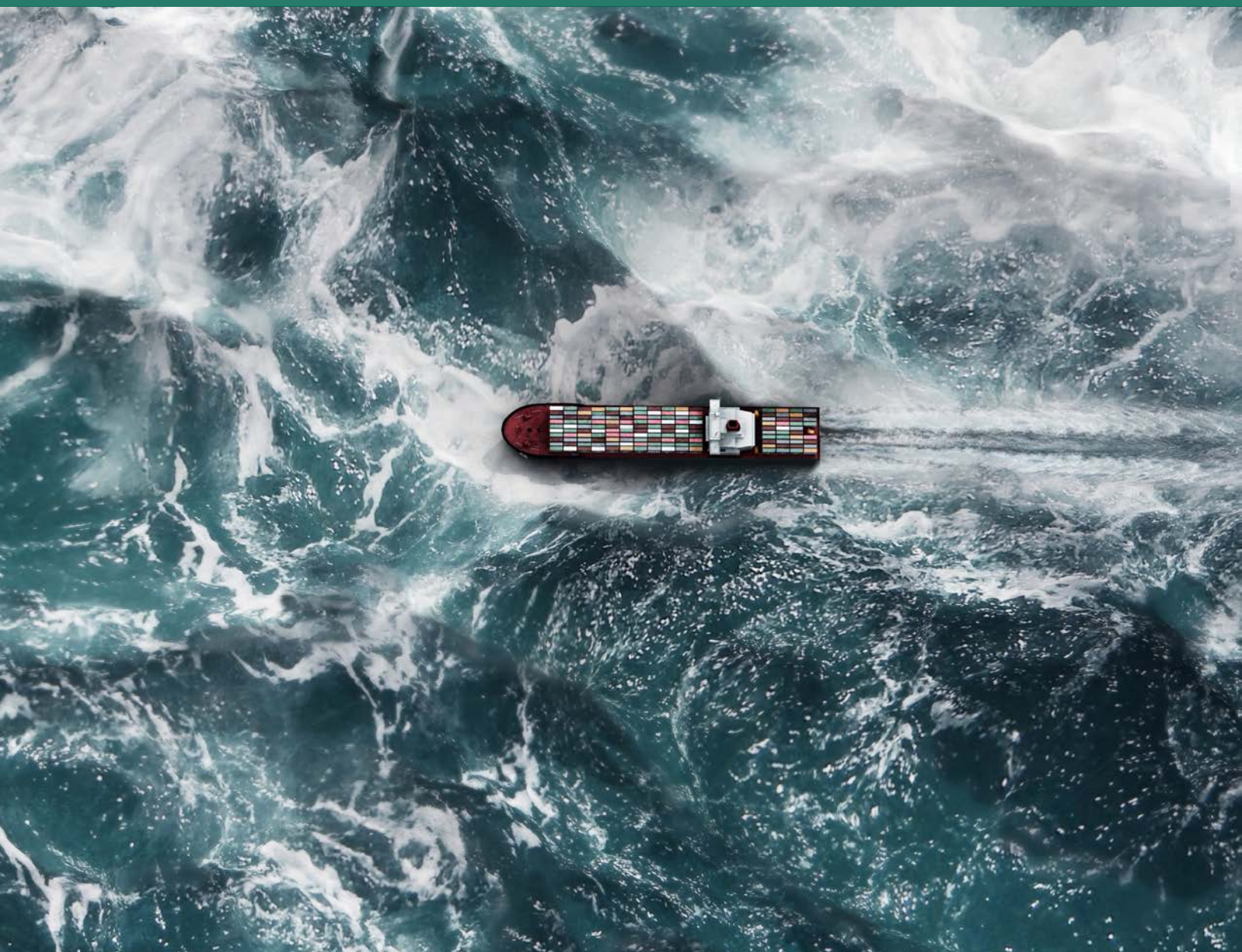
KORN FERRY

Commonwealth of Pennsylvania State Employees' Retirement System

2020 Stress Testing and Risk Assessment

September 29, 2020



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1 Introduction

The Commonwealth of Pennsylvania State Employees' Retirement System (SERS) provides retirement benefits through a Defined Benefit (DB) plan and a Defined Contribution (DC) plan. The future DB plan benefits are based on contingent events such as members remaining employed until retirement eligibility and the future rates of retiree mortality. The value of the benefits, and the cost for employers to provide the benefits, is unknown and can only be estimated. Determinations of the value of benefits and the allocation of employer costs are conducted annually through an actuarial valuation. The allocation calculates an Actuarially Determined Contribution (ADC) to set the employer contribution rates applicable to the SERS employers.

The annual actuarial valuation and calculation of the ADC represent only a single measurement based on a single set of expectations of future experience. The purpose of this report is to identify and assess major factors that contribute to the risk that the actual future value of benefits will differ from the estimated value provided by the actuarial valuation and the ADC.

This is provided through analysis of "What if?" scenarios to determine the effect on future employer contributions and the availability of assets to pay benefits when due to members. These "What if?" scenarios are referred to as Stress Tests or Scenario Tests. In each scenario, the effect on the Actuarially Determined Contribution (ADC) and funded ratio are projected over a period of 20 years and compared to the Baseline expectations.

Actuarially Determined Contribution: The employer contribution determined based on the SERS funding policy to ensure assets are accumulated and available to provide benefits when due to members.

Funded Ratio: The ratio of the Actuarial Value of Assets to the Actuarial Accrued Liability at a specified date. The Actuarial Value of Assets is based on the market value of SERS assets but reflects an adjustment to dampen the effect of market volatility. Investment markets are volatile, and this "smoothing" is used to spread investment returns that are above or below expectations over a period of 5 years. This method is set in the SERS funding policy and is a generally accepted and recommended practice for retirement systems in the Public Sector. The Actuarial Accrued Liability is the expected value of member benefits that is allocated to past years of service. The value of benefits allocated to future years of service is funded through future contributions from members and employers.

Baseline: The baseline results are the current expectations based on the completed December 31, 2019 actuarial valuation and reflect the action taken by the SERS Board at its July 2020 meeting to adopt the revised economic and demographic assumptions recommended in Korn Ferry's 19th Investigation of Actuarial Experience, covering the SERS experience from January 1, 2015 through December 31, 2019 (hereafter referred to as the 2020 experience study), including the reduction of the assumed investment return rate to 7.00%, effective with the December 31, 2020 actuarial valuation.

The stress testing scenarios are organized into three distinct sections based on the major categories of risks: Investment Risks, Demographic Risks, and Contribution Risks.

Investment Risks

SERS assets are accumulated and invested to create investment earnings that help offset the cost for employers to provide retirement benefits. The SERS funding policy is based on an assumed future investment return rate that is set as a long-term expectation of investment performance. However, it is important to understand that there is significant volatility in investment markets and that the actual investment return experienced during any given year may vary greatly from the long-term expected investment return rate.

The scenarios included in this section assess the sensitivity of the ADC and the funded ratio to:

2.1 – Differences in future investment performance
2.2 – A large investment loss
2.3 – The effect of investment liquidity
2.4 – Simulated future investment performance and volatility (Stochastic Analysis)
2.5 – Changes in the investment return assumption

Due mostly to the strong investment performance during 2019, the results of these scenarios as well as the scenarios included in the following sections, are generally more favorable than the results provided in the previous Stress Testing and Risk Assessment Report that was completed in 2019. However, it is important to understand that the sensitivity to investment performance will continue to increase as the funded ratio increases and additional assets are accumulated.

The SERS Board routinely monitors the effects of economic experience and changing capital market expectations. As a result of this monitoring, SERS has made periodic changes in the investment policy and the assumed investment return rate; therefore, SERS is well positioned to adjust to periods of unfavorable investment performance. Section 2.3 highlights the ability for SERS to meet cash flow needs without the need to liquidate investments at unfavorable values during periods like March 2020 when there was a sharp decline in equity values due to the global pandemic.

Demographic Risks

The value of retirement benefits paid by SERS is affected by the future experience of members. The actuarial valuation and ADC are based on a single set of demographic assumptions related to future member experience. There is a risk that future member experience will differ from the assumptions used and will cause changes in the value of plan benefits.

The scenarios included in this section assess the sensitivity of the ADC and the funded ratio to:

3.1 – Changes in rates of member mortality
3.2 – Changes in rates of member salary growth

Although the changes in rates of member mortality and salary growth have a relatively low effect on the future contribution needs and the funded ratio, the SERS Board monitors these rates, as well as other demographic experience of the plan, by having the plan actuary perform a comprehensive actuarial experience investigation every five years. The most recent such investigation was the 2020 experience study, which covered the period from January 1, 2015 through December 31, 2019. This periodic review reduces the likelihood of sustained periods of losses related to demographic experience affecting the funded status of SERS. Section 3.1 highlights the effect of changes in member mortality rates that could potentially be caused by the ongoing global pandemic.

Contribution Risks

The SERS funding policy sets employer contribution rates based on an Actuarially Determined Contribution (ADC). The ADC is designed to provide a relatively predictable and stable pattern of contributions that will ensure assets are accumulated to pay all benefits when due to members.

The scenarios included in this section assess the effect on future contribution needs and the funded ratio of employers making contributions that differ from the ADC. These scenarios do not assess the ability or willingness of the SERS employers to make future contributions. Any future contribution amounts shown are for illustrative purposes only. Contributing less than the ADC is neither recommended nor expected. The scenarios include the effect of:

4.1 – Reduced funding of the Actuarially Determined Contribution
4.2 – Limited employer contributions due to sustained unfavorable investment performance
4.3 – Limited employer contributions due to a large investment loss
4.4 – Funding in excess of the Actuarially Determined Contribution

SERS is well positioned to adjust to the risks analyzed in Section 2 and Section 3 if the SERS employers consistently contribute the full ADC. The current policies and practices utilized by SERS contain mechanisms to help control the volatility of the employer contribution rates and can help ensure assets will be available to pay all benefits when due to members. Section 4.1 provides the potential effect if employers were unable to contribute the full ADC due to unexpected circumstances, such as those that may be caused by the global pandemic.

Actuarial Certification

To the best of our knowledge, this report is complete and accurate, and all costs and liabilities have been determined in accordance with the applicable actuarial standards of practice and on the basis of actuarial assumptions and methods which are reasonable for the purpose of this analysis.

The actuaries certifying this analysis are members of the Society of Actuaries, or other professional actuarial organizations, and meet the Qualification Standards of the American Academy of Actuaries for purposes of issuing Statements of Actuarial Opinion.

Respectfully submitted,
Korn Ferry

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2 Investment Risks

2.1 Effect of Future Investment Performance

SERS assets are accumulated and invested to create investment earnings that help offset the cost for employers to provide retirement benefits. The SERS funding policy is based on an assumed future investment return rate that is set as a long-term expectation of investment performance. However, it is important to understand that there is significant volatility in investment markets and that the actual investment return experienced during any given year may vary greatly from the long-term expected investment return rate.

The SERS funding policy utilizes an asset smoothing method to help dampen the effect of market volatility on the Actuarially Determined Contribution (ADC) and the funded ratio. This smoothing method recognizes investment returns that are above or below the expected rate over a period of 5 years. This allows employers to plan and adjust future budgets for changes in contribution needs.

Investment returns below the expected investment return rate will dampen the growth of SERS assets and therefore increase the contributions needed to fund the benefits. The following scenarios provide the projected effects of various investment return rates over a 20-year period:

Baseline – Investment returns are equal to the assumed investment return throughout the 20-year period.

2% Above Assumption – Investment returns are equal to the assumed investment return rate plus 2% (200 basis points) for each of the first 10 years, then equal to the assumed investment return rate for the remainder of the period.

2% Below Assumption – Investment returns are equal to the assumed investment return rate minus 2% (200 basis points) for each of the first 10 years, then equal to the assumed investment return rate for the remainder of the period.

The investment return rates used by calendar year are provided in the following schedule:

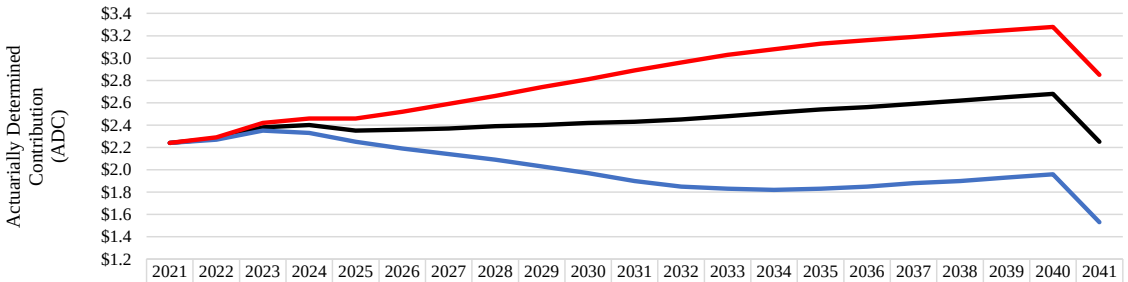
Calendar Year	Baseline	2% Above Assumption	2% Below Assumption
2020*	7.125%	9.125%	5.125%
2021-2029	7.000%	9.000%	5.000%
2030-2039	7.000%	7.000%	7.000%

*The scenarios are based on the assumed investment return rate for Calendar Year 2020 of 7.125% and do not reflect any actual 2020 investment performance. Pursuant to action taken by the SERS Board at its July 2020 meeting, the assumed investment return rate was reduced to 7.000% effective with the December 31, 2020 actuarial valuation.

Effect on Actuarially Determined Contribution (ADC)

Chart 1 provides the sensitivity of the Actuarially Determined Contribution (ADC) to future investment performance. Investment returns above the actuarial assumption reduce the ADC relative to the baseline. Investment returns below the actuarial assumption increase the ADC relative to the baseline.

Chart 1
Sensitivity to Future Investment Performance
Effect on Actuarially Determined Contribution
($ Billions; ADC for Fiscal Year Ending)



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Baseline	2.24	2.28	2.38	2.40	2.35	2.36	2.37	2.39	2.40	2.42	2.43	2.45	2.48	2.51	2.54	2.56	2.59	2.62	2.65	2.68	2.25
2% Above Assumption	2.24	2.27	2.35	2.33	2.25	2.19	2.14	2.09	2.03	1.97	1.90	1.85	1.83	1.82	1.83	1.85	1.88	1.90	1.93	1.96	1.53
2% Below Assumption	2.24	2.29	2.42	2.46	2.46	2.52	2.59	2.66	2.74	2.81	2.89	2.96	3.03	3.08	3.13	3.16	3.19	3.22	3.25	3.28	2.85

The favorable investment returns in the "2% Above Assumption" scenario gradually reduce the ADC compared to the baseline projection. The cumulative effect over the 10-year period results in an expected Fiscal Year 2030/2031 ADC of $1.90 billion, about $530 million lower than the baseline ADC. Since investment returns that are above the assumed rates are smoothed over a period of 5 years, the investment gains that occurred through Calendar Year 2029 continue to reduce the ADC through Fiscal Year 2034/2035. After the initial 10-year period, the investment performance is set equal to the assumed investment return rate of 7.00%. Table 1 provides the projected ADC, payroll, and contribution rates (ADC rates) as a percentage of payroll.

The unfavorable investment returns in the "2% Below Assumption" scenario gradually increase the ADC compared to the baseline projection. The cumulative effect over the 10-year period results in an expected Fiscal Year 2030/2031 ADC of $2.89 billion, about $460 million higher than the baseline ADC. Since investment returns that are below the assumed rates are smoothed over a period of 5 years, the investment losses that occurred through Calendar Year 2029 continue to increase the ADC through Fiscal Year 2034/2035. After the initial 10-year period, the investment performance is set equal to the assumed investment return rate of 7.00%. Table 1 provides the projected ADC, payroll, and contribution rates (ADC rates) as a percentage of payroll.

