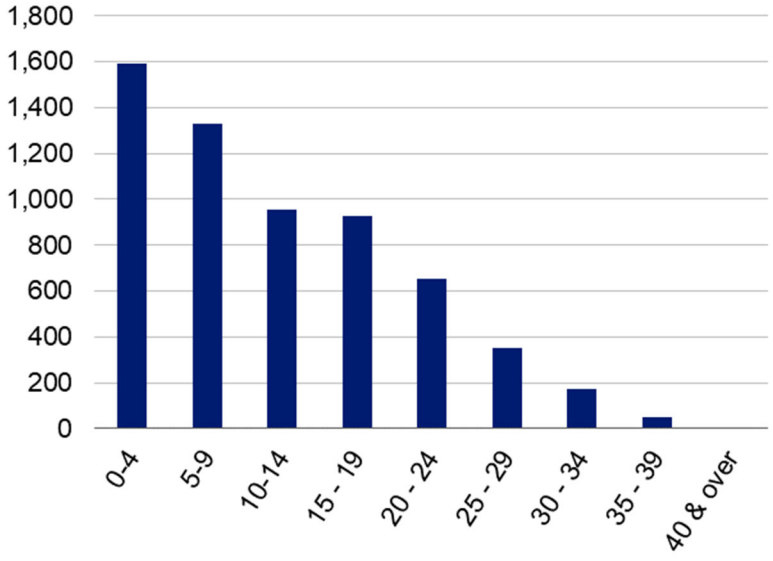
As of December 31,	2023	2021	Change
Active participants	6,035	6,303	-4.3%
Average age	43.4	42.6	0.8
Average years of service	12.1	11.4	0.7
Average compensation	$114,791	$103,946	10.4%

Distribution of Active Participants as of December 31, 2023

Actives by Age



Actives by Years of Service



Inactive participants

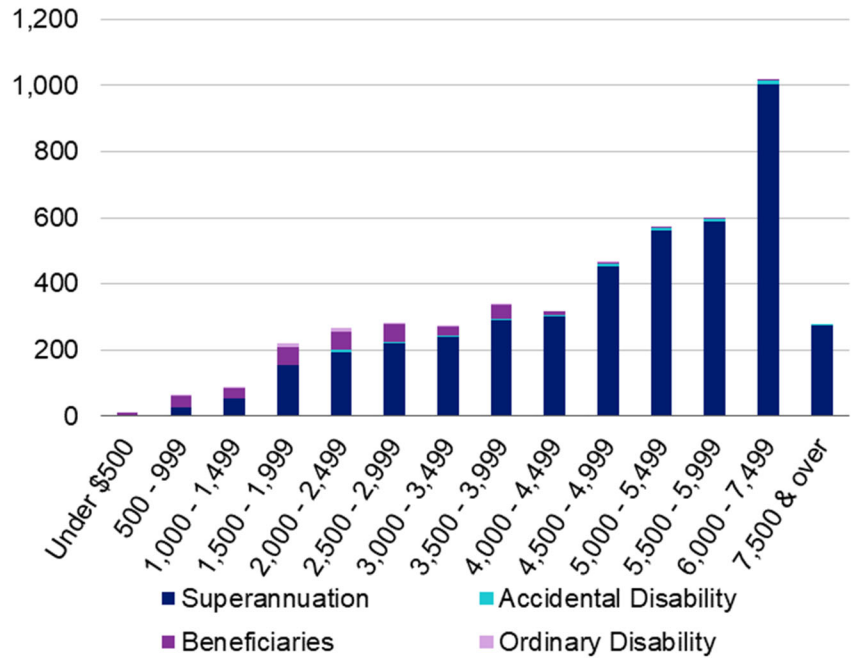
In this year's valuation, there were 548 inactive participants with a vested right to a deferred or immediate vested benefit. In addition, there were 3,169 inactive participants entitled to a return of their employee contributions.

Retired participants and beneficiaries

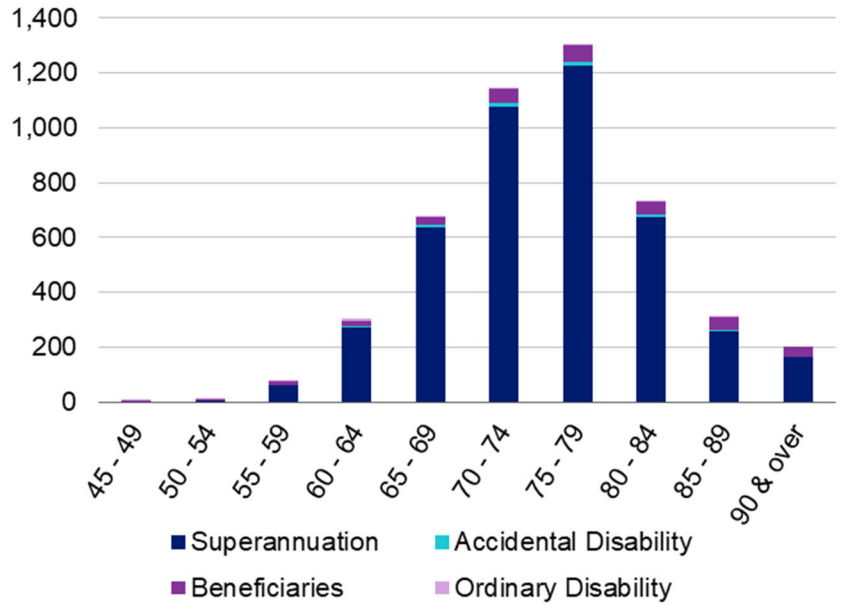
As of December 31,	2023	2021	Change
Retired participants	4,464	4,495	-0.7%
Beneficiaries	334	326	2.5%
Average age	74.9	74.1	0.8
Average amount[9]	$4,820	$4,655	3.5%
Total monthly amount[1]	23,127,996	22,442,351	3.1%

