

Massachusetts Water Resources Authority Employees' Retirement System

Actuarial Valuation and Review as of January 1, 2022



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

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August 31, 2022

Retirement Board
Massachusetts Water Resources Authority Employees' Retirement System
Two Griffin Way
Chelsea, MA 02150

Dear Board Members:

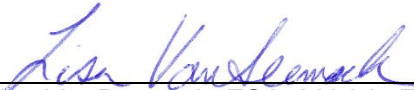
We are pleased to submit this Actuarial Valuation and Review as of January 1, 2022. It summarizes the actuarial data used in the valuation, analyzes the preceding year's experience, and establishes the funding requirements for fiscal 2023 and later years.

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

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

We look forward to reviewing this report with you and to answering any questions.

Sincerely,
Segal



Lisa VanDermark, FSA, MAAA, EA
Vice President and Consulting Actuary

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Section 1: Actuarial Valuation Summary

Purpose and basis

This report was prepared by Segal to present a valuation of the System as of January 1, 2022. The valuation was performed to determine whether the assets and contributions are sufficient to provide the prescribed benefits and to provide information for required disclosures under Governmental Accounting Standards Board (GASB) Statements No. 67 and 68. The measurements shown in this actuarial valuation may not be applicable for other purposes. In particular, the measures herein are not necessarily appropriate for assessing the sufficiency of System assets to cover the estimated cost of settling the System's benefit obligations. Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: System experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements; and changes in plan provisions or applicable law.

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, 2021, provided by the staff of the System;
- The assets of the System as of December 31, 2021, provided by the staff of the System;
- Economic assumptions regarding future salary increases and investment earnings; and
- Other actuarial assumptions regarding employee terminations, retirement, death, etc.

Section 1: Actuarial Valuation Summary

Valuation highlights

1. 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 Retirement Board meets this standard.
2. The funded ratio (the ratio of the actuarial value of assets to actuarial accrued liability) is 89.05%, compared to the prior year funded ratio of 88.23%. 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 97.32%, compared to 90.95% as of the prior valuation date. These measurements are not necessarily appropriate for assessing the sufficiency of the System assets to cover the estimated cost of settling the System's benefit obligation or the need for or the amount of future contributions.
3. The unfunded actuarial accrued liability is \$82.0 million, which is a decrease of \$1.9 million since the prior valuation.
4. The rate of return on the market value of assets was 13.82% for the plan year ended December 31, 2021. The rate of return on the actuarial value of assets was 7.44% for the same period. This resulted in an actuarial gain when measured against the assumed rate of return of 6.90%. Given the low fixed income interest rate environment, target asset allocation and expectations of future investment returns for various classes, we advise the Retirement Board to continue to monitor actual and anticipated investment returns relative to the assumed long-term rate of return on investments of 6.90%.
5. The actuarial value of assets is 91.49% 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 gain is recognized in future years, the cost of the System is likely to decrease unless the net gain is offset by future experience.
6. The following actuarial assumptions were approved by the Board and changed with this valuation:
 - The mortality improvement projection scale was updated from Scale MP-2020 to Scale MP-2021.
 - The administrative expense assumption was increased from \$550,000 for calendar 2021 to \$575,000 for calendar 2022. In both cases the expenses are projected to increase with inflation at 3.00% per year.

Changing these assumptions increased the unfunded liability by approximately \$1.2 million and kept the normal cost approximately level.

The System increased the COLA base from \$15,000 to \$17,000. This change increased the unfunded liability by approximately \$5.6 million and increased the normal cost by approximately \$0.1 million.

Section 1: Actuarial Valuation Summary

7. In the funding schedule included in this report, the fiscal 2023 appropriation has been set equal to the previously budgeted amount of \$12,555,203. The funding schedule is projected to fully fund the System by June 30, 2030 with appropriations that increase 12.05% per year, if all assumptions are met and there are no changes in the plan of benefits or actuarial assumptions.
8. 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 *Section 2*. A more detailed assessment would provide the Board with a better understanding of the inherent risks.

Section 1: Actuarial Valuation Summary

Summary of key valuation results

		2022	2021
Contributions for fiscal year beginning July 1:	• Actuarially determined contribution	\$12,555,203	\$11,205,000
	• Actuarially determined contribution as a percent of payroll	12.10%	10.54%
Actuarial accrued liability for plan year beginning January 1:	• Retired participants and beneficiaries	\$354,770,931	\$301,307,811
	• Inactive vested participants	9,799,309	8,956,769
	• Inactive participants due a refund of employee contributions	1,374,683	1,092,654
	• Active participants	382,757,285	401,507,158
	• Total	748,702,208	712,864,392
	• Normal cost including administrative expenses for plan year beginning January 1	14,523,669	14,880,187
Assets for plan year beginning January 1:	• Market value of assets (MVA)	\$728,672,689	\$648,376,216
	• Actuarial value of assets (AVA)	666,688,320	628,924,929
	• Actuarial value of assets as a percentage of market value of assets	91.49%	97.00%
Funded status for plan year beginning January 1:	• Unfunded/(overfunded) actuarial accrued liability on market value of assets	\$20,029,519	\$64,488,176
	• Funded percentage on MVA basis	97.32%	90.95%
	• Unfunded/(overfunded) actuarial accrued liability on actuarial value of assets	\$82,013,888	\$83,939,462
	• Funded percentage on AVA basis	89.05%	88.23%
Key assumptions:	• Net investment return	6.90%	6.90%
	• Wage-inflation rate	3.00%	3.00%
Demographic data for plan year beginning January 1:	• Number of retired participants and beneficiaries	763	702
	• Number of inactive vested participants	39	34
	• Number of inactive participants due a refund of employee contributions	104	89
	• Number of active participants	1,044	1,103
	• Total projected payroll	\$103,781,925	\$106,332,975
	• Average projected payroll	99,408	96,403

Section 1: Actuarial Valuation Summary

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:

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

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 of the System's assets and liabilities at a specific date. Accordingly, except where otherwise noted, Segal did not perform an analysis of the potential range of future financial measures. The actual long-term cost of the System will be determined by the actual benefits and expenses paid and the actual investment experience of the System.

Actuarial results in this report are not rounded, but that does not imply precision.

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. Segal's valuation is based on our understanding of applicable guidance in these areas and of the Plan's provisions, but they may be subject to alternative interpretations. The System should look to their other advisors for expertise in these areas.