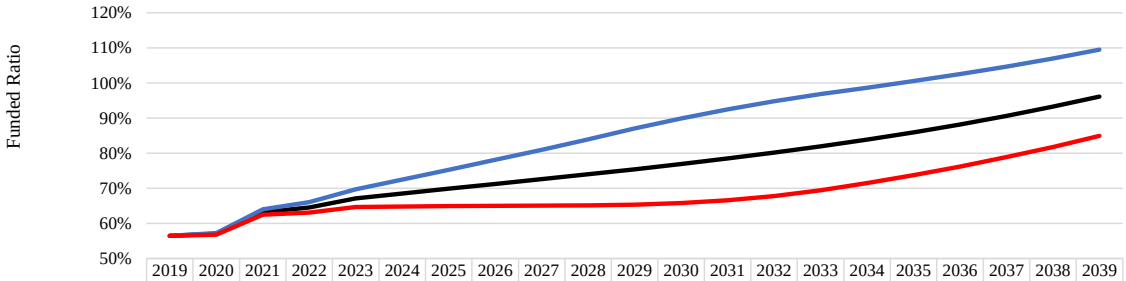
Table 1 –Projected ADC, Funding Payroll and Contribution Rates (ADC Rate)
(Dollars in Billions)

	Baseline			2% Above Assumption			2% Below Assumption		
Fiscal Year Ending (1)	ADC (2)	Payroll (3)	ADC Rate (4)	ADC (5)	Payroll (6)	ADC Rate (7)	ADC (8)	Payroll (9)	ADC Rate (10)
2021	$2.24	$6.66	33.6%	$2.24	$6.66	33.6%	$2.24	$6.66	33.6%
2022	$2.28	$6.78	33.6%	$2.27	$6.78	33.5%	$2.29	$6.78	33.8%
2023	$2.38	$6.97	34.1%	$2.35	$6.97	33.7%	$2.42	$6.97	34.7%
2024	$2.40	$7.16	33.5%	$2.33	$7.16	32.5%	$2.46	$7.16	34.4%
2025	$2.35	$7.36	31.9%	$2.25	$7.36	30.6%	$2.46	$7.36	33.4%
2026	$2.36	$7.57	31.2%	$2.19	$7.57	28.9%	$2.52	$7.57	33.3%
2027	$2.37	$7.78	30.5%	$2.14	$7.78	27.5%	$2.59	$7.78	33.3%
2028	$2.39	$8.00	29.9%	$2.09	$8.00	26.1%	$2.66	$8.00	33.3%
2029	$2.40	$8.22	29.2%	$2.03	$8.22	24.7%	$2.74	$8.22	33.3%
2030	$2.42	$8.45	28.6%	$1.97	$8.45	23.3%	$2.81	$8.45	33.3%
2031	$2.43	$8.69	28.0%	$1.90	$8.69	21.9%	$2.89	$8.69	33.3%
2032	$2.45	$8.93	27.4%	$1.85	$8.93	20.7%	$2.96	$8.93	33.1%
2033	$2.48	$9.18	27.0%	$1.83	$9.18	19.9%	$3.03	$9.18	33.0%
2034	$2.51	$9.44	26.6%	$1.82	$9.44	19.3%	$3.08	$9.44	32.6%
2035	$2.54	$9.71	26.2%	$1.83	$9.71	18.8%	$3.13	$9.71	32.2%
2036	$2.56	$9.98	25.7%	$1.85	$9.98	18.5%	$3.16	$9.98	31.7%
2037	$2.59	$10.26	25.2%	$1.88	$10.26	18.3%	$3.19	$10.26	31.1%
2038	$2.62	$10.54	24.9%	$1.90	$10.54	18.0%	$3.22	$10.54	30.6%
2039	$2.65	$10.84	24.4%	$1.93	$10.84	17.8%	$3.25	$10.84	30.0%
2040	$2.68	$11.14	24.1%	$1.96	$11.14	17.6%	$3.28	$11.14	29.4%
2041	$2.25	$11.45	19.7%	$1.53	$11.45	13.4%	$2.85	$11.45	24.9%

Effect on Funded Ratio

Chart 2 provides the sensitivity of the funded ratio to investment performance under the three scenarios. Investment returns above the actuarial assumption increase the funded ratio relative to the baseline. Investment returns below the actuarial assumption decrease the funded ratio relative to the baseline.

Chart 2
Sensitivity to Future Investment Performance
Effect on Funded Ratio
(Funded Ratio as of December 31)



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Baseline	56%	57%	63%	65%	67%	69%	70%	71%	73%	74%	75%	77%	78%	80%	82%	84%	86%	88%	91%	93%	96%
2% Above Assumption	56%	57%	64%	66%	70%	72%	75%	78%	81%	84%	87%	90%	92%	95%	97%	99%	101%	103%	105%	107%	110%
2% Below Assumption	56%	57%	63%	63%	65%	65%	65%	65%	65%	65%	65%	66%	67%	68%	69%	71%	74%	76%	79%	82%	85%

The effect of investment performance on the funded ratio is delayed by the asset smoothing method, which is designed to dampen the effect of market volatility. In the long-term, the unfavorable investment performance of the "2% Below Assumption" scenario does result in a lower funded ratio compared to the baseline but does not prevent the growth of the funded ratio from 56% in 2019 to 65% in 2029 and 85% in 2039. The favorable investment performance of the "2% Above Assumption" scenario accelerates the growth of the funded ratio from 56% in 2019 to 87% in 2029 and 110% in 2039.

Conclusions

The future investment performance of the SERS assets is unknown and will have a substantial impact on the contributions needed to fund benefits. These scenarios have shown the sensitivity of the ADC and funded ratio to sustained periods of favorable or unfavorable investment performance, including:

1. Investment market volatility will produce investment returns that, during any given year, may be either above or below the expected investment returns. The asset smoothing method is utilized to dampen the effect of market volatility on the ADC and funded ratio to provide a more stable and predictable contribution pattern. The effect of market underperformance is recognized over multiple years, allowing employers to plan for the contribution increases and set future budget expectations.

2. The ADC will increase over time if the actual investment returns are below the assumed investment return rate. The unfavorable investment performance in the "2% Below Assumption" scenario steadily increased the ADC relative to the baseline, causing the contribution rate (ADC Rate) to be as much as 6.0% of payroll higher than the baseline (31.7% in Fiscal Year 2035/2036 compared to the baseline ADC Rate of 25.7% of payroll). As the funded ratio increases and additional assets are accumulated, the sensitivity to investment performance will continue to increase.

3. Although unfavorable investment performance can cause the funded ratio to decrease temporarily, the funded ratio is still expected to increase in the long-term. Even during the 10 years of unfavorable performance in the "2% Below Assumption" scenario, in most years, the funded ratio is gradually increasing as the ADC is contributed.

2.2 Effect of a Large Investment Loss

SERS assets are accumulated and invested to create investment earnings that help offset the cost for employers to provide retirement benefits. The SERS funding policy is based on an assumed future investment return rate that is set as a long-term expectation of investment performance. However, it is important to understand that there is significant volatility in investment markets and that the actual investment return experienced during any given year may vary greatly from the long-term expected investment return rate.

The SERS funding policy utilizes an asset smoothing method to help dampen the effect of market volatility on the Actuarially Determined Contribution (ADC) and the funded ratio. This smoothing method recognizes investment returns that are above or below the expected rate over a period of 5 years. This allows employers to plan and adjust future budgets for changes in contribution needs.

Investment returns below the expected investment return rate will dampen the growth of SERS assets and therefore increase the contributions needed to fund the benefits. The following scenario provides the projected effects of a large investment loss:

Baseline – Investment returns are equal to the assumed investment return throughout the 20-year period.

Scenario – The investment return for Calendar Year 2020 is -20%. For the remainder of the 20-year period, the investment returns are equal to the assumed investment return rate.

The investment return rates used by calendar year are provided in the following schedule:

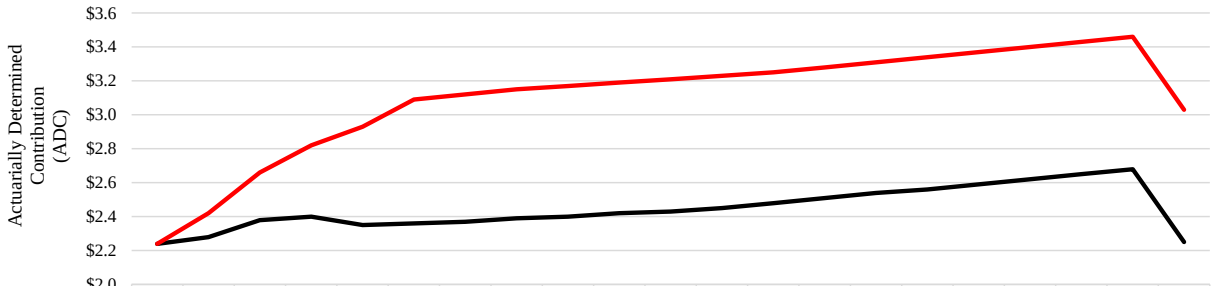
Calendar Year	Baseline	Scenario
2020*	7.125%	-20.000%
2021-2039	7.000%	7.000%

*The scenarios are based on the assumed investment return rate for Calendar Year 2020 of 7.125% and do not reflect any actual 2020 investment performance. Pursuant to action taken by the SERS Board at its July 2020 meeting, the assumed investment return rate was reduced to 7.000% effective with the December 31, 2020 actuarial valuation.

Effect on Actuarially Determined Contribution (ADC)

Chart 1 provides the sensitivity of the Actuarially Determined Contribution (ADC) to a large investment loss. The loss is assumed to occur during Calendar Year 2020, would first be recognized in the December 31, 2020 actuarial valuation and would first be reflected as an increase to the ADC in Fiscal Year 2021/2022.

Chart 1
Sensitivity to a Large Investment Loss
Effect on Actuarially Determined Contribution
($ Billions; ADC for Fiscal Year Ending)



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Baseline	2.24	2.28	2.38	2.40	2.35	2.36	2.37	2.39	2.40	2.42	2.43	2.45	2.48	2.51	2.54	2.56	2.59	2.62	2.65	2.68	2.25
Scenario	2.24	2.42	2.66	2.82	2.93	3.09	3.12	3.15	3.17	3.19	3.21	3.23	3.25	3.28	3.31	3.34	3.37	3.40	3.43	3.46	3.03

The asset smoothing method causes the hypothetical -20% return experienced during Calendar Year 2020 to be recognized over a 5-year period. One-fifth (1/5) of the 2020 loss is recognized each year, with the first amount recognized in the Fiscal Year 2021/2022 ADC and the final amount recognized in the Fiscal Year 2025/2026 ADC.

The hypothetical -20% return in Calendar Year 2020 causes the December 31, 2020 market value of assets to be $8.29 billion less in the Scenario as compared to the baseline. This shortfall will need to be funded through additional employer contributions and is reflected in Scenario ADC's that are significantly higher than the baseline ADC's. When the Calendar Year 2020 loss is fully recognized in Fiscal Year 2025/2026, the Scenario ADC is about $730 million higher than the baseline ADC. This $730 million increase represents about 9.6% of member payroll and would be a substantial additional burden on employers. Table 1 provides the effect of the hypothetical Calendar Year 2020 investment loss on the future contribution rates (ADC Rate) as a percentage of payroll.

Table 1 –Projected ADC, Funding Payroll and Contribution Rates (ADC Rate)

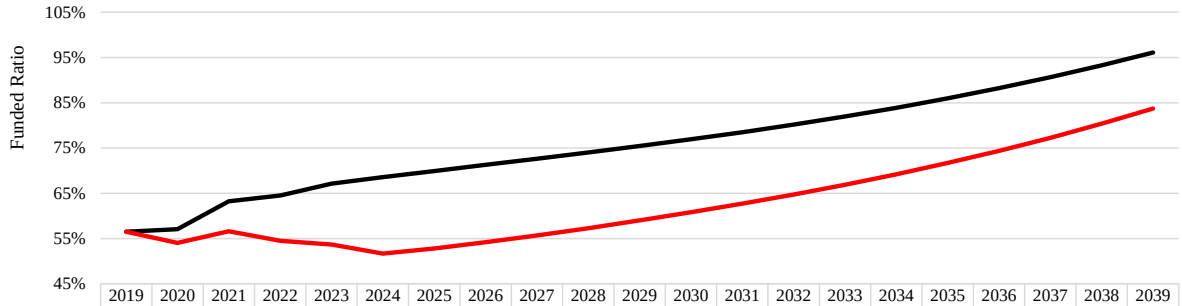
(Dollars in Billions)

	Baseline			Scenario		
Fiscal Year Ending (1)	ADC (2)	Payroll (3)	ADC Rate (4)	ADC (5)	Payroll (6)	ADC Rate (7)
2021	$2.24	$6.66	33.6%	$2.24	$6.66	33.6%
2022	$2.28	$6.78	33.6%	$2.42	$6.78	35.7%
2023	$2.38	$6.97	34.1%	$2.66	$6.97	38.2%
2024	$2.40	$7.16	33.5%	$2.82	$7.16	39.4%
2025	$2.35	$7.36	31.9%	$2.93	$7.36	39.8%
2026	$2.36	$7.57	31.2%	$3.09	$7.57	40.8%
2027	$2.37	$7.78	30.5%	$3.12	$7.78	40.1%
2028	$2.39	$8.00	29.9%	$3.15	$8.00	39.4%
2029	$2.40	$8.22	29.2%	$3.17	$8.22	38.6%
2030	$2.42	$8.45	28.6%	$3.19	$8.45	37.8%
2031	$2.43	$8.69	28.0%	$3.21	$8.69	36.9%
2032	$2.45	$8.93	27.4%	$3.23	$8.93	36.2%
2033	$2.48	$9.18	27.0%	$3.25	$9.18	35.4%
2034	$2.51	$9.44	26.6%	$3.28	$9.44	34.7%
2035	$2.54	$9.71	26.2%	$3.31	$9.71	34.1%
2036	$2.56	$9.98	25.7%	$3.34	$9.98	33.5%
2037	$2.59	$10.26	25.2%	$3.37	$10.26	32.8%
2038	$2.62	$10.54	24.9%	$3.40	$10.54	32.3%
2039	$2.65	$10.84	24.4%	$3.43	$10.84	31.6%
2040	$2.68	$11.14	24.1%	$3.46	$11.14	31.1%
2041	$2.25	$11.45	19.7%	$3.03	$11.45	26.5%

Effect on Funded Ratio

Chart 2 provides the sensitivity of the funded ratio to a large investment loss. The loss is assumed to occur during Calendar Year 2020 and would first be recognized as a reduction to the funded ratio in the December 31, 2020 actuarial valuation.

Chart 2
Sensitivity to a Large Investment Loss
Effect on Funded Ratio
(Funded Ratio as of December 31)



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Baseline	56%	57%	63%	65%	67%	69%	70%	71%	73%	74%	75%	77%	78%	80%	82%	84%	86%	88%	91%	93%	96%
Scenario	56%	54%	57%	54%	54%	52%	53%	54%	56%	57%	59%	61%	63%	65%	67%	69%	72%	74%	77%	80%	84%

The asset smoothing method causes the hypothetical -20% return experienced during Calendar Year 2020 to be recognized over a 5-year period. One-fifth (1/5) of the 2020 loss is recognized each year, with the first amount recognized in the December 31, 2020 funded ratio and the final amount recognized in the December 31, 2024 funded ratio.

The hypothetical large investment loss during Calendar Year 2020 in this stress test causes the December 31, 2024 funded ratio to decrease to 52%, substantially lower than the baseline December 31, 2024 funded ratio of 69% and the December 31, 2019 funded ratio of 56% before the investment loss occurred.

The effect on the funded ratio continues until the shortfall is fully funded through increased contributions. The December 31, 2039 funded ratio reflecting the large investment loss is only 84%, still substantially lower than the baseline December 31, 2039 funded ratio of 96%. The Scenario Funded Ratio would not return to the baseline value until December 31, 2055, when the large investment loss is fully amortized.

Conclusions

The future investment performance of the SERS assets is unknown and will have a substantial impact on the contributions needed to fund benefits. This scenario has shown the sensitivity of the ADC and funded ratio to a large investment loss, including:

1. The effect of a large investment loss is delayed by the asset smoothing method. The asset smoothing method recognizes the loss over a period of 5 years, causing the ADC to increase gradually over a 5-year period rather than one large increase in a single year. In this scenario, the ADC increased by about $140 million per year compared to the baseline for Fiscal Year 2021/2022 through Fiscal Year 2025/2026. Spreading the loss over the 5-year period allows employers to plan for the contribution increases and adjust future budgets.