Distribution of Retired Participants and Beneficiaries as of December 31, 2023

By Type and Monthly Amount



By Type and Age

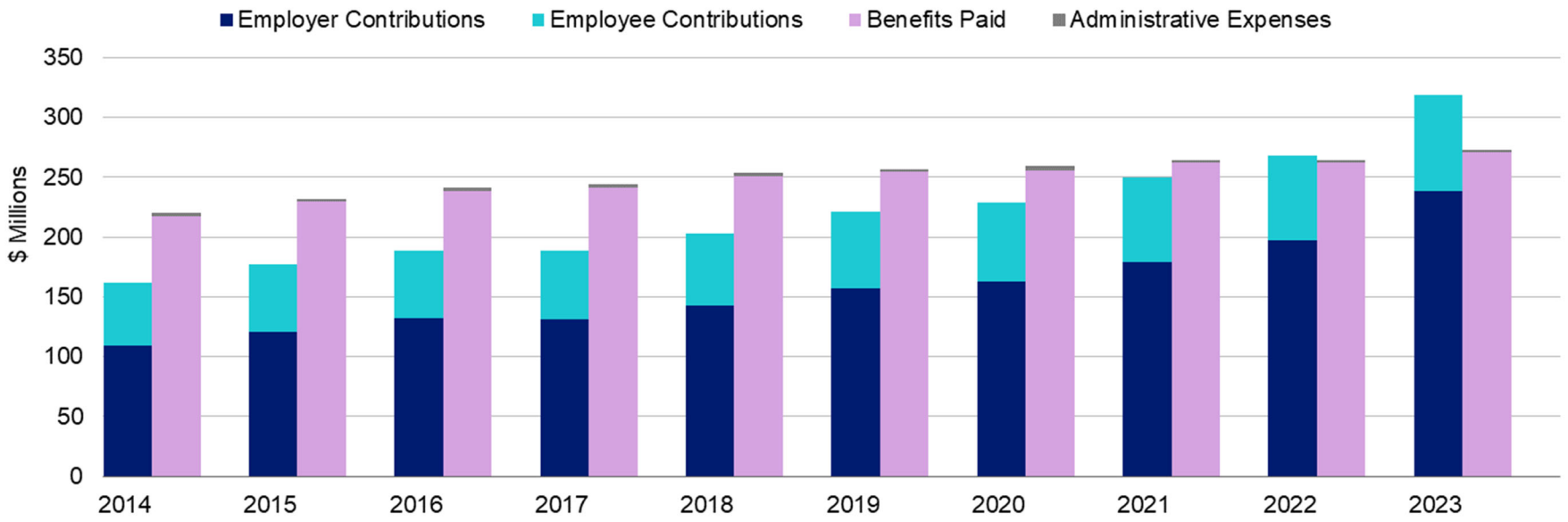


[1] Excludes COLAs reimbursed by the Commonwealth.

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.

Comparison of Contributions with Benefits and Expenses
for Years Ended December 31, 2014 – 2023



Section 3: Actuarial Valuation Results — Teachers

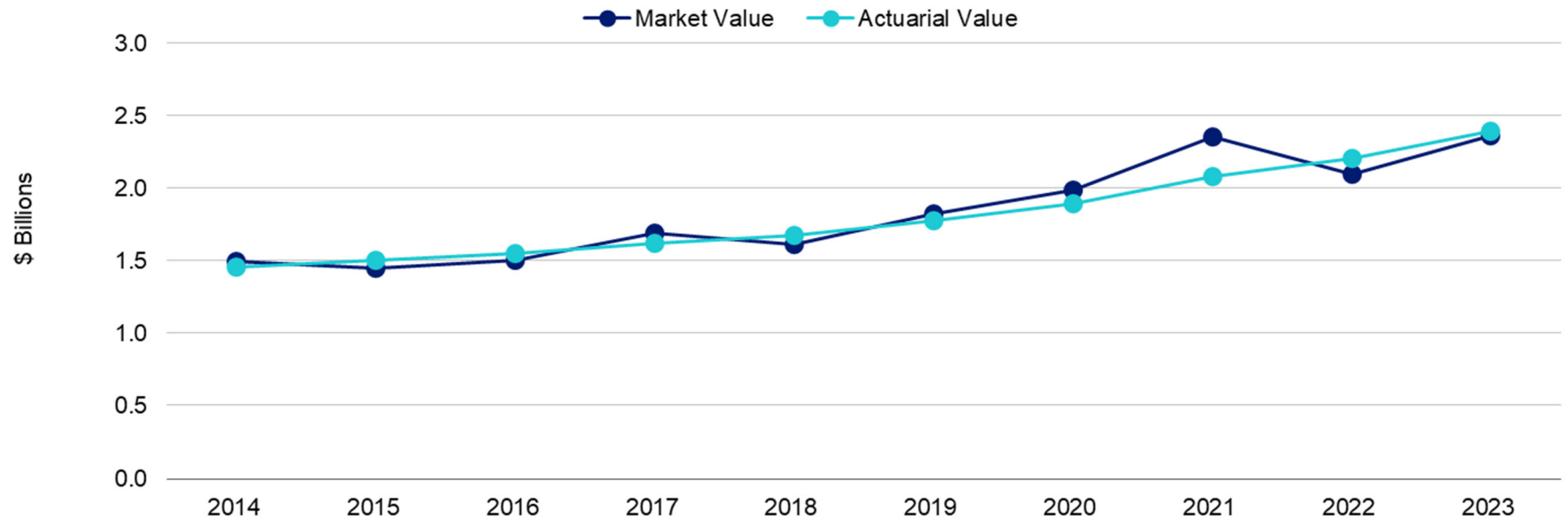
It is desirable to have level and predictable plan costs from one year to the next. For this reason, the Board has approved an asset valuation method that gradually adjusts to market value. Under this valuation method, the full value of market fluctuations is not recognized in a single year and, as a 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

	Component	Year Ended December 31, 2023	Year Ended December 31, 2022
1	Actuarial value of assets at the beginning of the year	$2,203,457,769	$2,080,996,195
2	Contributions, less benefit payments and expense during the year	45,693,507	3,747,171
3	Average actuarial value: **(1) + [50% of (2)]**	2,226,304,523	2,082,869,781
4	Expected investment income: **7.00% x (3)**	155,841,317	145,800,885
5	**Preliminary actuarial value of assets at the end of the year: (1) + (2) + (4)**	**$2,404,992,593**	**$2,230,544,251**
6	Market value of assets at the end of the year	2,363,600,554	2,095,111,840
7	Adjustment toward market value: **20% of [(6) – (5)]**	-8,278,408	-27,086,482
8	Adjustment to be within 20% corridor	0	0
9	**Final actuarial value of assets at the end of the year: (5) + (7) + (8)**	**$2,396,714,185**	**$2,203,457,769**
10	Actuarial value as a percentage of market value: **(9) ÷ (6)**	101.4%	105.2%

