

Middlesex County Retirement System

Actuarial Valuation and Review

as of January 1, 2020



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July 27, 2020

Middlesex County Retirement Board
Middlesex County Retirement System
25 Linnell Circle
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Dear Board Members:

We are pleased to submit this Actuarial Valuation and Review as of January 1, 2020. It summarizes the actuarial data used in the valuation, analyzes the preceding two years' experience, and establishes the funding requirements for fiscal 2021 and later years.

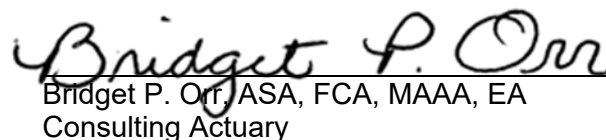
This report was prepared in accordance with generally accepted actuarial principles and practices at the request of the Board to assist in administering the Retirement System. The census information and financial information on which our calculations were based was prepared by the staff of the Middlesex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

The actuarial calculations were directed under the supervision of Kathleen A. Riley. 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. Further, in her opinion, the assumptions as approved by the Board are reasonably related to the experience of and the expectations for the Dedham Contributory Retirement System.

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

Sincerely,
Segal


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Section 1: Actuarial Valuation Summary

Purpose and basis

This report was prepared by Segal to present a valuation of the Middlesex County Retirement System as of January 1, 2020. The valuation was performed to determine whether the assets and contributions are sufficient to provide the prescribed benefits. The measurements shown in this actuarial valuation may not be applicable for other purposes. In particular, the measures herein are not necessarily appropriate for assessing the sufficiency of System assets to cover the estimated cost of settling the System's benefit obligations. Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements; and changes in plan provisions or applicable law.

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, 2019, provided by the staff of the Retirement System;
- The assets of the System as of December 31, 2019, provided by the staff of the Retirement System;
- Economic assumptions regarding future salary increases and investment earnings;
- Other actuarial assumptions regarding employee terminations, retirement, death, etc. and

Certain disclosure information required by GASB Statements No 67 and 68 as of December 31, 2019 for the Retirement System is provided in a separate report.

Section 1: Actuarial Valuation Summary

Valuation highlights

1. It is important to note that this actuarial valuation is based on plan assets as of December 31, 2019. Due to the COVID-19 pandemic, market conditions have changed significantly since the valuation date. The System's actuarial 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. While it is impossible to determine how the markets will perform over the next several months, and how that will affect the results of next year's valuation, Segal is available to prepare projections of potential outcomes upon request.
2. 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 Middlesex County Retirement Board meets this standard and funds the unfunded actuarial accrued liability by June 30, 2037.
3. The funded ratio (the ratio of the actuarial value of assets to actuarial accrued liability) is 48.13%, compared to the prior year funded ratio of 47.87%. 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 49.45%, compared to 49.27% 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 Middlesex County Retirement System's benefit obligation or the need for or the amount of future contributions.
4. The rate of return on the market value of assets was -2.25% and 15.40% for the plan years ended December 31, 2018 and December 31, 2019, respectively. The rate of return on the actuarial value of assets (which gradually recognizes market fluctuations) was 5.76% and 6.87% for the plan years ended December 31, 2018 and December 31, 2019, respectively. This resulted in an actuarial loss when measured against the assumed rate of return of 7.50%. Given the low fixed income interest rate environment, target asset allocation and expectations of future investment returns for various classes, the Board has lowered the assumed long-term rate of return on investments to 7.30%. Changing this assumption increased the unfunded liability by approximately \$65.0 million and increased the normal cost by approximately \$3.0 million.
5. The actuarial value of assets as of December 31, 2019 was \$1.52 billion, or 97.33% of the market value of assets of \$1.57 billion reported in the Annual Statement. As of December 31, 2017, the actuarial value of assets was 97.15% of the market value.
6. The investment experience in the past years has only been partially recognized in the actuarial value of assets. As the deferred net gain of \$41.8 million is recognized in future years, the cost of the Retirement System is likely to decrease unless the net gain is offset by future experience. This implies that earning the assumed rate of investment return (net of expenses) on a market value basis will result in investment gains on the actuarial value of assets in the next few years. The deferred investment gains are not recognized in the projection of the unfunded actuarial accrued liability in the funding schedule shown in *Section 2*.

Section 1: Actuarial Valuation Summary

7. As permitted by Section 19 of Chapter 188 of the Acts of 2010, the Cost of Living Adjustment base was increased to \$16,000 as of July 1, 2019.

This change to the COLA base increased the unfunded liability by approximately \$29.2 million and increased the normal cost by approximately \$642,000.
8. The unfunded liability was expected to increase by \$10.5 million from \$1,458.5 million as of January 1, 2018 to \$1,469.0 million as of January 1, 2020. The actual unfunded liability of \$1,641.8 million is \$172.8 million greater than expected, primarily due to an experience loss and the assumption change described above. The sources of the net experience loss are detailed in Section 2.
9. The funding schedule included in this report fully funds the System by fiscal 2037, two years later than the prior funding schedule. In fiscal 2022 through fiscal 2028, the appropriation increases 6.5% per year. Thereafter, the amortization payment on the unfunded liability will increase 4.0% per year. With the prior funding schedule, the appropriation increased 6.5% per year through 2027 and thereafter, the amortization payment on the unfunded liability increased 4.0%.
10. 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

		2020	2018
Contributions for fiscal year beginning July 1:	- Actuarially Determined Contributions for fiscal year 2021 and 2019 - Actuarially Determined Contributions for fiscal year 2022 and 2020 - Actuarially Determined Contributions for fiscal year 2023 and 2021	\$137,847,583 146,807,676 156,350,175	\$121,534,601 129,434,350 137,847,583
Actuarial accrued liability for plan year beginning January 1:	- Retired participants and beneficiaries - Inactive vested participants - Inactive participants due a refund of employee contributions - Active participants - Total - Normal cost including administrative expenses for plan year beginning January 1	\$1,650,074,999 44,546,428 19,938,302 1,451,024,547 3,165,584,276 77,091,386	\$1,417,545,709 34,368,739 16,499,876 1,329,121,646 2,797,535,970 68,115,910
Assets for plan year beginning January 1:	- Market value of assets (MVA) - Actuarial value of assets (AVA) - Actuarial value of assets as a percentage of market value of assets	\$1,565,528,261 1,523,736,765 97.33%	\$1,378,351,219 1,339,085,622 97.15%
Funded status for plan year beginning January 1:	- Unfunded actuarial accrued liability on market value of assets - Funded percentage on MVA basis - Unfunded actuarial accrued liability on actuarial value of assets - Funded percentage on AVA basis	\$1,600,056,015 49.45% \$1,641,847,511 48.13%	\$1,419,184,751 49.27% \$1,458,450,348 47.87%
Key assumptions:	- Net investment return - Long-term wage inflation rate	7.30% 3.25%	7.50% 3.25%
Demographic data for plan year beginning January 1:	- Number of retired participants and beneficiaries - Number of inactive vested participants - Number of inactive participants due a refund of employee contributions - Number of active participants - Total payroll¹ - Average payroll	5,862 381 3,082 9,282 \$492,109,775 53,018	5,531 343 2,771 9,168 \$451,777,105 49,278

¹ Payroll figures are for the prior year and reflect annualized salaries for participants hired during the year.

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 Retirement System. Segal does not audit such data for completeness or accuracy, other than reviewing it for obvious inconsistencies compared to prior data and other information that appears unreasonable. It is important for Segal to receive the best possible data and to be informed about any known incomplete or inaccurate data.
Assets	The valuation is based on the market value of assets as of the valuation date, as provided by the Retirement System. The Retirement System uses an “actuarial value of assets” that differs from market value to gradually reflect year-to-year changes in the market value of assets in determining the contribution requirements.
Actuarial assumptions	In preparing an actuarial valuation, Segal projects the benefits to be paid to existing plan participants for the rest of their lives and the lives of their beneficiaries. This projection requires actuarial assumptions as to the probability of death, disability, withdrawal, and retirement of each participant for each year. In addition, the benefits projected to be paid for each of those events in each future year reflect actuarial assumptions as to salary increases and cost-of-living adjustments. The projected benefits are then discounted to a present value, based on the assumed rate of return that is expected to be achieved on the plan’s assets. There is a reasonable range for each assumption used in the projection and the results may vary materially based on which assumptions are selected. It is important for any user of an actuarial valuation to understand this concept. Actuarial assumptions are periodically reviewed to ensure that future valuations reflect emerging plan experience. While future changes in actuarial assumptions may have a significant impact on the reported results that does not mean that the previous assumptions were unreasonable.

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

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

If the 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 Retirement Board 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 Retirement System, it is not a fiduciary in its capacity as actuaries and consultants with respect to the System.

Section 2: Actuarial Valuation Results

Participant data

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

This section presents a summary of significant statistical data on these participant groups.

More detailed information for this valuation year and the preceding valuation can be found in *Section 4, Exhibits A and B*.

Participant Population: 2001 – 2019

Year Ended December 31	Active Participants	Inactive Participants	Retired Participants and Beneficiaries	Total Non- Actives	Ratio of Non-Actives to Actives
2001	9,246	2,331	4,481	6,812	0.74
2003	9,043	2,913	4,780	7,693	0.85
2005	9,106	3,158	4,763	7,921	0.87
2007	9,285	3,267	4,764	8,031	0.86
2009	9,093	3,430	4,833	8,263	0.91
2011	8,979	3,102	4,886	7,988	0.89
2013	9,082	3,016	5,077	8,093	0.89
2015	9,072	2,961	5,327	8,288	0.91
2017	9,168	3,114	5,531	8,644	0.94
2019	9,282	3,463	5,862	9,325	1.00

Section 2: Actuarial Valuation Results

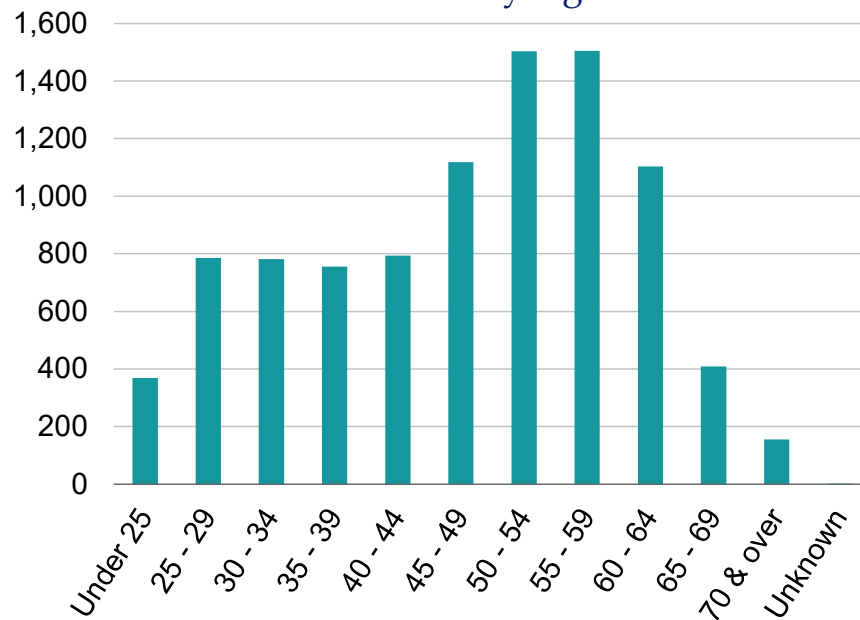
Active participants

Plan costs are affected by the age, years of service and payroll of active participants. In this year's valuation, there were 9,282 active participants with an average age of 47.9, average years of service of 11.2 years and average payroll of \$53,018. The 9,168 active participants in the prior valuation had an average age of 48.1, average service of 11.5 years and average payroll of \$49,278.

Among the active participants, there were 2 participants with unknown age. The actuarial calculations were adjusted for the missing information by assuming that it was the same as information provided for other active participants with similar known characteristics.

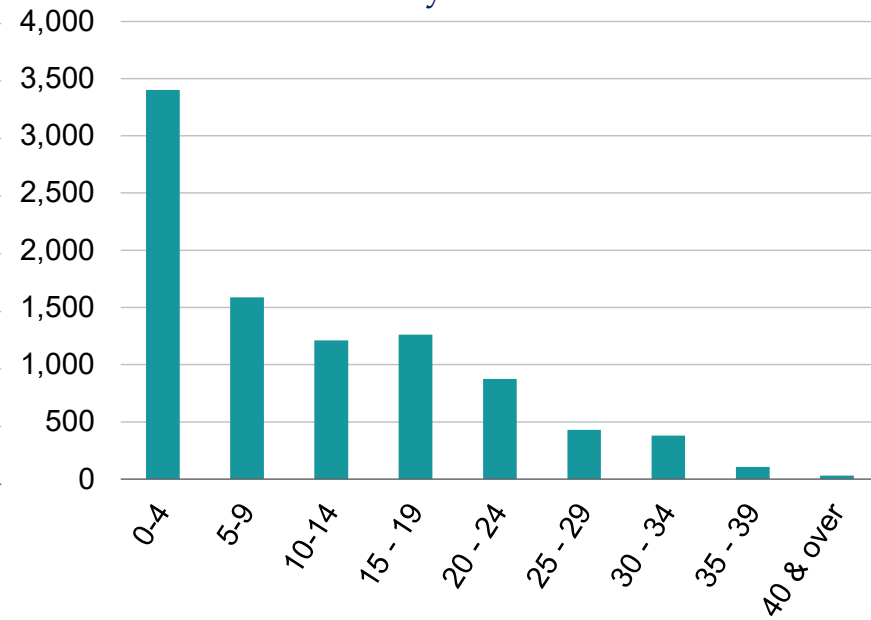
Distribution of Active Participants as of December 31, 2019

Actives by Age



Average age	47.9
Prior year average age	48.1
Difference	-0.2

Actives by Years of Service



Average years of service	11.2
Prior year average years of service	11.5
Difference	-0.3

Inactive participants

In this year's valuation, there were 381 participants with a vested right to a deferred or immediate vested benefit and 3,082 participants entitled to a return of their employee contributions.

Section 2: Actuarial Valuation Results

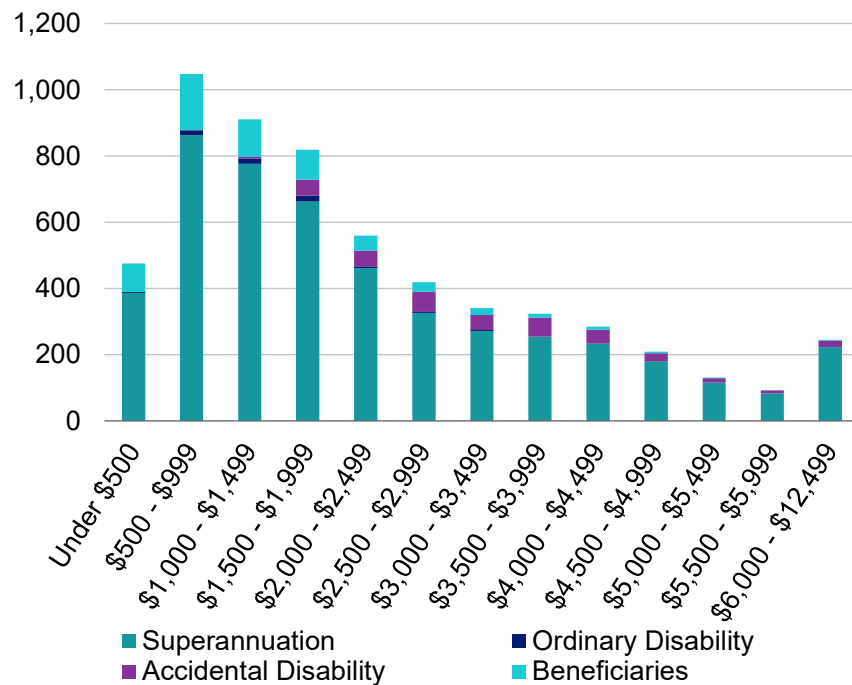
Retired participants and beneficiaries

As of December 31, 2019, 5,278 retired participants and 584 beneficiaries were receiving total monthly benefits of \$13,430,415, excluding COLAs reimbursed by the Commonwealth. For comparison, in the previous valuation, there were 4,965 retired participants and 566 beneficiaries receiving monthly benefits of \$11,848,656, excluding COLAs reimbursed by the Commonwealth.