2. This scenario assumes a large investment loss in a single year of -20% return on assets without considering the investment results in years preceding or following the year of the large loss. It is possible that the effect of a large investment loss in a given year could be partially offset by periods of favorable investment market performance. This was recently experienced when the unfavorable return of -4.6% during 2018 was followed by very favorable return of 18.8% in 2019. Another example is provided by the periods of favorable investment performance experienced by the SERS fund in the years preceding or following the large losses experienced in 2001-2002 and 2008:

Calendar Year	Investment Return
2001	-7.9%
2002	-10.9%
2003	24.3%
2004	15.1%
2005	14.5%
2006	16.4%
2007	17.2%
2008	-28.7%
2009	9.1%
2010	11.9%

3. A large investment loss could substantially reduce the funded ratio. In this scenario, the hypothetical -20% return in Calendar Year 2020 would cause the funded ratio to be as low as 52% in 2024. The calculation of the ADC reflects investment performance and would increase substantially to fund the investment shortfall. If the ADC is contributed each year, the funded ratio would be expected to return to 56%, the December 31, 2019 funded ratio just prior to the large investment loss, by December 31, 2027.

2.3 Effect on Investment Liquidity

Section 2.2 provides the effect of unfavorable investment performance on the Actuarially Determined Contribution (ADC) and the funded ratio. Although the ADC is designed to ensure assets are available to pay all benefits when due to members, there is a potential that SERS investments would need to be liquidated (sold) at unfavorable values in order to meet the cash flow needs of the plan.

The SERS investment policy includes an allocation to Capital Preservation investments that can be easily liquidated in public markets with values that have a low correlation to U.S. equity values. These Capital Preservation investments include Cash, Treasury Inflation-Protected Securities (TIPS), and U.S. public market fixed income investments based on the following target allocations:

Asset Class	Target Allocation
Cash	2%
TIPS	4%
U.S. Fixed Income	22%
Capital Preservation Total	28%

These Capital Preservation investments can be expected to maintain value during periods of unfavorable equity performance. If Capital Preservation investments were insufficient to pay member benefit payments net of contributions, there is a risk that other investments would need to be liquidated at unfavorable values.

The target allocation of 28% to Capital Preservation investments is expected to be sufficient to cover 87 months of member benefit payments net of contributions, thus providing a substantial period for equity investments to recover value or for other adjustments to be made to avoid liquidation at unfavorable values.

Future unfavorable investment performance could reduce the total fund values and therefore the Capital Preservation assets. Maintaining an allocation of 28% to Capital Preservation investments would provide sufficient assets to cover at least 36 months of expected member benefit payments net of contributions as long as the total fund value exceeded $12.1 billion, which is substantially lower than the December 31, 2019 fund value of $31.1 billion.

Future investment performance in a single year is not reasonably expected to cause the total fund value to decline from $31.1 billion to below $12.1 billion. Investment returns would need to be less than -23% per year for a 3-year period in order for the projected fund value to be approximately $12.1 billion and to include Capital Preservation investments sufficient to cover 36 months[1] of member benefit payments net of contributions. This investment performance was set to cause an adverse investment liquidity scenario that is not reasonably expected to occur.

[1] The Capital Preservation investments would be sufficient to cover the 36 months beginning at the end of the 3-year period. That is, the Capital Preservation investments would be available both during the 3-year period of -20% annual investment returns and still be sufficient to cover 36 months of expected member benefit payments net of contributions.

The following scenario provides the effect of severe investment losses over a 3-year period that would potentially cause the Capital Preservation assets to be sufficient to cover only 36 months of expected member benefits net of contributions:

Baseline – Investment returns are equal to the assumed investment return throughout the 20-year period.

Scenario – The investment return for Calendar Year 2020 through Calendar Year 2022 is -23% per year. For the remainder of the 20-year period, the investment returns are equal to the assumed investment return rate. These returns are expected to result in Capital Preservation investments as of December 31, 2022 that would be sufficient to cover approximately 36 months of expected member benefit payments net of contributions.

The investment return rates used by calendar year are provided in the following schedule:

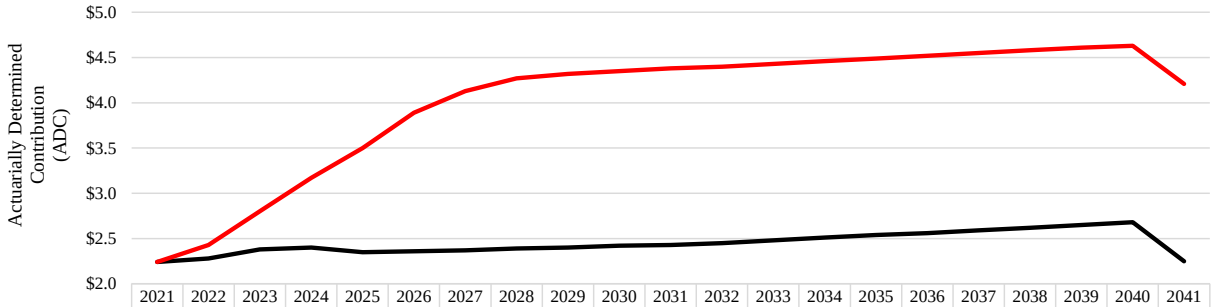
Calendar Year	Baseline	Scenario
2020*	7.125%	-23.000%
2021-2022	7.000%	-23.000%
2023-2039	7.000%	7.000%

*The scenarios are based on the assumed investment return rate for Calendar Year 2020 of 7.125% and do not reflect any actual 2020 investment performance. Pursuant to action taken by the SERS Board at its July 2020 meeting, the assumed investment return rate was reduced to 7.000% effective with the December 31, 2020 actuarial valuation.

Effect on Actuarially Determined Contribution (ADC)

Chart 1 provides the effect of the adverse investment liquidity scenario on the Actuarially Determined Contribution (ADC). The investment losses under the adverse investment liquidity scenario are severe and would cause substantial increases in the ADC.

Chart 1
Adverse Investment Liquidity Scenario
Effect on Actuarially Determined Contribution
($ Billions; ADC for Fiscal Year Ending)



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Baseline	2.24	2.28	2.38	2.40	2.35	2.36	2.37	2.39	2.40	2.42	2.43	2.45	2.48	2.51	2.54	2.56	2.59	2.62	2.65	2.68	2.25
Scenario	2.24	2.43	2.80	3.17	3.50	3.89	4.13	4.27	4.32	4.35	4.38	4.40	4.43	4.46	4.49	4.52	4.55	4.58	4.61	4.63	4.21

The hypothetical large investment losses in Calendar Year 2020 through Calendar Year 2022 cause the December 31, 2022 market value of assets to be $22.3 billion less in the Scenario as compared to the baseline. These investment losses represent a severely adverse scenario that may not be reasonably expected to occur. Table 1 provides the effect of the hypothetical investment losses in Calendar Year 2020 through Calendar Year 2022 on the future contribution rates (ADC Rate) as a percentage of payroll.

Table 1 –Projected ADC, Funding Payroll and Contribution Rates (ADC Rate)

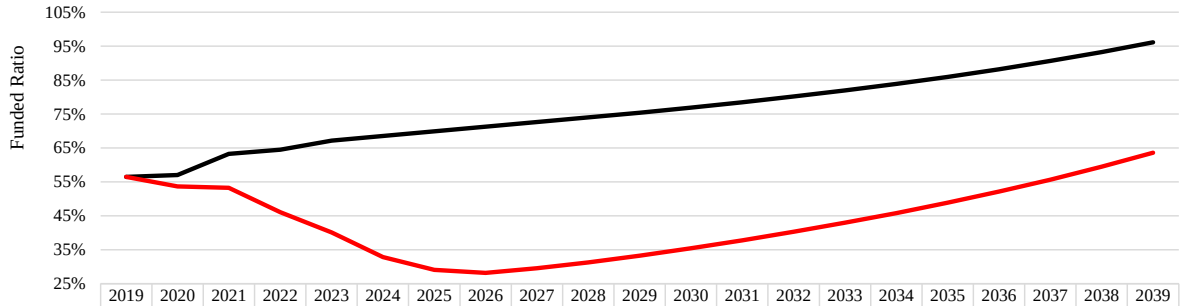
(Dollars in Billions)

	Baseline			Scenario		
Fiscal Year Ending (1)	ADC (2)	Payroll (3)	ADC Rate (4)	ADC (5)	Payroll (6)	ADC Rate (7)
2021	$2.24	$6.66	33.6%	$2.24	$6.66	33.6%
2022	$2.28	$6.78	33.6%	$2.43	$6.78	35.8%
2023	$2.38	$6.97	34.1%	$2.80	$6.97	40.2%
2024	$2.40	$7.16	33.5%	$3.17	$7.16	44.3%
2025	$2.35	$7.36	31.9%	$3.50	$7.36	47.6%
2026	$2.36	$7.57	31.2%	$3.89	$7.57	51.4%
2027	$2.37	$7.78	30.5%	$4.13	$7.78	53.1%
2028	$2.39	$8.00	29.9%	$4.27	$8.00	53.4%
2029	$2.40	$8.22	29.2%	$4.32	$8.22	52.6%
2030	$2.42	$8.45	28.6%	$4.35	$8.45	51.5%
2031	$2.43	$8.69	28.0%	$4.38	$8.69	50.4%
2032	$2.45	$8.93	27.4%	$4.40	$8.93	49.3%
2033	$2.48	$9.18	27.0%	$4.43	$9.18	48.3%
2034	$2.51	$9.44	26.6%	$4.46	$9.44	47.2%
2035	$2.54	$9.71	26.2%	$4.49	$9.71	46.2%
2036	$2.56	$9.98	25.7%	$4.52	$9.98	45.3%
2037	$2.59	$10.26	25.2%	$4.55	$10.26	44.3%
2038	$2.62	$10.54	24.9%	$4.58	$10.54	43.5%
2039	$2.65	$10.84	24.4%	$4.61	$10.84	42.5%
2040	$2.68	$11.14	24.1%	$4.63	$11.14	41.6%
2041	$2.25	$11.45	19.7%	$4.21	$11.45	36.8%

Effect on Funded Ratio

Chart 2 provides the effect of the adverse investment liquidity scenario on the funded ratio. The investment losses under the adverse investment liquidity scenario are severe and would cause substantial reductions in the funded ratio.

Chart 2
Adverse Investment Liquidity Scenario
Effect on Funded Ratio
(Funded Ratio as of December 31)



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Baseline	56%	57%	63%	65%	67%	69%	70%	71%	73%	74%	75%	77%	78%	80%	82%	84%	86%	88%	91%	93%	96%
Scenario	56%	54%	53%	46%	40%	33%	29%	28%	30%	31%	33%	35%	38%	40%	43%	46%	49%	52%	56%	60%	64%

The hypothetical large investment losses during Calendar Year 2020 through Calendar Year 2022 in this stress test causes the December 31, 2026 funded ratio to decrease to 28%, substantially lower than the baseline December 31, 2026 funded ratio of 71% and the December 31, 2019 funded ratio of 56% before the investment losses occurred. These investment losses represent a severely adverse scenario that may not be reasonably expected to occur.

Conclusions

The SERS investment policy includes Capital Preservation investments that are expected to be highly liquid and have a low correlation to changes in the U.S. equity markets. These investments provide a stable source for meeting the cash flow needs of the plan and to protect against the risk that equity investments would need to be liquidated at unfavorable values in order to pay member benefits. Analysis of the projected availability of Capital Preservation assets in this scenario has shown:

1. The Capital Preservation target allocation of 28% of total fund assets is expected to be sufficient to cover 87 months of projected member benefits net of contributions. The total fund would need to experience investment returns below -23% per year over a period of 3 years to cause the Capital Preservation investments to be insufficient to cover 36 months of the projected member benefits net of contributions. The Capital Preservation investments appear to be achieving the goal of providing security in both the ability to pay benefits when due and the ability to avoid liquidating equity investments at unfavorable values.

2. This scenario assumes significant investment losses over a period of 3 years. Although this is possible, the magnitude of the losses appears unlikely when compared to past performance and the expected range of future performance. Section 2.4 provides an analysis of simulated future investment performance to determine the likelihood of potential future outcomes. The unfavorable investment returns required for this adverse liquidity scenario are not reasonably expected to occur.

3. This analysis is based on the SERS investment policy, including a target allocation of 28% to Capital Preservation assets. Changes in the investment policy could significantly affect the results of this analysis. The projected availability of assets to pay member benefits when due should continue to be monitored.

2.4 Simulation of Future Investment Performance (Stochastic Analysis)

SERS assets are accumulated and invested to create investment earnings that help offset the cost for employers to provide retirement benefits. The SERS funding policy is based on an assumed future investment return rate that is set as a long-term expectation of investment performance. However, it is important to understand that there is significant volatility in investment markets and that the actual investment return experienced during any given year may vary greatly from the long-term expected investment return rate.

Simulations of future investment performance can be aggregated and analyzed to measure the expected likelihood of certain events. For this analysis, the SERS investment advisor, Callan LLC, provided 5,000 sets of simulated investment returns over a 20-year period based on the SERS investment policy and asset allocations. Korn Ferry has reviewed the simulated investment returns prepared by Callan LLC and found them to be reasonable to provide an estimated range of potential future investment performance. It is important to understand that this is only one set of simulations based on a single set of assumptions. Other simulations could be produced using other methods or assumptions that would provide different results.

The simulated returns were used to develop sets of future Actuarially Determined Contribution (ADC) amounts and funded ratios over a 20-year period. These results were aggregated and ranked by percentile. The following scenarios provide the projected effects of various investment return rates over a 20-year period:

Baseline – Investment returns are equal to the assumed investment return throughout the 20-year period.

95th Percentile – Results generated from the 95th percentile of simulated returns. This represents an **unlikely** scenario that would be **very unfavorable**. Only 5% of the simulated returns were less favorable than this scenario.

75th Percentile – Results generated from the 75th percentile of simulated returns. This represents a **reasonably likely unfavorable scenario**. 25% of the simulated returns were less favorable than this scenario.

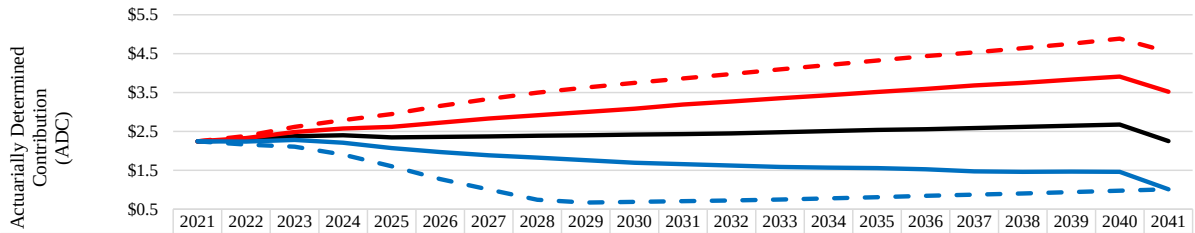
25th Percentile – Results generated from the 25th percentile of simulated returns. This represents a **reasonably likely favorable scenario**. 75% of the simulated returns were less favorable than this scenario.

5th Percentile – Results generated from the 5th percentile of simulated returns. This represents an **unlikely** scenario that would be **very favorable**. 95% of the simulated returns were less favorable than this scenario.

Simulated Future Actuarially Determined Contribution (ADC) Amounts

Chart 1 provides the simulated future Actuarially Determined Contribution (ADC) amounts. Unfavorable investment returns cause larger increases in the ADC relative to the baseline. Favorable investment returns cause larger reductions in the ADC relative to the baseline.

Chart 1
Effect of Future Investment Performance
Simulated Future Actuarially Determined Contribution Amounts
($ Billions; ADC for Fiscal Year Ending)



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Baseline	2.24	2.28	2.38	2.40	2.35	2.36	2.37	2.39	2.40	2.42	2.43	2.45	2.48	2.51	2.54	2.56	2.59	2.62	2.65	2.68	2.25
95th Percentile	2.24	2.39	2.62	2.79	2.95	3.16	3.34	3.50	3.63	3.75	3.87	3.98	4.10	4.21	4.33	4.44	4.53	4.64	4.75	4.89	4.55
75th Percentile	2.24	2.33	2.49	2.58	2.62	2.73	2.83	2.92	3.00	3.09	3.19	3.27	3.36	3.43	3.52	3.59	3.68	3.75	3.83	3.91	3.52
25th Percentile	2.24	2.24	2.28	2.21	2.07	1.97	1.89	1.83	1.76	1.70	1.66	1.62	1.59	1.57	1.56	1.53	1.47	1.46	1.46	1.46	1.01
5th Percentile	2.24	2.16	2.11	1.90	1.61	1.27	1.01	0.74	0.67	0.69	0.71	0.72	0.75	0.78	0.81	0.84	0.87	0.91	0.94	0.98	1.01

In general, favorable future investment performance results in future ADC amounts that are less than the baseline ADC. Unfavorable future investment performance results in future ADC amounts that exceed the baseline ADC. Comparing the "25th Percentile" scenario to the "75th Percentile" scenario provides a likely range of future ADC amounts. For example, the simulations predict that there is a 50% chance that the Fiscal Year 2030/2031 ADC will be in the range of $1.66 billion to $3.19 billion. It is important to understand that this also means there is a 50% chance that the Fiscal Year 2030/2031 ADC will be outside of that range.