Asset history for years ended December 31

Market Value of Assets vs Actuarial Value of Assets

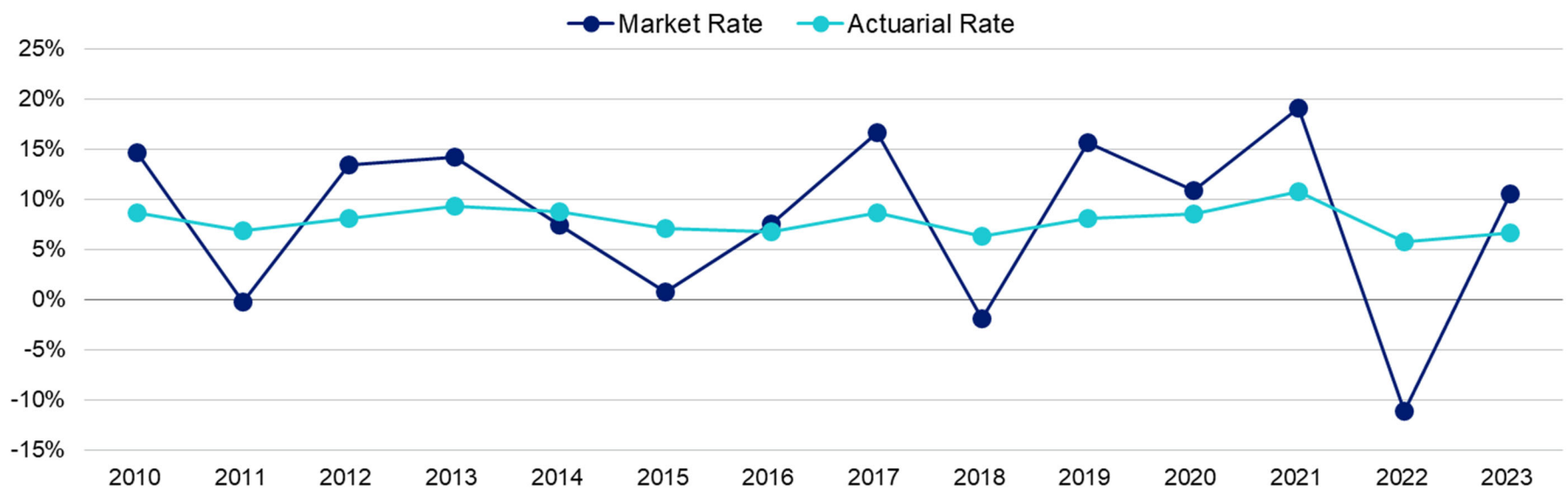


Legend	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Market value[1]	$1.49	$1.45	$1.50	$1.69	$1.61	$1.82	$1.99	$2.35	$2.10	$2.36
Actuarial value[1]	1.45	1.50	1.55	1.62	1.67	1.77	1.89	2.08	2.20	2.40

[1] In $ billions

Historical investment returns

Market and Actuarial Rates of Return for Years Ended December 31, 2010 – 2023



Legend	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Market rate	14.59%	-0.21%	13.45%	14.17%	7.47%	0.79%	7.48%	16.66%	-1.95%	15.62%	10.86%	19.05%	-11.12%	10.52%
Actuarial rate	8.64%	6.84%	8.05%	9.26%	8.72%	7.11%	6.76%	8.66%	6.36%	8.12%	8.53%	10.76%	5.70%	6.63%
Assumed rate	8.25%	8.25%	8.25%	8.25%	8.00%	8.00%	7.50%	7.50%	7.35%	7.35%	7.15%	7.15%	7.00%	7.00%

Average Rates of Return	Market Value	Actuarial Value
Most recent five-year average return:	7.95%	7.84%
Most recent ten-year average return:	7.06%	7.69%
14-year average return:	7.77%	7.81%

Actuarial experience

Assumptions should consider experience and should be based on reasonable expectations for the future.

Each year actual experience is compared to that projected by the assumptions. Differences are reflected in the actuarial valuation.

Assumptions are not changed if experience is believed to be a short-term development that will not continue over the long term. On the other hand, if experience is expected to continue, assumptions are changed.

Actuarial Experience for Two-Year Period Ended December 31, 2023

	Source of Gain/(Loss)	Amount
1.	(Loss) from investments[1]	-$35,364,890
2.	Gain from administrative expenses	2,925,328
3.	Gain from other experience	84,856,256
4.	**Net experience gain: 1 + 2 + 3**	**$52,416,694**

[1] Details on next page

Investment experience

Actuarial planning is long term. The obligations of a pension plan are expected to continue for the lifetime of all its participants.

The assumed long-term rate of return of 7.00% considers past experience, the asset allocation policy of the Board and future expectations.

Investment Experience for Years Ended December 31, 2023 and December 31, 2022

	Investment	2023 Market Value	2023 Actuarial Value	2022 Market Value	2022 Actuarial Value
1.	Net investment income	$222,795,207	$147,562,909	-$261,760,508	$118,714,403
2.	Average value of assets	2,117,958,594	2,226,304,523	2,354,998,763	2,082,869,781
3.	Rate of return: **1 ÷ 2**	10.52%	6.63%	-11.12%	5.70%
4.	Assumed rate of return	7.00%	7.00%	7.00%	7.00%
5.	Expected investment income: **2 x 4**	$148,257,102	$155,841,317	$164,849,913	$145,800,885
6.	**Net investment gain/(loss): 1 – 5**	**$74,538,105**	**-$8,278,408**	**-$426,610,421**	**-$27,086,482**

Non-investment experience

Administrative expenses

Administrative expenses for the year ended December 31, 2023 and December 31, 2022 totaled $1,868,529 and $1,829,271, respectively, as compared to the assumption of $3,120,000 for calendar year 2022 and $3,221,400 for calendar year 2023. This resulted in an experience gain of $2,925,328 for the year, including an adjustment for interest.

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:

- Mortality experience (more or fewer than expected deaths)
- The extent of turnover among participants
- Retirement experience (earlier or later than projected)
- The number of disability retirements (more or fewer than projected)
- Salary increases (greater or smaller than projected)

The net gain from this other experience for the two-year period ending December 31, 2023 amounted to $84,856,256, which is 1.7% of the actuarial accrued liability.

Liability Changes Due to Demographic Experience for Two-Year Period Ended December 31, 2023

Other Experience	Gain or (Loss)
Gain due to transfers to Non-Teachers	$23,405,722
Gain due to mortality experience	15,448,561
Gain due to salaries increasing less than expected	141,299
Miscellaneous experience gain, including a gain from a reduction in the number of active participants	45,860,674
Net gain	**$84,856,256**

Actuarial assumptions

Based on information on expenses provided by the Retirement System, we have increased the assumption from $10,400,000 to $11,700,000 for the Boston Retirement System for calendar year 2024, with 30% or $3,510,000 assigned to the Teachers.

Plan provisions

Pursuant to Chapter 269 of the Acts of 2022, the Board approved a one-time increase in the COLA from 3% to 5% effective July 1, 2022, which increased the January 1, 2024 unfunded liability by $15.1 million.