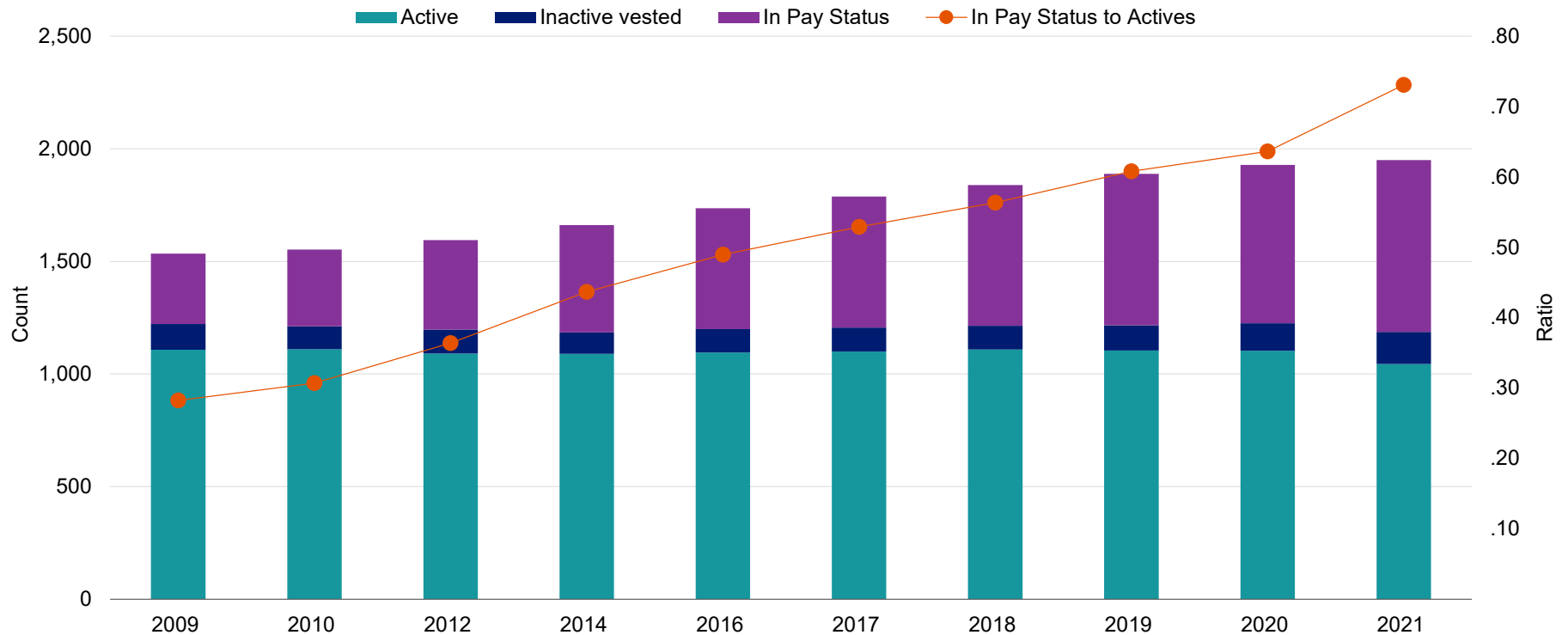
As Segal has no discretionary authority with respect to the management or assets of the System, it is not a fiduciary in its capacity as actuaries and consultants with respect to the Plan.

Section 2: Actuarial Valuation Results

Participant data

This section presents a summary of significant statistical data on covered participants.

Participant Population: 2009 – 2021



In Pay Status	313	341	397	476	536	582	625	672	702	763
Inactive vested ¹	114	102	106	95	105	106	105	112	123	143
Active	1,108	1,110	1,091	1,090	1,095	1,100	1,109	1,105	1,103	1,044
Ratio	0.28	0.31	0.36	0.44	0.49	0.53	0.56	0.61	0.64	0.73

¹ Includes terminated participants due a refund of employee contributions

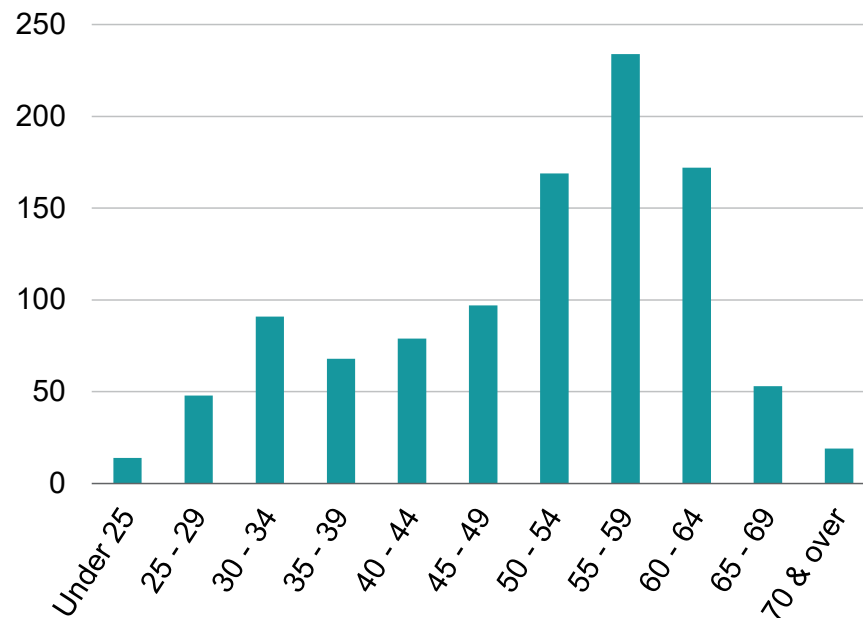
Section 2: Actuarial Valuation Results

Active participants

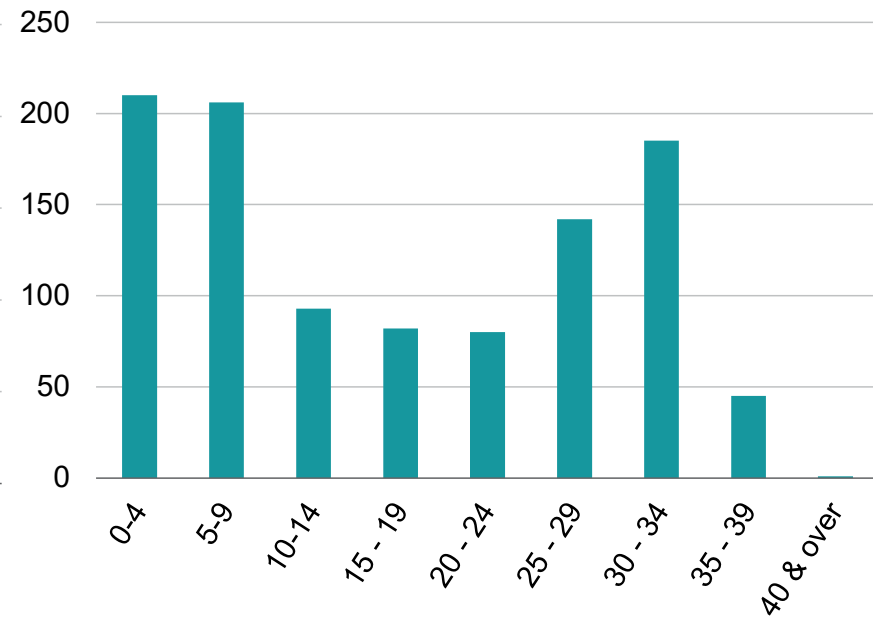
As of December 31,	2020	2021	Change
Active participants	1,103	1,044	-5.3%
Average age	51.1	51.0	-0.1
Average years of service	17.5	17.2	-0.3
Average projected compensation	96,403	99,408	3.1%

Distribution of Active Participants as of December 31, 2021

Actives by Age



Actives by Years of Service



Section 2: Actuarial Valuation Results

Inactive participants

In this year's valuation, there were 39 participants with a vested right to a deferred or immediate vested benefit.