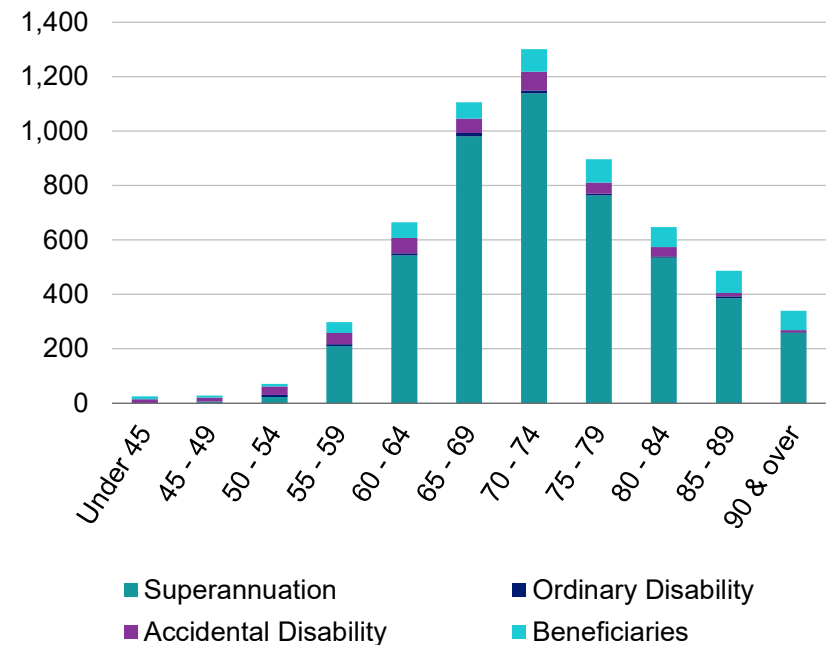
As of December 31, 2019, the average monthly benefit for retired participants and beneficiaries is \$2,291, compared to \$2,142 in the previous valuation. The average age for retired participants and beneficiaries is 73.0 in the current valuation, compared with 73.1 in the prior valuation.

Distribution of Pensioners and Beneficiaries as of December 31, 2019

By Type and Monthly Amount



By Type and Age



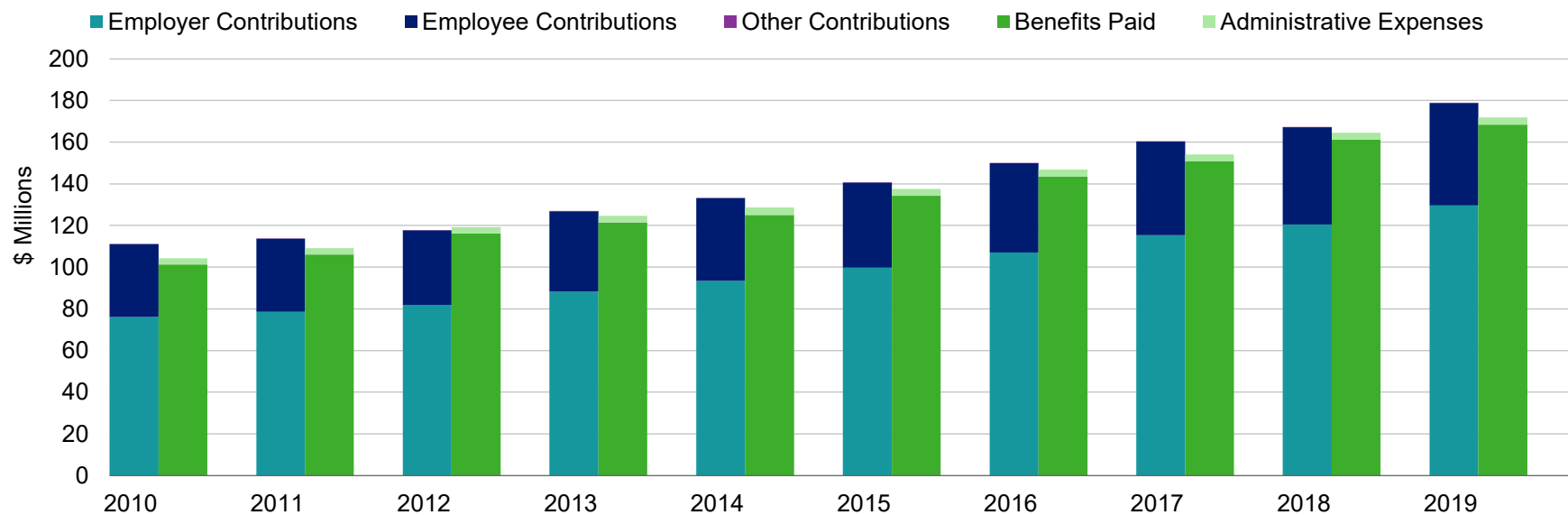
Section 2: Actuarial Valuation Results

Financial information

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

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

Comparison of Contributions with Benefits and Expenses
for Years Ended December 31, 2010 – 2019



Section 2: Actuarial Valuation Results

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

Determination of Actuarial Value of Assets

			Year Ended	
			December 31, 2019	December 31, 2018
1	Market value of assets at the end of the year		\$1,565,528,261	\$1,350,039,767
2	Calculation of unrecognized return	Original Amount¹	Percent Deferred	Unrecognized Amount²
(a)	Year ended December 31, 2019	\$106,954,044	80%	\$85,563,235
(b)	Year ended December 31, 2018	-134,459,875	60%	-80,675,925
(c)	Year ended December 31, 2017	97,658,911	40%	39,063,564
(d)	Year ended December 31, 2016	-10,796,891	20%	-2,159,378
(e)	Year ended December 31, 2015	-78,422,911	0%	0
(f)	Total unrecognized return		\$41,791,496	-\$68,975,892
3	Preliminary actuarial value: (1) - (2f)		1,523,736,765	1,419,015,659
4	Adjustment to be within 20% corridor		0	0
5	Final actuarial value of assets as of December 31, 2019: (3) + (4)		1,523,736,765	1,419,015,659
6	Actuarial value as a percentage of market value: (5) ÷ (1)		97.33%	105.11%
7	Amount deferred for future recognition: (1) - (5)		\$41,791,496	-\$68,975,892

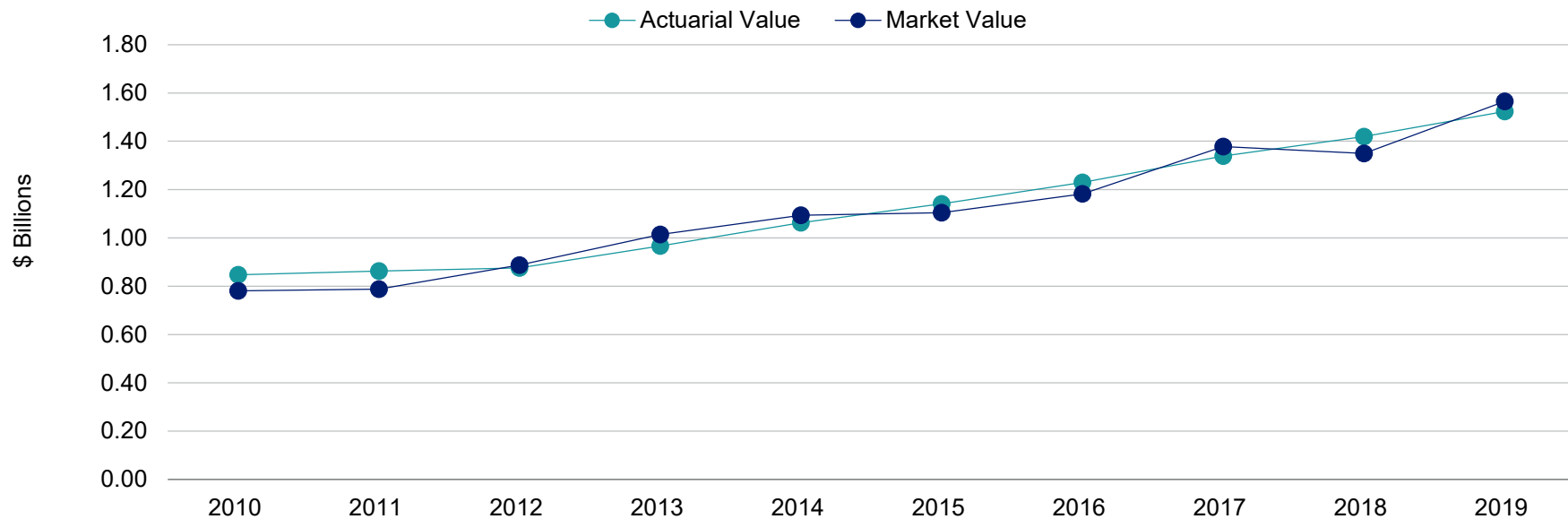
¹ Total return minus expected return on a market value basis.

² 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 Middlesex County Retirement 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 Middlesex County Retirement 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.

Actuarial Value of Assets vs. Market Value of Assets as of December 31, 2010 – 2019



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.

The net experience loss is \$78,703,265, which includes \$32,260,002 from investment losses and \$46,443,263 in losses from all other sources. The net experience variation from individual sources other than investments was 1.5% of the actuarial accrued liability. A discussion of the major components of the actuarial experience is on the following pages.

Actuarial Experience for Two-Year Period Ended December 31, 2019

1	Net loss from investments	-\$32,260,002
2	Net gain from administrative expenses	651,816
3	Net loss from other experience	-47,095,079
4	Net experience loss: 1 + 2 + 3	-\$78,703,265

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 Middlesex County Retirement System's investment policy. The rate of return on the market value of assets for the 2019 and 2018 plan years was 15.40% and -2.25%, respectively.

For valuation purposes, the assumed rate of return on the actuarial value of assets was 7.50% for the 2019 and 2018 plan years. The actual rate of return on an actuarial basis was 6.87% for the 2019 plan year and 5.76% for the 2018 plan year. Since the actual return for the year was less than the assumed return, the Middlesex County Retirement System experienced an actuarial loss during the two-year period ending December 31, 2019 with regard to its investments.

Investment Experience

	Year Ended December 31, 2019		Year Ended December 31, 2018	
	Market Value	Actuarial Value	Market Value	Actuarial Value
1 Net investment income	\$208,470,212	\$97,702,824	-\$30,983,338	\$77,258,151
2 Average value of assets	1,353,548,908	1,422,524,800	1,379,687,162	1,340,421,565
3 Rate of return: 1 ÷ 2	15.40%	6.87%	-2.25%	5.76%
4 Assumed rate of return	7.50%	7.50%	7.50%	7.50%
5 Expected investment income: 2 x 4	\$101,516,168	\$106,689,360	\$103,476,537	\$100,531,617
6 Actuarial gain/(loss): 1 - 5	\$106,954,044	-\$8,986,536	-\$134,459,875	-\$23,273,466

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 14 years, including averages over select time periods. Based on this experience and future expectations, we have lowered the assumed rate of return from 7.50% to 7.30%.

Investment Return – Actuarial Value vs. Market Value: 2006 - 2019

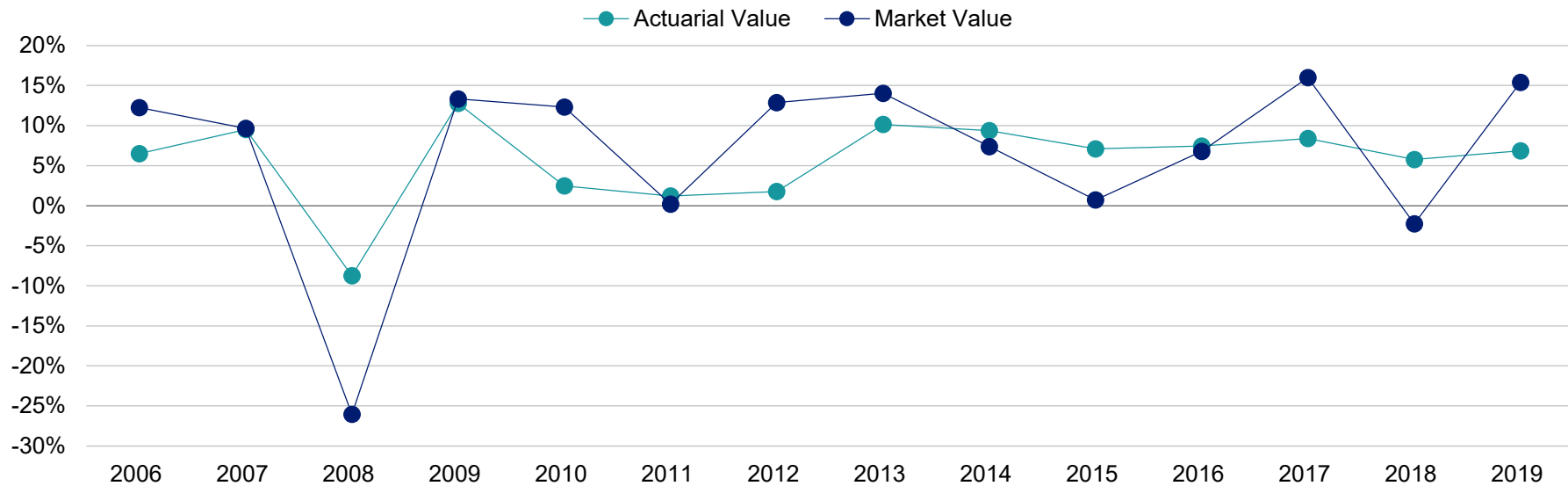
Year Ended December 31	Actuarial Value Investment Return		Market Value Investment Return		Year Ended December 31	Actuarial Value Investment Return		Market Value Investment Return	
	Amount	Percent	Amount	Percent		Amount	Percent	Amount	Percent
2006	\$42,522,819	6.49%	\$78,230,492	12.26%	2013	\$88,945,014	10.14%	\$124,783,005	14.05%
2007	67,081,999	9.53	69,754,061	9.66	2014	90,787,044	9.36	74,962,895	7.38
2008	-68,010,444	-8.73	-208,326,323	-26.04	2015	75,500,265	7.10	7,817,250	0.71
2009	92,107,036	12.77	80,318,175	13.34	2016	85,250,906	7.46	74,917,549	6.77
2010	20,487,695	2.49	85,309,569	12.32	2017	103,305,254	8.38	189,543,974	15.99
2011	10,333,913	1.22	1,488,563	0.19	2018	77,258,151	5.76	-30,983,338	-2.25
2012	15,213,243	1.77	101,170,082	12.86	2019	97,702,824	6.87	208,470,212	15.40
Most recent five-year average return							7.08%		7.35%
Most recent ten-year average return							6.28%		8.14%
Most recent 14-year average return							5.94%		6.57%

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

Section 2: Actuarial Valuation Results

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, 2006 - 2019



Section 2: Actuarial Valuation Results

Non-investment experience

Administrative expenses

- Administrative expenses for the years ended December 31, 2018 and 2019 totaled \$3,273,735 and \$3,352,400, respectively, as compared to the assumption of \$3,500,000 for calendar year 2018 and \$3,613,750 for calendar year 2019. This resulted in a gain of \$651,816 for the two-year period, including an adjustment for interest. Based on information on expenses provided by the Retirement System, we have reset the assumption to \$3,500,000 for calendar year 2020.

Mortality experience

- Mortality experience (more or fewer than expected deaths) yields actuarial gains or losses.
- The number of deaths for nondisabled pensioners over the past two years was 328 compared to 315.3 projected deaths. The number of deaths for disabled pensioners over the past two years was 29 compared to 23.8 projected deaths. The number of deaths for beneficiaries over the past two years was 61 compared to 56.0 projected deaths.

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),
- the number of disability retirements (more or fewer than projected), and
- salary increases (greater or smaller than projected).

The net loss from this other experience for the two-year period ending December 31, 2019 amounted to \$47,095,079, which is 1.5% of the actuarial accrued liability.

Liability Changes Due to Demographic Experience for Two-Year Period Ended December 31, 2019

Loss due to salaries increasing more than expected	-\$7,565,290
Loss due to mortality experience	-7,128,934
Increase in liability due to new active participants	-30,966,667
Miscellaneous experience loss	-1,434,188
Total	-\$47,095,079

Section 2: Actuarial Valuation Results

Actuarial assumptions

The assumption changes reflected in this report are:

- The net investment return assumption was lowered from 7.50% to 7.30%.
- The administrative expense assumption was reset from \$3,500,000 for calendar 2018, increasing 3.25% per year to \$3,500,000 for calendar 2020, increasing 3.25% per year.

Changing these assumptions increased the unfunded liability by approximately \$65.0 million and increased the normal cost by approximately \$3.0 million.

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

Plan provisions

As permitted by Section 19 of Chapter 188 of the Acts of 2010, the Cost of Living Adjustment base was increased to \$16,000 as of July 1, 2019. This change to the COLA base increased the unfunded liability by approximately \$29.2 million and increased the normal cost by approximately \$642,000.

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

Section 2: Actuarial Valuation Results

Development of Unfunded Actuarial Accrued Liability

		Year Ended	
		December 31, 2019	December 31, 2018
1	Unfunded actuarial accrued liability at beginning of year	\$1,468,180,662	\$1,458,450,348
2	Normal cost at beginning of year	70,329,677	68,115,910
3	Total contributions	-178,856,685	-167,205,425
4	Interest		
	• For whole year on 1 + 2	\$115,388,275	\$114,492,469
	• For half year on 3	-6,067,923	-5,672,640
	Total interest	<u>109,320,352</u>	<u>108,819,829</u>
5	Expected unfunded actuarial accrued liability	\$1,468,974,007	\$1,468,180,662
6	Changes due to:		
	• Net loss from investments	\$32,260,002	--
	• Net loss from other experience	46,443,263	--
	• Increase from change in assumptions	65,013,900	--
	• Increase from changes in COLA base	<u>29,156,339</u>	--
	Total changes	<u>172,873,504</u>	--
7	Unfunded actuarial accrued liability at end of year	\$1,641,847,511	--

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 2021, the Actuarially Determined Contribution has been set equal to the previously budgeted amount of \$137,847,583. The detail of the Actuarially Determined Contribution is shown below.