Development of Unfunded Actuarial Accrued Liability

	Unfunded Actuarial Accrued Liability	Amount for Year Ended December 31, 2023	Amount for Year Ended December 31, 2022
1.	Unfunded actuarial accrued liability at beginning of year	$2,548,075,137	$2,543,739,222
2.	Normal cost at beginning of year	100,118,386	96,966,960
3.	Total contributions	-318,719,517	-268,097,079
4.	Interest on **1, 2 & 3**	174,218,364	175,466,034
5.	**Expected unfunded actuarial accrued liability**	**$2,503,692,370**	**$2,548,075,137**
6.	Changes due to:		
	a. Net experience gain	-$52,416,694	
	b. Adoption of 5% COLA	15,104,275	
	c. Total changes	**-$37,312,419**	
7.	**Unfunded actuarial accrued liability at end of year**	**$2,466,379,951**	

Actuarially determined contribution

The actuarially determined contribution is equal to the employer normal cost payment and a payment on the unfunded actuarial accrued liability and is determined based on the results of the Commonwealth valuation completed by PERAC. The Commonwealth appropriation for the Teachers is $261,107,423 for fiscal 2025. The total Commonwealth appropriation is expected to increase by 9.63% through fiscal 2028 with a 4.00% increasing amortization payment on the unfunded actuarial accrued lability thereafter, and the Commonwealth's liabilities are expected to be fully funded in 2036. The allocation of the total Commonwealth appropriation in future fiscal years to the Teachers will be determined each year. The detail of the Actuarially Determined Contribution is shown below.

If the allocation of the Commonwealth appropriation for the Teachers increases 9.63% through fiscal 2028, with a 4.00% increasing amortization payment on the unfunded actuarial accrued liability thereafter, the unfunded liability is projected to be fully funded by the target date of June 30, 2036, if all assumptions are met and there are no future changes in assumptions or the plan of benefits. The actuarially determined contribution for fiscal 2025 can be considered a "Reasonable Actuarially Determined Contribution" as required under ASOP 4.

Actuarially Determined Contribution for Years beginning July 1, 2024 and July 1, 2022

Component	2024 Amount	2024 Percent of Projected Payroll	2022 Amount	2022 Percent of Projected Payroll
1. Total normal cost	$97,995,181	13.43%	$93,846,960	13.62%
2. Administrative expense assumption	3,510,000	0.48%	3,120,000	0.45%
3. Expected employee contributions	-79,378,343	-10.88%	-74,760,210	-10.85%
4. Employer normal cost: (1) + (2) + (3)	**$22,126,838**	**3.03%**	**$22,206,750**	**3.22%**
5. Actuarial accrued liability	$4,863,094,136		$4,624,735,417	
6. Actuarial value of assets	2,396,714,185		2,080,996,195	
7. Unfunded actuarial accrued liability: (5) - (6)	**$2,466,379,951**		**$2,543,739,222**	
8. Employer normal cost projected to July 1, 2024 and 2022, adjusted for timing	23,257,138	3.14%	23,341,132	3.33%
9. Projected unfunded actuarial accrued liability	2,551,243,259		2,631,264,311	
10. Payment on projected unfunded actuarial accrued liability, adjusted for timing	237,850,285	32.08%	173,491,827	24.78%
11. Actuarially determined contribution: (8) + (10)	**$261,107,423**	**35.22%**	**$196,832,959**	**28.11%**
12. Projected payroll as of July 1	741,335,457		700,162,530	

Note:
Actuarially Determined Contributions are assumed to be paid on December 31.

Section 3: Actuarial Valuation Results — Teachers

The funding schedule adopted by the Commonwealth is designed to reduce the volatility of the actuarially determined contribution by increasing the total contribution by a fixed percentage per year. As noted in Section 1, ASOP 4 requires the disclosure of the impact of smoothing the increases in the appropriation over the funding schedule. If the actuarially determined contribution were determined by amortizing the projected July 1, 2024 unfunded actuarial accrued liability in amortization payments that increase 3.25% per year for twelve years, plus payment of the fiscal 2025 employer normal cost, the actuarially determined contribution for fiscal 2025 would increase from $261,107,423 to $288,833,583 and increase by approximately 3.25% per year through 2036.

Low-Default-Risk Obligation Measure (LDROM)

As noted in Section 1, ASOP 4 requires the disclosure of a Low-Default-Risk Obligation Measure (LDROM) when performing a funding valuation. The LDROM presented in this report is calculated using the same methodology and assumptions used to determine the Actuarial Accrued Liability (AAL) used for funding, except for the discount rate. The LDROM is required to be calculated using "a discount rate…derived from low-default-risk fixed income securities whose cash flows are reasonably consistent with the pattern of benefits expected to be paid in the future."

The LDROM is a calculation assuming a plan's assets are invested in an all-bond portfolio, generally lowering expected long-term investment returns. The discount rate selected and used for this purpose is the Bond Buyer General Obligation 20-year Municipal Bond Index Rate, published at the end of each week. The last published rate in December of the measurement period, by The Bond Buyer (www.bondbuyer.com), is 3.26% for use effective December 31, 2023. This is the rate used to determine the discount rate for valuing reported public pension plan liabilities in accordance with Governmental Accounting Standards when plan assets are projected to be insufficient to make projected benefit payments, and the 20-year period reasonably approximates the duration of plan liabilities. The LDROM is not used to determine a plan's funded status or Actuarially Determined Contribution. The plan's expected return on assets, currently 7.00%, is used for these calculations.

As of December 31, 2023, the LDROM for the system, including only Boston Teachers, is $7,807,867,555. The difference between the plan's AAL of $4,863,094,136 and the LDROM can be thought of as the increase in the AAL if the entire portfolio were invested in low-default-risk securities. Alternatively, this difference could also be viewed as representing the expected savings from investing in the plan's diversified portfolio compared to investing only in low-default-risk securities.

ASOP 4 requires commentary to help the intended user understand the significance of the LDROM with respect to the funded status of the plan, plan contributions, and the security of participant benefits. In general, if plan assets were invested exclusively in low-default-risk securities, the funded status would be lower and the Actuarially Determined Contribution would be higher. While investing in a portfolio with low-default-risk securities may be more likely to reduce investment volatility and the volatility of employer contributions, it also may be more likely to result in higher employer contributions or lower benefits.

Risk

The actuarial valuation results are dependent on a single set of assumptions; however, 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 risks that may affect the System.