In addition, there were 104 participants entitled to a return of their employee contributions.

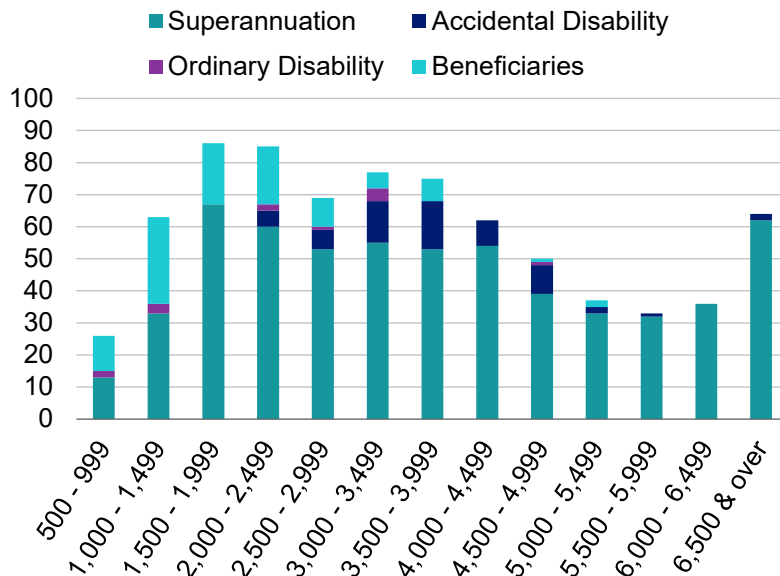
Section 2: Actuarial Valuation Results

Retired participants and beneficiaries

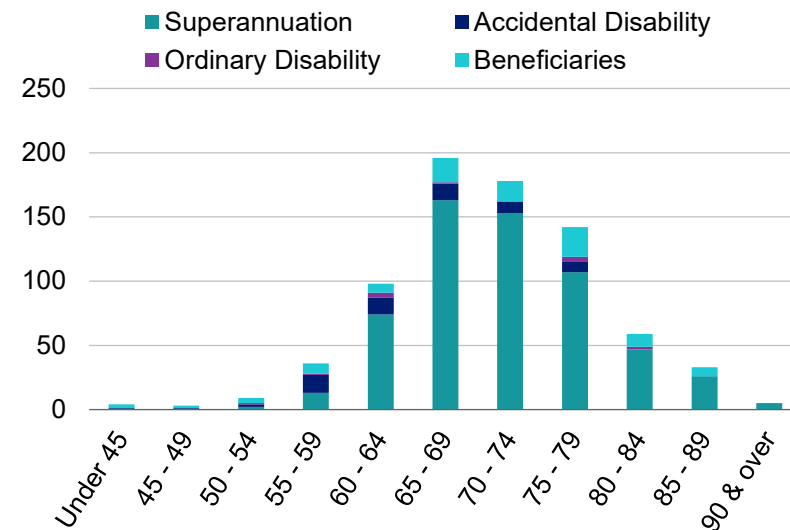
As of December 31,	2020	2021	Change
Retirees	605	664	9.8%
Beneficiaries	97	99	2.1%
Average age	70.5	70.7	0.2
Average amount	\$3,378	\$3,610	6.9%
Total monthly amount	\$2,371,057	\$2,754,600	16.2%

Distribution as of December 31, 2021

by Type and Monthly Amount



by Type and Age



Section 2: Actuarial Valuation Results

Financial information

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 for Year Ended December 31, 2021

1	Market value of assets, December 31, 2021				\$728,672,689
2	Calculation of unrecognized return	Original Amount¹	Percent Deferred²	Unrecognized Amount³	
	(a) Year ended December 31, 2021	\$44,581,563	80%	\$35,665,250	
	(b) Year ended December 31, 2020	34,037,865	60%	20,422,719	
	(c) Year ended December 31, 2019	43,064,423	40%	17,225,770	
	(d) Year ended December 31, 2018	-56,646,851	20%	-11,329,370	
	(e) Year ended December 31, 2017	35,832,761	0%	0	
	(f) Total unrecognized return				\$61,984,369
3	Preliminary actuarial value: (1) - (2f)				666,688,320
4	Adjustment to be within 10% corridor				0
5	Final actuarial value of assets as of December 31, 2021: (3) + (4)				<u>666,688,320</u>
6	Actuarial value as a percentage of market value: (5) ÷ (1)				91.5%
7	Amount deferred for future recognition: (1) - (5)				\$61,984,369

¹ Total return minus expected return on a market value basis

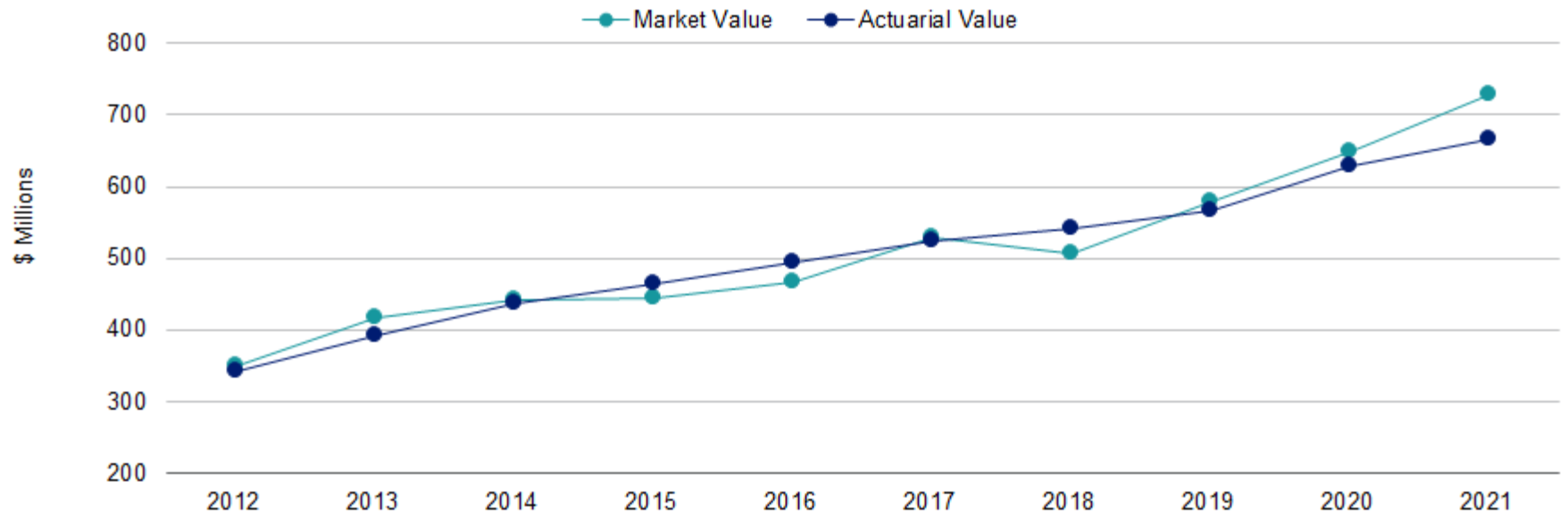
² Percent deferred applies to the current valuation year