The funding schedule included in this report fully funds the System by fiscal 2037, two years later than the prior funding schedule. In fiscal 2022 through fiscal 2028, the appropriation increases 6.5% per year. Thereafter, the amortization payment on the unfunded liability will increase 4.0% per year. With the prior funding schedule, the appropriation increased 6.5% per year through 2027 and thereafter, the amortization payment on the unfunded liability increased 4.0%.

Actuarially Determined Contribution for Year Beginning January 1

		2020		2018	
		Amount	% of Projected Payroll	Amount	% of Projected Payroll
1	Total normal cost	\$73,591,386	14.34%	\$64,615,910	13.72%
2	Administrative expenses	3,500,000	0.68%	3,500,000	0.74%
3	Expected employee contributions	<u>-50,243,061</u>	<u>-9.79%</u>	<u>-45,566,198</u>	<u>-9.67%</u>
4	Employer normal cost: (1) + (2) + (3)	\$26,848,325	5.23%	\$22,549,712	4.79%
5	Actuarial accrued liability	\$3,165,584,276		\$2,797,535,970	
6	Actuarial value of assets	<u>1,523,736,765</u>		<u>1,339,085,622</u>	
7	Unfunded actuarial accrued liability: (5) - (6)	\$1,641,847,511		\$1,458,450,348	
8	Employer normal cost projected to July 1, 2020 and 2018, adjusted for timing	27,765,926	5.32%	23,331,257	4.87%
9	Projected unfunded actuarial accrued liability	1,700,719,456		1,512,153,505	
10	Payment on projected unfunded actuarial accrued liability, adjusted for timing	<u>110,081,657</u>	<u>21.11%</u>	<u>98,203,344</u>	<u>20.51%</u>
11	Actuarially determined contribution: (8) + (10)	\$137,847,583	26.43%	\$121,534,601	25.39%
12	Projected payroll as of July 1	\$521,474,124		\$478,709,596	

Notes:

Actuarially Determined Contributions are assumed to be paid on July 1 and December 31.

Actuarially Determined Contributions are set equal to the budgeted amounts determined with the prior valuation.

Section 2: Actuarial Valuation Results

Funding schedule

(1) Fiscal year ended June 30:	(2) Employer Normal Cost	(3) Amortization of 2010 ERI Liability	(4) Amortization of Remaining Unfunded Liability	(5) Actuarially Determined Contribution (ADC): (2) + (3) + (4)	(6) Total Unfunded Actuarial Accrued Liability at Beginning of Fiscal Year	(7) Percent Increase in ADC Over Prior Year
2021	\$27,765,926	\$60,290	\$110,021,367	\$137,847,583	\$1,700,719,456	- -
2022	28,786,188	60,291	117,961,197	146,807,676	1,708,816,737	6.50%
2023	29,843,623	0	126,506,552	156,350,175	1,709,134,434	6.50%
2024	30,939,574	0	135,573,362	166,512,936	1,700,529,817	6.50%
2025	32,075,434	0	145,260,843	177,336,277	1,681,738,242	6.50%
2026	33,252,648	0	155,610,487	188,863,135	1,651,361,710	6.50%
2027	34,472,710	0	166,666,529	201,139,239	1,607,856,424	6.50%
2028	35,737,168	0	178,476,122	214,213,290	1,549,519,254	6.50%
2029	37,047,627	0	188,320,724	225,368,351	1,474,473,030	5.21%
2030	38,405,750	0	195,853,553	234,259,303	1,383,569,612	3.95%
2031	39,813,257	0	203,687,695	243,500,952	1,278,088,646	3.95%
2032	41,271,934	0	211,835,203	253,107,137	1,156,648,308	3.95%
2033	42,783,626	0	220,308,611	263,092,237	1,017,753,193	3.95%
2034	44,350,249	0	229,120,955	273,471,204	859,785,517	3.94%
2035	45,973,785	0	238,285,793	284,259,578	680,995,655	3.94%
2036	47,656,289	0	247,817,225	295,473,514	479,491,965	3.94%
2037	49,399,886	0	257,729,914	307,129,800	253,229,850	3.94%
2038	51,206,783	0	0	51,206,783	0	-83.33%

Notes:

Fiscal 2021 Actuarially Determined Contribution set to budgeted amount.

Actuarially Determined Contributions are assumed to be paid on July 1 and December 31.

Item (2) reflects 3.25% growth in payroll, plus an additional 0.15% adjustment to total normal cost to reflect the effects of mortality improvement due to generational mortality assumption.

Item (3) reflects level dollar amortization.

Item (4) increases 4% per year beginning in fiscal 2030.

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

Projected unfunded actuarial accrued liability does not reflect the recognition of deferred investment gains.

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 Retirement System. We recommend a more detailed assessment to provide the Board with a better understanding of the risks inherent in the Retirement 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 14 years has ranged from a low of -26.04% to a high of 15.99%.

As an illustration of the sensitivity of future employer contributions to investment volatility, we have estimated the impact of a 0% return in 2020 on the funding schedule that would be developed with the next valuation. Because the actuarial value of assets is used, only 40% of the 2020 investment loss will be recognized as of January 1, 2022. If all assumptions other than the investment return assumption for 2020 are met, we estimate that the funding schedule included in next year's valuation report would reflect appropriations that increase 6.50% per year through fiscal 2030, compared with 6.50% increases through fiscal 2028 in the current funding schedule, if the current full funding date of 2037 is maintained. Please note that this estimate assumes that any deferred investment losses as of January 1, 2022 are not recognized in the projection of the unfunded actuarial accrued liability in the funding schedule.

- 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 seventeen years.

Section 2: Actuarial Valuation Results

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

Examples of this risk include:

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

- Actual Experience in Recent Years and Implications for the Future

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

The investment gain(loss) for a year has ranged from a loss of \$134,459,875 to a gain of \$106,954,044.

The non-investment gain(loss) for a year has ranged from a loss of \$46,443,263 to a gain of \$16,974,209.

The funded percentage on the actuarial value of assets has ranged from a low of 43.7% as of January 1, 2012 to a high of 48.1% as of January 1, 2020.

- 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 Plan's asset allocation is aligned to meet emerging pension liabilities.

In 2019, benefits paid and administrative expenses were \$7,018,282 less than contributions received. As the Retirement System matures, cash may needed from the investment portfolio to meet benefit payments.

Section 3: Unit Results

Summary of Actuarial Valuation Results

		Total
The valuation was made with respect to the following data supplied to us:		
1	Retired participants as of the valuation date (including 584 beneficiaries in pay status)	5,862
2	Participants active during the year ended December 31, 2019	9,282
3	Inactive participants entitled to a return of their employee contributions	3,082
4	Inactive participants with a vested right to a deferred or immediate benefit	381
The actuarial factors as of January 1, 2020 are as follows:		
1	Normal cost	\$73,591,386
2	Administrative expenses	3,500,000
3	Expected employee contributions	<u>-50,243,061</u>
4	Employer normal cost: (1) + (2) + (3)	\$26,848,325
5	Actuarial accrued liability	3,165,584,276
	Retired participants and beneficiaries	\$1,650,074,999
	Active participants	1,451,024,547
	Inactive participants	<u>64,484,730</u>
6	Actuarial value of assets	1,523,736,765
7	Unfunded actuarial accrued liability: (5) – (6)	1,641,847,511
8	Reallocated unfunded actuarial accrued liability	0
9	Total unfunded actuarial accrued liability: (7) + (8)	\$1,641,847,511
The actuarial factors projected to FY21 are as follows:		
		<u>Amount</u> <u>% of Payroll</u>
1	Projected employer normal cost	\$27,765,926 5.32%
2	Projected unfunded actuarial accrued liability	1,700,719,456
3	Payment on projected unfunded actuarial accrued liability	110,021,367
4	Payment on 2010 ERI	<u>60,290</u>
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$137,847,583 26.43%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	135,377,672 25.96%
7	Projected payroll	521,474,125
The actuarial factors projected to FY22 and FY23 are as follows:		
		<u>FY22</u> <u>FY23</u>
1	Projected employer normal cost	\$28,786,188 \$29,843,623
2	Payment on projected unfunded actuarial accrued liability	117,961,197 126,506,552
3	Payment on 2010 ERI	<u>60,291</u> 0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$146,807,676 \$156,350,175
5	Total Actuarially Determined Contribution, payable on July 1	144,244,359 153,620,238

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Middlesex County Retirement Board

1

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	15
2	Participants active during the year ended December 31, 2019	17
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$154,834
2	Administrative expenses		7,364
3	Expected employee contributions		-139,375
4	Employer normal cost: (1) + (2) + (3)		\$22,823
5	Actuarial accrued liability		10,905,301
	Retired participants and beneficiaries	\$5,158,079	
	Active participants	5,747,222	
	Inactive participants	0	
6	Actuarial value of assets		5,295,013
7	Unfunded actuarial accrued liability: (5) – (6)		5,610,288
8	Reallocated unfunded actuarial accrued liability		78,665
9	Total unfunded actuarial accrued liability: (7) + (8)		\$5,688,953

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	1.66%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	25.49%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	25.03%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$25,675
2	Payment on projected unfunded actuarial accrued liability	441,650
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$467,325
5	Total Actuarially Determined Contribution, payable on July 1	459,165

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Middlesex County

100

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 35 beneficiaries in pay status)	99
2	Participants active during the year ended December 31, 2019	0
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$0
2	Administrative expenses		0
3	Expected employee contributions		0
4	Employer normal cost: (1) + (2) + (3)		\$0
5	Actuarial accrued liability		13,908,271
	Retired participants and beneficiaries	\$13,908,271	
	Active participants	0	
	Inactive participants	0	
6	Actuarial value of assets		0
7	Unfunded actuarial accrued liability: (5) – (6)		13,908,271
8	Reallocated unfunded actuarial accrued liability		-13,908,271
9	Total unfunded actuarial accrued liability: (7) + (8)		\$0

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	\$0 0.00%
2	Projected unfunded actuarial accrued liability	0
3	Payment on projected unfunded actuarial accrued liability	0
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$0 0.00%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	0 0.00%
7	Projected payroll	0

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$0 \$0
2	Payment on projected unfunded actuarial accrued liability	0 0
3	Payment on 2010 ERI	0 0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$0 \$0
5	Total Actuarially Determined Contribution, payable on July 1	0 0

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Middlesex Hospital

200

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 4 beneficiaries in pay status)	69
2	Participants active during the year ended December 31, 2019	0
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$0
2	Administrative expenses		0
3	Expected employee contributions		0
4	Employer normal cost: (1) + (2) + (3)		\$0
5	Actuarial accrued liability		8,762,986
	Retired participants and beneficiaries	\$8,762,986	
	Active participants	0	
	Inactive participants	0	
6	Actuarial value of assets		0
7	Unfunded actuarial accrued liability: (5) – (6)		8,762,986
8	Reallocated unfunded actuarial accrued liability		-8,762,986
9	Total unfunded actuarial accrued liability: (7) + (8)		\$0

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	\$0 0.00%
2	Projected unfunded actuarial accrued liability	0
3	Payment on projected unfunded actuarial accrued liability	0
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$0 0.00%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	0 0.00%
7	Projected payroll	0

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$0 \$0
2	Payment on projected unfunded actuarial accrued liability	0 0
3	Payment on 2010 ERI	0 0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$0 \$0
5	Total Actuarially Determined Contribution, payable on July 1	0 0

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Acton

300

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 21 beneficiaries in pay status)	185
2	Participants active during the year ended December 31, 2019	195
3	Inactive participants entitled to a return of their employee contributions	29
4	Inactive participants with a vested right to a deferred or immediate benefit	8

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$2,206,788
2	Administrative expenses		104,955
3	Expected employee contributions		<u>-1,508,969</u>
4	Employer normal cost: (1) + (2) + (3)		\$802,774
5	Actuarial accrued liability		108,500,392
	Retired participants and beneficiaries	\$57,479,737	
	Active participants	50,063,563	
	Inactive participants	<u>957,092</u>	
6	Actuarial value of assets		53,045,476
7	Unfunded actuarial accrued liability: (5) – (6)		55,454,916
8	Reallocated unfunded actuarial accrued liability		<u>782,663</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$56,237,579

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.37%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	29.88%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	29.34%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$892,356
2	Payment on projected unfunded actuarial accrued liability	4,332,166
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$5,224,522
5	Total Actuarially Determined Contribution, payable on July 1	5,133,300

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Ashby

400

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	11
2	Participants active during the year ended December 31, 2019	21
3	Inactive participants entitled to a return of their employee contributions	5
4	Inactive participants with a vested right to a deferred or immediate benefit	3

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$198,794
2	Administrative expenses		9,455
3	Expected employee contributions		<u>-115,287</u>
4	Employer normal cost: (1) + (2) + (3)		\$92,962
5	Actuarial accrued liability		5,406,288
	Retired participants and beneficiaries	\$2,210,742	
	Active participants	2,744,799	
	Inactive participants	<u>450,747</u>	
6	Actuarial value of assets		3,405,802
7	Unfunded actuarial accrued liability: (5) – (6)		2,000,486
8	Reallocated unfunded actuarial accrued liability		<u>38,998</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$2,039,484

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	8.16%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	21.77%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	21.38%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$103,148
2	Payment on projected unfunded actuarial accrued liability	155,301
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$258,449
5	Total Actuarially Determined Contribution, payable on July 1	253,936

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Ashland

500

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 15 beneficiaries in pay status)	140
2	Participants active during the year ended December 31, 2019	306
3	Inactive participants entitled to a return of their employee contributions	135
4	Inactive participants with a vested right to a deferred or immediate benefit	14

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$2,148,389
2	Administrative expenses		102,177
3	Expected employee contributions		-1,474,801
4	Employer normal cost: (1) + (2) + (3)		\$775,765
5	Actuarial accrued liability		80,243,259
	Retired participants and beneficiaries	\$40,265,771	
	Active participants	37,863,144	
	Inactive participants	<u>2,114,344</u>	
6	Actuarial value of assets		42,049,018
7	Unfunded actuarial accrued liability: (5) – (6)		38,194,241
8	Reallocated unfunded actuarial accrued liability		<u>578,831</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$38,773,072

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.22%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	21.25%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	20.87%
7	Projected payroll	15,378,258

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$862,385
2	Payment on projected unfunded actuarial accrued liability	2,998,029
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$3,860,414
5	Total Actuarially Determined Contribution, payable on July 1	3,793,010

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Ayer

600

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 14 beneficiaries in pay status)	76
2	Participants active during the year ended December 31, 2019	106
3	Inactive participants entitled to a return of their employee contributions	13
4	Inactive participants with a vested right to a deferred or immediate benefit	8

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$1,129,153
2	Administrative expenses		53,702
3	Expected employee contributions		<u>-753,057</u>
4	Employer normal cost: (1) + (2) + (3)		\$429,798
5	Actuarial accrued liability		43,004,186
	Retired participants and beneficiaries	\$19,571,958	
	Active participants	22,582,933	
	Inactive participants	<u>849,295</u>	
6	Actuarial value of assets		22,354,199
7	Unfunded actuarial accrued liability: (5) – (6)		20,649,987
8	Reallocated unfunded actuarial accrued liability		<u>310,209</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$20,960,196

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.78%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	23.67%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	23.25%
7	Projected payroll	7,690,120

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$477,586
2	Payment on projected unfunded actuarial accrued liability	1,617,366
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$2,094,952
5	Total Actuarially Determined Contribution, payable on July 1	2,058,373

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Bedford

700

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 17 beneficiaries in pay status)	186
2	Participants active during the year ended December 31, 2019	371
3	Inactive participants entitled to a return of their employee contributions	168
4	Inactive participants with a vested right to a deferred or immediate benefit	12

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$2,845,288
2	Administrative expenses		135,322
3	Expected employee contributions		-1,998,175
4	Employer normal cost: (1) + (2) + (3)		\$982,435
5	Actuarial accrued liability		114,371,929
	Retired participants and beneficiaries	\$52,179,138	
	Active participants	60,005,099	
	Inactive participants	<u>2,187,692</u>	
6	Actuarial value of assets		59,405,788
7	Unfunded actuarial accrued liability: (5) – (6)		54,966,141
8	Reallocated unfunded actuarial accrued liability		<u>825,017</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$55,791,158

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	4.89%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	23.47%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	23.05%
7	Projected payroll	20,767,767

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$1,092,544
2	Payment on projected unfunded actuarial accrued liability	4,289,780
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$5,382,324
5	Total Actuarially Determined Contribution, payable on July 1	5,288,347