Comparing the "5th Percentile" scenario to the "95th Percentile" scenario provides a highly likely range of future ADC amounts. For example, the simulations predict that there is a 90% chance that the Fiscal Year 2030/2031 ADC will be in the range of $0.71 billion to $3.87 billion. This is a very wide range that may not be reasonable for budgeting purposes but does provide a reasonable range for the "best case" ("5th Percentile") and "worst case" ("95th Percentile"). However, this is not a guarantee that future results will be within this range.

The simulations predict a relatively narrow range of likely ADC amounts during the initial years, but the volatility of investment returns causes the range of potential outcomes to widen over the projection period. Table 1 provides the projected ADC, payroll, and contribution rates (ADC rates) as a percentage of payroll.

Table 1 –Projected ADC, Funding Payroll and Contribution Rates (ADC Rate)

(Dollars in Billions)

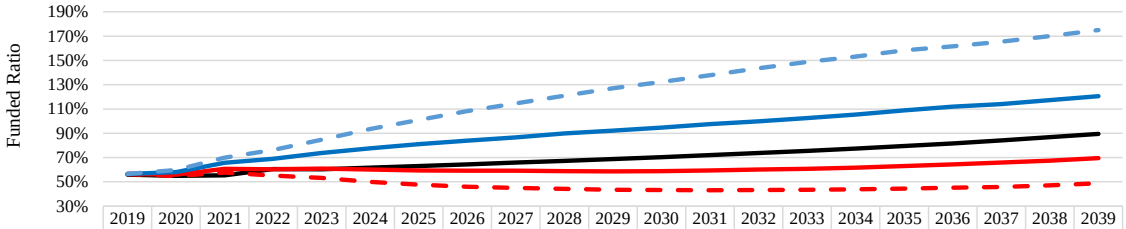
	Baseline			95th Percentile		75th Percentile		25th Percentile		5th Percentile	
Fiscal Year Ending (1)	ADC (2)	Payroll (3)	ADC Rate* (4)	ADC (5)	ADC Rate* (6)	ADC (7)	ADC Rate* (8)	ADC (9)	ADC Rate* (10)	ADC (11)	ADC Rate* (12)
2021	$2.24	$6.66	33.6%	$2.24	33.6%	$2.24	33.6%	$2.24	33.6%	$2.24	33.6%
2022	$2.28	$6.78	33.6%	$2.39	35.3%	$2.33	34.4%	$2.24	33.0%	$2.16	31.9%
2023	$2.38	$6.97	34.1%	$2.62	37.6%	$2.49	35.7%	$2.28	32.7%	$2.11	30.3%
2024	$2.40	$7.16	33.5%	$2.79	39.0%	$2.58	36.0%	$2.21	30.9%	$1.90	26.5%
2025	$2.35	$7.36	31.9%	$2.95	40.1%	$2.62	35.6%	$2.07	28.1%	$1.61	21.9%
2026	$2.36	$7.57	31.2%	$3.16	41.7%	$2.73	36.1%	$1.97	26.0%	$1.27	16.8%
2027	$2.37	$7.78	30.5%	$3.34	42.9%	$2.83	36.4%	$1.89	24.3%	$1.01	13.0%
2028	$2.39	$8.00	29.9%	$3.50	43.8%	$2.92	36.5%	$1.83	22.9%	$0.74	9.3%
2029	$2.40	$8.22	29.2%	$3.63	44.2%	$3.00	36.5%	$1.76	21.4%	$0.67	8.2%
2030	$2.42	$8.45	28.6%	$3.75	44.4%	$3.09	36.6%	$1.70	20.1%	$0.69	8.2%
2031	$2.43	$8.69	28.0%	$3.87	44.5%	$3.19	36.7%	$1.66	19.1%	$0.71	8.2%
2032	$2.45	$8.93	27.4%	$3.98	44.6%	$3.27	36.6%	$1.62	18.1%	$0.72	8.1%
2033	$2.48	$9.18	27.0%	$4.10	44.7%	$3.36	36.6%	$1.59	17.3%	$0.75	8.2%
2034	$2.51	$9.44	26.6%	$4.21	44.6%	$3.43	36.3%	$1.57	16.6%	$0.78	8.3%
2035	$2.54	$9.71	26.2%	$4.33	44.6%	$3.52	36.3%	$1.56	16.1%	$0.81	8.3%
2036	$2.56	$9.98	25.7%	$4.44	44.5%	$3.59	36.0%	$1.53	15.3%	$0.84	8.4%
2037	$2.59	$10.26	25.2%	$4.53	44.2%	$3.68	35.9%	$1.47	14.3%	$0.87	8.5%
2038	$2.62	$10.54	24.9%	$4.64	44.0%	$3.75	35.6%	$1.46	13.9%	$0.91	8.6%
2039	$2.65	$10.84	24.4%	$4.75	43.8%	$3.83	35.3%	$1.46	13.5%	$0.94	8.7%
2040	$2.68	$11.14	24.1%	$4.89	43.9%	$3.91	35.1%	$1.46	13.1%	$0.98	8.8%
2041	$2.25	$11.45	19.7%	$4.55	39.7%	$3.52	30.7%	$1.01	8.8%	$1.01	8.8%

*All simulations and ADC Rates are based on the same projection of member payroll shown in the “Baseline” results.

Simulated Future Funded Ratios

Chart 2 provides the simulated future funded ratios. Unfavorable investment returns cause reductions in the funded ratio relative to the baseline. Favorable investment returns cause increases in the funded ratio relative to the baseline.

Chart 2
Effect of Future Investment Performance
Simulated Future Funded Ratios
(Funded Ratio as of December 31)



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Baseline	56%	55%	55%	61%	60%	62%	63%	64%	66%	67%	69%	70%	72%	74%	75%	77%	79%	82%	84%	87%	90%
95th Percentile	56%	55%	58%	55%	53%	50%	48%	46%	45%	44%	44%	43%	43%	43%	43%	44%	44%	45%	46%	47%	49%
75th Percentile	56%	56%	61%	60%	61%	60%	59%	59%	59%	59%	59%	59%	59%	60%	61%	62%	63%	64%	66%	68%	70%
25th Percentile	56%	58%	66%	69%	74%	78%	81%	84%	87%	90%	92%	95%	98%	100%	102%	105%	109%	112%	114%	117%	121%
5th Percentile	56%	60%	70%	76%	85%	94%	101%	108%	115%	121%	127%	132%	138%	144%	149%	153%	158%	162%	165%	170%	175%

In general, favorable future investment performance results in future funded ratios that are greater than the baseline results. Unfavorable future investment performance results in future funded ratios that are less than the baseline results. Comparing the "25th Percentile" scenario to the "75th Percentile" scenario provides a likely range of future funded ratios. For example, the simulations predict that there is a 50% chance that the December 31, 2029 funded ratio will be in the range of 59% to 92%.

Comparing the "5th Percentile" scenario to the "95th Percentile" scenario provides a highly likely range of future funded ratios. For example, the simulations predict that there is a 90% chance that the December 31, 2029 funded ratio will be in the range of 44% to 127%. This is a very wide range that may not be reasonable for understanding funding expectations but does provide a reasonable range for the "best case" ("5th Percentile") and "worst case" ("95th Percentile"). However, this is not a guarantee that future results will be within this range.

Conclusions

The future investment performance of the SERS assets is unknown and will have a substantial impact on the contributions needed to fund benefits. These scenarios have shown the sensitivity of the ADC and funded ratio to future volatility of investment performance, including:

1. It is likely that investment market volatility will cause future ADC amounts to be significantly different from the expected long-term amounts shown in the "Baseline" projections. Based on the simulated investment returns, there is a 50% chance that the expected ("Baseline") Fiscal Year 2030/2031 ADC of $2.43 billion could instead be either above $3.19 billion or below $1.66 billion.

2. Assets are expected to be available to pay benefits when due to members. In the reasonably likely unfavorable outcome represented by the "75th Percentile" scenario, the funded ratio is expected to remain relatively stable compared to the December 31, 2019 funded ratio of 56%. Even in the unlikely very unfavorable outcome represented by the "95th Percentile" scenario, the funded ratio is not expected to fall below 43% as long as the SERS employers continue to contribute the full ADC.

This analysis only recognizes the effect of future investment performance based on a single expectation of future investment returns. The effect of changes in future expectations, reflected through changes in the investment return assumption, are included in the "Sensitivity to Changes in the Investment Return Assumption" section of this report. Many other factors affect the contribution needs of the plan and can cause the ADC to vary widely in the future. Analysis of the effects of other major risks are included within the "Demographic Risks" and "Contribution Risks" sections of this report.

2.5 Sensitivity to Changes in the Investment Return Assumption

The SERS funding policy is based on an assumed future investment return rate that is set as a long-term expectation of investment performance. Changes in the expected future investment performance and the assumed future investment return rate can have significant effects on the results of future actuarial valuations. As of the December 31, 2019 actuarial valuation date, this assumption was 7.125% compounded annually. Pursuant to action taken by the SERS Board at its July 2020 meeting, this assumption was reduced to 7.000% effective with the December 31, 2020 actuarial valuation.

This section provides the sensitivity of the key actuarial cost and liability components and the funded ratio as of December 31, 2019 under alternative investment return assumptions. The cost and liability components include the Total Normal Cost (i.e., the total allocated cost of benefits), the Employer Normal Cost (i.e., the allocated costs to employers calculated as the Total Normal Cost offset by the contributions from employees), the Actuarial Accrued Liability and the Unfunded Actuarial Accrued Liability.

Although the investment return assumption used in the December 31, 2019 (most recent) actuarial valuation was 7.125%, the "Baseline" results provided in Table 1 reflect the new 7.000% assumption to be implemented in the December 31, 2020 valuation.

Table 1 provides the hypothetical valuation results as of December 31, 2019 based on adjusting the investment return assumption (i) upward by 1% (to 8.00%), (ii) downward by 1% (to 6.00%) and (iii) downward by 2% (to 5.00%) compared to the Baseline assumption of 7.00%.

Table 1 – Hypothetical Valuation Results as of December 31, 2019 Under Various Investment Return Assumptions

Annual Investment Return Assumption	Baseline 7.00%	(i) 8.00%	(ii) 6.00%	(iii) 5.00%
Total Normal Cost Rate (As % of Payroll)	6.37%	5.28%	7.77%	9.63%
Employer Normal Cost Rate (As % of Payroll)	1.42%	0.33%	2.82%	4.68%
Actuarial Accrued Liability ($ Billions)	$54.10	$48.34	$61.21	$70.08
Unfunded Actuarial Accrued Liability ($ Billions)	$24.17	$18.41	$31.27	$40.15
Funded Ratio	55.3%	61.9%	48.9%	42.7%

Note: The results shown above are based upon the same census and asset data used in the SERS December 31, 2019 actuarial valuation but reflect the recommended actuarial assumptions from the 2020 experience study that will be effective for the December 31, 2020 actuarial valuation.

Conclusions

This analysis has shown the sensitivity of valuation results to changes in the investment return assumption, including:

1. Reducing the investment return assumption would result in higher actuarial costs and liabilities, since a smaller share of the funding of SERS would be expected to be covered by annual net investment returns. Increases in the investment return assumption would reduce the actuarial costs and liabilities.

2. Reducing the investment return assumption would increase the Actuarial Accrued Liability and reduce the funded ratio. Increasing the investment return assumption would reduce the Actuarial Accrued Liability and increase the funded ratio.

3. The SERS Board, with input and assistance from both the actuary and the investment advisor, reviews the investment return assumption annually to determine the appropriate assumption to be used for each actuarial valuation. The SERS Board makes this determination based upon a review of the SERS asset allocation and Investment Policy Statement as well as recent economic experience, future capital market expectations, and the projected effect on future contribution requirements.

3 Demographic Risks

3.1 Effect of Changes in Rates of Member Mortality

The value of retirement benefits paid by SERS is affected by the future experience of members. Because most SERS retirement benefits are paid in the form of a lifetime annuity, the valuation of such benefits requires that mortality assumptions be used to estimate the future lifetimes of SERS annuitants, both those currently receiving benefits and those projected to receive annuity benefits in the future.

The mortality assumptions used for SERS annual actuarial valuation purposes, when applied to any individual member, will not likely accurately predict that individual's remaining lifetime; however, when these assumptions are applied to the entire SERS covered population of 240,000+ members, they generally will result in fairly accurate predictions of the remaining lifetimes of the population on average.

The actuarial valuation and Actuarially Determined Contribution (ADC) are based on a single set of demographic assumptions related to future member experience. Included in this set of assumptions are the mortality assumptions. There is a risk that future member mortality experience will differ from the mortality assumptions currently used in the SERS valuations and that this difference will cause changes in the value of plan benefits. Increased future annuitant longevity compared to the current SERS mortality assumptions will increase the value of benefits and therefore increase the contributions needed to fund the benefits. The following scenarios provide the projected effects of actual rates of member mortality deviating from the current mortality assumptions over a 20-year period:

Baseline – Members (specifically, healthy annuitants) will experience deaths consistent with the mortality assumptions recommended in the 2020 experience study to be used beginning with the December 31, 2020 valuation throughout the 20-year period.

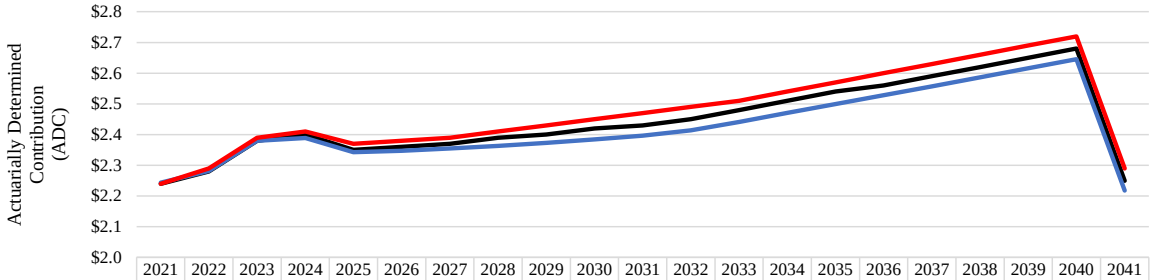
10% More Deaths – Members (specifically, healthy annuitants) will experience 10% more deaths than would result from the assumed mortality rates recommended in the 2020 experience study to be used beginning with the December 31, 2020 valuation during the first 10 years of the projection, then will experience deaths consistent with the mortality assumptions for the remainder of the 20-year projection.

10% Less Deaths – Members (specifically, healthy annuitants) will experience 10% less deaths than would result from the assumed mortality rates recommended in the 2020 experience study to be used beginning with the December 31, 2020 valuation during the first 10 years of the projection, then will experience deaths consistent with the mortality assumptions for the remainder of the 20-year projection.

Effect on Actuarially Determined Contribution (ADC)

Chart 1 provides the sensitivity of the Actuarially Determined Contribution (ADC) to changes in healthy annuitant mortality rates under the three scenarios. Member mortality rates that are higher than the actuarial assumptions decrease annuitant lifetimes, increase the number of deaths and thus decrease the value of plan benefits and the ADC relative to the baseline. Member mortality rates that are lower than the actuarial assumptions increase annuitant lifetimes, decrease the number of deaths and thus increase the value of plan benefits and the ADC relative to the baseline.