³ Recognition at 20% per year over five years

Section 2: Actuarial Valuation Results

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

Market Value of Assets vs. Actuarial Value of Assets



Market Value ¹	\$350.50	\$415.68	\$441.82	\$444.58	\$465.60	\$529.82	\$507.29	\$578.96	\$648.38	\$728.67
Actuarial Value ¹	341.52	391.06	435.84	465.38	493.40	523.14	541.62	566.19	628.92	666.69

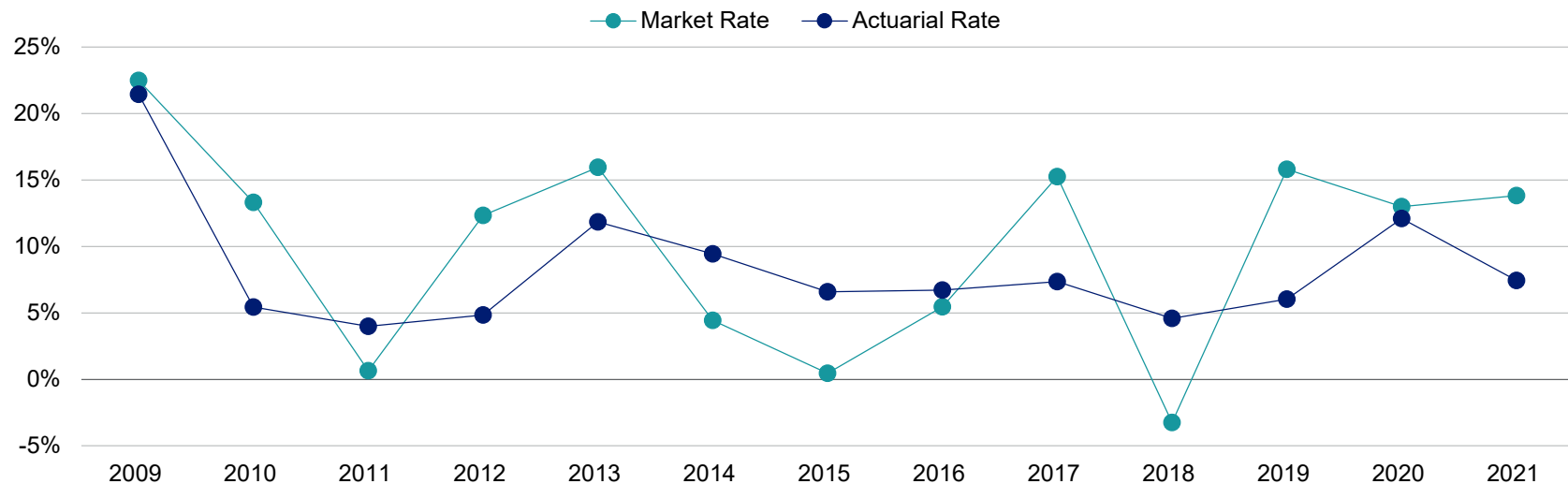
¹ In millions

Section 2: Actuarial Valuation Results

Because actuarial planning is long term, it is useful to see how the assumed investment rate of return has followed actual experience over time. The chart below shows the rate of return on an actuarial basis compared to the actual market value investment return for the last 13 years, including averages over select time periods.

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

Market and Actuarial Rates of Return for Years Ended December 31, 2009 - 2021



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Market rate	22.5%	13.3%	0.7%	12.3%	16.0%	4.4%	0.5%	5.5%	15.2%	-3.2%	15.8%	13.0%	13.8%
Actuarial rate	21.5%	5.4%	4.0%	4.8%	11.9%	9.4%	6.6%	6.7%	7.3%	4.6%	6.0%	12.1%	7.4%
Assumed rate	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	7.75%	7.75%	7.5%	7.5%	7.25%	7.1%	6.9%

Average Rates of Return	Actuarial Value	Market Value
Most recent five-year average return:	8.23%	10.94%
Most recent ten-year average return:	8.07%	9.32%

Section 2: Actuarial Valuation Results

Actuarial experience

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

Taking account of experience gains or losses in one year without making a change in assumptions reflects the belief that the single year's experience was a short-term development and that, over the long term, experience will return to the original assumptions. For contribution requirements to remain stable, assumptions should approximate experience. If assumptions are changed, the contribution requirement is adjusted to take into account a change in experience anticipated for all future years.

Actuarial Experience for Year Ended December 31, 2021

1	Net gain/(loss) from investments ¹	\$3,390,620
2	Net gain/(loss) from administrative expenses	251,163
3	Net gain/(loss) from other experience	4,955,209
4	Net experience gain/(loss): 1 + 2 + 3	\$8,596,991

¹ Details on next page

Section 2: Actuarial Valuation Results

Investment experience

A major component of projected asset growth is the assumed rate of return. The assumed return should represent the expected long-term rate of return, based on the System's investment policy. The rate of return on the market value of assets was 13.82% for the year ended December 31, 2021.

For valuation purposes, the assumed rate of return on the actuarial value of assets was 6.90%. The actual rate of return on an actuarial basis for the 2021 Plan Year was 7.44%. Since the actual return for the year was greater than the assumed return, the Plan experienced an actuarial gain during the year ended December 31, 2021 with regard to its investments.

Investment Experience

		Year Ended December 31, 2021	
		Market Value	Actuarial Value
1	Net investment income	\$89,018,608	\$46,485,526
2	Average value of assets	644,015,149	624,563,862
3	Rate of return: $1 \div 2$	13.82%	7.44%
4	Assumed rate of return	6.90%	6.90%
5	Expected investment income: 2×4	44,437,045	43,094,906
6	Actuarial gain/(loss): $1 - 5$	<u>\$44,581,563</u>	<u>\$3,390,620</u>

Section 2: Actuarial Valuation Results

Non-investment experience

Administrative expenses

- Administrative expenses for the year ended December 31, 2021 totaled \$325,737, as compared to the assumption of \$550,000.

Other experience

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

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

The net gain from this other experience for the year ended December 31, 2021 amounted to \$4,955,209, which is 0.7% of the actuarial accrued liability.

Section 2: Actuarial Valuation Results

Actuarial assumptions

The assumption changes reflected in this report are:

- The mortality improvement projection scale was updated from Scale MP-2020 to Scale MP-2021.
- The administrative expense assumption was increased from \$550,000 for calendar 2021 to \$575,000 for calendar 2022. In both cases the expenses are projected to increase with inflation at 3.00% per year.

Changing these assumptions increased the unfunded liability by approximately \$1.2 million and kept the normal cost approximately level.