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Billerica

800

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 54 beneficiaries in pay status)	455
2	Participants active during the year ended December 31, 2019	655
3	Inactive participants entitled to a return of their employee contributions	137
4	Inactive participants with a vested right to a deferred or immediate benefit	16

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$5,706,599
2	Administrative expenses		271,404
3	Expected employee contributions		<u>-3,772,958</u>
4	Employer normal cost: (1) + (2) + (3)		\$2,205,045
5	Actuarial accrued liability		272,538,836
	Retired participants and beneficiaries	\$143,331,742	
	Active participants	125,914,542	
	Inactive participants	<u>3,292,552</u>	
6	Actuarial value of assets		114,937,058
7	Unfunded actuarial accrued liability: (5) – (6)		157,601,778
8	Reallocated unfunded actuarial accrued liability		<u>1,965,950</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$159,567,728

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.81%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	33.17%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	32.57%
7	Projected payroll	39,241,530

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$2,449,929
2	Payment on projected unfunded actuarial accrued liability	12,292,478
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$14,742,407
5	Total Actuarially Determined Contribution, payable on July 1	14,484,999

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Boxborough

900

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 3 beneficiaries in pay status)	42
2	Participants active during the year ended December 31, 2019	51
3	Inactive participants entitled to a return of their employee contributions	13
4	Inactive participants with a vested right to a deferred or immediate benefit	4

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$550,873
2	Administrative expenses		26,199
3	Expected employee contributions		-351,682
4	Employer normal cost: (1) + (2) + (3)		\$225,390
5	Actuarial accrued liability		23,254,623
	Retired participants and beneficiaries	\$12,489,397	
	Active participants	10,075,764	
	Inactive participants	689,462	
6	Actuarial value of assets		10,636,765
7	Unfunded actuarial accrued liability: (5) – (6)		12,617,858
8	Reallocated unfunded actuarial accrued liability		167,746
9	Total unfunded actuarial accrued liability: (7) + (8)		\$12,785,604

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	6.49%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	28.59%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	28.08%
7	Projected payroll	3,593,285

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$250,314
2	Payment on projected unfunded actuarial accrued liability	990,101
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$1,240,415
5	Total Actuarially Determined Contribution, payable on July 1	1,218,757

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Burlington

1000

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 31 beneficiaries in pay status)	373
2	Participants active during the year ended December 31, 2019	564
3	Inactive participants entitled to a return of their employee contributions	207
4	Inactive participants with a vested right to a deferred or immediate benefit	16

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$5,163,513
2	Administrative expenses		245,576
3	Expected employee contributions		<u>-3,647,310</u>
4	Employer normal cost: (1) + (2) + (3)		\$1,761,779
5	Actuarial accrued liability		245,907,614
	Retired participants and beneficiaries	\$124,466,396	
	Active participants	118,886,212	
	Inactive participants	<u>2,555,006</u>	
6	Actuarial value of assets		107,767,058
7	Unfunded actuarial accrued liability: (5) – (6)		138,140,556
8	Reallocated unfunded actuarial accrued liability		<u>1,773,843</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$139,914,399

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	4.85%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	28.97%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	28.45%
7	Projected payroll	37,529,422

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$1,959,437
2	Payment on projected unfunded actuarial accrued liability	10,806,903
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$12,766,340
5	Total Actuarially Determined Contribution, payable on July 1	12,543,435

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Carlisle

1100

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 3 beneficiaries in pay status)	45
2	Participants active during the year ended December 31, 2019	108
3	Inactive participants entitled to a return of their employee contributions	29
4	Inactive participants with a vested right to a deferred or immediate benefit	4

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$887,291
2	Administrative expenses		42,199
3	Expected employee contributions		-583,135
4	Employer normal cost: (1) + (2) + (3)		\$346,355
5	Actuarial accrued liability		30,686,579
	Retired participants and beneficiaries	\$12,269,412	
	Active participants	17,832,720	
	Inactive participants	584,447	
6	Actuarial value of assets		19,251,825
7	Unfunded actuarial accrued liability: (5) – (6)		11,434,754
8	Reallocated unfunded actuarial accrued liability		221,356
9	Total unfunded actuarial accrued liability: (7) + (8)		\$11,656,110

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.86%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	17.61%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	17.29%
7	Projected payroll	6,117,684

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$384,790
2	Payment on projected unfunded actuarial accrued liability	903,035
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$1,287,825
5	Total Actuarially Determined Contribution, payable on July 1	1,265,339

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Chelmsford

1200

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 46 beneficiaries in pay status)	436
2	Participants active during the year ended December 31, 2019	566
3	Inactive participants entitled to a return of their employee contributions	173
4	Inactive participants with a vested right to a deferred or immediate benefit	21

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$4,244,815
2	Administrative expenses		201,883
3	Expected employee contributions		<u>-2,834,243</u>
4	Employer normal cost: (1) + (2) + (3)		\$1,612,455
5	Actuarial accrued liability		192,401,185
	Retired participants and beneficiaries	\$108,623,629	
	Active participants	80,391,706	
	Inactive participants	<u>3,385,850</u>	
6	Actuarial value of assets		77,617,659
7	Unfunded actuarial accrued liability: (5) – (6)		114,783,526
8	Reallocated unfunded actuarial accrued liability		<u>1,387,877</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$116,171,403

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.64%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	32.74%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	32.16%
7	Projected payroll	29,577,991

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$1,791,767
2	Payment on projected unfunded actuarial accrued liability	8,933,635
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$10,725,402
5	Total Actuarially Determined Contribution, payable on July 1	10,538,132

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Dracut

1300

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 20 beneficiaries in pay status)	244
2	Participants active during the year ended December 31, 2019	332
3	Inactive participants entitled to a return of their employee contributions	62
4	Inactive participants with a vested right to a deferred or immediate benefit	10

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$2,716,874
2	Administrative expenses		129,214
3	Expected employee contributions		<u>-1,706,095</u>
4	Employer normal cost: (1) + (2) + (3)		\$1,139,993
5	Actuarial accrued liability		124,724,081
	Retired participants and beneficiaries	\$72,216,986	
	Active participants	50,936,584	
	Inactive participants	<u>1,570,511</u>	
6	Actuarial value of assets		55,524,952
7	Unfunded actuarial accrued liability: (5) – (6)		69,199,129
8	Reallocated unfunded actuarial accrued liability		<u>899,691</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$70,098,820

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	6.65%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	<u>0</u>
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	32.88%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	32.29%
7	Projected payroll	17,736,189

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$1,265,825
2	Payment on projected unfunded actuarial accrued liability	5,405,044
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$6,670,869
5	Total Actuarially Determined Contribution, payable on July 1	6,554,393

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Dunstable

1400

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	10
2	Participants active during the year ended December 31, 2019	23
3	Inactive participants entitled to a return of their employee contributions	2
4	Inactive participants with a vested right to a deferred or immediate benefit	1

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$252,357
2	Administrative expenses		12,002
3	Expected employee contributions		-147,665
4	Employer normal cost: (1) + (2) + (3)		\$116,694
5	Actuarial accrued liability		7,045,099
	Retired participants and beneficiaries	\$2,651,860	
	Active participants	4,312,563	
	Inactive participants	80,676	
6	Actuarial value of assets		3,684,975
7	Unfunded actuarial accrued liability: (5) – (6)		3,360,124
8	Reallocated unfunded actuarial accrued liability		50,819
9	Total unfunded actuarial accrued liability: (7) + (8)		\$3,410,943

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	7.89%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	19.46%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	19.11%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$129,489
2	Payment on projected unfunded actuarial accrued liability	266,866
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$396,355
5	Total Actuarially Determined Contribution, payable on July 1	389,434

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Groton

1500

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 4 beneficiaries in pay status)	65
2	Participants active during the year ended December 31, 2019	110
3	Inactive participants entitled to a return of their employee contributions	16
4	Inactive participants with a vested right to a deferred or immediate benefit	4

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$1,281,439
2	Administrative expenses		60,945
3	Expected employee contributions		-837,852
4	Employer normal cost: (1) + (2) + (3)		\$504,532
5	Actuarial accrued liability		50,711,162
	Retired participants and beneficiaries	\$25,899,069	
	Active participants	23,694,540	
	Inactive participants	<u>1,117,553</u>	
6	Actuarial value of assets		24,961,763
7	Unfunded actuarial accrued liability: (5) – (6)		25,749,399
8	Reallocated unfunded actuarial accrued liability		<u>365,803</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$26,115,202

The actuarial factors projected to FY21 are as follows:

		<u>Amount</u>	<u>% of Payroll</u>
1	Projected employer normal cost	\$521,775	6.18%
2	Projected unfunded actuarial accrued liability	27,051,618	
3	Payment on projected unfunded actuarial accrued liability	1,606,650	
4	Payment on 2010 ERI	<u>0</u>	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$2,128,425	25.22%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	2,090,289	24.77%
7	Projected payroll	8,439,358	

The actuarial factors projected to FY22 and FY23 are as follows:

	<u>FY22</u>	<u>FY23</u>
1	Projected employer normal cost	\$540,786
2	Payment on projected unfunded actuarial accrued liability	1,886,857
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$2,427,643
5	Total Actuarially Determined Contribution, payable on July 1	2,385,255
		2,538,910

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Holliston

1600

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 11 beneficiaries in pay status)	126
2	Participants active during the year ended December 31, 2019	276
3	Inactive participants entitled to a return of their employee contributions	177
4	Inactive participants with a vested right to a deferred or immediate benefit	19

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$1,654,806
2	Administrative expenses		78,702
3	Expected employee contributions		-1,139,184
4	Employer normal cost: (1) + (2) + (3)		\$594,324
5	Actuarial accrued liability		66,569,619
	Retired participants and beneficiaries	\$30,493,943	
	Active participants	33,498,905	
	Inactive participants	<u>2,576,771</u>	
6	Actuarial value of assets		39,284,645
7	Unfunded actuarial accrued liability: (5) – (6)		27,284,974
8	Reallocated unfunded actuarial accrued liability		<u>480,197</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$27,765,171

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.10%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	20.15%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	19.79%
7	Projected payroll	12,052,189

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$660,714
2	Payment on projected unfunded actuarial accrued liability	2,143,094
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$2,803,808
5	Total Actuarially Determined Contribution, payable on July 1	2,754,852

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Hopkinton

1700

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 8 beneficiaries in pay status)	115
2	Participants active during the year ended December 31, 2019	312
3	Inactive participants entitled to a return of their employee contributions	97
4	Inactive participants with a vested right to a deferred or immediate benefit	15

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$2,450,275
2	Administrative expenses		116,535
3	Expected employee contributions		-1,668,882
4	Employer normal cost: (1) + (2) + (3)		\$897,928
5	Actuarial accrued liability		77,788,522
	Retired participants and beneficiaries	\$34,619,089	
	Active participants	40,750,677	
	Inactive participants	<u>2,418,756</u>	
6	Actuarial value of assets		50,770,346
7	Unfunded actuarial accrued liability: (5) – (6)		27,018,176
8	Reallocated unfunded actuarial accrued liability		<u>561,124</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$27,579,300

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.37%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	14.66%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	14.39%
7	Projected payroll	17,276,847

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$998,068
2	Payment on projected unfunded actuarial accrued liability	2,144,260
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$3,142,328
5	Total Actuarially Determined Contribution, payable on July 1	3,087,462

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Hudson

1800

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 23 beneficiaries in pay status)	228
2	Participants active during the year ended December 31, 2019	434
3	Inactive participants entitled to a return of their employee contributions	195
4	Inactive participants with a vested right to a deferred or immediate benefit	12

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$3,359,227
2	Administrative expenses		159,765
3	Expected employee contributions		<u>-2,207,398</u>
4	Employer normal cost: (1) + (2) + (3)		\$1,311,594
5	Actuarial accrued liability		138,365,289
	Retired participants and beneficiaries	\$74,198,194	
	Active participants	61,671,195	
	Inactive participants	<u>2,495,900</u>	
6	Actuarial value of assets		68,329,943
7	Unfunded actuarial accrued liability: (5) – (6)		70,035,346
8	Reallocated unfunded actuarial accrued liability		<u>998,092</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$71,033,438

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.91%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	<u>0</u>
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	27.51%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	27.02%
7	Projected payroll	22,962,566

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$1,457,140
2	Payment on projected unfunded actuarial accrued liability	5,457,931
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$6,915,071
5	Total Actuarially Determined Contribution, payable on July 1	6,794,331

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Lincoln

1900

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 11 beneficiaries in pay status)	114
2	Participants active during the year ended December 31, 2019	198
3	Inactive participants entitled to a return of their employee contributions	88
4	Inactive participants with a vested right to a deferred or immediate benefit	10

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$1,553,264
2	Administrative expenses		73,873
3	Expected employee contributions		-1,085,477
4	Employer normal cost: (1) + (2) + (3)		\$541,660
5	Actuarial accrued liability		59,499,402
	Retired participants and beneficiaries	\$29,861,088	
	Active participants	28,218,802	
	Inactive participants	1,419,512	
6	Actuarial value of assets		31,360,230
7	Unfunded actuarial accrued liability: (5) – (6)		28,139,172
8	Reallocated unfunded actuarial accrued liability		429,196
9	Total unfunded actuarial accrued liability: (7) + (8)		\$28,568,368

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.01%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	22.17%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	21.77%
7	Projected payroll	11,179,768

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$602,317
2	Payment on projected unfunded actuarial accrued liability	2,201,088
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$2,803,405
5	Total Actuarially Determined Contribution, payable on July 1	2,754,456

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Littleton

2000

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 10 beneficiaries in pay status)	114
2	Participants active during the year ended December 31, 2019	244
3	Inactive participants entitled to a return of their employee contributions	88
4	Inactive participants with a vested right to a deferred or immediate benefit	8

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$2,014,387
2	Administrative expenses		95,804
3	Expected employee contributions		-1,359,836
4	Employer normal cost: (1) + (2) + (3)		\$750,355
5	Actuarial accrued liability		69,553,263
	Retired participants and beneficiaries	\$35,936,884	
	Active participants	31,583,478	
	Inactive participants	<u>2,032,901</u>	
6	Actuarial value of assets		42,781,480
7	Unfunded actuarial accrued liability: (5) – (6)		26,771,783
8	Reallocated unfunded actuarial accrued liability		<u>501,719</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$27,273,502

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.57%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	17.21%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	16.90%
7	Projected payroll	13,934,456

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$833,927
2	Payment on projected unfunded actuarial accrued liability	2,117,649
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$2,951,576
5	Total Actuarially Determined Contribution, payable on July 1	2,900,040

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of North Reading

2100

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 24 beneficiaries in pay status)	184
2	Participants active during the year ended December 31, 2019	250
3	Inactive participants entitled to a return of their employee contributions	50
4	Inactive participants with a vested right to a deferred or immediate benefit	10

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$2,068,766
2	Administrative expenses		98,390
3	Expected employee contributions		-1,402,564
4	Employer normal cost: (1) + (2) + (3)		\$764,592
5	Actuarial accrued liability		98,066,263
	Retired participants and beneficiaries	\$51,576,289	
	Active participants	44,757,897	
	Inactive participants	<u>1,732,077</u>	
6	Actuarial value of assets		45,555,904
7	Unfunded actuarial accrued liability: (5) – (6)		52,510,359
8	Reallocated unfunded actuarial accrued liability		<u>707,396</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$53,217,755

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.42%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	30.75%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	30.19%
7	Projected payroll	14,578,800

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$849,803
2	Payment on projected unfunded actuarial accrued liability	4,091,008
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$4,940,811
5	Total Actuarially Determined Contribution, payable on July 1	4,854,543

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Pepperell

2200

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 5 beneficiaries in pay status)	62
2	Participants active during the year ended December 31, 2019	74
3	Inactive participants entitled to a return of their employee contributions	13
4	Inactive participants with a vested right to a deferred or immediate benefit	5

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$798,882
2	Administrative expenses		37,995
3	Expected employee contributions		-506,353
4	Employer normal cost: (1) + (2) + (3)		\$330,524
5	Actuarial accrued liability		35,167,997
	Retired participants and beneficiaries	\$19,961,176	
	Active participants	14,086,155	
	Inactive participants	<u>1,120,666</u>	
6	Actuarial value of assets		16,718,619
7	Unfunded actuarial accrued liability: (5) – (6)		18,449,378
8	Reallocated unfunded actuarial accrued liability		<u>253,683</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$18,703,061

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	6.64%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	30.28%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	29.74%
7	Projected payroll	5,145,895

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$367,044
2	Payment on projected unfunded actuarial accrued liability	1,444,080
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$1,811,124
5	Total Actuarially Determined Contribution, payable on July 1	1,779,501

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Sherborn

2300

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	44
2	Participants active during the year ended December 31, 2019	82
3	Inactive participants entitled to a return of their employee contributions	35
4	Inactive participants with a vested right to a deferred or immediate benefit	9