Chart 1
Sensitivity to Changes in Participant Mortality
Effect on Actuarially Determined Contribution
($ Billions; ADC for Fiscal Year Ending)



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Baseline	2.24	2.28	2.38	2.40	2.35	2.36	2.37	2.39	2.40	2.42	2.43	2.45	2.48	2.51	2.54	2.56	2.59	2.62	2.65	2.68	2.25
10% More Deaths	2.24	2.28	2.38	2.39	2.34	2.35	2.35	2.36	2.37	2.38	2.40	2.41	2.44	2.47	2.50	2.53	2.56	2.59	2.62	2.65	2.22
10% Less Deaths	2.24	2.29	2.39	2.41	2.37	2.38	2.39	2.41	2.43	2.45	2.47	2.49	2.51	2.54	2.57	2.60	2.63	2.66	2.69	2.72	2.29

The higher mortality rates in the "10% More Deaths" scenario gradually decrease the ADC compared to the baseline projection. The cumulative effect over the 10-year period results in an expected Fiscal Year 2030/2031 ADC of $2.40 billion, about $30 million lower than the baseline ADC. After the initial 10-year period, the mortality rates return to the actuarial assumption, but the ADC remains lower than the baseline to reflect the lower than expected number of living healthy annuitants. Table 1 provides the projected ADC, payroll, and contribution rates (ADC rate) as a percentage of payroll.

The lower mortality rates in the "10% Less Deaths" scenario gradually increase the ADC compared to the baseline projection. The cumulative effect over the 10-year period results in an expected Fiscal Year 2030/2031 ADC of $2.47 billion, about $40 million higher than the baseline ADC. After the initial 10-year period, the mortality rates return to the actuarial assumption, but the ADC remains higher than the baseline to reflect the higher than expected number of living healthy annuitants. Table 1 provides the projected ADC, payroll, and contribution rates (ADC rate) as a percentage of payroll.

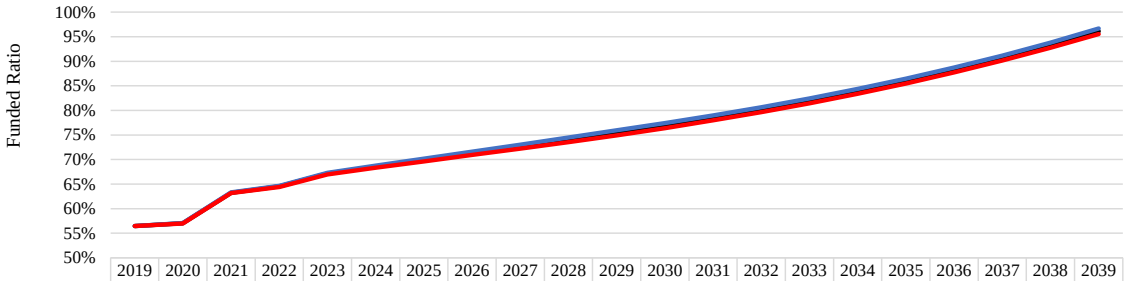
Table 1 –Projected ADC, Funding Payroll and Contribution Rates (ADC Rate)
(Dollars in Billions)

	Baseline			10% More Deaths			10% Less Deaths		
Fiscal Year Ending (1)	ADC (2)	Payroll (3)	ADC Rate (4)	ADC (5)	Payroll (6)	ADC Rate (7)	ADC (8)	Payroll (9)	ADC Rate (10)
2021	$2.24	$6.66	33.6%	$2.24	$6.66	33.6%	$2.24	$6.66	33.6%
2022	$2.28	$6.78	33.6%	$2.28	$6.78	33.6%	$2.29	$6.78	33.8%
2023	$2.38	$6.97	34.1%	$2.38	$6.97	34.1%	$2.39	$6.97	34.3%
2024	$2.40	$7.16	33.5%	$2.39	$7.16	33.4%	$2.41	$7.16	33.7%
2025	$2.35	$7.36	31.9%	$2.34	$7.36	31.8%	$2.37	$7.36	32.2%
2026	$2.36	$7.57	31.2%	$2.35	$7.57	31.0%	$2.38	$7.57	31.4%
2027	$2.37	$7.78	30.5%	$2.35	$7.78	30.2%	$2.39	$7.78	30.7%
2028	$2.39	$8.00	29.9%	$2.36	$8.00	29.5%	$2.41	$8.00	30.1%
2029	$2.40	$8.22	29.2%	$2.37	$8.22	28.8%	$2.43	$8.22	29.6%
2030	$2.42	$8.45	28.6%	$2.38	$8.45	28.2%	$2.45	$8.45	29.0%
2031	$2.43	$8.69	28.0%	$2.40	$8.69	27.6%	$2.47	$8.69	28.4%
2032	$2.45	$8.93	27.4%	$2.41	$8.93	27.0%	$2.49	$8.93	27.9%
2033	$2.48	$9.18	27.0%	$2.44	$9.18	26.6%	$2.51	$9.18	27.3%
2034	$2.51	$9.44	26.6%	$2.47	$9.44	26.2%	$2.54	$9.44	26.9%
2035	$2.54	$9.71	26.2%	$2.50	$9.71	25.7%	$2.57	$9.71	26.5%
2036	$2.56	$9.98	25.7%	$2.53	$9.98	25.4%	$2.60	$9.98	26.1%
2037	$2.59	$10.26	25.2%	$2.56	$10.26	25.0%	$2.63	$10.26	25.6%
2038	$2.62	$10.54	24.9%	$2.59	$10.54	24.6%	$2.66	$10.54	25.2%
2039	$2.65	$10.84	24.4%	$2.62	$10.84	24.2%	$2.69	$10.84	24.8%
2040	$2.68	$11.14	24.1%	$2.65	$11.14	23.8%	$2.72	$11.14	24.4%
2041	$2.25	$11.45	19.7%	$2.22	$11.45	19.4%	$2.29	$11.45	20.0%

Effect on Funded Ratio

Chart 2 provides the sensitivity of the funded ratio to changes in healthy annuitant mortality under the three scenarios. Member mortality rates that are higher than the actuarial assumptions decrease annuitant lifetimes, increase the number of deaths and thus decrease the liability for plan benefits, thereby increasing the funded ratio relative to the baseline. Member mortality rates that are lower than the actuarial assumptions increase annuitant lifetimes, decrease the number of deaths and thus increase the liability for plan benefits, thereby decreasing the funded ratio relative to the baseline.

Chart 2
Sensitivity to Changes in Participant Mortality
Effect on Funded Ratio
(Funded Ratio as of December 31)



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Baseline	56%	57%	63%	65%	67%	69%	70%	71%	73%	74%	75%	77%	78%	80%	82%	84%	86%	88%	91%	93%	96%
10% More Deaths	56%	57%	63%	65%	67%	69%	70%	72%	73%	74%	76%	77%	79%	81%	82%	84%	86%	89%	91%	94%	97%
10% Less Deaths	56%	57%	63%	64%	67%	68%	70%	71%	72%	74%	75%	76%	78%	80%	81%	83%	85%	88%	90%	93%	96%

Although the sustained period of higher mortality rates in the "10% More Deaths" scenario does increase the funded ratio, and the sustained period of lower mortality rates in the "10% Less Deaths" scenario does decrease the funded ratio, the funded ratio effect in both scenarios is not significant. Throughout the 20-year period, the funded ratios under the three scenarios were always within 1% of each other.

Conclusions

Although sustained lower mortality rates will increase the ADC, it is unlikely to be a significant risk since:

1. During the 20-year period, the "10% Less Deaths" ADC never exceeded the baseline ADC by more than about $40 million, or about 0.5% of covered payroll.

2. As shown in Chart 2, sustained periods of lower mortality rates are not expected to significantly affect the funded ratio or the availability of assets to pay benefits when due to members. There was no significant difference (never greater than 1%) in the funded ratio under the "10% Less Deaths" scenario compared to the baseline funded ratio.

3. Every 5 years, the SERS actuary performs an actuarial experience study, which includes a review of the actual SERS member mortality experience of the recent past compared to the then current mortality assumptions. The most recent experience study was completed in 2020 covering the period January 1, 2015 through December 31, 2019. As a result of the experience study, the SERS Board approved new, lower mortality assumptions to be used beginning with the December 31, 2020 actuarial valuation. This analysis reflects the revised mortality assumptions. The actual SERS member mortality experience will continue to be monitored and new mortality assumptions will be recommended as appropriate. The adoption of new, lower mortality assumptions (absent any other assumption changes) will result in higher ADC amounts and lower funded ratios.

3.2 Effect of Changes in Rates of Member Salary Growth

The retirement benefits paid by SERS are based on each member's salary (compensation) at the time of their retirement. SERS funding is based on each member's current salary projected to retirement, using a salary scale to reflect increases for general inflation, real wage growth, and career (merit) growth. This salary increase scale is used as a budgeting tool to reflect expected overall salary growth in funding the future benefits. It is not a guarantee of future salary increases nor a reflection of the expected career progression of any single individual.

It is common for actual member salary increases to be significantly higher or lower than expected during any individual year or over a period of multiple years as the economy moves through cycles. For example, many retirement systems experienced dampened salary growth following the economic recession of 2007-2009.

Member salary increases above the expected growth rate will increase the value of benefits and therefore increase the contributions needed to fund the benefits. The following scenarios provide the projected effects of salaries increasing by various rates over a 20-year period:

Baseline – Member salaries increase based on the salary scale recommended in the 2020 experience study to be used beginning with the December 31, 2020 valuation throughout the 20-year period.

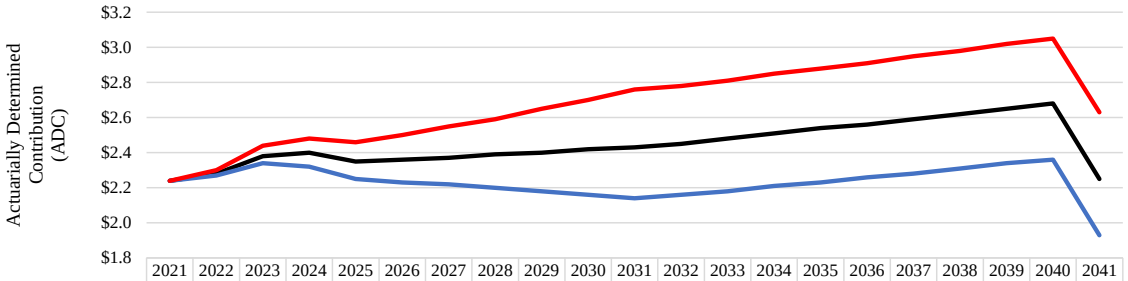
2% Above Assumption – Member salaries increase by the salary scale recommended in the 2020 experience study to be used beginning with the December 31, 2020 valuation plus 2% (200 basis points) for each of the first 10 years, then increase by the assumed salary scale for the remainder of the period.

2% Below Assumption – Member salaries increase by the salary scale recommended in the 2020 experience study to be used beginning with the December 31, 2020 valuation minus 2% (200 basis points) for each of the first 10 years, then increase by the assumed salary scale for the remainder of the period.

Effect on Actuarially Determined Contribution (ADC)

Chart 1 provides the sensitivity of the Actuarially Determined Contribution (ADC) to changes in salary growth rates under the three scenarios. Salary growth rates above the actuarial assumption increase the ADC relative to the baseline. Salary growth rates below the actuarial assumption decrease the ADC relative to the baseline.

Chart 1
Sensitivity to Changes in Participant Mortality
Effect on Actuarially Determined Contribution
($ Billions; ADC for Fiscal Year Ending)



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Baseline	2.24	2.28	2.38	2.40	2.35	2.36	2.37	2.39	2.40	2.42	2.43	2.45	2.48	2.51	2.54	2.56	2.59	2.62	2.65	2.68	2.25
2% Below Assumption	2.24	2.27	2.34	2.32	2.25	2.23	2.22	2.20	2.18	2.16	2.14	2.16	2.18	2.21	2.23	2.26	2.28	2.31	2.34	2.36	1.93
2% Above Assumption	2.24	2.30	2.44	2.48	2.46	2.50	2.55	2.59	2.65	2.70	2.76	2.78	2.81	2.85	2.88	2.91	2.95	2.98	3.02	3.05	2.63

The larger salary growth rate in the "2% Above Assumption" scenario gradually increases the ADC compared to the baseline projection. The cumulative effect over the 10-year period results in an expected Fiscal Year 2030/2031 ADC of $2.76 billion, about $330 million higher than the baseline ADC. After the initial 10-year period, the salary growth rates return to the actuarial assumption, but the ADC remains larger than the baseline to reflect the larger payroll. The larger projected payroll in the "2% Above Assumption" scenario also results in a decrease in the contribution rate as a percentage of payroll compared to the baseline projection. Table 1 provides the projected ADC, payroll, and contribution rates (ADC rate) as a percentage of payroll.

The reduced salary growth rate in the "2% Below Assumption" scenario gradually reduces the ADC compared to the baseline projection. The cumulative effect over the 10-year period results in an expected Fiscal Year 2030/2031 ADC of $2.14 billion, about $290 million lower than the baseline ADC. After the initial 10-year period, the salary growth rates return to the actuarial assumption, but the ADC remains lower than the baseline to reflect the reduced payroll. The reduced projected payroll in the "2% Above Assumption" scenario also results in an increase in the contribution rate as a percentage of payroll compared to the baseline projection. Table 1 provides the projected ADC, payroll, and contribution rates (ADC rate) as a percentage of payroll.

Table 1 –Projected ADC, Funding Payroll and Contribution Rates (ADC Rate)

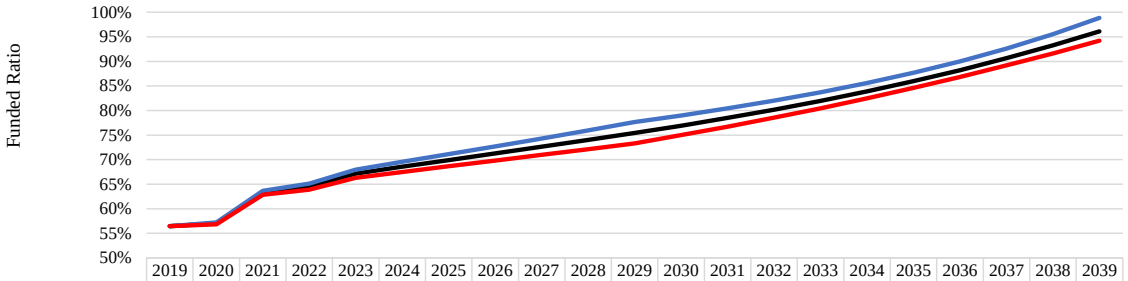
(Dollars in Billions)

	Baseline			2% Below Assumption			2% Above Assumption		
Fiscal Year Ending (1)	ADC (2)	Payroll (3)	ADC Rate (4)	ADC (5)	Payroll (6)	ADC Rate (7)	ADC (8)	Payroll (9)	ADC Rate (10)
2021	$2.24	$6.66	33.6%	$2.24	$6.64	33.7%	$2.24	$6.91	32.4%
2022	$2.28	$6.78	33.6%	$2.27	$6.69	33.9%	$2.30	$7.25	31.7%
2023	$2.38	$6.97	34.1%	$2.34	$6.74	34.7%	$2.44	$7.60	32.1%
2024	$2.40	$7.16	33.5%	$2.32	$6.79	34.2%	$2.48	$7.97	31.1%
2025	$2.35	$7.36	31.9%	$2.25	$6.84	32.9%	$2.46	$8.36	29.4%
2026	$2.36	$7.57	31.2%	$2.23	$6.89	32.4%	$2.50	$8.76	28.5%
2027	$2.37	$7.78	30.5%	$2.22	$6.94	32.0%	$2.55	$9.19	27.7%
2028	$2.39	$8.00	29.9%	$2.20	$7.00	31.4%	$2.59	$9.63	26.9%
2029	$2.40	$8.22	29.2%	$2.18	$7.05	30.9%	$2.65	$10.10	26.2%
2030	$2.42	$8.45	28.6%	$2.16	$7.10	30.4%	$2.70	$10.59	25.5%
2031	$2.43	$8.69	28.0%	$2.14	$7.30	29.3%	$2.76	$10.89	25.3%
2032	$2.45	$8.93	27.4%	$2.16	$7.50	28.8%	$2.78	$11.19	24.8%
2033	$2.48	$9.18	27.0%	$2.18	$7.71	28.3%	$2.81	$11.51	24.4%
2034	$2.51	$9.44	26.6%	$2.21	$7.93	27.9%	$2.85	$11.83	24.1%
2035	$2.54	$9.71	26.2%	$2.23	$8.15	27.4%	$2.88	$12.16	23.7%
2036	$2.56	$9.98	25.7%	$2.26	$8.38	27.0%	$2.91	$12.50	23.3%
2037	$2.59	$10.26	25.2%	$2.28	$8.61	26.5%	$2.95	$12.85	23.0%
2038	$2.62	$10.54	24.9%	$2.31	$8.86	26.1%	$2.98	$13.21	22.6%
2039	$2.65	$10.84	24.4%	$2.34	$9.10	25.7%	$3.02	$13.58	22.2%
2040	$2.68	$11.14	24.1%	$2.36	$9.36	25.2%	$3.05	$13.96	21.8%
2041	$2.25	$11.45	19.7%	$1.93	$9.62	20.1%	$2.63	$14.35	18.3%

Effect on Funded Ratio

Chart 2 provides the sensitivity of the funded ratio to changes in salary growth rates under the three scenarios. Salary growth rates above the actuarial assumption slightly reduce the funded ratio relative to the baseline. Salary growth rates below the actuarial assumption slightly increase the funded ratio relative to the baseline.