Details on actuarial assumptions and methods are in *Section 4, Exhibit I*.

Plan provisions

The System increased the COLA base from \$15,000 to \$17,000. This change increased the unfunded liability by approximately \$5.6 million and increased the normal cost by approximately \$0.1 million.

A summary of plan provisions is in *Section 4, Exhibit II*.

Section 2: Actuarial Valuation Results

Development of Unfunded/(Overfunded) Actuarial Accrued Liability for Year Ended December 31, 2021

1	Unfunded/(overfunded) actuarial accrued liability at beginning of year	\$83,939,462
2	Normal cost at beginning of year	14,880,187
3	Total contributions	-21,097,233
4	Interest on 1, 2 & 3	6,159,394
5	Expected unfunded/(overfunded) actuarial accrued liability	\$83,881,811
6	Changes due to:	
	(a) (Gain)/loss	-8,596,991
	(b) Assumptions	1,161,149
	(c) Plan provisions	5,567,919
	Total changes	<u>-\$1,867,923</u>
7	Unfunded/(overfunded) actuarial accrued liability at end of year	\$82,013,888

Section 2: Actuarial Valuation Results

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 2023, the Actuarially Determined Contribution has been set equal to the previously budgeted amount of \$12,555,203.

The funding schedule included in this report is projected to fully fund the System by June 30, 2030 with appropriations that increase 12.05% per year, if all assumptions are met and there are no changes in the plan benefits or actuarial assumptions.

Actuarially Determined Contribution for Year Beginning July 1

	2022		2021	
	Amount	% of Projected Payroll	Amount	% of Projected Payroll
1 Total normal cost	\$13,948,669	13.44%	\$14,330,187	13.48%
2 Administrative expenses	575,000	0.55%	550,000	0.52%
3 Expected employee contributions	<u>-10,381,470</u>	<u>-10.00%</u>	<u>-10,570,943</u>	<u>-9.94%</u>
4 Employer normal cost: (1) + (2) + (3)	\$4,142,199	3.99%	\$4,309,244	4.05%
5 Actuarial accrued liability	\$748,702,208		\$712,864,392	
6 Actuarial value of assets	<u>666,688,320</u>		<u>628,924,930</u>	
7 Unfunded/(overfunded) actuarial accrued liability: (5) - (6)	\$82,013,888		\$83,939,462	
8 Employer normal cost projected to July 1, 2022 and 2021	4,203,873	4.05%	4,373,405	4.11%
9 Projected unfunded actuarial accrued liability	84,796,173		86,787,072	
10 Payment on unfunded actuarial accrued liability	8,351,330	8.05%	6,831,595	6.42%
11 Actuarially determined contribution: (8) + (10)	<u>\$12,555,203</u>	<u>12.10%</u>	<u>\$11,205,000</u>	<u>10.54%</u>
12 Projected payroll	\$103,781,925		\$106,332,975	

Section 2: Actuarial Valuation Results

Funding schedule

(1) Fiscal Year Ended June 30	(2) Employer Normal Cost	(3) Amortization of Remaining Unfunded Liability	(4) Actuarially Determined Contribution (ADC): (2)+(3)	(5) Total Unfunded Actuarial Accrued Liability at Beginning of Fiscal Year	(6) Percent Increase in Actuarially Determined Contribution
2023	\$4,203,873	\$8,351,330	\$12,555,203	\$84,796,173	--
2024	4,351,861	9,716,244	14,068,105	81,719,537	12.05%
2025	4,504,979	11,258,333	15,763,312	76,971,520	12.05%
2026	4,663,402	12,999,389	17,662,791	70,247,397	12.05%
2027	4,827,313	14,963,844	19,791,157	61,198,121	12.05%
2028	4,996,897	17,179,094	22,175,991	49,424,442	12.05%
2029	5,172,350	19,675,848	24,848,198	34,470,277	12.05%
2030	5,353,871	15,815,245	21,169,116	15,815,245	-14.81%
2031	5,541,670	0	5,541,670	0	-73.82%

Notes:

The fiscal 2023 appropriation is set equal to the budgeted amount determined with the prior valuation.

The appropriation is assumed to be paid on July 1.

Employer normal cost is projected based on a 3.00% growth in payroll per year, as well as a 0.15% adjustment to total normal cost to reflect the effects of mortality improvements due to the generational mortality assumption.

Projected normal cost does not reflect the future impact of pension reform for future hires.

The projected unfunded actuarial accrued liability does not reflect the recognition of deferred investment gains/losses.

Section 2: Actuarial Valuation Results

Risk

Since the actuarial valuation results are dependent on a given set of assumptions and data as of a specific date, there is a risk that emerging results may differ significantly as actual experience differs from the assumptions.

This report does not contain a detailed analysis of the potential range of future measurements but does include a brief discussion of some risks that may affect the System. We recommend a more detailed assessment to provide the Retirement Board with a better understanding of the risks inherent in the System. This assessment may include scenario testing, sensitivity testing, stress testing and stochastic modeling.

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

The market value rate of return over the last 13 years has ranged from a low of -3.25% to a high of 22.49%.

- 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 eight 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 retirement experience greater or less than assumed.
- Salary increases greater or less than assumed.

- Maturity Measures

As pension plans mature, the cash need 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.

Section 3: Supplemental Information

Exhibit A: Table of Plan Demographics

Category	Year Ended December 31		Change From Prior Year
	2021	2020	
Active participants in valuation:			
• Number	1,044	1,103	-5.3%
• Average age	51.0	51.1	-0.1
• Average years of service	17.2	17.5	-0.3
• Total projected payroll	\$103,781,925	\$106,332,975	-2.4%
• Average projected payroll	99,408	96,403	3.1%
• Account balances	116,416,494	122,379,340	-4.9%
Inactive vested participants	39	34	14.7%
Inactive nonvested participants due a refund	104	89	16.9%
Retired participants:			
• Number in pay status	590	531	11.1%
• Average age	71.5	71.6	-0.1
• Average monthly benefit	\$3,888	\$3,624	7.3%
Disabled participants:			
• Number in pay status	74	74	0.0%
• Average age	65.4	64.3	1.1
• Average monthly benefit	\$3,573	\$3,551	0.6%
Beneficiaries:			
• Number in pay status	99	97	2.1%
• Average age	69.7	69.1	0.6
• Average monthly benefit	\$1,984	\$1,897	4.6%