- Economic and Other Related Risks. Potential implications for the System due to the following economic effects (that were not reflected as of the valuation date) include:
  - Volatile financial markets and investment returns lower than assumed
  - High inflationary environment impacting salary increases
- Investment Risk (the risk that returns will be different than expected)

  If the actual return on market value for the prior plan year were 1% different (either higher or lower), the unfunded actuarial liability would change by 0.86%, or about $21,179,586, disregarding the asset smoothing method.

  The market value rate of return over the last 14 years has ranged from a low of -11.12% to a high of 19.05%.
- 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)

  If the Commonwealth appropriation for the BRS teachers described in the fiscal 2025 appropriation letter, dated May 10, 2024, is made, including the pattern of increases described in the letter, the unfunded liability is expected to be paid off within 12 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.

Section 3: Actuarial Valuation Results — Teachers

- Actual Experience Over the Last Ten Years

  Past experience can help demonstrate the sensitivity of key results to the System's actual experience. Over the past ten years:

  – The investment gain/(loss) for a year has ranged from a loss of $426,610,421 to a gain of $236,016,226 and the non-investment gain(loss) for a year has ranged from a loss of $20,837,666 to a gain of $122,688,672.

Plan Year Ended	Investment Gain/(Loss)	All Other Gains and (Losses)
2014	-$7,505,073	N/A
2015	-105,767,364	$122,688,672
2016	-316,519	N/A
2017	135,246,116	63,785,673
2018	-155,204,671	N/A
2019	131,683,065	107,722,988
2020	67,117,062	N/A
2021	236,016,226	-20,837,666
2022	-426,610,421	N/A
2023	74,538,105	87,781,584

  – 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 49.3% as of January 1, 2024.

Maturity Measures

- As pension plans mature, the cash needed to fulfill benefit obligations will increase over time. Therefore, cash flow projections and analysis should be performed to assure that the System's asset allocation is aligned to meet emerging pension liabilities.
- Currently the System has a non-active to active participant ratio of 1.41.
- For the prior year, benefits paid and expenses were $45,693,507 less than contributions received. While this excess continues, the System is not dependent on investment returns to pay benefits. In future years, cash may be needed from the investment portfolio to pay benefits.

Section 4: Supplemental Information

Exhibit A: Participants in active service as of December 31, 2023 — BRS excluding Teachers by age, years of service and average compensation

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	360	360	--	--	--	--	--	--	--	--
	$54,574	$54,574	--	--	--	--	--	--	--	--
25 - 29	1,226	1,084	140	2	--	--	--	--	--	--
	$69,189	$67,669	$80,725	$85,366	--	--	--	--	--	--
30 - 34	1,794	1,057	635	99	3	--	--	--	--	--
	$80,838	$72,088	$92,948	$97,024	$66,301	--	--	--	--	--
35 - 39	1,846	672	563	447	159	5	--	--	--	--
	$90,610	$69,697	$95,337	$111,442	$104,525	$64,351	--	--	--	--
40 - 44	1,695	440	333	335	481	101	5	--	--	--
	$93,697	$56,322	$82,439	$107,638	$122,950	$108,816	$78,864	--	--	--
45 - 49	1,566	337	261	185	356	315	108	4	--	--
	$92,981	$56,460	$66,464	$88,909	$112,889	$123,080	$122,693	$144,001	--	--
50 - 54	1,815	340	232	170	227	319	395	109	23	--
	$93,499	$50,664	$65,507	$73,777	$86,769	$109,467	$134,779	$128,361	$125,653	--
55 - 59	1,868	294	232	167	196	248	288	240	197	6
	$89,704	$48,271	$59,030	$71,026	$73,010	$87,979	$120,828	$129,916	$126,438	$133,836
60 - 64	1,398	190	159	132	169	198	170	136	200	44
	$84,755	$46,046	$63,063	$63,486	$63,810	$76,707	$102,485	$117,606	$130,718	$131,789
65 - 69	575	70	67	70	88	115	67	35	37	26
	$67,202	$42,438	$56,270	$65,602	$60,562	$69,270	$75,810	$81,184	$95,173	$98,867
70 & over	333	70	39	37	53	42	34	20	18	20
	$53,551	$26,988	$39,619	$49,099	$56,652	$61,202	$65,245	$79,347	$76,249	$91,536
Total	14,476	4,914	2,661	1,644	1,732	1,343	1,067	544	475	96
	$85,204	$62,041	$80,057	$92,025	$97,730	$98,694	$118,464	$121,636	$123,865	$114,614

Notes:
Compensation figures are for the prior calendar year and reflect annualized salaries for participants hired during the year.
Calendar year 2023 compensation figures were increased by 15.1% for Police to estimate unsettled contracts and TCAP impact in fiscal 2025 and decreased by 5.6% for Fire Fighters and 2.5% for Non-teacher school employees to estimate retroactive payments made during the year.

Exhibit B: Summary statement of income and expenses on a market value basis — BRS excluding Teachers

Years Ended December 31, 2023 and December 31, 2022

Item	Income and Expenses	Assets as of December 31, 2023	Income and Expenses	Assets as of December 31, 2022
Net assets at market value at the beginning of the year		**$6,437,648,248**		**$7,130,505,146**
Contribution and other income:				
• Employer contributions	$468,490,429		$409,997,886	
• Employee contributions	131,498,695		118,351,451	
• **Total contribution income**		**$599,989,124**		**$528,349,337**
Investment income:				
• Investment income	$678,350,422		-$747,480,158	
• **Net investment income**		**$678,350,422**		**-$747,480,158**
• **Total income available for benefits**		**$1,278,339,546**		**-$219,130,821**
Less benefit payments and administrative expenses:				
• Administrative expenses	-$5,861,288		-$6,430,862	
• Pensions	-487,296,403		-467,295,215	
• **Net benefit payments and administrative expenses**		**-$493,157,691**		**-$473,726,077**
Change in market value of assets		**$785,181,855**		**-$692,856,898**
Net assets at market value at the end of the year		**$7,222,830,103**		**$6,437,648,248**

Exhibit C: Participants in active service as of December 31, 2023 — Teachers by age, years of service, and average compensation