Chart 2
Sensitivity to Changes in Participant Salary Growth
Effect on Funded Ratio
(Funded Ratio as of December 31)



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Baseline	56%	57%	63%	65%	67%	69%	70%	71%	73%	74%	75%	77%	78%	80%	82%	84%	86%	88%	91%	93%	96%
2% Below Assumption	56%	57%	64%	65%	68%	70%	71%	73%	74%	76%	78%	79%	80%	82%	84%	86%	88%	90%	93%	96%	99%
2% Above Assumption	56%	57%	63%	64%	66%	68%	69%	70%	71%	72%	73%	75%	77%	79%	80%	82%	85%	87%	89%	92%	94%

Although the sustained period of larger salary growth rates does reduce the funded ratio, the effect is not significant compared to the total SERS benefits. The larger salary growth rates increase the future benefits for current active members but do not affect the value of benefits for current retirees, which account for a large portion of the total SERS benefits. Also, the increased ADC increases SERS assets as the additional contributions are received and invested to pay future benefits, which somewhat offsets the reduction to the funded ratio.

Conclusions

Although sustained salary growth that exceeds the expected growth rates will increase the ADC, it is unlikely to be a significant risk since:

1. Sustained periods of high salary growth rates are likely to coincide with strong economic growth periods that could also provide favorable investment returns and revenue growth.

2. High salary growth rates would reduce the ADC rate as a percentage of payroll. A reduced ADC rate may be viewed as a reduced burden on employers to provide the benefits since the contributions would represent a smaller portion of the total compensation costs.

3. Sustained periods of high salary growth rates are not expected to significantly affect the funded ratio or the availability of assets to pay benefits when due to members. There was no significant difference in the funded ratio under the “2% Above Assumption” scenario compared to the baseline.

4 Contribution Risks

4.1 Effect of Reduced Funding of Actuarially Determined Contribution

It is the SERS funding policy to fully fund the Actuarially Determined Contribution (ADC), the annual employer contribution calculated by the actuary based on a defined actuarial cost method, asset valuation method and amortization method. Developing an ADC each year serves two primary purposes:

1. Ensures assets are accumulated to pay all benefits when due to members

2. Provides a relatively predictable and stable pattern of contributions to assist with budgeting

Substantial underfunding can result in an insufficient accumulation of assets to pay benefits when due to members. However, even temporary periods of underfunding can create a significant burden on future budgets.

When contributions are not appropriately budgeted and paid, many governments have struggled to restore the appropriation in subsequent years. Therefore, it is important to recognize both the effect of underfunding and the difficulty to return to full funding. Although we neither recommend nor expect future underfunding, the following scenarios provide the projected effects of temporarily reducing SERS funding:

Baseline – Employers contribute 100% of the ADC in all years.

Scenario Contribution – Employers contribute all required contributions to the Defined Contribution Plan but provide reduced funding to the Defined Benefit Plan based on the following schedule:

Fiscal Year	Percentage of ADC Contributed to Defined Benefit Plan
2020/2021	0%
2021/2022	20%
2022/2023	40%
2023/2024	60%
2024/2025	80%
2025/2026 through 2040/2041	100%

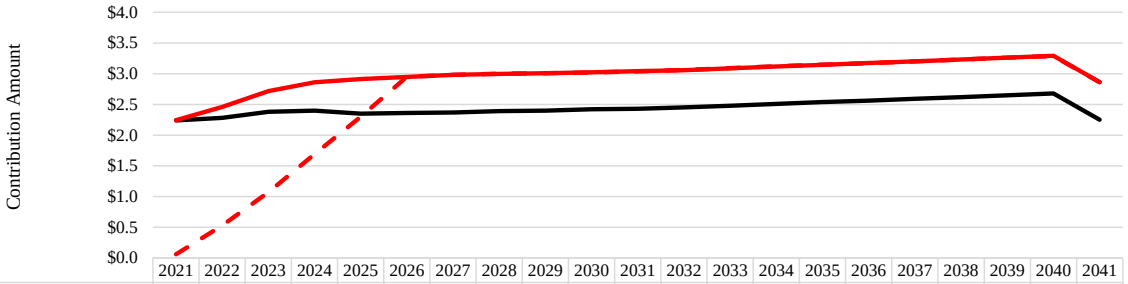
This scenario reflects a missed contribution during Fiscal Year 2020/2021 followed by a four-year period of partial funding during Fiscal Year 2021/2022 through Fiscal Year 2024/2025, as the annual budget gradually ramps up before recovering to full funding in Fiscal Year 2025/2026 and thereafter.

Scenario ADC – The Actuarially Determined Contribution (ADC) reflecting the reduced funding provided in the Scenario Contribution.

Effect on Actuarially Determined Contribution (ADC)

Chart 1 provides the sensitivity of the Actuarially Determined Contribution (ADC) to reduced funding of the ADC. The reduced funding for Fiscal Year 2020/2021 through Fiscal Year 2024/2025 in this stress test increases the unfunded actuarial liabilities relative to the baseline. These additional unfunded liabilities cause the Scenario ADC to increase relative to the baseline.

Chart 1
Reduced Funding of the Actuarially Determined Contribution (ADC)
Effect on ADC
($ Billions; ADC for Fiscal Year Ending)



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Baseline	2.24	2.28	2.38	2.40	2.35	2.36	2.37	2.39	2.40	2.42	2.43	2.45	2.48	2.51	2.54	2.56	2.59	2.62	2.65	2.68	2.25
Scenario Contribution	0.06	0.53	1.07	1.69	2.30	2.95	2.98	3.00	3.01	3.02	3.04	3.06	3.09	3.12	3.15	3.17	3.20	3.23	3.26	3.29	2.86
Scenario ADC	2.24	2.46	2.72	2.86	2.91	2.95	2.98	3.00	3.01	3.02	3.04	3.06	3.09	3.12	3.15	3.17	3.20	3.23	3.26	3.29	2.86

The accumulated effect of the reduced funding for Fiscal Year 2020/2021 through Fiscal Year 2024/2025 results in an expected Fiscal Year 2025/2026 ADC of $2.95 billion, about $590 million higher than the baseline ADC. The increased ADC continues throughout the projection period until the System's 30-year amortization of the underfunded liabilities is complete.

In this scenario, there is about $6.00 billion of underfunding during Fiscal Year 2020/2021 through Fiscal Year 2024/2025 relative to the baseline. This $6.00 billion of underfunding causes future contributions (through Fiscal Year 2054/2055) to increase by $14.51 billion.

The underfunding also creates a larger burden for future employers since the Scenario ADC represents a larger percentage of member funding payroll. Table 1 provides the effect of the underfunding on the future contribution rates (ADC Rate) as a percentage of payroll.

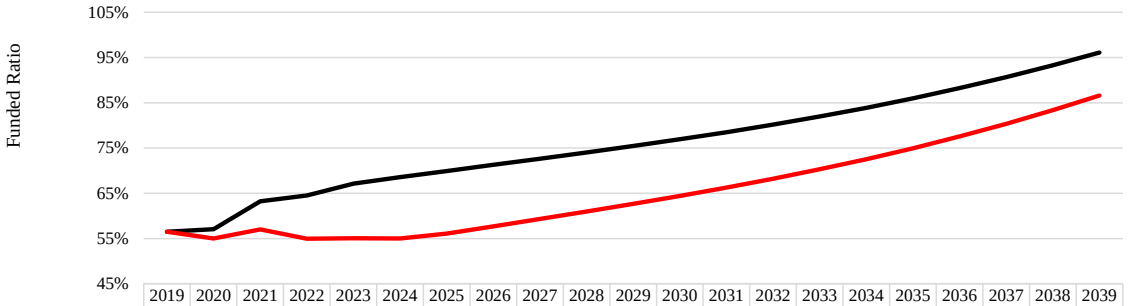
Table 1 –Projected ADC, Funding Payroll and Contribution Rates (ADC Rate)
(Dollars in Billions)

	Baseline			Scenario ADC		
Fiscal Year Ending (1)	ADC (2)	Payroll (3)	ADC Rate (4)	ADC (5)	Payroll (6)	ADC Rate (7)
2021	$2.24	$6.66	33.6%	$2.24	$6.66	33.6%
2022	$2.28	$6.78	33.6%	$2.46	$6.78	36.3%
2023	$2.38	$6.97	34.1%	$2.72	$6.97	39.0%
2024	$2.40	$7.16	33.5%	$2.86	$7.16	39.9%
2025	$2.35	$7.36	31.9%	$2.91	$7.36	39.5%
2026	$2.36	$7.57	31.2%	$2.95	$7.57	39.0%
2027	$2.37	$7.78	30.5%	$2.98	$7.78	38.3%
2028	$2.39	$8.00	29.9%	$3.00	$8.00	37.5%
2029	$2.40	$8.22	29.2%	$3.01	$8.22	36.6%
2030	$2.42	$8.45	28.6%	$3.02	$8.45	35.7%
2031	$2.43	$8.69	28.0%	$3.04	$8.69	35.0%
2032	$2.45	$8.93	27.4%	$3.06	$8.93	34.3%
2033	$2.48	$9.18	27.0%	$3.09	$9.18	33.7%
2034	$2.51	$9.44	26.6%	$3.12	$9.44	33.1%
2035	$2.54	$9.71	26.2%	$3.15	$9.71	32.4%
2036	$2.56	$9.98	25.7%	$3.17	$9.98	31.8%
2037	$2.59	$10.26	25.2%	$3.20	$10.26	31.2%
2038	$2.62	$10.54	24.9%	$3.23	$10.54	30.6%
2039	$2.65	$10.84	24.4%	$3.26	$10.84	30.1%
2040	$2.68	$11.14	24.1%	$3.29	$11.14	29.5%
2041	$2.25	$11.45	19.7%	$2.86	$11.45	25.0%

Effect on Funded Ratio

Chart 2 provides the sensitivity of the Funded Ratio to reduced funding of the ADC. The reduced funding for Fiscal Year 2020/2021 through Fiscal Year 2024/2025 in this stress test substantially reduces the SERS assets relative to the baseline. These reduced asset values cause the Scenario Funded Ratio to decrease relative to the baseline funded ratio.

Chart 2
Reduced Funding of the Actuarially Determined Contribution (ADC)
Effect on Funded Ratio
(Funded Ratio as of December 31)



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Baseline	56%	57%	63%	65%	67%	69%	70%	71%	73%	74%	75%	77%	78%	80%	82%	84%	86%	88%	91%	93%	96%
Scenario Funded Ratio	56%	55%	57%	55%	55%	55%	56%	58%	59%	61%	63%	64%	66%	68%	70%	73%	75%	78%	80%	83%	87%

The reduced funding for Fiscal Year 2020/2021 through Fiscal Year 2024/2025 in this stress test causes the December 31, 2025 funded ratio to decrease to 56%, substantially lower than the baseline December 31, 2025 funded ratio of 70% and about equal to the December 31, 2019 funded ratio of 56% before the reduced funding begins.

The effect on the funded ratio continues until the underfunding is fully amortized over the 30-year period. The December 31, 2039 funded ratio reflecting the reduced funding is only 87%, still substantially lower than the baseline December 31, 2039 funded ratio of 96%. The Scenario Funded Ratio would not return to the baseline value until December 31, 2056, when the additional contributions for the underfunding are fully amortized.

Conclusions

Even temporary reductions in funding can have significant effects on both the future contribution burden and the funded ratio. This hypothetical scenario of missed contributions has shown:

1. The $6.00 billion of missed contributions increased future contributions by a total of $14.5 billion and increased the future employer contribution rate by as much as 7.8% of payroll.

2. Each dollar of shortfall between the amount contributed and the baseline ADC immediately increases the unfunded liability and reduces the funded ratio. The funded ratio is expected to steadily increase in the baseline scenario from 56% in 2019 to 96% in 2039. The reduced funding scenario would reduce the funded ratio from 56% in 2019 to as low as 55% in 2024 before recovering to only 87% by 2039.

3. The ADC is designed to provide relatively predictable and stable contribution patterns. When ADC-level contributions are not appropriately budgeted and paid, it may be very difficult to budget for the large contribution increases needed to return to fully funding the ADC.

4.2 Effect of Limited Employer Contributions Due to Sustained Unfavorable Investment Performance

The Investment Risks Section includes a stress test to assess the effect of future investment performance assuming SERS employers continue to contribute the full Actuarially Determined Contribution (ADC). However, if there is sustained unfavorable investment performance, there is an additional risk that SERS employers would be unable to adjust their budgets to meet the increases in the ADC without adversely impacting their ability to meet the critical needs of the Commonwealth.

The following scenarios provide the projected effects of sustained unfavorable investment performance assuming various employer contribution patterns:

Baseline – Investment returns are equal to the assumed investment return throughout the 20-year period. All employers contribute the ADC in each year of the 20-year period.

Full Funding Scenario – Investment returns are equal to the assumed investment return rate minus 2% (200 basis points) for each year of the 20-year period. All employers contribute the ADC in each year of the 20-year period.

Limited Funding Scenario – Investment returns are equal to the assumed investment return rate minus 2% (200 basis points) for each year of the 20-year period. Employers contribute all required contributions to the Defined Contribution Plan in each year of the 20-year period; however, after Fiscal Year 2020/2021, the annual rate of growth of employer contributions to the Defined Benefit Plan is limited to the 3.2% per year average projected rate of State revenue growth.

The investment return rates used by calendar year are provided in the following schedule:

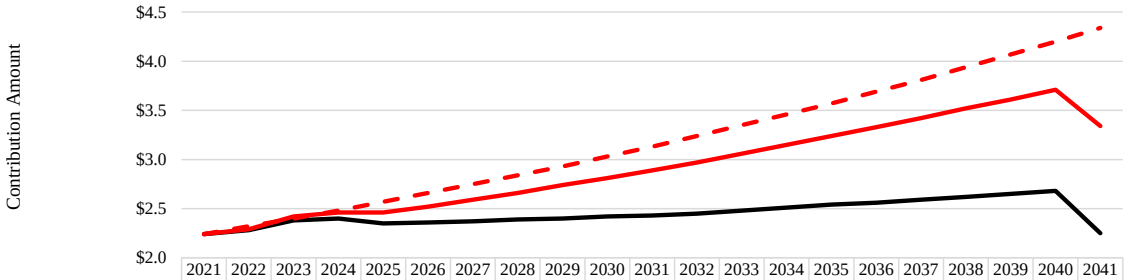
Calendar Year	Baseline	Full Funding Scenario	Limited Funding Scenario
2020*	7.125%	5.125%	5.125%
2021-2039	7.000%	5.000%	5.000%

*The scenarios are based on the assumed investment return rate for Calendar Year 2020 of 7.125% and do not reflect any actual 2020 investment performance. Pursuant to action taken by the SERS Board at its July 2020 meeting, the assumed investment return rate was reduced to 7.000% effective with the December 31, 2020 actuarial valuation.

Effect on the Actuarially Determined Contribution (ADC)

Chart 1 provides the projected contribution amounts by Fiscal Year for each scenario.