Section 3: Supplemental Information

Exhibit B: Summary Statement of Income and Expenses on a Market Value Basis

	Year Ended December 31, 2021	Year Ended December 31, 2020
Net assets at market value at the beginning of the year	\$648,376,216	\$578,956,952
Contribution income:		
• Employer contributions	\$11,205,000	\$10,000,000
• Employee contributions	9,892,233	10,187,970
• Less administrative expenses	<u>-325,737</u>	<u>-403,213</u>
<i>Net contribution income</i>	\$20,771,496	\$19,784,757
Investment income:		
• Investment income	\$92,107,316	\$77,760,627
• Less investment fees	<u>-3,088,708</u>	<u>-2,813,073</u>
<i>Net investment income</i>	<u>\$89,018,608</u>	<u>\$74,947,554</u>
Total income available for benefits	\$109,790,104	\$94,732,311
Less benefit payments:		
• Pensions	-\$23,010,119	-\$20,326,803
• Net 3(8)(c) reimbursements	1,188,983	1,200,803
• Refunds, annuities, & Option B refunds	-7,990,464	-6,821,547
• Workers Compensation Settlements	10,000	30,916
• Net Transfers	<u>307,969</u>	<u>603,584</u>
<i>Net benefit payments</i>	-\$29,493,631	-\$25,313,047
Change in reserve for future benefits	\$80,296,473	\$69,419,264
Net assets at market value at the end of the year	\$728,672,689	\$648,376,216

Section 3: Supplemental Information

Exhibit C: Definition of Pension Terms

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

Actuarial Accrued Liability for Actives:	The equivalent of the accumulated normal costs allocated to the years before the valuation date.
Actuarial Accrued Liability for 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 (APV):	<p>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:</p> <p>Adjusted for the probable financial effect of certain intervening events (such as changes in compensation levels, marital status, etc.)</p> <p>Multiplied by the probability of the occurrence of an event (such as survival, death, disability, withdrawal, etc.) on which the payment is conditioned, and</p> <p>Discounted according to an assumed rate (or rates) of return to reflect the time value of money.</p>
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.

Section 3: Supplemental Information

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 (AVA):	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 Plan.
Actuarially Determined Contribution (ADC):	The employer's periodic required contributions, expressed as a dollar amount or a percentage of covered plan compensation, determined under the Plan's funding policy. The ADC consists of the Employer Normal Cost and the Amortization Payment.
Amortization Method:	A method for determining the Amortization Payment. The most common methods used are level dollar and level percentage of payroll. Under the Level Dollar method, the Amortization Payment is one of a stream of payments, all equal, whose Actuarial Present Value is equal to the 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 Plan is calculated, including: <u>Investment return</u> - the rate of investment yield that the Plan will earn over the long-term future; <u>Mortality rates</u> - the rate or probability of death at a given age for employees and retirees; <u>Retirement rates</u> - the rate or probability of retirement at a given age or service; <u>Disability rates</u> - the rate or probability of disability retirement at a given age; <u>Withdrawal rates</u> - the rate or probability at which employees of various ages are expected to leave employment for reasons other than death, disability, or retirement; <u>Salary increase rates</u> - the rates of salary increase due to inflation, real wage growth and merit and promotion increases.
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.

Section 3: Supplemental Information

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 Plan 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 Plan 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 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.
Plan Fiduciary Net Position:	Market value of assets.
Total Pension Liability (TPL):	The actuarial accrued liability under the entry age normal cost method and based on the blended discount rate as described in GASB 67 and 68.

Section 3: Supplemental Information

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.

Section 4: Actuarial Valuation Basis

Exhibit I: Actuarial Assumptions and Actuarial Cost Method

Rationale for Assumptions:	Current data is reviewed in conjunction with each annual valuation. Assumption changes are listed at the end of this exhibit.																						
Net Investment Return:	6.90%. 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:	<table border="1"> <thead> <tr> <th>Years</th> <th>Rate</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>5.75%</td> </tr> <tr> <td>1</td> <td>5.25%</td> </tr> <tr> <td>2</td> <td>5.25%</td> </tr> <tr> <td>3</td> <td>5.00%</td> </tr> <tr> <td>4</td> <td>5.00%</td> </tr> <tr> <td>5</td> <td>4.50%</td> </tr> <tr> <td>6</td> <td>4.50%</td> </tr> <tr> <td>7</td> <td>4.25%</td> </tr> <tr> <td>8</td> <td>4.25%</td> </tr> <tr> <td>9+</td> <td>4.00%</td> </tr> </tbody> </table> <p>Salary increases include an assumed inflation rate of 3.00%. The salary increase assumption is a long-term estimate derived from historical data, current and recent market expectations, and professional judgement.</p>	Years	Rate	0	5.75%	1	5.25%	2	5.25%	3	5.00%	4	5.00%	5	4.50%	6	4.50%	7	4.25%	8	4.25%	9+	4.00%
Years	Rate																						
0	5.75%																						
1	5.25%																						
2	5.25%																						
3	5.00%																						
4	5.00%																						
5	4.50%																						
6	4.50%																						
7	4.25%																						
8	4.25%																						
9+	4.00%																						
Interest on Employee Contributions:	3.5%																						
Administrative Expenses:	\$575,000 for calendar 2022, increasing 3.00% per year (previously, \$550,000 for calendar 2021, increasing 3.00% per year). The administrative expense assumption is based on information on expenses provided by the Retirement System.																						

Section 4: Actuarial Valuation Basis

Mortality Rates:

Healthy: Pub-2010 General Employee, Healthy Retiree and Contingent Survivor Amount-Weighted Mortality Tables projected generationally using Scale MP-2021 (previously, projected generationally using Scale MP-2020)

Disabled: Pub-2010 General Healthy Retiree Amount-Weighted Mortality Tables set forward one year projected generationally using Scale MP-2021 (previously, projected generationally using Scale MP-2020)

The underlying tables reasonably reflect the mortality experience of the System as of the measurement date. These mortality tables were then adjusted to future years using the generational projection to reflect future mortality improvement between the measurement date and those years.

The mortality rates were based on historical and current data, adjusted to reflect estimated future experience and professional judgement.

Termination Rates Before Retirement:

Age	Rate (%)		
	Mortality		Disability
	Male	Female	
20	0.04	0.01	0.01
25	0.03	0.01	0.02
30	0.04	0.02	0.03
35	0.05	0.02	0.06
40	0.07	0.04	0.10
45	0.10	0.06	0.15
50	0.15	0.08	0.19
55	0.22	0.12	0.24
60	0.32	0.19	0.28

Notes:

Mortality rates do not reflect generational projection.

55% of the disability rates shown represent accidental disability.

40% of the accidental disabilities will die from the same cause as the disability. 55% of the death rates shown represent accidental death.

Section 4: Actuarial Valuation Basis

Withdrawal Rates:	Years of Service	Rate per year (%)
	0	15.0
	1	12.0
	2	10.0
	3	9.0
	4	8.0
	5	7.6
	6	7.5
	7	6.7
	8	6.3
	9	5.9
	10	5.4
	11	5.0
	12	4.6
	13	4.1
	14	3.7
	15	3.3
	16 - 20	2.0
	21 - 29	1.0
	30+	0.0

The withdrawal rates and disability rates were based on historical and current data, adjusted to reflect estimated future experience and professional judgment.