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	45	45	--	--	--	--	--	--	--	--
	$73,059	$73,059	--	--	--	--	--	--	--	--
25 - 29	520	452	68	--	--	--	--	--	--	--
	$87,668	$85,175	$104,244	--	--	--	--	--	--	--
30 - 34	982	450	465	67	--	--	--	--	--	--
	$103,607	$92,531	$111,186	$125,393	--	--	--	--	--	--
35 - 39	1,009	234	369	350	56	--	--	--	--	--
	$113,136	$93,951	$113,547	$123,075	$128,472	--	--	--	--	--
40 - 44	969	150	193	231	343	51	1	--	--	--
	$118,898	$92,835	$117,077	$122,625	$127,082	$130,314	$129,226	--	--	--
45 - 49	808	99	92	126	228	230	32	1	--	--
	$124,269	$104,819	$117,786	$123,716	$127,276	$131,389	$132,757	$121,409	--	--
50 - 54	746	78	79	82	145	188	145	28	1	--
	$123,803	$100,565	$117,427	$120,740	$123,900	$128,575	$133,654	$132,148	$117,994	--
55 - 59	521	46	35	58	70	100	103	90	19	--
	$126,501	$105,263	$117,127	$122,970	$127,916	$126,717	$130,459	$135,927	$133,496	--
60 - 64	310	23	23	30	60	59	49	41	25	--
	$125,360	$93,757	$111,987	$118,610	$125,917	$130,625	$132,637	$133,109	$134,104	--
65 - 69	100	9	6	7	20	22	20	11	3	2
	$122,536	$84,391	$96,669	$129,477	$124,727	$127,054	$131,283	$127,667	$132,449	$145,354
70 & over	25	4	2	3	3	4	4	1	2	2
	$119,684	$80,584	$96,082	$123,825	$125,472	$125,700	$140,048	$144,784	$126,866	$134,104
Total	6,035	1,590	1,332	954	925	654	354	172	50	4
	$114,791	$91,596	$113,247	$122,915	$126,647	$129,532	$132,428	$134,079	$133,162	$139,729

Note:
Compensation figures are for the prior year and reflect annualized salaries for participants hired during the year.
Calendar 2023 compensation figures decreased by 2.5% to estimate retroactive payments made during the year.

Exhibit D: Summary statement of income and expenses on a market value basis — Teachers

Years Ended December 31, 2023 and December 31, 2022

Item	Income and Expenses	Assets as of December 31, 2023	Income and Expenses	Assets as of December 31, 2022
Net assets at market value at the beginning of the year		**$2,095,111,840**		**$2,353,125,177**
Contribution and other income:				
• Employer contributions	$238,472,411		$196,832,959	
• Employee contributions	80,247,106		71,264,120	
• **Total contribution income**		**$318,719,517**		**$268,097,079**
Investment income:				
• Investment income	$222,795,207		-$261,760,508	
• **Net investment income**		**$222,795,207**		**-$261,760,508**
• **Total income available for benefits**		**$541,514,724**		**$6,336,571**
Less benefit payments and administrative expenses:				
• Administrative expenses	-$1,868,529		-$1,829,271	
• Pensions	-271,157,481		-262,520,637	
• Net benefit payments and administrative expenses		-$273,026,010		-$264,349,908
Change in market value of assets		**$268,488,714**		**-$258,013,337**
Net assets at market value at the end of the year		**$2,363,600,554**		**$2,095,111,840**

Exhibit E: Historical plan population — All Employees: 2005 - 2023

Participant Data Statistics: 2005 – 2023

Active Participants versus Retired Participants and Beneficiaries

Year Ended December 31	Active Participants Count	Inactive Participants Count	Retired Participants and Beneficiaries Count	Ratio of Non-Actives to Actives
2005	20,917	6,178	13,783	0.95
2007	21,748	6,240	13,939	0.93
2009	20,015	7,613	13,958	1.08
2011	19,399	8,787	14,189	1.18
2013	20,278	8,791	14,341	1.14
2015	20,498	9,740	14,485	1.18
2017	20,995	10,623	14,448	1.19
2019	20,856	12.678	14,559	1.31
2021	20,884	14,124	14,819	1.39
2023	20,511	15,520	15,005	1.45

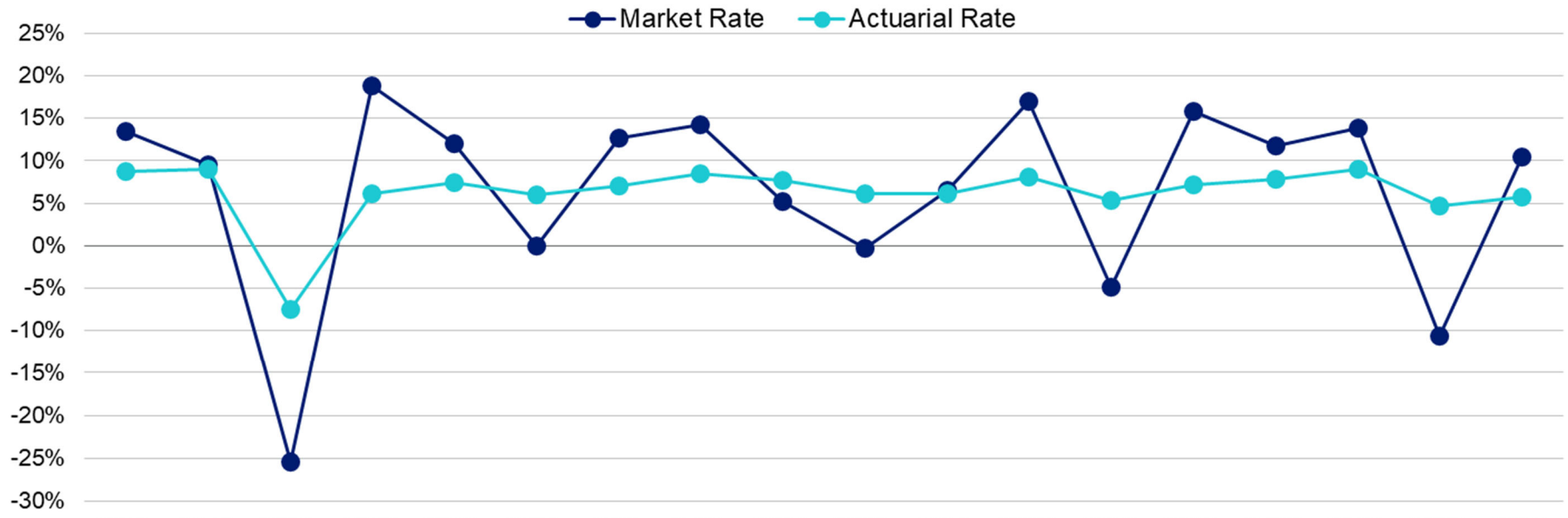
Exhibit F: Table of plan demographics — All Employees