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$689,015
2	Administrative expenses		32,769
3	Expected employee contributions		-444,649
4	Employer normal cost: (1) + (2) + (3)		\$277,135
5	Actuarial accrued liability		23,896,655
	Retired participants and beneficiaries	\$11,809,297	
	Active participants	10,892,606	
	Inactive participants	<u>1,194,752</u>	
6	Actuarial value of assets		13,266,347
7	Unfunded actuarial accrued liability: (5) – (6)		10,630,308
8	Reallocated unfunded actuarial accrued liability		<u>172,377</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$10,802,685

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	6.17%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	23.84%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	23.41%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$307,819
2	Payment on projected unfunded actuarial accrued liability	824,865
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$1,132,684
5	Total Actuarially Determined Contribution, payable on July 1	1,112,907

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Shirley

2400

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 8 beneficiaries in pay status)	44
2	Participants active during the year ended December 31, 2019	34
3	Inactive participants entitled to a return of their employee contributions	23
4	Inactive participants with a vested right to a deferred or immediate benefit	4

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$331,040
2	Administrative expenses		15,744
3	Expected employee contributions		<u>-207,738</u>
4	Employer normal cost: (1) + (2) + (3)		\$139,046
5	Actuarial accrued liability		16,994,636
	Retired participants and beneficiaries	\$12,211,363	
	Active participants	3,937,722	
	Inactive participants	<u>845,551</u>	
6	Actuarial value of assets		7,624,016
7	Unfunded actuarial accrued liability: (5) – (6)		9,370,620
8	Reallocated unfunded actuarial accrued liability		<u>122,590</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$9,493,210

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	6.77%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	39.23%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	38.53%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$154,393
2	Payment on projected unfunded actuarial accrued liability	727,305
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$881,698
5	Total Actuarially Determined Contribution, payable on July 1	866,303

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Stow

2500

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 4 beneficiaries in pay status)	43
2	Participants active during the year ended December 31, 2019	57
3	Inactive participants entitled to a return of their employee contributions	5
4	Inactive participants with a vested right to a deferred or immediate benefit	2

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$546,327
2	Administrative expenses		25,983
3	Expected employee contributions		<u>-365,050</u>
4	Employer normal cost: (1) + (2) + (3)		\$207,260
5	Actuarial accrued liability		23,552,661
	Retired participants and beneficiaries	\$12,630,836	
	Active participants	10,658,637	
	Inactive participants	<u>263,188</u>	
6	Actuarial value of assets		11,536,523
7	Unfunded actuarial accrued liability: (5) – (6)		12,016,138
8	Reallocated unfunded actuarial accrued liability		<u>169,896</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$12,186,034

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.72%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	27.84%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	27.34%
7	Projected payroll	3,748,689

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$230,311
2	Payment on projected unfunded actuarial accrued liability	938,027
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$1,168,338
5	Total Actuarially Determined Contribution, payable on July 1	1,147,938

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Sudbury

2600

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 20 beneficiaries in pay status)	214
2	Participants active during the year ended December 31, 2019	307
3	Inactive participants entitled to a return of their employee contributions	96
4	Inactive participants with a vested right to a deferred or immediate benefit	16

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$2,665,101
2	Administrative expenses		126,752
3	Expected employee contributions		<u>-1,825,066</u>
4	Employer normal cost: (1) + (2) + (3)		\$966,787
5	Actuarial accrued liability		116,717,753
	Retired participants and beneficiaries	\$62,285,174	
	Active participants	51,658,102	
	Inactive participants	<u>2,774,477</u>	
6	Actuarial value of assets		52,227,292
7	Unfunded actuarial accrued liability: (5) – (6)		64,490,461
8	Reallocated unfunded actuarial accrued liability		<u>841,938</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$65,332,399

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.28%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	29.00%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	28.49%
7	Projected payroll	18,921,604

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$1,074,695
2	Payment on projected unfunded actuarial accrued liability	5,025,695
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$6,100,390
5	Total Actuarially Determined Contribution, payable on July 1	5,993,875

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Tewksbury

2700

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 30 beneficiaries in pay status)	315
2	Participants active during the year ended December 31, 2019	397
3	Inactive participants entitled to a return of their employee contributions	121
4	Inactive participants with a vested right to a deferred or immediate benefit	13

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$3,645,589
2	Administrative expenses		173,384
3	Expected employee contributions		<u>-2,391,581</u>
4	Employer normal cost: (1) + (2) + (3)		\$1,427,392
5	Actuarial accrued liability		179,364,203
	Retired participants and beneficiaries	\$104,320,952	
	Active participants	72,968,702	
	Inactive participants	<u>2,074,549</u>	
6	Actuarial value of assets		71,767,395
7	Unfunded actuarial accrued liability: (5) – (6)		107,596,808
8	Reallocated unfunded actuarial accrued liability		<u>1,293,835</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$108,890,643

The actuarial factors projected to FY21 are as follows:

		<u>Amount</u>	<u>% of Payroll</u>
1	Projected employer normal cost	\$1,476,176	5.99%
2	Projected unfunded actuarial accrued liability	112,795,149	
3	Payment on projected unfunded actuarial accrued liability	7,482,307	
4	Payment on 2010 ERI	<u>0</u>	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$8,958,483	36.33%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	8,797,968	35.68%
7	Projected payroll	24,661,175	

The actuarial factors projected to FY22 and FY23 are as follows:

	<u>FY22</u>	<u>FY23</u>
1	Projected employer normal cost	\$1,529,991
2	Payment on projected unfunded actuarial accrued liability	7,810,489
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$9,340,480
5	Total Actuarially Determined Contribution, payable on July 1	9,177,392
		9,788,110

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Townsend

2800

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 4 beneficiaries in pay status)	36
2	Participants active during the year ended December 31, 2019	65
3	Inactive participants entitled to a return of their employee contributions	10
4	Inactive participants with a vested right to a deferred or immediate benefit	3

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$623,694
2	Administrative expenses		29,663
3	Expected employee contributions		-365,769
4	Employer normal cost: (1) + (2) + (3)		\$287,588
5	Actuarial accrued liability		21,302,131
	Retired participants and beneficiaries	\$12,575,321	
	Active participants	7,940,784	
	Inactive participants	<u>786,026</u>	
6	Actuarial value of assets		12,474,680
7	Unfunded actuarial accrued liability: (5) – (6)		8,827,451
8	Reallocated unfunded actuarial accrued liability		<u>153,662</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$8,981,113

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	7.87%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	24.54%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	24.10%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$319,128
2	Payment on projected unfunded actuarial accrued liability	689,829
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$1,008,957
5	Total Actuarially Determined Contribution, payable on July 1	991,340

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Tyngsborough

2900

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 13 beneficiaries in pay status)	93
2	Participants active during the year ended December 31, 2019	177
3	Inactive participants entitled to a return of their employee contributions	50
4	Inactive participants with a vested right to a deferred or immediate benefit	8

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$1,427,065
2	Administrative expenses		67,871
3	Expected employee contributions		-889,434
4	Employer normal cost: (1) + (2) + (3)		\$605,502
5	Actuarial accrued liability		51,964,352
	Retired participants and beneficiaries	\$27,951,331	
	Active participants	23,094,328	
	Inactive participants	918,693	
6	Actuarial value of assets		26,650,448
7	Unfunded actuarial accrued liability: (5) – (6)		25,313,904
8	Reallocated unfunded actuarial accrued liability		374,842
9	Total unfunded actuarial accrued liability: (7) + (8)		\$25,688,746

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	6.78%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	23.73%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	23.30%
7	Projected payroll	9,237,326

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$672,284
2	Payment on projected unfunded actuarial accrued liability	1,991,642
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$2,663,926
5	Total Actuarially Determined Contribution, payable on July 1	2,617,413

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Wayland

3000

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 20 beneficiaries in pay status)	250
2	Participants active during the year ended December 31, 2019	398
3	Inactive participants entitled to a return of their employee contributions	168
4	Inactive participants with a vested right to a deferred or immediate benefit	21

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$2,954,335
2	Administrative expenses		140,508
3	Expected employee contributions		<u>-2,046,025</u>
4	Employer normal cost: (1) + (2) + (3)		\$1,048,818
5	Actuarial accrued liability		119,792,241
	Retired participants and beneficiaries	\$68,370,827	
	Active participants	48,096,789	
	Inactive participants	<u>3,324,625</u>	
6	Actuarial value of assets		59,996,379
7	Unfunded actuarial accrued liability: (5) – (6)		59,795,862
8	Reallocated unfunded actuarial accrued liability		<u>864,116</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$60,659,978

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.11%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	24.86%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	24.41%
7	Projected payroll	21,228,731

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$1,166,091
2	Payment on projected unfunded actuarial accrued liability	4,664,336
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$5,830,427
5	Total Actuarially Determined Contribution, payable on July 1	5,728,625

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Westford

3100

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 11 beneficiaries in pay status)	239
2	Participants active during the year ended December 31, 2019	543
3	Inactive participants entitled to a return of their employee contributions	180
4	Inactive participants with a vested right to a deferred or immediate benefit	18

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$3,902,123
2	Administrative expenses		185,585
3	Expected employee contributions		<u>-2,636,354</u>
4	Employer normal cost: (1) + (2) + (3)		\$1,451,354
5	Actuarial accrued liability		144,372,799
	Retired participants and beneficiaries	\$64,873,095	
	Active participants	76,310,063	
	Inactive participants	<u>3,189,641</u>	
6	Actuarial value of assets		83,635,201
7	Unfunded actuarial accrued liability: (5) – (6)		60,737,598
8	Reallocated unfunded actuarial accrued liability		<u>1,041,426</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$61,779,024

The actuarial factors projected to FY21 are as follows:

		Amount	% of Payroll
1	Projected employer normal cost	\$1,500,957	5.47%
2	Projected unfunded actuarial accrued liability	63,994,243	
3	Payment on projected unfunded actuarial accrued liability	4,012,338	
4	Payment on 2010 ERI	<u>60,290</u>	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$5,573,585	20.30%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	5,473,719	19.94%
7	Projected payroll	27,452,504	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$1,555,988
2	Payment on projected unfunded actuarial accrued liability	4,439,737
3	Payment on 2010 ERI	<u>60,291</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$6,056,016
5	Total Actuarially Determined Contribution, payable on July 1	5,950,276

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Weston

3200

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 22 beneficiaries in pay status)	246
2	Participants active during the year ended December 31, 2019	380
3	Inactive participants entitled to a return of their employee contributions	174
4	Inactive participants with a vested right to a deferred or immediate benefit	18

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$2,946,831
2	Administrative expenses		140,151
3	Expected employee contributions		<u>-2,106,268</u>
4	Employer normal cost: (1) + (2) + (3)		\$980,714
5	Actuarial accrued liability		128,903,636
	Retired participants and beneficiaries	\$66,150,912	
	Active participants	58,837,313	
	Inactive participants	<u>3,915,411</u>	
6	Actuarial value of assets		60,794,264
7	Unfunded actuarial accrued liability: (5) – (6)		68,109,372
8	Reallocated unfunded actuarial accrued liability		<u>929,840</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$69,039,212

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	4.66%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	26.49%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	26.02%
7	Projected payroll	21,787,828

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$1,090,982
2	Payment on projected unfunded actuarial accrued liability	5,309,684
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$6,400,666
5	Total Actuarially Determined Contribution, payable on July 1	6,288,908

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Town of Wilmington

3300

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 38 beneficiaries in pay status)	278
2	Participants active during the year ended December 31, 2019	417
3	Inactive participants entitled to a return of their employee contributions	119
4	Inactive participants with a vested right to a deferred or immediate benefit	13

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$3,415,288
2	Administrative expenses		162,431
3	Expected employee contributions		<u>-2,411,422</u>
4	Employer normal cost: (1) + (2) + (3)		\$1,166,297
5	Actuarial accrued liability		168,966,637
	Retired participants and beneficiaries	\$91,328,584	
	Active participants	75,473,855	
	Inactive participants	<u>2,164,198</u>	
6	Actuarial value of assets		76,816,589
7	Unfunded actuarial accrued liability: (5) – (6)		92,150,048
8	Reallocated unfunded actuarial accrued liability		<u>1,218,833</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$93,368,881

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	4.83%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	30.98%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	30.43%
7	Projected payroll	24,956,279

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$1,297,136
2	Payment on projected unfunded actuarial accrued liability	7,173,676
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$8,470,812
5	Total Actuarially Determined Contribution, payable on July 1	8,322,908

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Acton-Boxborough RSD

3400

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 5 beneficiaries in pay status)	136
2	Participants active during the year ended December 31, 2019	366
3	Inactive participants entitled to a return of their employee contributions	79
4	Inactive participants with a vested right to a deferred or immediate benefit	13

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$2,176,737
2	Administrative expenses		103,525
3	Expected employee contributions		<u>-1,479,732</u>
4	Employer normal cost: (1) + (2) + (3)		\$800,530
5	Actuarial accrued liability		64,400,223
	Retired participants and beneficiaries	\$27,477,528	
	Active participants	35,025,413	
	Inactive participants	<u>1,897,282</u>	
6	Actuarial value of assets		32,694,890
7	Unfunded actuarial accrued liability: (5) – (6)		31,705,333
8	Reallocated unfunded actuarial accrued liability		<u>464,548</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$32,169,881

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.27%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	18.10%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	17.78%
7	Projected payroll	15,717,451

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$889,782
2	Payment on projected unfunded actuarial accrued liability	2,489,704
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$3,379,486
5	Total Actuarially Determined Contribution, payable on July 1	3,320,479

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Acton Water Supply

3500

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	8
2	Participants active during the year ended December 31, 2019	16
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	2

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$119,094
2	Administrative expenses		5,664
3	Expected employee contributions		-127,175
4	Employer normal cost: (1) + (2) + (3)		-\$2,417
5	Actuarial accrued liability		8,083,965
	Retired participants and beneficiaries	\$2,764,196	
	Active participants	5,065,127	
	Inactive participants	<u>254,642</u>	
6	Actuarial value of assets		4,299,020
7	Unfunded actuarial accrued liability: (5) – (6)		3,784,945
8	Reallocated unfunded actuarial accrued liability		<u>58,313</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$3,843,258

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	-\$2,500 -0.19%
2	Projected unfunded actuarial accrued liability	3,981,066
3	Payment on projected unfunded actuarial accrued liability	264,159
4	Payment on 2010 ERI	<u>0</u>
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$261,659 20.18%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	256,971 19.82%
7	Projected payroll	1,296,434

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	-\$2,390 -\$2,271
2	Payment on projected unfunded actuarial accrued liability	275,663 295,633
3	Payment on 2010 ERI	<u>0</u> <u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$273,273 \$293,362
5	Total Actuarially Determined Contribution, payable on July 1	268,502 288,240

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Bedford Housing Authority

3600

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	2
2	Participants active during the year ended December 31, 2019	3
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$20,939
2	Administrative expenses		996
3	Expected employee contributions		-17,513
4	Employer normal cost: (1) + (2) + (3)		\$4,422
5	Actuarial accrued liability		739,307
	Retired participants and beneficiaries	\$237,337	
	Active participants	501,970	
	Inactive participants	0	
6	Actuarial value of assets		401,573
7	Unfunded actuarial accrued liability: (5) – (6)		337,734
8	Reallocated unfunded actuarial accrued liability		5,333
9	Total unfunded actuarial accrued liability: (7) + (8)		\$343,067

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	2.56%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	15.68%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	15.40%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	\$4,755	\$4,945
2	24,620	26,404
3	0	0
4	\$29,375	\$31,349
5	28,862	30,802

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Billerica Housing Authority

3700

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	5
2	Participants active during the year ended December 31, 2019	6
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$48,434
2	Administrative expenses		2,304
3	Expected employee contributions		-41,367
4	Employer normal cost: (1) + (2) + (3)		\$9,371
5	Actuarial accrued liability		2,695,861
	Retired participants and beneficiaries	\$1,571,694	
	Active participants	1,124,167	
	Inactive participants	0	
6	Actuarial value of assets		1,048,322
7	Unfunded actuarial accrued liability: (5) – (6)		1,647,539
8	Reallocated unfunded actuarial accrued liability		19,446
9	Total unfunded actuarial accrued liability: (7) + (8)		\$1,666,985

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	\$9,691 2.30%
2	Projected unfunded actuarial accrued liability	1,726,758
3	Payment on projected unfunded actuarial accrued liability	105,762
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$115,453 27.45%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	113,384 26.96%
7	Projected payroll	420,604

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$10,084 \$10,492
2	Payment on projected unfunded actuarial accrued liability	120,208 128,917
3	Payment on 2010 ERI	0 0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$130,292 \$139,409
5	Total Actuarially Determined Contribution, payable on July 1	128,017 136,975

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Chelmsford Housing Authority

3800

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	4
2	Participants active during the year ended December 31, 2019	36
3	Inactive participants entitled to a return of their employee contributions	6
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$334,729
2	Administrative expenses		15,920
3	Expected employee contributions		<u>-276,403</u>
4	Employer normal cost: (1) + (2) + (3)		\$74,246
5	Actuarial accrued liability		7,081,438
	Retired participants and beneficiaries	\$1,337,066	
	Active participants	5,700,576	
	Inactive participants	<u>43,796</u>	
6	Actuarial value of assets		4,716,900
7	Unfunded actuarial accrued liability: (5) – (6)		2,364,538
8	Reallocated unfunded actuarial accrued liability		<u>51,082</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$2,415,620