Section 4: Actuarial Valuation Basis

Retirement Rates:

Age	Rate (%)			
	Members Hired Before April 2, 2012		Members Hired On or After April 2, 2012	
	Male	Female	Male	Female
50 – 51	0.75	1.125	0	0
52	0.75	1.5	0	0
53	0.75	1.875	0	0
54	1.5	1.875	0	0
55	1.5	4.125	0	0
56 – 57	1.875	4.875	0	0
58	3.75	4.875	0	0
59	4.875	4.875	0	0
60	9.0	3.75	15.0	6.25
61	15.0	9.75	15.0	9.75
62	22.5	11.25	22.5	11.25
63	18.75	9.375	18.75	9.375
64	16.5	13.5	16.5	13.5
65	30.0	11.25	30.0	11.25
66 – 67	18.75	15.0	18.75	15.0
68	22.5	18.75	22.5	18.75
69	22.5	15.0	22.5	15.0
70+	100.0	100.0	100.0	100.0

The retirement rates were based on historical and current data, adjusted to reflect estimated future experience and professional judgment.

Retirement Age for Inactive Vested Participants:

Age 55

The retirement age for inactive vested participants was based on historical and current data, adjusted to reflect estimated future experience and professional judgment.

Unknown Data for Participants:

Same as those exhibited by participants with similar known characteristics.

Section 4: Actuarial Valuation Basis

Family Composition:	80% of participants are assumed to be married. Females are assumed to be three years younger than their spouses.
Benefit Election:	All participants are assumed to elect Option A. The benefit election reflects the fact that all benefit options are actuarially equivalent.
Total Service:	Total creditable service reported in the data.
Net 3(8)(c) Liability:	Estimated based on anticipated annual net 3(8)(c) benefits and average characteristics of retired participants and beneficiaries.
Actuarial Value of Assets:	Market value of assets as reported in the System's Annual Statement less unrecognized return in each of the last five years. Unrecognized return is equal to the difference between the actual market value return and the expected market value return and is recognized over a five-year period, further adjusted, if necessary, to be within 10% of the market value.
Actuarial Cost Method:	Entry Age Normal Actuarial Cost Method. Entry Age is the age of the participant less Total Service as defined above. Normal Cost and Actuarial Accrued Liability are calculated on an individual basis and are allocated by salary. Normal Cost is determined using the plan of benefits applicable to each participant.
Justification for Change in Actuarial Assumptions:	Based on past experience and future expectations, the following actuarial assumptions were changed: <ul style="list-style-type: none">• The mortality table projection scale was updated to MP-2021 (previously, MP-2020).• The administrative expense assumption was increased to \$575,000 (previously, \$550,000) increasing 3.00%, based on information on expenses provided by the staff of the System.

Section 4: Actuarial Valuation Basis

Exhibit II: Summary of Plan Provisions

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

Plan Year:	January 1 through December 31			
Plan Status:	Ongoing			
Retirement Benefits:	<p>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.)</p> <p>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:</p>			
	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
	<p>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.</p>			

Section 4: Actuarial Valuation Basis

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

Section 4: Actuarial Valuation Basis

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.

Section 4: Actuarial Valuation Basis

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:	<p>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.</p> <p>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.</p> <p>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 \$9,000 if the member dies for a reason unrelated to cause of disability.</p>
"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.

Section 4: Actuarial Valuation Basis

Post-Retirement Benefits:	The Retirement 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 \$17,000 (previously, \$15,000) of a retirement allowance.
Changes in Plan Provisions:	The COLA base was increased from \$15,000 to \$17,000.

Section 5: GASB Information

Exhibit 1: Net Pension Liability

Reporting Date for Employer under GASB 68	June 30, 2022	June 30, 2021
Measurement Date	December 31, 2021	December 31, 2020
Components of the Net Pension Liability		
Total Pension Liability	\$748,702,208	\$712,864,392
Plan Fiduciary Net Position	728,672,689	648,376,216
Net Pension Liability	20,029,519	64,488,176
Plan Fiduciary Net Position as a percentage of the Total Pension Liability	97.32%	90.95%

The Net Pension Liability (NPL) for the plan was measured as of December 31, 2021 and 2020. Plan Fiduciary Net Position (plan assets) was valued as of the measurement dates and the Total Pension Liability (TPL) was determined from actuarial valuations as of January 1, 2022 and 2021, respectively.

Actuarial assumptions. The TPL as of December 31, 2021 and 2020, that were measured by actuarial valuations as of January 1, 2022 and 2021, respectively, used the following actuarial assumptions, applied to all periods included in the measurement:

Salary increases	Based on years of service, ranging from 5.75% at 0 years of service decreasing to 4.00% after 9 years of service
Investment rate of return	6.90%, net of pension plan investment expense, including inflation
Other assumptions	See Section 4 for a complete description of all actuarial assumptions.

Section 5: GASB Information

Exhibit 2: Determination of discount rate and investment rates of return

The long-term expected rate of return on pension plan investments was determined using a building-block method in which expected future real rates of return (expected returns, net of inflation) are developed for each major asset class. These returns are combined to produce the long-term expected rate of return by weighting the expected future real rates of return by the target asset allocation percentage and adding expected inflation. The target allocation (approved by the Board) and projected arithmetic real rates of return for each major asset class, after deducting inflation, but before investment expenses, used in the derivation of the long-term expected investment rate of return assumption are summarized in the following table:

Asset Class	Target Allocation	Long-Term Expected Real Rate of Return
Domestic equity	31%	6.11%
International developed markets equity	12%	6.49%
International emerging markets equity	7%	8.12%
Core fixed income	12%	0.38%
High-yield fixed income	8%	2.48%
Real estate	12%	3.72%
Hedge fund, GTAA, Risk parity	6%	2.63%
Private equity	12%	9.93%
Total	100%	5.28%

Discount rate. The discount rate used to measure the Total Pension Liability (TPL) was 6.90% as of December 31, 2021 and December 31, 2020. The projection of cash flows used to determine the discount rate assumed plan member contributions will be made at the current contribution rate and that employer contributions will be made at rates equal to the actuarially determined contribution rates. For this purpose, only employer contributions that are intended to fund benefits for current plan members and their beneficiaries are included. Projected employer contributions that are intended to fund the service costs for future plan members and their beneficiaries, as well as projected contributions from future plan members, are not included. Based on those assumptions, the Plan Fiduciary Net Position (FNP) was projected to be available to make all projected future benefit payments for current plan members. Therefore, the long-term expected rate of return on pension plan investments was applied to all periods of projected benefit payments to determine the TPL as of both December 31, 2021 and December 31, 2020.

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Exhibit 3: Discount rate sensitivity

Sensitivity of the Net Pension Liability to changes in the discount rate. The following presents the Net Pension Liability (NPL) of the Retirement System as of December 31, 2021, calculated using the discount rate of 6.90%, as well as what the Retirement System's NPL would be if it were calculated using a discount rate that is 1-percentage-point lower (5.90%) or 1-percentage-point higher (7.90%) than the current rate.