Category	Year Ended December 31, 2023	Year Ended December 31, 2021	Change From Prior Year
Active participants in valuation:			
• Number	20,511	20,884	-1.8%
• Average age	45.4	45.1	0.3
• Average years of service	12.2	12.2	0.0
• Average compensation	$93,910	$85,481	9.9%
• Account balances	1,846,853,630	1,744,573,853	5.9%
• Number with unknown age and/or service information	0	1	-100.0%
Inactive participants			
• Inactive participants with a vested right to a deferred or immediate benefit	1,482	1,303	13.7%
• Inactive participants due a refund of employee contributions	14,038	12,821	9.5%
Retired participants:			
• Number in pay status	11,277	11,034	2.2%
• Average age	74.1	73.8	0.3
• Average monthly benefit	$4,296	$4,074	5.4%
Disabled participants:			
• Number in pay status	1,687	1,677	0.6%
• Average age	70.2	69.9	0.3
• Average monthly benefit	$5,045	$4,674	7.9%
Beneficiaries:			
• Number in pay status	2,041	2,108	-3.2%
• Average age	76.1	76.5	-0.4
• Average monthly benefit	$2,378	$2,155	10.3%

Notes:
Compensation figures are for the prior calendar year and reflect annualized salaries for participants hired during the year.
Calendar year 2023 compensation figures were increased by 15.1% for Police to estimate unsettled contracts and TCAP impact in fiscal 2025 and decreased by 5.6% for Fire Fighters and 2.5% for Teachers and Non-teacher school employees to estimate retroactive payments made during the year.
Calendar year 2021 compensation figures were increased by 3% for Police, 1% for Fire Fighters and Teachers, and 2.5% for Group 1 and Group 2 employees to estimate unsettled contracts.

Exhibit G: Historical investment returns — All Assets: Years Ended December 31, 2006 - 2023

Market and Actuarial Rates of Return for Years Ended December 31



Legend	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Market rate	13.43%	9.53%	-25.41%	18.76%	11.99%	-0.08%	12.65%	14.26%	5.21%	-0.28%	6.52%	16.98%	-4.83%	15.74%	11.68%	13.85%	-10.61%	10.47%
Actuarial rate	8.79%	8.95%	-7.44%	6.17%	7.48%	6.00%	7.03%	8.41%	7.72%	6.12%	6.08%	8.11%	5.30%	7.21%	7.79%	9.03%	4.69%	5.77%

Average Rates of Return	Market Value	Actuarial Value
Most recent five-year average return:	7.25%	6.80%
Most recent ten-year average return:	6.06%	6.73%
Most recent 15-year average return:	7.25%	6.81%
18-year average return:	6.12%	6.36%

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Section 5: Actuarial Valuation Basis

Exhibit H: Actuarial assumptions, methods and models

Net investment return

6.90% for BRS excluding Teachers and 7.00% for Teachers

The net investment return assumption 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 System's target asset allocation.

Salary increases

Years of Service	Teachers	BRS excluding Teachers Group 1	BRS excluding Teachers Group 2	BRS excluding Teachers 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%

Years of Service	Teachers	BRS excluding Teachers Group 1	BRS excluding Teachers Group 2	BRS excluding Teachers Group 4
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 & later	4.00%	4.00%	4.25%	4.50%

Note:
Includes an allowance for wage inflation of 3.25%.

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

Cost-of-living adjustments

3.00% increase on the first $15,000 of retirement allowance.

Interest on employee contributions

3.5%

Administrative expenses

$11,700,000 for calendar year 2024, increasing 3.25% per year, with 70%, or $8,190,000 assigned to the BRS excluding Teachers and 30%, or $3,510,000, assigned to the Teachers. (Previously, $10,400,000 for calendar year 2022, increasing 3.25% per year, with 70%, or $7,280,000 assigned to the BRS excluding Teachers, and 30%, or $3,120,000, assigned to the Teachers.)

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

Mortality rates

BRS excluding Teachers

Groups 1 and 2

Healthy: Pub-2010 General Employee, Healthy Retiree and Contingent Survivor Amount-Weighted Mortality Tables set forward one year projected generationally using Scale MP-2021

Disabled: Pub-2010 General Healthy Retiree Amount-Weighted Mortality Tables set forward one year projected generationally using Scale MP-2021

Group 4

Healthy: Pub-2010 Safety Employee, Healthy Retiree and Contingent Survivor Amount-Weighted Mortality Tables projected generationally using Scale MP-2021

Disabled: Pub-2010 Disabled Retiree Amount-Weighted Mortality Tables projected generationally using Scale MP-2021

Teachers

Healthy: Pub-2010 Teacher Employee, Healthy Retiree and Contingent Survivor Headcount-Weighted Mortality Tables projected generationally using Scale MP-2021

Disabled: Pub-2010 Teacher Healthy Retiree Headcount-Weighted Mortality Tables projected generationally using Scale MP-2021

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 Retirement System 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 five most recent valuations. The mortality tables were then adjusted to future years using a generational projection under Scale MP-2021 to reflect future mortality improvement.

Termination rates before retirement

Groups 1 and 2 – BRS excluding Teachers

Age	Mortality Male	Mortality Female	Disability	Withdrawal
20	0.04%	0.01%	0.03%	6.58%
25	0.03%	0.01%	0.04%	5.27%
30	0.04%	0.02%	0.06%	4.83%
35	0.05%	0.03%	0.07%	4.47%
40	0.07%	0.04%	0.11%	3.84%
45	0.11%	0.06%	0.18%	3.21%
50	0.16%	0.09%	0.30%	1.52%
55	0.24%	0.13%	0.50%	0.33%
60	0.34%	0.20%	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 – BRS excluding Teachers

Age	Mortality Male	Mortality Female	Disability	Withdrawal
20	0.04%	0.02%	0.15%	0.00%
25	0.04%	0.02%	0.21%	0.00%
30	0.04%	0.03%	0.28%	0.00%
35	0.05%	0.04%	0.37%	0.00%
40	0.06%	0.05%	0.55%	0.00%
45	0.08%	0.07%	0.90%	0.00%
50	0.12%	0.09%	1.51%	0.00%
55	0.18%	0.12%	2.52%	0.00%
60	0.26%	0.17%	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.