Chart 1
Effect of Sustained Unfavorable Investment Performance
Projected Contributions
($ Billions; Contributions for Fiscal Year Ending)



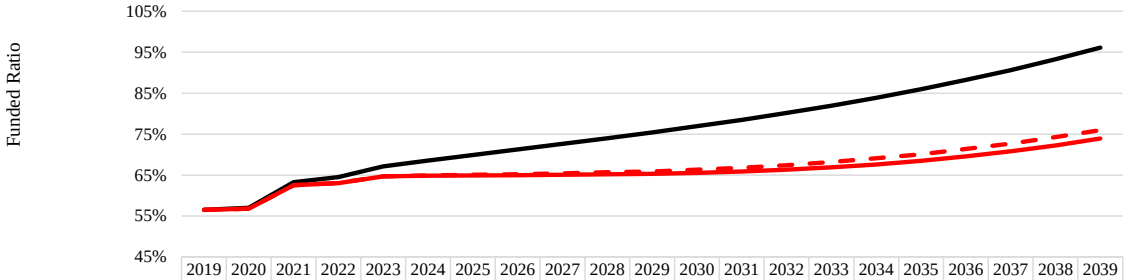
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Baseline	2.24	2.28	2.38	2.40	2.35	2.36	2.37	2.39	2.40	2.42	2.43	2.45	2.48	2.51	2.54	2.56	2.59	2.62	2.65	2.68	2.25
Full Funding Scenario	2.24	2.29	2.42	2.46	2.46	2.52	2.59	2.66	2.74	2.81	2.89	2.97	3.06	3.15	3.24	3.33	3.42	3.52	3.61	3.71	3.34
Limited Funding Scenario	2.24	2.32	2.40	2.48	2.57	2.66	2.75	2.84	2.93	3.03	3.13	3.24	3.35	3.46	3.57	3.69	3.81	3.94	4.07	4.20	4.34

The sustained unfavorable investment performance gradually increases the ADC compared to the baseline projection. Given the current funded position of SERS, the "Limited Funding Scenario" would generate sufficient employer contributions to fund the ADC. That is, moderate increases of 3.2% per year in the employer contributions would provide sufficient funding even if there was sustained unfavorable investment performance. Analysis of the effect on the funded ratio is provided in the following section. Detailed projections of the results are provided in Table 1 (Baseline), Table 2 (Full Funding Scenario), and Table 3 (Limited Funding Scenario), which follow the "Conclusions" section.

Effect on Funded Ratio

Chart 2 provides the projected funded ratios by Calendar Year for each scenario.

Chart 2
Effect of Sustained Unfavorable Investment Performance
Projected Funded Ratios
(Funded Ratio as of December 31)



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Baseline	56%	57%	63%	65%	67%	69%	70%	71%	73%	74%	75%	77%	78%	80%	82%	84%	86%	88%	91%	93%	96%
Full Funding Scenario	56%	57%	63%	63%	65%	65%	65%	65%	65%	65%	65%	66%	66%	66%	67%	68%	68%	70%	71%	72%	74%
Limited Funding Scenario	57%	57%	63%	63%	65%	65%	65%	65%	65%	66%	66%	66%	67%	67%	68%	69%	70%	71%	73%	74%	76%

The sustained unfavorable investment performance gradually reduces the funded ratio compared to the baseline. The Actuarially Determined Contribution (ADC) is adjusted to reflect the unfavorable investment performance and is contributed in the "Full Funding Scenario". The 3.2% annual increases in employer contributions in the "Limited Funding Scenario" cause the funded ratio to increase relatively similar to the "Full Funding Scenario". That is, moderate increases of 3.2% per year in the employer contributions would gradually increase the funded ratio even if there was sustained unfavorable investment performance Although these increases are sufficient for this scenario, other potential limited funding scenarios could substantially increase the future contributions needed to fund member benefits. Detailed projections of the results are provided in Table 1 (Baseline), Table 2 (Full Funding Scenario), and Table 3 (Limited Funding Scenario), which follow the "Conclusions" section.

Conclusions

Sustained periods of unfavorable investment performance can increase the future contributions needed to fund member benefits. Analysis of the "Limited Funding Scenario" has shown:

1. The 3.2% annual growth in employer contributions is projected to provide sufficient funding even in the event of sustained periods of unfavorable investment performance. This is primarily due to the large amount of unrecognized investment gains during 2019 offsetting the unfavorable investment performance in this scenario. Although this shows that SERS is well positioned to adjust to periods of unfavorable investment performance, limited funding is not recommended. Other scenarios, including the scenario analyzed in Section 4.3, show that these limited contributions would not always provide sufficient funding.

2. Although the Actuarially Determined Contribution (ADC) is designed to provide relatively predictable and stable contribution patterns, adjustments are required to reflect actual investment performance and to ensure member benefits are fully funded. When the ADC is not fully contributed, even though contribution levels are stable, as they are under the "Limited Funding Scenario", there is a funding deficiency that can substantially increase the future employer contributions needed to fund member benefits. Each dollar of shortfall between the amount contributed and the ADC immediately increases the unfunded liability and reduces the funded ratio.

3. The sustained unfavorable performance reflected in these scenarios would likely result in changes to plan funding. If SERS' annual investment performance repeatedly fell short of the actuarial expectations, it is important to note that the SERS Board, with assistance from both the plan's actuary and investment consultant, would re-examine and potentially adjust the plan's investment return assumption and other actuarial assumptions. Analysis of the effect of changes in the investment return assumption is included in the Investment Risks section of this report.

Table 1 – Baseline Projection of Results

(Dollars in Billions)

Calendar Year	Fiscal Year	Employer Contrib.	Payroll	Employer Contrib. Rate	Actuarial Accrued Liability	Assets	Unfunded Actuarial Accrued Liability	Change in Unfunded Liability from Prior Year	Funded Ratio	Service Cost	Benefit Payments	Ratio of Net Cash Flow to Assets
2019	2020/2021	$2.24	$6.66	33.6%	$52.94	$29.91	$23.04	-	56.5%	$0.11	$3.59	3.3%
2020	2021/2022	$2.28	$6.78	33.6%	$54.68	$31.19	$23.49	$0.45	57.0%	$0.10	$3.70	3.3%
2021	2022/2023	$2.38	$6.97	34.1%	$51.52	$32.59	$18.93	($4.56)	63.3%	$0.56	$3.82	3.3%
2022	2023/2024	$2.40	$7.16	33.5%	$52.07	$33.60	$18.47	($0.47)	64.5%	$0.57	$3.94	3.4%
2023	2024/2025	$2.35	$7.36	31.9%	$52.59	$35.31	$17.28	($1.19)	67.1%	$0.57	$4.06	3.6%
2024	2025/2026	$2.36	$7.57	31.2%	$53.07	$36.38	$16.69	($0.59)	68.6%	$0.58	$4.17	3.9%
2025	2026/2027	$2.37	$7.78	30.5%	$53.46	$37.38	$16.08	($0.60)	69.9%	$0.59	$4.27	4.0%
2026	2027/2028	$2.39	$8.00	29.9%	$53.80	$38.34	$15.46	($0.63)	71.3%	$0.60	$4.37	4.1%
2027	2028/2029	$2.40	$8.22	29.2%	$54.06	$39.26	$14.79	($0.66)	72.6%	$0.60	$4.48	4.3%
2028	2029/2030	$2.42	$8.45	28.6%	$54.25	$40.15	$14.10	($0.70)	74.0%	$0.61	$4.58	4.4%
2029	2030/2031	$2.43	$8.69	28.0%	$54.36	$41.00	$13.36	($0.74)	75.4%	$0.62	$4.69	4.5%
2030	2031/2032	$2.45	$8.93	27.4%	$54.45	$41.88	$12.56	($0.79)	76.9%	$0.63	$4.74	4.5%
2031	2032/2033	$2.48	$9.18	27.0%	$54.48	$42.77	$11.72	($0.85)	78.5%	$0.64	$4.82	4.5%
2032	2033/2034	$2.51	$9.44	26.6%	$54.47	$43.66	$10.81	($0.91)	80.2%	$0.66	$4.89	4.5%
2033	2034/2035	$2.54	$9.71	26.2%	$54.42	$44.60	$9.82	($0.99)	82.0%	$0.67	$4.95	4.5%
2034	2035/2036	$2.56	$9.98	25.7%	$54.34	$45.58	$8.76	($1.06)	83.9%	$0.68	$5.01	4.4%
2035	2036/2037	$2.59	$10.26	25.2%	$54.23	$46.62	$7.61	($1.15)	86.0%	$0.69	$5.07	4.4%
2036	2037/2038	$2.62	$10.54	24.9%	$54.11	$47.74	$6.37	($1.24)	88.2%	$0.71	$5.11	4.3%
2037	2038/2039	$2.65	$10.84	24.4%	$53.94	$48.90	$5.04	($1.33)	90.7%	$0.72	$5.19	4.3%
2038	2039/2040	$2.68	$11.14	24.1%	$53.74	$50.13	$3.61	($1.43)	93.3%	$0.74	$5.23	4.2%
2039	2040/2041	$2.25	$11.45	19.7%	$53.51	$51.43	$2.08	($1.54)	96.1%	$0.75	$5.30	4.6%

Table 2 – Full Funding Scenario Projection of Results

(Dollars in Billions)

Calendar Year	Fiscal Year	Employer Contrib.	Payroll	Employer Contrib. Rate	Actuarial Accrued Liability	Assets	Unfunded Actuarial Accrued Liability	Change in Unfunded Liability from Prior Year	Funded Ratio	Service Cost	Benefit Payments	Ratio of Net Cash Flow to Assets
2019	2020/2021	$2.24	$6.66	33.6%	$52.94	$29.91	$23.04	-	56.5%	$0.11	$3.59	3.3%
2020	2021/2022	$2.29	$6.78	33.8%	$54.68	$31.07	$23.62	$0.58	56.8%	$0.10	$3.70	3.3%
2021	2022/2023	$2.42	$6.97	34.7%	$51.52	$32.21	$19.31	($4.31)	62.5%	$0.56	$3.82	3.3%
2022	2023/2024	$2.46	$7.16	34.4%	$52.07	$32.83	$19.23	($0.08)	63.1%	$0.57	$3.94	3.3%
2023	2024/2025	$2.46	$7.36	33.4%	$52.59	$34.01	$18.57	($0.66)	64.7%	$0.57	$4.06	3.5%
2024	2025/2026	$2.52	$7.57	33.3%	$53.07	$34.41	$18.66	$0.09	64.8%	$0.58	$4.17	3.7%
2025	2026/2027	$2.59	$7.78	33.3%	$53.46	$34.71	$18.75	$0.09	64.9%	$0.59	$4.27	3.8%
2026	2027/2028	$2.66	$8.00	33.3%	$53.80	$34.96	$18.83	$0.08	65.0%	$0.60	$4.37	3.8%
2027	2028/2029	$2.74	$8.22	33.3%	$54.06	$35.17	$18.88	$0.05	65.1%	$0.60	$4.48	3.9%
2028	2029/2030	$2.81	$8.45	33.3%	$54.25	$35.35	$18.89	$0.01	65.2%	$0.61	$4.58	3.9%
2029	2030/2031	$2.89	$8.69	33.3%	$54.36	$35.51	$18.86	($0.04)	65.3%	$0.62	$4.69	4.0%
2030	2031/2032	$2.97	$8.93	33.3%	$54.45	$35.69	$18.76	($0.10)	65.6%	$0.63	$4.74	3.9%
2031	2032/2033	$3.06	$9.18	33.3%	$54.48	$35.89	$18.59	($0.16)	65.9%	$0.64	$4.82	3.8%
2032	2033/2034	$3.15	$9.44	33.4%	$54.47	$36.11	$18.35	($0.24)	66.3%	$0.66	$4.89	3.8%
2033	2034/2035	$3.24	$9.71	33.4%	$54.42	$36.39	$18.03	($0.32)	66.9%	$0.67	$4.95	3.6%
2034	2035/2036	$3.33	$9.98	33.4%	$54.34	$36.73	$17.61	($0.42)	67.6%	$0.68	$5.01	3.5%
2035	2036/2037	$3.42	$10.26	33.3%	$54.23	$37.13	$17.10	($0.51)	68.5%	$0.69	$5.07	3.4%
2036	2037/2038	$3.52	$10.54	33.4%	$54.11	$37.63	$16.48	($0.62)	69.5%	$0.71	$5.11	3.2%
2037	2038/2039	$3.61	$10.84	33.3%	$53.94	$38.18	$15.76	($0.72)	70.8%	$0.72	$5.19	3.1%
2038	2039/2040	$3.71	$11.14	33.3%	$53.74	$38.82	$14.92	($0.84)	72.2%	$0.74	$5.23	2.9%
2039	2040/2041	$3.34	$11.45	29.2%	$53.51	$39.55	$13.96	($0.96)	73.9%	$0.75	$5.30	3.3%

Table 3 – Limited Funding Scenario Projection of Results

(Dollars in Billions)

Calendar Year	Fiscal Year	Employer Contrib.	Payroll	Employer Contrib. Rate	Actuarial Accrued Liability	Assets	Unfunded Actuarial Accrued Liability	Change in Unfunded Liability from Prior Year	Funded Ratio	Service Cost	Benefit Payments	Ratio of Net Cash Flow to Assets
2019	2020/2021	$2.24	$6.66	33.6%	$52.94	$29.91	$23.03	-	56.5%	$0.11	$3.59	3.3%
2020	2021/2022	$2.32	$6.78	34.2%	$54.68	$31.06	$23.62	$0.59	56.8%	$0.10	$3.70	3.3%
2021	2022/2023	$2.40	$6.97	34.4%	$51.52	$32.20	$19.32	($4.30)	62.5%	$0.56	$3.82	3.3%
2022	2023/2024	$2.48	$7.16	34.6%	$52.07	$32.85	$19.21	($0.11)	63.1%	$0.57	$3.94	3.3%
2023	2024/2025	$2.57	$7.36	34.9%	$52.59	$34.02	$18.56	($0.65)	64.7%	$0.57	$4.06	3.3%
2024	2025/2026	$2.66	$7.57	35.1%	$53.07	$34.44	$18.63	$0.06	64.9%	$0.58	$4.17	3.3%
2025	2026/2027	$2.75	$7.78	35.3%	$53.46	$34.80	$18.66	$0.03	65.1%	$0.59	$4.27	3.3%
2026	2027/2028	$2.84	$8.00	35.5%	$53.80	$35.07	$18.72	$0.06	65.2%	$0.60	$4.37	3.3%
2027	2028/2029	$2.93	$8.22	35.6%	$54.06	$35.35	$18.70	($0.02)	65.4%	$0.60	$4.48	3.3%
2028	2029/2030	$3.03	$8.45	35.9%	$54.25	$35.64	$18.61	($0.10)	65.7%	$0.61	$4.58	3.3%
2029	2030/2031	$3.13	$8.69	36.0%	$54.36	$35.82	$18.54	($0.07)	65.9%	$0.62	$4.69	3.3%
2030	2031/2032	$3.24	$8.93	36.3%	$54.45	$36.10	$18.35	($0.19)	66.3%	$0.63	$4.74	3.1%
2031	2032/2033	$3.35	$9.18	36.5%	$54.48	$36.39	$18.09	($0.26)	66.8%	$0.64	$4.82	3.0%
2032	2033/2034	$3.46	$9.44	36.7%	$54.47	$36.71	$17.76	($0.33)	67.4%	$0.66	$4.89	2.9%
2033	2034/2035	$3.57	$9.71	36.8%	$54.42	$37.11	$17.31	($0.45)	68.2%	$0.67	$4.95	2.7%
2034	2035/2036	$3.69	$9.98	37.0%	$54.34	$37.55	$16.79	($0.51)	69.1%	$0.68	$5.01	2.5%
2035	2036/2037	$3.81	$10.26	37.1%	$54.23	$38.02	$16.21	($0.58)	70.1%	$0.69	$5.07	2.3%
2036	2037/2038	$3.94	$10.54	37.4%	$54.11	$38.63	$15.48	($0.74)	71.4%	$0.71	$5.11	2.0%
2037	2038/2039	$4.07	$10.84	37.5%	$53.94	$39.21	$14.72	($0.75)	72.7%	$0.72	$5.19	1.9%
2038	2039/2040	$4.20	$11.14	37.7%	$53.74	$39.93	$13.81	($0.91)	74.3%	$0.74	$5.23	1.6%
2039	2040/2041	$4.34	$11.45	37.9%	$53.51	$40.67	$12.84	($0.97)	76.0%	$0.75	$5.30	1.4%

4.3 Effect of Limited Employer Contributions Due to a Large Investment Loss

The Investment Risks Section includes a stress test to assess the effect of future investment performance assuming SERS employers continue to contribute the full Actuarially Determined Contribution (ADC). However, if there is a large investment loss during a single calendar year, there is an additional risk that SERS employers would be unable to adjust their budgets to meet the increases in the ADC without adversely impacting their ability to meet the critical needs of the Commonwealth.