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	2.77%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	8.69%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	8.54%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$82,963
2	Payment on projected unfunded actuarial accrued liability	185,947
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$268,910
5	Total Actuarially Determined Contribution, payable on July 1	264,215

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Chelmsford Water District

3900

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	11
2	Participants active during the year ended December 31, 2019	21
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$160,460
2	Administrative expenses		7,631
3	Expected employee contributions		-142,803
4	Employer normal cost: (1) + (2) + (3)		\$25,288
5	Actuarial accrued liability		8,647,978
	Retired participants and beneficiaries	\$3,426,475	
	Active participants	5,221,503	
	Inactive participants	0	
6	Actuarial value of assets		8,088,416
7	Unfunded actuarial accrued liability: (5) – (6)		559,562
8	Reallocated unfunded actuarial accrued liability		62,382
9	Total unfunded actuarial accrued liability: (7) + (8)		\$621,944

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	1.76%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	4.64%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	4.56%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$28,411
2	Payment on projected unfunded actuarial accrued liability	47,827
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$76,238
5	Total Actuarially Determined Contribution, payable on July 1	74,907

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Dracut Housing Authority

4000

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	6
2	Participants active during the year ended December 31, 2019	6
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$45,694
2	Administrative expenses		2,173
3	Expected employee contributions		<u>-42,303</u>
4	Employer normal cost: (1) + (2) + (3)		\$5,564
5	Actuarial accrued liability		3,456,242
	Retired participants and beneficiaries	\$1,841,072	
	Active participants	1,615,170	
	Inactive participants	<u>0</u>	
6	Actuarial value of assets		1,148,096
7	Unfunded actuarial accrued liability: (5) – (6)		2,308,146
8	Reallocated unfunded actuarial accrued liability		<u>24,931</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$2,333,077

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	1.33%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	38.08%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	37.40%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$6,286
2	Payment on projected unfunded actuarial accrued liability	179,536
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$185,822
5	Total Actuarially Determined Contribution, payable on July 1	182,577

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Dracut Water Supply

4100

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 2 beneficiaries in pay status)	6
2	Participants active during the year ended December 31, 2019	15
3	Inactive participants entitled to a return of their employee contributions	2
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$79,812
2	Administrative expenses		3,796
3	Expected employee contributions		-71,095
4	Employer normal cost: (1) + (2) + (3)		\$12,513
5	Actuarial accrued liability		5,710,563
	Retired participants and beneficiaries	\$2,407,750	
	Active participants	3,280,894	
	Inactive participants	21,919	
6	Actuarial value of assets		2,348,373
7	Unfunded actuarial accrued liability: (5) – (6)		3,362,190
8	Reallocated unfunded actuarial accrued liability		41,193
9	Total unfunded actuarial accrued liability: (7) + (8)		\$3,403,383

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	1.73%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	33.67%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	33.07%
7	Projected payroll	747,994

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$14,060
2	Payment on projected unfunded actuarial accrued liability	261,407
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$275,467
5	Total Actuarially Determined Contribution, payable on July 1	270,657

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for E. Chelmsford Water

4200

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	2
2	Participants active during the year ended December 31, 2019	3
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$28,113
2	Administrative expenses		1,337
3	Expected employee contributions		<u>-21,553</u>
4	Employer normal cost: (1) + (2) + (3)		\$7,897
5	Actuarial accrued liability		1,095,382
	Retired participants and beneficiaries	\$275,969	
	Active participants	819,413	
	Inactive participants	<u>0</u>	
6	Actuarial value of assets		687,843
7	Unfunded actuarial accrued liability: (5) – (6)		407,539
8	Reallocated unfunded actuarial accrued liability		<u>7,901</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$415,440

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	3.62%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	<u>0</u>
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	16.24%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	15.95%
7	Projected payroll	225,717

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$8,799
2	Payment on projected unfunded actuarial accrued liability	31,962
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$40,761
5	Total Actuarially Determined Contribution, payable on July 1	40,049

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for E. Middlesex Mosq Control

4300

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	4
2	Participants active during the year ended December 31, 2019	6
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$39,461
2	Administrative expenses		1,877
3	Expected employee contributions		<u>-37,302</u>
4	Employer normal cost: (1) + (2) + (3)		\$4,036
5	Actuarial accrued liability		2,410,191
	Retired participants and beneficiaries	\$1,672,399	
	Active participants	737,792	
	Inactive participants	<u>0</u>	
6	Actuarial value of assets		1,664,919
7	Unfunded actuarial accrued liability: (5) – (6)		745,272
8	Reallocated unfunded actuarial accrued liability		<u>17,386</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$762,658

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	1.09%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	13.64%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	13.40%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	\$4,373	\$4,580
2	55,005	58,989
3	<u>0</u>	<u>0</u>
4	\$59,378	\$63,569
5	58,341	62,459

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Greater Lowell RVTSD

4400

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 9 beneficiaries in pay status)	82
2	Participants active during the year ended December 31, 2019	88
3	Inactive participants entitled to a return of their employee contributions	21
4	Inactive participants with a vested right to a deferred or immediate benefit	6

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$531,721
2	Administrative expenses		25,289
3	Expected employee contributions		<u>-430,331</u>
4	Employer normal cost: (1) + (2) + (3)		\$126,679
5	Actuarial accrued liability		31,615,211
	Retired participants and beneficiaries	\$18,131,902	
	Active participants	12,285,366	
	Inactive participants	<u>1,197,943</u>	
6	Actuarial value of assets		13,203,713
7	Unfunded actuarial accrued liability: (5) – (6)		18,411,498
8	Reallocated unfunded actuarial accrued liability		<u>228,055</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$18,639,553

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	2.88%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	29.29%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	28.77%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$141,422
2	Payment on projected unfunded actuarial accrued liability	1,440,140
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$1,581,562
5	Total Actuarially Determined Contribution, payable on July 1	1,553,947

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Groton-Dunstable RSD

4500

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 4 beneficiaries in pay status)	92
2	Participants active during the year ended December 31, 2019	119
3	Inactive participants entitled to a return of their employee contributions	62
4	Inactive participants with a vested right to a deferred or immediate benefit	5

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$564,543
2	Administrative expenses		26,850
3	Expected employee contributions		-381,416
4	Employer normal cost: (1) + (2) + (3)		\$209,977
5	Actuarial accrued liability		29,084,400
	Retired participants and beneficiaries	\$18,595,656	
	Active participants	9,692,591	
	Inactive participants	<u>796,153</u>	
6	Actuarial value of assets		15,832,894
7	Unfunded actuarial accrued liability: (5) – (6)		13,251,506
8	Reallocated unfunded actuarial accrued liability		<u>209,799</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$13,461,305

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.26%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	26.58%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	26.10%
7	Projected payroll	4,129,632

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$233,366
2	Payment on projected unfunded actuarial accrued liability	1,038,979
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$1,272,345
5	Total Actuarially Determined Contribution, payable on July 1	1,250,129

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Hudson Housing Authority

4600

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	4
2	Participants active during the year ended December 31, 2019	6
3	Inactive participants entitled to a return of their employee contributions	1
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$44,397
2	Administrative expenses		2,112
3	Expected employee contributions		-37,242
4	Employer normal cost: (1) + (2) + (3)		\$9,267
5	Actuarial accrued liability		1,640,547
	Retired participants and beneficiaries	\$1,097,259	
	Active participants	540,707	
	Inactive participants	<u>2,581</u>	
6	Actuarial value of assets		923,028
7	Unfunded actuarial accrued liability: (5) – (6)		717,519
8	Reallocated unfunded actuarial accrued liability		<u>11,834</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$729,353

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	2.54%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	26.47%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	26.00%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$10,364
2	Payment on projected unfunded actuarial accrued liability	52,970
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$63,334
5	Total Actuarially Determined Contribution, payable on July 1	62,228

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Lincoln Sudbury

4700

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 2 beneficiaries in pay status)	40
2	Participants active during the year ended December 31, 2019	60
3	Inactive participants entitled to a return of their employee contributions	26
4	Inactive participants with a vested right to a deferred or immediate benefit	4

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$370,487
2	Administrative expenses		17,620
3	Expected employee contributions		<u>-290,754</u>
4	Employer normal cost: (1) + (2) + (3)		\$97,353
5	Actuarial accrued liability		17,305,778
	Retired participants and beneficiaries	\$7,576,027	
	Active participants	8,710,716	
	Inactive participants	<u>1,019,035</u>	
6	Actuarial value of assets		8,117,555
7	Unfunded actuarial accrued liability: (5) – (6)		9,188,223
8	Reallocated unfunded actuarial accrued liability		<u>124,834</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$9,313,057

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	3.31%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	25.29%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	24.83%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	\$104,546	\$108,557
2	665,892	714,131
3	0	0
4	\$770,438	\$822,688
5	756,986	808,324

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Nashoba Vally THSD

4900

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 2 beneficiaries in pay status)	16
2	Participants active during the year ended December 31, 2019	21
3	Inactive participants entitled to a return of their employee contributions	6
4	Inactive participants with a vested right to a deferred or immediate benefit	1

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$149,927
2	Administrative expenses		7,131
3	Expected employee contributions		<u>-96,816</u>
4	Employer normal cost: (1) + (2) + (3)		\$60,242
5	Actuarial accrued liability		5,299,555
	Retired participants and beneficiaries	\$2,777,499	
	Active participants	2,286,708	
	Inactive participants	<u>235,348</u>	
6	Actuarial value of assets		1,586,335
7	Unfunded actuarial accrued liability: (5) – (6)		3,713,220
8	Reallocated unfunded actuarial accrued liability		<u>38,228</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$3,751,448

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	6.17%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	32.68%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	32.10%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$66,913
2	Payment on projected unfunded actuarial accrued liability	287,808
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$354,721
5	Total Actuarially Determined Contribution, payable on July 1	348,527

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for N. Chelmsford Water

5000

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	1
2	Participants active during the year ended December 31, 2019	8
3	Inactive participants entitled to a return of their employee contributions	1
4	Inactive participants with a vested right to a deferred or immediate benefit	1

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$56,594
2	Administrative expenses		2,692
3	Expected employee contributions		<u>-61,863</u>
4	Employer normal cost: (1) + (2) + (3)		<u>-\$2,577</u>
5	Actuarial accrued liability		3,596,783
	Retired participants and beneficiaries	\$58,522	
	Active participants	3,443,292	
	Inactive participants	<u>94,969</u>	
6	Actuarial value of assets		2,473,196
7	Unfunded actuarial accrued liability: (5) – (6)		1,123,587
8	Reallocated unfunded actuarial accrued liability		<u>25,945</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$1,149,532

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	<u>-\$2,665</u>
2	Projected unfunded actuarial accrued liability	1,190,751
3	Payment on projected unfunded actuarial accrued liability	76,323
4	Payment on 2010 ERI	<u>0</u>
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$73,658
6	Total FY21 Actuarially Determined Contribution, payable on July 1	72,338
7	Projected payroll	680,145

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	<u>-\$2,661</u>
2	Payment on projected unfunded actuarial accrued liability	82,647
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$79,986
5	Total Actuarially Determined Contribution, payable on July 1	78,589

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for North Middlesex RSD

5100

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 7 beneficiaries in pay status)	90
2	Participants active during the year ended December 31, 2019	156
3	Inactive participants entitled to a return of their employee contributions	90
4	Inactive participants with a vested right to a deferred or immediate benefit	9

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$720,327
2	Administrative expenses		34,259
3	Expected employee contributions		-519,167
4	Employer normal cost: (1) + (2) + (3)		\$235,419
5	Actuarial accrued liability		27,439,453
	Retired participants and beneficiaries	\$12,510,832	
	Active participants	13,878,546	
	Inactive participants	1,050,075	
6	Actuarial value of assets		13,893,270
7	Unfunded actuarial accrued liability: (5) – (6)		13,546,183
8	Reallocated unfunded actuarial accrued liability		197,933
9	Total unfunded actuarial accrued liability: (7) + (8)		\$13,744,116

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	4.35%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	20.43%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	20.06%
7	Projected payroll	5,601,805

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$261,932
2	Payment on projected unfunded actuarial accrued liability	1,060,643
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$1,322,575
5	Total Actuarially Determined Contribution, payable on July 1	1,299,482

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Shawsheen Valley RVS

5300

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 6 beneficiaries in pay status)	47
2	Participants active during the year ended December 31, 2019	57
3	Inactive participants entitled to a return of their employee contributions	24
4	Inactive participants with a vested right to a deferred or immediate benefit	2

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$333,734
2	Administrative expenses		15,872
3	Expected employee contributions		<u>-265,817</u>
4	Employer normal cost: (1) + (2) + (3)		\$83,789
5	Actuarial accrued liability		16,138,990
	Retired participants and beneficiaries	\$8,507,206	
	Active participants	6,444,100	
	Inactive participants	<u>1,187,684</u>	
6	Actuarial value of assets		7,226,485
7	Unfunded actuarial accrued liability: (5) – (6)		8,912,505
8	Reallocated unfunded actuarial accrued liability		<u>116,418</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$9,028,923

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	3.11%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	25.82%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	25.36%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$93,481
2	Payment on projected unfunded actuarial accrued liability	693,595
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$787,076
5	Total Actuarially Determined Contribution, payable on July 1	773,333

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for South Middlesex RVTS

5400

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 4 beneficiaries in pay status)	42
2	Participants active during the year ended December 31, 2019	43
3	Inactive participants entitled to a return of their employee contributions	22
4	Inactive participants with a vested right to a deferred or immediate benefit	1

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$275,310
2	Administrative expenses		13,094
3	Expected employee contributions		-216,465
4	Employer normal cost: (1) + (2) + (3)		\$71,939
5	Actuarial accrued liability		14,119,182
	Retired participants and beneficiaries	\$7,901,855	
	Active participants	5,967,602	
	Inactive participants	<u>249,725</u>	
6	Actuarial value of assets		7,022,939
7	Unfunded actuarial accrued liability: (5) – (6)		7,096,243
8	Reallocated unfunded actuarial accrued liability		<u>101,848</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$7,198,091

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	3.24%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	26.57%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	26.10%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$80,223
2	Payment on projected unfunded actuarial accrued liability	550,436
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$630,659
5	Total Actuarially Determined Contribution, payable on July 1	619,647

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Sudbury Water District

5500

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	3
2	Participants active during the year ended December 31, 2019	10
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$87,996
2	Administrative expenses		4,185
3	Expected employee contributions		-103,387
4	Employer normal cost: (1) + (2) + (3)		-11,206
5	Actuarial accrued liability		6,253,542
	Retired participants and beneficiaries	\$1,228,439	
	Active participants	5,025,103	
	Inactive participants	0	
6	Actuarial value of assets		3,627,568
7	Unfunded actuarial accrued liability: (5) – (6)		2,625,974
8	Reallocated unfunded actuarial accrued liability		45,110
9	Total unfunded actuarial accrued liability: (7) + (8)		\$2,671,084

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	-11,589 -1.06%
2	Projected unfunded actuarial accrued liability	2,766,861
3	Payment on projected unfunded actuarial accrued liability	156,346
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$144,757 13.27%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	142,163 13.03%
7	Projected payroll	1,091,196

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	-11,825 -12,063
2	Payment on projected unfunded actuarial accrued liability	193,570 207,593
3	Payment on 2010 ERI	0 0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$181,745 \$195,530
5	Total Actuarially Determined Contribution, payable on July 1	178,572 192,116

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Tewksbury Housing Authority

5600

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	6
2	Participants active during the year ended December 31, 2019	7
3	Inactive participants entitled to a return of their employee contributions	1
4	Inactive participants with a vested right to a deferred or immediate benefit	2

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$54,642
2	Administrative expenses		2,599
3	Expected employee contributions		-42,078
4	Employer normal cost: (1) + (2) + (3)		\$15,163
5	Actuarial accrued liability		3,227,034
	Retired participants and beneficiaries	\$1,937,868	
	Active participants	974,709	
	Inactive participants	314,457	
6	Actuarial value of assets		1,492,879
7	Unfunded actuarial accrued liability: (5) – (6)		1,734,155
8	Reallocated unfunded actuarial accrued liability		23,278
9	Total unfunded actuarial accrued liability: (7) + (8)		\$1,757,433

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	3.67%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	32.09%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	31.52%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$16,898
2	Payment on projected unfunded actuarial accrued liability	135,130
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$152,028
5	Total Actuarially Determined Contribution, payable on July 1	149,374

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Wayland Housing Authority

5700

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	2
2	Participants active during the year ended December 31, 2019	4
3	Inactive participants entitled to a return of their employee contributions	1
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$36,251
2	Administrative expenses		1,724
3	Expected employee contributions		<u>-30,623</u>
4	Employer normal cost: (1) + (2) + (3)		\$7,352
5	Actuarial accrued liability		1,874,874
	Retired participants and beneficiaries	\$201,203	
	Active participants	1,673,121	
	Inactive participants	<u>550</u>	
6	Actuarial value of assets		1,178,672
7	Unfunded actuarial accrued liability: (5) – (6)		696,202
8	Reallocated unfunded actuarial accrued liability		<u>13,524</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$709,726