Teachers

Age	Mortality Male	Mortality Female	Disability
20	0.04%	0.01%	0.04%
25	0.02%	0.01%	0.05%
30	0.03%	0.02%	0.06%
35	0.04%	0.02%	0.06%
40	0.05%	0.03%	0.10%
45	0.08%	0.05%	0.30%
50	0.13%	0.08%	0.50%
55	0.19%	0.12%	0.70%
60	0.29%	0.18%	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

Teachers - Male

Age	0 – 1 Years of Service	2 Years of Service	3 Years of Service	4 Years of Service	5 Years of Service	6 Years of Service	7 Years of Service	8 Years of Service	9 Years of Service	10 or More Years of Service
20	13.0%	11.5%	8.3%	6.6%	5.5%	4.0%	4.0%	3.3%	1.5%	1.5%
30	15.0%	11.0%	8.9%	7.0%	5.4%	4.5%	4.0%	3.3%	1.5%	1.5%
40	13.3%	13.0%	7.1%	7.5%	5.2%	5.5%	3.0%	3.4%	2.5%	1.7%
50	16.2%	11.2%	8.8%	9.0%	7.0%	6.5%	5.0%	2.2%	2.5%	2.3%

Teachers - Female

Age	0 – 1 Years of Service	2 Years of Service	3 Years of Service	4 Years of Service	5 Years of Service	6 Years of Service	7 Years of Service	8 Years of Service	9 Years of Service	10 or More Years of Service
20	10.0%	10.5%	7.5%	7.3%	7.0%	5.0%	6.0%	7.0%	7.0%	5.0%
30	15.0%	11.5%	10.0%	10.0%	8.8%	7.3%	6.0%	7.0%	6.0%	4.5%
40	10.5%	8.5%	6.6%	5.2%	5.0%	5.0%	4.5%	3.5%	3.0%	2.2%
50	9.8%	12.0%	7.9%	6.6%	5.0%	3.0%	4.0%	2.4%	3.0%	2.0%

The termination rates and disability rates 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 five most recent valuations.

Retirement rates

BRS Excluding Teachers

Age	Groups 1 & 2	Group 4
50	- -	1.0%
51	- -	1.0%
52	- -	1.0%
53	- -	1.0%
54	- -	1.0%
55	3.0%	10.0%
56	3.0%	5.0%
57	3.0%	5.0%
58	3.0%	5.0%
59	3.0%	5.0%
60	8.0%	10.0%
61	8.0%	15.0%
62	15.0%	15.0%
63	10.0%	15.0%
64	10.0%	25.0%
65	35.0%	100.0%
66	20.0%	- -
67	20.0%	- -
68	20.0%	- -
69	20.0%	- -
70	100.0%	- -

Non-TARP Teachers

Age	Less than 20 Years of Service Male	Less than 20 Years of Service Female	20 or More Years of Service Male	20 or More Years of Service 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%

TARP Teachers – Male

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

TARP Teachers – Female

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

The retirement rates 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 five most recent valuations.

Retirement ages 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. The benefit election reflects the fact that all benefit options are actuarially equivalent.

2023 compensation

2023 compensation equal to compensation provided in the data, except salaries for new hires were annualized.

Calendar year 2023 compensation figures were increased by 15.1% for Police to estimate unsettled contracts and TCAP impact in fiscal 2025, and decreased by 5.6% for Fire Fighters, and 2.5% for Teachers and Non-Teacher school employees to estimate retroactive payments made during the year. For participants hired in December 2023, compensation was set equal to $35,000 for Group 1 and $80,000 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 to or received from other municipal retirement 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.

Actuarial models

Segal valuation results are based on proprietary actuarial modeling software. The actuarial valuation models generate a comprehensive set of liability and cost calculations that are presented to meet regulatory, legislative and client requirements. Our Actuarial Technology and Systems unit, comprised of both actuaries and programmers, is responsible for the initial development and maintenance of these models. The models have a modular structure that allows for a high degree of accuracy, flexibility and user control. The client team programs the assumptions and the plan provisions, validates the models, and reviews test lives and results, under the supervision of the responsible actuary.

Justification for change in actuarial assumptions

Based on past experience and future expectations, the following actuarial assumptions were changed:

- The administrative expense assumption for Non-Teachers was increased from $7,280,000 for calendar year 2022 to $8,190,000 for calendar year 2024.
- The administrative expense assumption for Teachers was increased from $3,120,000 for calendar year 2022 to $3,510,000 for calendar year 2024.

Exhibit I: Summary of plan provisions

This exhibit summarizes the major provisions of the System 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

Date of Hire	Contribution Rate
Prior to January 1, 1975	5%
January 1, 1975 – December 31, 1983	7%
January 1, 1984 – June 30, 1996	8%
July 1, 1996 onward	9%

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 $15,000 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

Pursuant to Chapter 269 of the Acts of 2022, the Board approved a one-time increase in the COLA from 3% to 5% effective July 1, 2022.

Appendix A: Definition of Pension Terms

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

Term	Definition
Actuarial accrued liability for actives	The equivalent of the accumulated normal costs allocated to the years before the valuation date.
Actuarial accrued liability for retirees and beneficiaries	Actuarial Present Value of lifetime benefits to existing retirees 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. 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 actuarial liabilities that are larger than projected.
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	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.

Appendix A: Definition of Pension Terms

Term	Definition
Actuarial present value of future 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 Benefits includes the liabilities for active members, retired members, beneficiaries receiving benefits, and inactive members entitled to either a refund of member contributions 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, as well as Actuarially Determined Contributions.
Actuarial value of assets	The value of the System'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 Actuarially Determined Contribution.
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 System.
Actuarially determined contribution	The employer's contributions, expressed as a dollar amount or a percentage of covered plan compensation, determined under the System'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 Unfunded Actuarial Accrued Liability. 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 Unfunded Actuarial Accrued Liability. 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 intended to pay off the Unfunded Actuarial Accrued Liability.
Assumptions or actuarial assumptions	The estimates upon which the cost of the System is calculated, including: **Investment return** — the rate of investment yield that the System will earn over the long-term future; **Mortality rates** — the rate or probability of death at a given age for employees and retirees; **Retirement rates** — the rate or probability of retirement at a given age or service; **Disability rates** — the rate or probability of disability retirement at a given age; **Withdrawal rates** — the rate or probability 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, real wage growth and merit and promotion increases.

Appendix A: Definition of Pension Terms

Term	Definition
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 20 years, it is 19 years at the end of one year, 18 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 based on the member's compensation, age 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 System 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 based on recommendations from the Actuary.
Funded ratio	The ratio of the Actuarial Value of Assets (AVA) to the Actuarial Accrued Liability (AAL). Plans sometimes also 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 System 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	The portion of the Actuarial Present Value of Future Benefits and expenses, if applicable, allocated to a valuation year by the Actuarial Cost Method. Any payment with respect to an Unfunded Actuarial Accrued Liability is not part of the Normal Cost (see Amortization Payment). For pension plan benefits that are provided in part by employee contributions, Normal Cost refers to the total of member 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 each future year in determining the Amortization Period.

Appendix A: Definition of Pension Terms

Term	Definition
Plan Fiduciary Net Position	Market value of assets.
Service costs	The portions of the actuarial present value of projected benefit payments that are attributed to valuation years.
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 or an Overfunded Actuarial Accrued Liability.
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 Benefits is determined. The expected benefits to be paid in the future are discounted to this date.