	1% Decrease (5.90%)	Current Discount (6.90%)	1% Increase (7.90%)
Net pension liability	\$109,511,270	\$20,029,519	-\$55,830,184

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Exhibit 4: Schedule of changes in Net Pension Liability – Last two fiscal years

Reporting Date for Employer under GASB 68 Measurement Date	June 30, 2022 December 31, 2021	June 30, 2021 December 31, 2020
Total Pension Liability		
Service cost	\$14,330,187	\$13,338,631
Interest	49,158,896	46,455,166
Change of benefit terms	5,567,919	0
Differences between expected and actual experience	-4,886,704	-263,516
Changes of assumptions	1,161,149	25,031,146
Benefit payments, including refunds of member contributions	<u>-29,493,631</u>	<u>-25,313,047</u>
Net change in Total Pension Liability	\$35,837,816	\$59,248,380
Total Pension Liability – beginning	<u>712,864,392</u>	<u>653,616,012</u>
Total Pension Liability – ending	<u>\$748,702,208</u>	<u>\$712,864,392</u>
Plan Fiduciary Net Position		
Contributions – employer	\$11,205,000	\$10,000,000
Contributions – employee	9,892,233	10,187,970
Net investment income	89,018,608	74,947,554
Benefit payments, including refunds of member contributions	-29,493,631	-25,313,047
Administrative expense	-325,737	-403,213
Other	<u>0</u>	<u>0</u>
Net change in Plan Fiduciary Net Position	\$80,296,473	\$69,419,264
Plan Fiduciary Net Position – beginning	<u>648,376,216</u>	<u>578,956,952</u>
Plan Fiduciary Net Position – ending	\$728,672,689	\$648,376,216
Net Pension Liability – ending	<u>\$20,029,519</u>	<u>\$64,488,176</u>
Plan Fiduciary Net Position as a percentage of the Total Pension Liability	97.32%	90.95%
Covered payroll	\$99,689,252	\$102,143,068
Plan Net Pension Liability as percentage of covered payroll	20.09%	63.14%

Notes to Schedule: See Section 4 for changes in actuarial assumptions and benefit changes applicable to the current measurement date.

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Exhibit 5: Deferred outflows of resources and deferred inflows of resources

Reporting Date for Employer under GASB 68	June 30, 2022	June 30, 2021
Measurement Date	December 31, 2021	December 31, 2020
Deferred Outflows of Resources		
Changes of assumptions or other inputs	\$27,997,718	\$40,105,641
Net difference between projected and actual earnings on pension plan investments	0	0
Difference between expected and actual experience in the Total Pension Liability	<u>2,847,916</u>	<u>3,977,800</u>
Total Deferred Outflows of Resources	\$30,845,634	\$44,083,441
Deferred Inflows of Resources		
Changes of assumptions or other inputs	\$0	\$0
Net difference between projected and actual earnings on pension plan investments	61,984,369	37,576,755
Difference between expected and actual experience in the Total Pension Liability	<u>4,091,732</u>	<u>1,783,278</u>
Total Deferred Inflows of Resources	\$66,076,101	\$39,360,033
Deferred outflows of resources and deferred inflows of resources related to pension will be recognized as follows:		
Reporting Date for Employer under GASB 68 Year Ended June 30:		
2022	N/A	\$1,308,179
2023	-\$1,879,109	7,782,315
2024	-14,513,780	-4,852,356
2025	-9,176,154	485,270
2026	-9,661,424	0
2027	0	0
Thereafter	0	0

The average of the expected remaining service lives of all employees that are provided with pensions through the Retirement System (active and inactive employees) determined as of December 31, 2020 (the beginning of the measurement period ending December 31, 2021) is 5 years.

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Exhibit 6: Pension expense

Reporting Date for Employer under GASB 68 Measurement Date	June 30, 2022 December 31, 2021	June 30, 2021 December 31, 2020
Components of Pension Expense		
Service cost	\$14,330,187	\$13,338,631
Interest	49,158,896	46,455,166
Current-period benefit changes	5,567,919	0
Expensed portion of current-period difference between expected and actual experience in the Total Pension Liability	-977,340	-52,704
Expensed portion of current-period changes of assumptions or other inputs	232,229	5,006,230
Member contributions	-9,892,233	-10,187,970
Projected earnings on plan investments	-44,437,045	-40,909,689
Expensed portion of current-period differences between actual and projected earnings on plan investments	-8,916,311	-6,807,573
Administrative expense	325,737	403,213
Recognition of beginning of year deferred outflows of resources as pension expense	25,496,097	22,519,821
Recognition of beginning of year deferred inflows of resources as pension expense	<u>-24,187,918</u>	<u>-17,327,647</u>
Pension Expense	\$6,700,218	\$12,437,478

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Exhibit 7: Schedule of reconciliation of Net Pension Liability

Reporting Date for Employer under GASB 68	June 30, 2022	June 30, 2021
Measurement Date	December 31, 2021	December 31, 2020
Beginning Net Pension Liability	\$64,488,176	\$74,659,060
Pension expense	6,700,218	12,437,478
Employer contributions	-11,205,000	-10,000,000
New net deferred inflows/outflows	-38,645,696	-7,416,188
Change in allocation of prior deferred inflows/outflows	0	0
New net deferred inflows/outflows due to change in proportion	0	0
Recognition of prior deferred inflows/outflows	-1,308,179	-5,192,174
Recognition of prior deferred inflows/outflows due to change in proportion	<u>0</u>	<u>0</u>
Ending Net Pension Liability	\$20,029,519	\$64,488,176

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Exhibit 8: Schedule of contributions

Year Ended December 31	Actuarially Determined Contributions	Contributions in Relation to the Actuarially Determined Contributions	Contribution Deficiency / (Excess)	Covered Payroll	Contributions as a Percentage of Covered Payroll
2014	\$7,808,155	\$12,629,474	-\$4,821,319	\$85,537,485	14.76%
2015	8,159,521	8,159,521	0	89,168,911	9.15%
2016	3,132,624	4,632,624	-1,500,000	89,755,173	5.16%
2017	3,277,369	3,277,369	0	92,975,107	3.52%
2018	7,000,000	7,000,000	0	95,818,684	7.31%
2019	7,315,000	7,315,000	0	98,145,213	7.45%
2020	10,000,000	10,000,000	0	102,143,068	9.79%
2021	11,205,000	11,205,000	0	99,689,252	11.24%

See accompanying notes to this schedule on next page.

Section 5: GASB Information

Notes to Schedule:

Methods and assumptions used to establish “actuarially determined contribution” rates for fiscal 2022:

Valuation date	Actuarially determined contribution for fiscal 2022 was determined with the January 1, 2020 actuarial valuation.
Actuarial cost method	Entry Age Actuarial Cost Method
Amortization method	Appropriations increasing 12.05% per year
Remaining amortization period	As of July 1, 2020, 10 years for the remaining unfunded liability
Asset valuation method	The difference between the expected return and the actual investment return on a market value basis is recognized over a five-year period. Asset value is adjusted as necessary to be within 20% of the market value
Actuarial assumptions:	
Investment rate of return	7.10%, net of pension plan investment expense, including inflation.
Wage Inflation	3.00%
Projected salary increases	Bases on years of service, rating from 5.75% at 0 years of service decreasing to 4.00% after 9 years of service.
Cost of living adjustments	3.00% of first \$15,000
Other assumptions	Same as those used in the January 1, 2020 funding actuarial valuation.