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	2.35%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	17.38%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	17.07%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	\$7,908	\$8,226
2	50,926	54,615
3	0	0
4	\$58,834	\$62,841
5	57,807	61,744

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Hopkinton Housing Authority

5800

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	2
2	Participants active during the year ended December 31, 2019	2
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$11,132
2	Administrative expenses		529
3	Expected employee contributions		-7,677
4	Employer normal cost: (1) + (2) + (3)		\$3,984
5	Actuarial accrued liability		1,044,731
	Retired participants and beneficiaries	\$1,001,973	
	Active participants	42,758	
	Inactive participants	0	
6	Actuarial value of assets		503,054
7	Unfunded actuarial accrued liability: (5) – (6)		541,677
8	Reallocated unfunded actuarial accrued liability		7,536
9	Total unfunded actuarial accrued liability: (7) + (8)		\$549,213

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.02%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	48.81%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	47.93%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$4,429
2	Payment on projected unfunded actuarial accrued liability	42,391
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$46,820
5	Total Actuarially Determined Contribution, payable on July 1	46,003

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Sudbury Housing Authority

6000

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	3
2	Participants active during the year ended December 31, 2019	2
3	Inactive participants entitled to a return of their employee contributions	2
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$17,466
2	Administrative expenses		831
3	Expected employee contributions		-10,555
4	Employer normal cost: (1) + (2) + (3)		\$7,742
5	Actuarial accrued liability		886,116
	Retired participants and beneficiaries	\$742,609	
	Active participants	126,221	
	Inactive participants	17,286	
6	Actuarial value of assets		393,749
7	Unfunded actuarial accrued liability: (5) – (6)		492,367
8	Reallocated unfunded actuarial accrued liability		6,392
9	Total unfunded actuarial accrued liability: (7) + (8)		\$498,759

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	7.37%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	40.47%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	39.74%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$8,593
2	Payment on projected unfunded actuarial accrued liability	38,237
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$46,830
5	Total Actuarially Determined Contribution, payable on July 1	46,012

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Wilmington Housing Authority

6100

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	4
2	Participants active during the year ended December 31, 2019	3
3	Inactive participants entitled to a return of their employee contributions	1
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$20,812
2	Administrative expenses		990
3	Expected employee contributions		<u>-14,301</u>
4	Employer normal cost: (1) + (2) + (3)		\$7,501
5	Actuarial accrued liability		737,689
	Retired participants and beneficiaries	\$324,063	
	Active participants	412,525	
	Inactive participants	<u>1,101</u>	
6	Actuarial value of assets		352,594
7	Unfunded actuarial accrued liability: (5) – (6)		385,095
8	Reallocated unfunded actuarial accrued liability		<u>5,321</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$390,416

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.24%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	22.40%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	22.00%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$8,339
2	Payment on projected unfunded actuarial accrued liability	30,143
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$38,482
5	Total Actuarially Determined Contribution, payable on July 1	37,810

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Acton Housing Authority

6200

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 1 beneficiary in pay status)	6
2	Participants active during the year ended December 31, 2019	6
3	Inactive participants entitled to a return of their employee contributions	1
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$47,866
2	Administrative expenses		2,277
3	Expected employee contributions		<u>-41,312</u>
4	Employer normal cost: (1) + (2) + (3)		\$8,831
5	Actuarial accrued liability		2,191,626
	Retired participants and beneficiaries	\$1,416,865	
	Active participants	771,156	
	Inactive participants	<u>3,605</u>	
6	Actuarial value of assets		1,265,254
7	Unfunded actuarial accrued liability: (5) – (6)		926,372
8	Reallocated unfunded actuarial accrued liability		<u>15,809</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$942,181

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	2.15%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	15.73%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	15.45%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	\$9,506	\$9,895
2	68,103	73,036
3	0	0
4	\$77,609	\$82,931
5	76,254	81,483

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Burlington Housing Authority

6300

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	2
2	Participants active during the year ended December 31, 2019	3
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$27,099
2	Administrative expenses		1,289
3	Expected employee contributions		<u>-21,200</u>
4	Employer normal cost: (1) + (2) + (3)		\$7,188
5	Actuarial accrued liability		1,290,195
	Retired participants and beneficiaries	\$630,564	
	Active participants	659,631	
	Inactive participants	<u>0</u>	
6	Actuarial value of assets		925,187
7	Unfunded actuarial accrued liability: (5) – (6)		365,008
8	Reallocated unfunded actuarial accrued liability		<u>9,307</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$374,315

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	3.37%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	<u>0</u>
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	6.62%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	6.51%
7	Projected payroll	220,559

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	\$7,719	\$8,014
2	28,198	30,241
3	<u>0</u>	<u>0</u>
4	\$35,917	\$38,255
5	35,290	37,587

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Ayer Housing Authority

6400

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	1
2	Participants active during the year ended December 31, 2019	2
3	Inactive participants entitled to a return of their employee contributions	2
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$14,828
2	Administrative expenses		705
3	Expected employee contributions		-12,178
4	Employer normal cost: (1) + (2) + (3)		\$3,355
5	Actuarial accrued liability		1,180,762
	Retired participants and beneficiaries	\$701,130	
	Active participants	474,648	
	Inactive participants	4,984	
6	Actuarial value of assets		308,582
7	Unfunded actuarial accrued liability: (5) – (6)		872,180
8	Reallocated unfunded actuarial accrued liability		8,517
9	Total unfunded actuarial accrued liability: (7) + (8)		\$880,697

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	2.81%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	51.18%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	50.26%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$3,748
2	Payment on projected unfunded actuarial accrued liability	67,804
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$71,552
5	Total Actuarially Determined Contribution, payable on July 1	70,303

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Holliston Housing Authority

6500

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	1
2	Participants active during the year ended December 31, 2019	2
3	Inactive participants entitled to a return of their employee contributions	2
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$14,106
2	Administrative expenses		671
3	Expected employee contributions		-8,227
4	Employer normal cost: (1) + (2) + (3)		\$6,550
5	Actuarial accrued liability		416,700
	Retired participants and beneficiaries	\$118,182	
	Active participants	296,622	
	Inactive participants	1,896	
6	Actuarial value of assets		237,697
7	Unfunded actuarial accrued liability: (5) – (6)		179,003
8	Reallocated unfunded actuarial accrued liability		3,006
9	Total unfunded actuarial accrued liability: (7) + (8)		\$182,009

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	7.90%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	18.75%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	18.42%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$7,268
2	Payment on projected unfunded actuarial accrued liability	14,251
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$21,519
5	Total Actuarially Determined Contribution, payable on July 1	21,143

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Littleton Housing Authority

6600

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	2
2	Participants active during the year ended December 31, 2019	1
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$7,195
2	Administrative expenses		342
3	Expected employee contributions		-3,921
4	Employer normal cost: (1) + (2) + (3)		\$3,616
5	Actuarial accrued liability		647,534
	Retired participants and beneficiaries	\$592,680	
	Active participants	54,854	
	Inactive participants	0	
6	Actuarial value of assets		35,651
7	Unfunded actuarial accrued liability: (5) – (6)		611,883
8	Reallocated unfunded actuarial accrued liability		4,671
9	Total unfunded actuarial accrued liability: (7) + (8)		\$616,554

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	8.96%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	103.83%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	101.97%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$4,010
2	Payment on projected unfunded actuarial accrued liability	47,642
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$51,652
5	Total Actuarially Determined Contribution, payable on July 1	50,750

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Westford Housing Authority

6700

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	2
2	Participants active during the year ended December 31, 2019	4
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$32,604
2	Administrative expenses		1,551
3	Expected employee contributions		-23,509
4	Employer normal cost: (1) + (2) + (3)		\$10,646
5	Actuarial accrued liability		1,283,498
	Retired participants and beneficiaries	\$677,246	
	Active participants	606,252	
	Inactive participants	0	
6	Actuarial value of assets		703,528
7	Unfunded actuarial accrued liability: (5) – (6)		579,970
8	Reallocated unfunded actuarial accrued liability		9,258
9	Total unfunded actuarial accrued liability: (7) + (8)		\$589,228

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	4.61%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	21.23%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	20.85%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$11,845
2	Payment on projected unfunded actuarial accrued liability	45,158
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$57,003
5	Total Actuarially Determined Contribution, payable on July 1	56,008

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Shirley Water District

6800

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 2 beneficiaries in pay status)	2
2	Participants active during the year ended December 31, 2019	3
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$19,487
2	Administrative expenses		927
3	Expected employee contributions		<u>-21,592</u>
4	Employer normal cost: (1) + (2) + (3)		<u>-\$1,178</u>
5	Actuarial accrued liability		1,485,408
	Retired participants and beneficiaries	\$384,591	
	Active participants	1,100,817	
	Inactive participants	<u>0</u>	
6	Actuarial value of assets		982,213
7	Unfunded actuarial accrued liability: (5) – (6)		503,195
8	Reallocated unfunded actuarial accrued liability		<u>10,715</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$513,910

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	<u>-\$1,218</u>
2	Projected unfunded actuarial accrued liability	532,337
3	Payment on projected unfunded actuarial accrued liability	26,274
4	Payment on 2010 ERI	<u>0</u>
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$25,056
6	Total FY21 Actuarially Determined Contribution, payable on July 1	24,607
7	Projected payroll	229,201

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	<u>-\$1,227</u>
2	Payment on projected unfunded actuarial accrued liability	37,519
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$36,292
5	Total Actuarially Determined Contribution, payable on July 1	35,658

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Tyngsboro Housing Authority

6900

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	2
2	Participants active during the year ended December 31, 2019	3
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	1

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$25,978
2	Administrative expenses		1,236
3	Expected employee contributions		-18,027
4	Employer normal cost: (1) + (2) + (3)		\$9,187
5	Actuarial accrued liability		798,694
	Retired participants and beneficiaries	\$403,190	
	Active participants	292,419	
	Inactive participants	103,085	
6	Actuarial value of assets		271,687
7	Unfunded actuarial accrued liability: (5) – (6)		527,007
8	Reallocated unfunded actuarial accrued liability		5,761
9	Total unfunded actuarial accrued liability: (7) + (8)		\$532,768

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.19%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	24.78%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	24.33%
7	Projected payroll	183,152

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$10,215
2	Payment on projected unfunded actuarial accrued liability	41,040
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$51,255
5	Total Actuarially Determined Contribution, payable on July 1	50,360

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Pepperell Housing Authority

7000

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	1
2	Participants active during the year ended December 31, 2019	2
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$15,370
2	Administrative expenses		731
3	Expected employee contributions		-10,695
4	Employer normal cost: (1) + (2) + (3)		\$5,406
5	Actuarial accrued liability		448,884
	Retired participants and beneficiaries	\$247,725	
	Active participants	201,159	
	Inactive participants	0	
6	Actuarial value of assets		196,501
7	Unfunded actuarial accrued liability: (5) – (6)		252,383
8	Reallocated unfunded actuarial accrued liability		3,238
9	Total unfunded actuarial accrued liability: (7) + (8)		\$255,621

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	5.09%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	16.99%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	16.68%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	\$5,797	\$6,011
2	18,662	20,014
3	0	0
4	\$24,459	\$26,025
5	24,032	25,571

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Groton Housing Authority

7100

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	0
2	Participants active during the year ended December 31, 2019	0
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$0
2	Administrative expenses		0
3	Expected employee contributions		0
4	Employer normal cost: (1) + (2) + (3)		\$0
5	Actuarial accrued liability		0
	Retired participants and beneficiaries	\$0	
	Active participants	0	
	Inactive participants	0	
6	Actuarial value of assets		0
7	Unfunded actuarial accrued liability: (5) – (6)		0
8	Reallocated unfunded actuarial accrued liability		0
9	Total unfunded actuarial accrued liability: (7) + (8)		\$0

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	\$0
2	Projected unfunded actuarial accrued liability	0
3	Payment on projected unfunded actuarial accrued liability	2,919
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$2,919
6	Total FY21 Actuarially Determined Contribution, payable on July 1	2,867
7	Projected payroll	0

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$0
2	Payment on projected unfunded actuarial accrued liability	0
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$0
5	Total Actuarially Determined Contribution, payable on July 1	0

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Tyngsboro Water District

7200

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	2
2	Participants active during the year ended December 31, 2019	7
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$25,955
2	Administrative expenses		1,234
3	Expected employee contributions		<u>-20,221</u>
4	Employer normal cost: (1) + (2) + (3)		\$6,968
5	Actuarial accrued liability		1,494,110
	Retired participants and beneficiaries	\$648,110	
	Active participants	846,000	
	Inactive participants	<u>0</u>	
6	Actuarial value of assets		993,602
7	Unfunded actuarial accrued liability: (5) – (6)		500,508
8	Reallocated unfunded actuarial accrued liability		<u>10,778</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$511,286

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	3.36%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	19.11%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	18.76%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	\$7,482	\$7,768
2	36,772	39,436
3	<u>0</u>	<u>0</u>
4	\$44,254	\$47,204
5	43,481	46,380

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for North Reading Housing Authority

7400

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	2
2	Participants active during the year ended December 31, 2019	3
3	Inactive participants entitled to a return of their employee contributions	0
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$13,983
2	Administrative expenses		665
3	Expected employee contributions		-8,764
4	Employer normal cost: (1) + (2) + (3)		\$5,884
5	Actuarial accrued liability		462,982
	Retired participants and beneficiaries	\$173,038	
	Active participants	289,944	
	Inactive participants	0	
6	Actuarial value of assets		245,782
7	Unfunded actuarial accrued liability: (5) – (6)		217,200
8	Reallocated unfunded actuarial accrued liability		3,340
9	Total unfunded actuarial accrued liability: (7) + (8)		\$220,540

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	6.33%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	0
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	18.75%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	18.42%
7	Projected payroll	96,141

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$6,533
2	Payment on projected unfunded actuarial accrued liability	17,215
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$23,748
5	Total Actuarially Determined Contribution, payable on July 1	23,333

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for West Groton Water

7500

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	0
2	Participants active during the year ended December 31, 2019	2
3	Inactive participants entitled to a return of their employee contributions	1
4	Inactive participants with a vested right to a deferred or immediate benefit	0

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$10,703
2	Administrative expenses		509
3	Expected employee contributions		<u>-12,126</u>
4	Employer normal cost: (1) + (2) + (3)		<u>-\$914</u>
5	Actuarial accrued liability		495,434
	Retired participants and beneficiaries	\$0	
	Active participants	483,124	
	Inactive participants	<u>12,310</u>	
6	Actuarial value of assets		447,036
7	Unfunded actuarial accrued liability: (5) – (6)		48,398
8	Reallocated unfunded actuarial accrued liability		<u>3,574</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$51,972

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	<u>-\$945</u>
2	Projected unfunded actuarial accrued liability	53,836
3	Payment on projected unfunded actuarial accrued liability	3,732
4	Payment on 2010 ERI	<u>0</u>
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	\$2,787
6	Total FY21 Actuarially Determined Contribution, payable on July 1	2,737
7	Projected payroll	131,907

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	<u>-\$959</u>
2	Payment on projected unfunded actuarial accrued liability	3,716
3	Payment on 2010 ERI	<u>0</u>
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$2,757
5	Total Actuarially Determined Contribution, payable on July 1	2,709
		3,985
		<u>0</u>
		\$3,013
		2,960

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 3: Unit Results

Summary of Actuarial Valuation Results for Ayer-Shirley RSD

7600

The valuation was made with respect to the following data supplied to us:

1	Retired participants as of the valuation date (including 0 beneficiaries in pay status)	25
2	Participants active during the year ended December 31, 2019	110
3	Inactive participants entitled to a return of their employee contributions	53
4	Inactive participants with a vested right to a deferred or immediate benefit	9

The actuarial factors as of January 1, 2020 are as follows:

1	Normal cost		\$474,378
2	Administrative expenses		22,561
3	Expected employee contributions		<u>-345,897</u>
4	Employer normal cost: (1) + (2) + (3)		\$151,042
5	Actuarial accrued liability		15,593,564
	Retired participants and beneficiaries	\$5,837,751	
	Active participants	8,864,430	
	Inactive participants	<u>891,383</u>	
6	Actuarial value of assets		10,670,110
7	Unfunded actuarial accrued liability: (5) – (6)		4,923,454
8	Reallocated unfunded actuarial accrued liability		<u>112,483</u>
9	Total unfunded actuarial accrued liability: (7) + (8)		\$5,035,937

The actuarial factors projected to FY21 are as follows:

	Amount	% of Payroll
1	Projected employer normal cost	4.19%
2	Projected unfunded actuarial accrued liability	
3	Payment on projected unfunded actuarial accrued liability	
4	Payment on 2010 ERI	
5	Total FY21 Actuarially Determined Contribution: (1) + (3) + (4)	13.61%
6	Total FY21 Actuarially Determined Contribution, payable on July 1	13.36%
7	Projected payroll	

The actuarial factors projected to FY22 and FY23 are as follows:

	FY22	FY23
1	Projected employer normal cost	\$168,093
2	Payment on projected unfunded actuarial accrued liability	386,997
3	Payment on 2010 ERI	0
4	Total Actuarially Determined Contribution: (1) + (2) + (3)	\$555,090
5	Total Actuarially Determined Contribution, payable on July 1	545,398

Note: Actuarially Determined Contributions are assumed to be paid on July 1 and December 31, unless otherwise noted.

Section 4: Supplemental Information

Exhibit A: Table of Plan Coverage

Category	Year Ended December 31		Change From Prior Year
	2019	2017	
Active participants in valuation:			
• Number	9,282	9,168	1.2%
• Average age	47.9	48.1	-0.2
• Average years of service	11.2	11.5	-0.3
• Total payroll ¹	\$492,109,775	\$451,777,105	8.9%
• Average payroll	53,018	49,278	7.6%
• Member contributions	453,462,416	430,795,611	5.3%
• Number with unknown age	2	9	-77.8%
Inactive participants with a vested right to a deferred or immediate benefit	381	343	11.1%
Inactive participants due a refund of employee contributions	3,082	2,771	11.2%
Retired participants:			
• Number in pay status	4,840	4,532	6.8%
• Average age	73.3	73.4	-0.1
• Average monthly benefit	\$2,319	\$2,172	6.8%
Disabled participants:			
• Number in pay status	438	433	1.2%
• Average age	67.1	66.8	0.3
• Average monthly benefit	\$3,146	\$2,911	8.1%
Beneficiaries:			
• Number in pay status	584	566	3.2%
• Average age	75.0	75.3	-0.3
• Average monthly benefit	\$1,420	\$1,313	8.1%

¹ Payroll figures are for the prior year and reflect annualized salaries for participants hired during the year

Section 4: Supplemental Information

Exhibit B: Participants in Active Service as of December 31, 2019 by Age, Years of Service, and Average Payroll

Age	Years of Service									
	Total	0-4	5-9	10-14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 & over
Under 25	369	364	5	--	--	--	--	--	--	--
	\$34,012	\$33,799	\$49,514	--	--	--	--	--	--	--
25 - 29	785	689	94	2	--	--	--	--	--	--
	\$44,585	\$42,890	\$57,113	\$39,679	--	--	--	--	--	--
30 - 34	782	443	275	63	1	--	--	--	--	--
	\$54,543	\$47,108	\$62,695	\$71,707	\$25,477	--	--	--	--	--
35 - 39	756	322	184	174	74	2	--	--	--	--
	\$55,452	\$41,058	\$62,585	\$66,911	\$72,289	\$96,718	--	--	--	--
40 - 44	794	335	124	127	155	53	--	--	--	--
	\$54,710	\$36,567	\$49,327	\$67,193	\$79,319	\$80,101	--	--	--	--
45 - 49	1,118	369	202	129	174	181	57	6	--	--
	\$56,904	\$35,323	\$43,524	\$58,847	\$75,962	\$82,882	\$93,452	\$109,195	--	--
50 - 54	1,503	404	256	213	197	190	137	102	4	--
	\$57,421	\$34,668	\$45,628	\$48,667	\$62,832	\$76,313	\$93,954	\$98,714	\$108,235	--
55 - 59	1,505	278	244	253	290	157	81	156	44	2
	\$54,910	\$37,615	\$43,320	\$46,242	\$49,413	\$59,829	\$83,086	\$96,082	\$97,432	\$92,445
60 - 64	1,103	144	144	188	243	172	82	76	39	15
	\$51,284	\$40,155	\$46,254	\$43,562	\$45,816	\$52,316	\$64,122	\$80,147	\$82,161	\$83,237
65 - 69	409	40	50	43	99	94	50	18	8	7
	\$48,716	\$30,087	\$39,698	\$51,450	\$46,351	\$51,048	\$60,499	\$52,205	\$78,410	\$77,866
70 & over	156	11	10	19	29	25	24	21	10	7
	\$47,423	\$31,717	\$51,307	\$47,648	\$51,132	\$41,705	\$42,816	\$56,476	\$48,005	\$58,805
Unknown	2	1	--	--	--	--	--	--	1	--
	\$47,667	\$22,567	--	--	--	--	--	--	\$72,767	--
Total	9,282	3,400	1,588	1,211	1,262	874	431	379	106	31
	\$53,018	\$39,132	\$50,813	\$54,283	\$59,270	\$66,559	\$79,441	\$89,524	\$85,890	\$77,101

Section 4: Supplemental Information

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

	Year Ended December 31, 2019	Year Ended December 31, 2018
Net assets at market value at the beginning of the year	\$1,350,039,767	\$1,378,351,219
Contribution income:		
• Employer contributions	\$129,610,441	\$120,499,451
• Employee contributions	49,170,931	46,670,212
• Federal grant reimbursement and other contributions	75,313	35,762
• Less administrative expenses	<u>-3,352,400</u>	<u>-3,273,735</u>
Net contribution income	175,504,285	163,931,690
Investment income:		
• Interest, dividends and other income	\$15,437,750	\$14,733,931
• Asset appreciation	200,352,225	-38,644,862
• Less investment fees	<u>-7,319,763</u>	<u>-7,072,407</u>
Net investment income	<u>208,470,212</u>	<u>-30,983,338</u>
Total income available for benefits	\$383,974,497	\$132,948,352
Less benefit payments:		
• Pensions, annuities, refunds and net transfers	<u>-\$161,013,390</u>	<u>-\$152,180,341</u>
• Net 3(8)(c) reimbursements	<u>-7,472,613</u>	<u>-9,079,463</u>
Net benefit payments	<u>-\$168,486,003</u>	<u>-\$161,259,804</u>
Change in reserve for future benefits	\$215,488,494	-\$28,311,452
Net assets at market value at the end of the year	\$1,565,528,261	\$1,350,039,767

Section 4: Supplemental Information

Exhibit D: Development of the Fund through December 31, 2019

Year Ended December 31	Employer Contributions	Employee Contributions	Other Contributions	Net Investment Return ¹	Administrative Expenses	Benefit Payments	Market Value of Assets at Year- End	Actuarial Value of Assets at Year-End	Actuarial Value as a Percent of Market Value	Employee Contributions as a Percent of Total Contributions
2010	\$76,087,532	\$35,031,485	\$59,431	\$85,309,569	-\$3,042,747	-\$101,242,424	\$781,286,804	\$847,368,886	108.5%	31.51%
2011	78,594,607	35,094,482	67,607	1,488,563	-3,075,272	-106,060,828	787,395,962	862,323,395	109.5%	30.85%
2012	81,896,208	35,766,080	37,240	101,170,082	-3,051,893	-116,194,523	887,019,156	875,989,750	98.8%	30.39%
2013	88,252,356	38,568,968	34,756	124,783,005	-3,170,834	-121,473,992	1,014,013,415	967,146,018	95.4%	30.40%
2014	93,368,685	39,806,980	32,261	74,962,895	-3,540,884	-125,082,678	1,093,560,674	1,062,517,426	97.2%	29.88%
2015	99,792,642	40,870,163	27,839	7,817,250	-3,290,167	-134,295,505	1,104,482,897	1,141,122,663	103.3%	29.05%
2016	107,032,211	42,841,461	35,496	74,917,549	-3,460,782	-143,428,636	1,182,420,196	1,229,393,319	104.0%	28.58%
2017	115,377,205	44,841,008	183,914	189,543,974	-3,234,147	-150,780,931	1,378,351,219	1,339,085,622	97.2%	27.96%
2018	120,499,451	46,670,212	35,762	-30,983,338	-3,273,735	-161,259,804	1,350,039,767	1,419,015,659	105.1%	27.91%
2019	129,610,441	49,170,931	75,313	208,470,212	-3,352,400	-168,486,003	1,565,528,261	1,523,736,765	97.3%	27.49%

¹ On a market basis, net of investment fees.

Section 4: Supplemental Information

Exhibit E: Table of Amortization Bases

Type	Outstanding Balance as of July 1, 2020	Annual Fiscal 2021 Payment	Outstanding Balance as of July 1, 2021	Annual Fiscal 2022 Payment	Rate of Increase	Years Remaining as of July 1, 2020
2010 ERI	\$114,445	\$60,290	\$59,238	\$60,291	0.0%	2.00
Remaining unfunded liability	<u>1,700,605,011</u>	<u>110,021,367</u>	<u>1,708,757,499</u>	<u>117,961,197</u>	N/A	17.00
Total	\$1,700,719,456	\$110,081,657	\$1,708,816,737	\$118,021,488		

Notes:

Payments assumed to be made on July 1 and December 31.

Payment on remaining unfunded liability reflects adjustment to set fiscal 2021 appropriation to budgeted amount.

Total payment for fiscal 2022 is calculated to increase 6.5% over fiscal 2021.

Section 4: Supplemental Information

Exhibit F: 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 Pensioners and Beneficiaries:	Actuarial Present Value of lifetime benefits to existing pensioners and beneficiaries. This sum takes account of life expectancies appropriate to the ages of the annuitants and the interest that the sum is expected to earn before it is entirely paid out in benefits.
Actuarial Cost Method:	A procedure allocating the Actuarial Present Value of Future Benefits to various time periods; a method used to determine the Normal Cost and the Actuarial Accrued Liability that are used to determine the actuarially determined contribution.
Actuarial Gain or Loss:	A measure of the difference between actual experience and that expected based upon a set of Actuarial Assumptions, during the period between two Actuarial Valuation dates. 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):	The value of an amount or series of amounts payable or receivable at various times, determined as of a given date by the application of a particular set of Actuarial Assumptions. Each such amount or series of amounts is: Adjusted for the probable financial effect of certain intervening events (such as changes in compensation levels, marital status, etc.) Multiplied by the probability of the occurrence of an event (such as survival, death, disability, withdrawal, etc.) on which the payment is conditioned, and Discounted according to an assumed rate (or rates) of return to reflect the time value of money.
Actuarial Present Value of Future 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 4: 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 Plan'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 pensioners; <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 4: 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 Valuation/Actuarial Value of Assets (VVA/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 VVA/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 4: Supplemental Information

Unfunded Actuarial Accrued Liability:	The excess of the Actuarial Accrued Liability over the Valuation/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.
Valuation Value of Assets	The Actuarial Value of Assets reduced by the value of non-valuation reserves.

Section 5: Actuarial Valuation Basis

Exhibit I: Actuarial Assumptions and Actuarial Cost Method

Net Investment Return:	7.30% (previously, 7.50%). 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 Plan's target asset allocation.			
Salary Increases:	Years of Service	Group 1	Group 2	Group 4
	0	6.00%	6.00%	7.00%
	1	5.50%	5.50%	6.50%
	2	5.50%	5.50%	6.00%
	3	5.25%	5.25%	5.75%
	4	5.25%	5.25%	5.25%
	5	4.75%	4.75%	5.25%
	6	4.75%	4.75%	4.75%
	7	4.50%	4.50%	4.75%
	8	4.50%	4.50%	4.50%
	9	4.25%	4.25%	4.50%
	10	4.25%	4.25%	4.50%
	11	4.00%	4.25%	4.50%
	12+	4.00%	4.25%	4.50%
	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.			
Interest on Employee Contributions:	3.5%			

Section 5: Actuarial Valuation Basis

Administrative Expenses: \$3,500,000 for calendar 2020, increasing 3.25% per year (previously, \$3,500,000 for calendar 2018, increasing 3.25% per year)
The administrative expense assumption is based on information on expected expenses provided by the Retirement System.

Mortality Rates: *Pre-Retirement:* RP-2014 Blue Collar Employee Mortality Table projected generationally with Scale MP-2017
Healthy Retiree: RP-2014 Blue Collar Healthy Annuitant Mortality Table projected generationally with Scale MP-2017
Disabled Retiree: RP-2014 Blue Collar Healthy Annuitant Mortality Table set forward one year and projected generationally with Scale MP-2017
The mortality tables reasonably reflect the projected mortality experience of the Plan as of the measurement date based on historical and current demographic data. As part of the analysis, a comparison was made between the actual number of retiree deaths and the projected number based on the prior years' assumptions over the most recent ten years. The mortality tables were then adjusted to future years using generational projection under Scale MP-2017 to reflect future mortality improvement.

Termination Rates before Retirement:

Groups 1 and 2 - Rate (%)			
Mortality			
Age	Male	Female	Disability
20	0.05	0.02	0.02
25	0.06	0.02	0.02
30	0.06	0.02	0.03
35	0.07	0.03	0.06
40	0.08	0.04	0.10
45	0.13	0.07	0.15
50	0.22	0.12	0.19
55	0.36	0.19	0.24
60	0.61	0.27	0.28

Notes:

Mortality rates do not reflect generational projection.

55% of the disability rates shown represent accidental disability.

20% of the accidental disabilities will die from the same cause as the disability.

55% of the death rates shown represent accidental death.

Section 5: Actuarial Valuation Basis

Age	Group 4 - Rate (%)		
	Mortality		Disability
	Male	Female	
20	0.05	0.02	0.20
25	0.06	0.02	0.20
30	0.06	0.02	0.30
35	0.07	0.03	0.30
40	0.08	0.04	0.30
45	0.13	0.07	1.00
50	0.22	0.12	1.25
55	0.36	0.19	1.20
60	0.61	0.27	0.85

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.

90% of the death rates shown represent accidental death.

Section 5: Actuarial Valuation Basis

Withdrawal Rates:

Rate per year (%)			
Years of Service	Groups 1 and 2	Years of Service	Group 4
0	15.0	0 – 10	1.5
1	12.0	11+	0.0
2	10.0		
3	9.0		
4	8.0		
5 – 9	7.6		
10 – 14	5.4		
15 – 19	3.3		
20 – 24	2.0		
25 - 29	1.0		
30+	0.0		

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' assumption over the most recent ten years.

Section 5: Actuarial Valuation Basis

Retirement Rates:	Rate per year (%)			
	Groups 1 and 2			Group 4
	Age	Male	Female	
	45 – 49	--	--	1.0
	50 – 54	--	--	2.0
	55 – 59	2.0	5.5	15.0
	60 – 61	12.0	5.0	20.0
	62 – 64	30.0	15.0	25.0
	65 – 68	40.0	15.0	100.0
	69	50.0	20.0	--
	70	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' assumption over the most recent ten years.			
Retirement Rates for Inactive Vested Participants:	Age 60 for Group 1 and Group 2 members and age 55 for participants hired prior to April 2, 2012. For participants hired April 2, 2012 or later, 60 for Group 1, 55 for Group 2 and 50 for Group 4. 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.			
Unknown Data for Participants:	Same as those exhibited by participants with similar known characteristics. If not specified, participants are assumed to be male.			
Family Composition:	75% of participants are assumed to be married. 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.			
2019 Salary:	2019 salaries are equal to salaries provided in the data, except for actives missing salary and employees with less than one year of service, where salaries are calculated from annualized contributions divided by the contribution rates provided.			
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 systems.			

Section 5: Actuarial Valuation Basis

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 20% of the market value.
Actuarial Cost Method:	Entry Age Normal Actuarial Cost Method. Entry Age is the attained 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 assumption was changed as of January 1, 2020: • The investment return assumption was lowered from 7.50% to 7.30%. • The administrative expense assumption was reset from \$3,500,000 for calendar 2018, increasing 3.25% per year to \$3,500,000 for calendar 2020, increasing 3.25% per year.

Section 5: 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:	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: <table><tr><th colspan="4">Age Last Birthday at Date of Retirement</th></tr><tr><th>Percent</th><th>Group 1</th><th>Group 2</th><th>Group 4</th></tr><tr><td>2.5</td><td>65 or over</td><td>60 or over</td><td>55 or over</td></tr><tr><td>2.4</td><td>64</td><td>59</td><td>54</td></tr><tr><td>2.3</td><td>63</td><td>58</td><td>53</td></tr><tr><td>2.2</td><td>62</td><td>57</td><td>52</td></tr><tr><td>2.1</td><td>61</td><td>56</td><td>51</td></tr><tr><td>2.0</td><td>60</td><td>55</td><td>50</td></tr><tr><td>1.9</td><td>59</td><td>--</td><td>49</td></tr><tr><td>1.8</td><td>58</td><td>--</td><td>48</td></tr><tr><td>1.7</td><td>57</td><td>--</td><td>47</td></tr><tr><td>1.6</td><td>56</td><td>--</td><td>46</td></tr><tr><td>1.5</td><td>55</td><td>--</td><td>45</td></tr></table> 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.				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
Age Last Birthday at Date of Retirement																																																								
Percent	Group 1	Group 2	Group 4																																																					
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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																																																					

Section 5: 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

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.

Section 5: Actuarial Valuation Basis

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 5: 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:	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.

Section 5: Actuarial Valuation Basis

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 \$16,000 (previously, \$14,000) 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:	As permitted by Section 19 of Chapter 188 of the Acts of 2010, the Cost of Living Adjustment base was increased from \$14,000 to \$16,000 as of July 1, 2019.