The following scenarios provide the projected effects of a large investment loss assuming various employer contribution patterns:

Baseline – Investment returns are equal to the assumed investment return throughout the 20-year period. All employers contribute the ADC in each year of the 20-year period.

Full Funding Scenario – The investment return for Calendar Year 2020 is -20%. For the remainder of the 20-year period, the investment returns are equal to the assumed investment return rate. All employers contribute the ADC in each year of the 20-year period.

Limited Funding Scenario – The investment return for Calendar Year 2020 is -20%. For the remainder of the 20-year period, the investment returns are equal to the assumed investment return rate. Employers contribute all required contributions to the Defined Contribution Plan in each year of the 20-year period; however, after Fiscal Year 2020/2021, the annual rate of growth of employer contributions to the Defined Benefit Plan is limited to the 3.2% per year average projected rate of State revenue growth.

The investment return rates used by calendar year are provided in the following schedule:

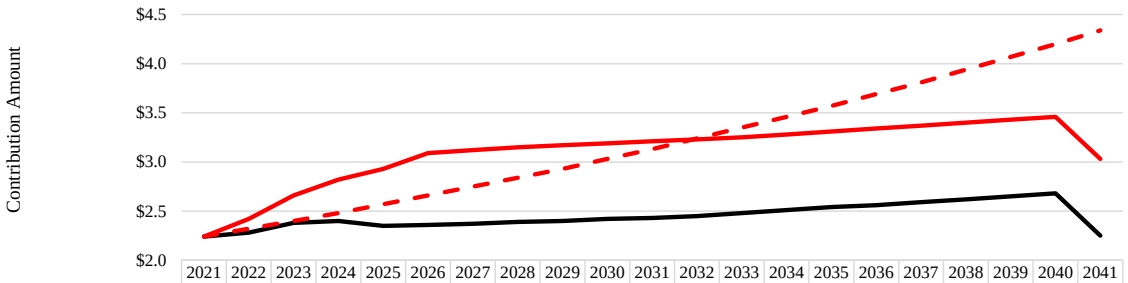
Calendar Year	Baseline	Full Funding Scenario	Limited Funding Scenario
2020*	7.125%	-20.000%	-20.000%
2021-2039	7.000%	7.000%	7.000%

*The scenarios are based on the assumed investment return rate for Calendar Year 2020 of 7.125% and do not reflect any actual 2020 investment performance. Pursuant to action taken by the SERS Board at its June 2020 meeting, the assumed investment return rate was reduced to 7.000% effective with the December 31, 2020 actuarial valuation.

Effect on the Actuarially Determined Contribution (ADC)

Chart 1 provides the projected contribution amounts by Fiscal Year for each scenario. The large loss is assumed to occur during Calendar Year 2020, would first be recognized in the December 31, 2020 actuarial valuation and would first be reflected as an increase to the ADC in Fiscal Year 2021/2022.

Chart 1
Effect of Large Investment Loss
Projected Contributions
($ Billions; Contributions for Fiscal Year Ending)



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Baseline	2.24	2.28	2.38	2.40	2.35	2.36	2.37	2.39	2.40	2.42	2.43	2.45	2.48	2.51	2.54	2.56	2.59	2.62	2.65	2.68	2.25
Full Funding Scenario	2.24	2.42	2.66	2.82	2.93	3.09	3.12	3.15	3.17	3.19	3.21	3.23	3.25	3.28	3.31	3.34	3.37	3.40	3.43	3.46	3.03
Limited Funding Scenario	2.24	2.32	2.40	2.48	2.57	2.66	2.75	2.84	2.93	3.03	3.13	3.24	3.35	3.46	3.57	3.69	3.81	3.94	4.07	4.20	4.34

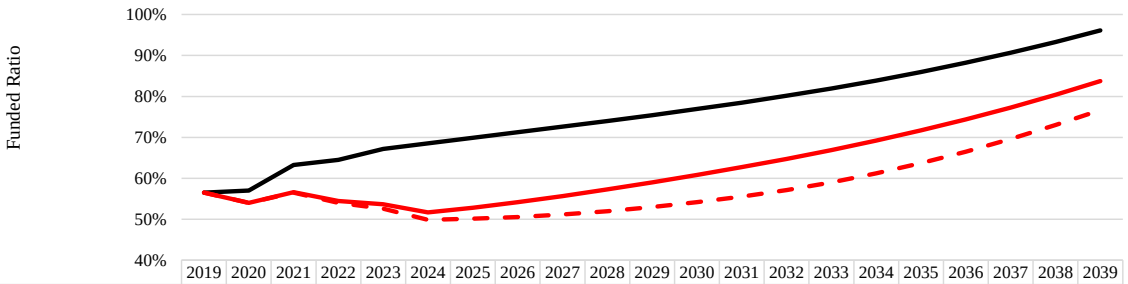
While SERS' 5-year asset smoothing method, which causes the hypothetical -20% return experienced in Calendar Year 2020 to be recognized over a 5-year period, dampens the effect on the ADC, the large investment loss causes the December 31, 2020 market value of assets to be $8.29 billion less as compared to the baseline. This shortfall will need to be funded through additional employer contributions. The ADC is adjusted for the shortfall and results in significantly higher contributions in the "Full Funding Scenario" compared to the baseline.

The "Limited Funding Scenario" would not generate sufficient increases in employer contributions to fund the ADC. Although contributions under the "Limited Funding Scenario" would gradually recover to the level under the "Full Funding Scenario" by Fiscal Year 2031/2032 and even be substantially higher by Fiscal Year 2040/2041, the lower contributions in the earlier years create a funding deficiency. The funding deficiency is shown by analyzing the effect on the funded ratio. Analysis of the effect on the funded ratio is provided in the following section. Detailed projections of the results are provided in Table 1 (Baseline), Table 2 (Full Funding Scenario), and Table 3 (Limited Funding Scenario), which follow the "Conclusions" section.

Effect on Funded Ratio

Chart 2 provides the projected funded ratios by Calendar Year for each scenario. The loss is assumed to occur during Calendar Year 2020 and would first be recognized as a reduction to the funded ratio in the December 31, 2020 actuarial valuation.

Chart 2
Effect of Large Investment Loss
Projected Funded Ratios
(Funded Ratio as of December 31)



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Baseline	56%	57%	63%	65%	67%	69%	70%	71%	73%	74%	75%	77%	78%	80%	82%	84%	86%	88%	91%	93%	96%
Full Funding Scenario	56%	54%	57%	54%	54%	52%	53%	54%	56%	57%	59%	61%	63%	65%	67%	69%	72%	74%	77%	80%	84%
Limited Funding Scenario	56%	54%	57%	54%	53%	50%	50%	51%	51%	52%	53%	54%	56%	57%	59%	61%	64%	67%	70%	73%	77%

Again, SERS' 5-year asset smoothing method, which causes the hypothetical -20% return experienced in Calendar Year 2020 to be recognized over a 5-year period, dampens the effect on the funded ratio. The hypothetical large investment loss causes the December 31, 2024 funded ratio to decrease to 52%, substantially lower than the baseline December 31, 2024 funded ratio of 69% and the December 31, 2019 funded ratio of 56% before the investment loss occurred.

The Actuarially Determined Contribution (ADC) is adjusted to reflect the large investment loss and is contributed in the "Full Funding Scenario". These increased contributions cause the funded ratio to increase much more rapidly compared to the "Limited Funding Scenario" funded ratio. Although the December 31, 2039 funded ratio of 84% under the "Full Funding Scenario" is below the baseline funded ratio of 96%, it is substantially higher than the "Limited Funding Scenario" funded ratio of 77%. The funding deficiency under the "Limited Funding Scenario" causes the projected unfunded liability as of December 31, 2039 to be $3.79 billion higher than the unfunded liability under the "Full Funding Scenario". The ADC is designed to reflect investment performance and fully fund member benefits. Limited funding can substantially increase the future contributions needed to fund member benefits. Detailed projections of the results are provided in Table 1 (Baseline), Table 2 (Full Funding Scenario), and Table 3 (Limited Funding Scenario), which follow the "Conclusions" section.

Conclusions

A large investment loss in a given year will have a substantial impact on the employer contributions needed to fund benefits, the unfunded liability and the funded ratio. Our analyses of these scenarios have shown:

1. Although the Actuarially Determined Contribution (ADC) is designed to provide relatively predictable and stable contribution patterns, adjustments are required to reflect actual investment performance and to ensure member benefits are fully funded. When the ADC is not fully contributed, even though contribution levels are stable, as they are under the "Limited Funding Scenario", there is a funding deficiency that can substantially increase the future contributions needed to fund member benefits.

2. Each dollar of shortfall between the amount contributed and the ADC immediately increases the unfunded liability and reduces the funded ratio. By December 31, 2039, reduced contributions under the "Limited Funding Scenario" would increase the total unfunded liability by $3.79 billion compared to the "Full Funding Scenario".

3. A large investment loss could substantially reduce the funded ratio. In this scenario, the hypothetical -20% return in Calendar Year 2020 would cause the funded ratio to be as low as 52% in 2024. The calculation of the ADC reflects investment performance and would increase substantially to fund the investment shortfall. If the ADC is contributed each year, the funded ratio would be expected to return to 56%, the December 31, 2019 funded ratio just prior to the large investment loss, by December 31, 2027.

Table 1 – Baseline Projection of Results

(Dollars in Billions)

Calendar Year	Fiscal Year	Employer Contrib.	Payroll	Employer Contrib. Rate	Actuarial Accrued Liability	Assets	Unfunded Actuarial Accrued Liability	Change in Unfunded Liability from Prior Year	Funded Ratio	Service Cost	Benefit Payments	Ratio of Net Cash Flow to Assets
2019	2020/2021	$2.24	$6.66	33.6%	$52.94	$29.91	$23.04	-	56.5%	$0.11	$3.59	3.3%
2020	2021/2022	$2.28	$6.78	33.6%	$54.68	$31.19	$23.49	$0.45	57.0%	$0.10	$3.70	3.3%
2021	2022/2023	$2.38	$6.97	34.1%	$51.52	$32.59	$18.93	($4.56)	63.3%	$0.56	$3.82	3.3%
2022	2023/2024	$2.40	$7.16	33.5%	$52.07	$33.60	$18.47	($0.47)	64.5%	$0.57	$3.94	3.4%
2023	2024/2025	$2.35	$7.36	31.9%	$52.59	$35.31	$17.28	($1.19)	67.1%	$0.57	$4.06	3.6%
2024	2025/2026	$2.36	$7.57	31.2%	$53.07	$36.38	$16.69	($0.59)	68.6%	$0.58	$4.17	3.9%
2025	2026/2027	$2.37	$7.78	30.5%	$53.46	$37.38	$16.08	($0.60)	69.9%	$0.59	$4.27	4.0%
2026	2027/2028	$2.39	$8.00	29.9%	$53.80	$38.34	$15.46	($0.63)	71.3%	$0.60	$4.37	4.1%
2027	2028/2029	$2.40	$8.22	29.2%	$54.06	$39.26	$14.79	($0.66)	72.6%	$0.60	$4.48	4.3%
2028	2029/2030	$2.42	$8.45	28.6%	$54.25	$40.15	$14.10	($0.70)	74.0%	$0.61	$4.58	4.4%
2029	2030/2031	$2.43	$8.69	28.0%	$54.36	$41.00	$13.36	($0.74)	75.4%	$0.62	$4.69	4.5%
2030	2031/2032	$2.45	$8.93	27.4%	$54.45	$41.88	$12.56	($0.79)	76.9%	$0.63	$4.74	4.5%
2031	2032/2033	$2.48	$9.18	27.0%	$54.48	$42.77	$11.72	($0.85)	78.5%	$0.64	$4.82	4.5%
2032	2033/2034	$2.51	$9.44	26.6%	$54.47	$43.66	$10.81	($0.91)	80.2%	$0.66	$4.89	4.5%
2033	2034/2035	$2.54	$9.71	26.2%	$54.42	$44.60	$9.82	($0.99)	82.0%	$0.67	$4.95	4.5%
2034	2035/2036	$2.56	$9.98	25.7%	$54.34	$45.58	$8.76	($1.06)	83.9%	$0.68	$5.01	4.4%
2035	2036/2037	$2.59	$10.26	25.2%	$54.23	$46.62	$7.61	($1.15)	86.0%	$0.69	$5.07	4.4%
2036	2037/2038	$2.62	$10.54	24.9%	$54.11	$47.74	$6.37	($1.24)	88.2%	$0.71	$5.11	4.3%
2037	2038/2039	$2.65	$10.84	24.4%	$53.94	$48.90	$5.04	($1.33)	90.7%	$0.72	$5.19	4.3%
2038	2039/2040	$2.68	$11.14	24.1%	$53.74	$50.13	$3.61	($1.43)	93.3%	$0.74	$5.23	4.2%
2039	2040/2041	$2.25	$11.45	19.7%	$53.51	$51.43	$2.08	($1.54)	96.1%	$0.75	$5.30	4.6%

Table 2 – Full Funding Scenario Projection of Results

(Dollars in Billions)

Calendar Year	Fiscal Year	Employer Contrib.	Payroll	Employer Contrib. Rate	Actuarial Accrued Liability	Assets	Unfunded Actuarial Accrued Liability	Change in Unfunded Liability from Prior Year	Funded Ratio	Service Cost	Benefit Payments	Ratio of Net Cash Flow to Assets
2019	2020/2021	$2.24	$6.66	33.6%	$52.94	$29.91	$23.04	-	56.5%	$0.11	$3.59	3.3%
2020	2021/2022	$2.42	$6.78	35.7%	$54.68	$29.53	$25.15	$2.11	54.0%	$0.10	$3.70	3.3%
2021	2022/2023	$2.66	$6.97	38.2%	$51.52	$29.17	$22.35	($2.80)	56.6%	$0.56	$3.82	3.0%
2022	2023/2024	$2.82	$7.16	39.4%	$52.07	$28.36	$23.71	$1.35	54.5%	$0.57	$3.94	2.8%
2023	2024/2025	$2.93	$7.36	39.8%	$52.59	$28.21	$24.37	$0.67	53.7%	$0.57	$4.06	2.8%
2024	2025/2026	$3.09	$7.57	40.8%	$53.07	$27.42	$25.65	$1.28	51.7%	$0.58	$4.17	2.7%
2025	2026/2027	$3.12	$7.78	40.1%	$53.46	$28.23	$25.23	($0.42)	52.8%	$0.59	$4.27	2.7%
2026	2027/2028	$3.15	$8.00	39.4%	$53.80	$29.14	$24.66	($0.58)	54.2%	$0.60	$4.37	2.8%
2027	2028/2029	$3.17	$8.22	38.6%	$54.06	$30.09	$23.96	($0.69)	55.7%	$0.60	$4.48	3.0%
2028	2029/2030	$3.19	$8.45	37.8%	$54.25	$31.08	$23.17	($0.79)	57.3%	$0.61	$4.58	3.2%
2029	2030/2031	$3.21	$8.69	36.9%	$54.36	$32.07	$22.29	($0.88)	59.0%	$0.62	$4.69	3.3%
2030	2031/2032	$3.23	$8.93	36.2%	$54.45	$33.12	$21.33	($0.95)	60.8%	$0.63	$4.74	3.3%
2031	2032/2033	$3.25	$9.18	35.4%	$54.48	$34.17	$20.31	($1.02)	62.7%	$0.64	$4.82	3.4%
2032	2033/2034	$3.28	$9.44	34.7%	$54.47	$35.26	$19.21	($1.10)	64.7%	$0.66	$4.89	3.4%
2033	2034/2035	$3.31	$9.71	34.1%	$54.42	$36.40	$18.02	($1.19)	66.9%	$0.67	$4.95	3.3%
2034	2035/2036	$3.34	$9.98	33.5%	$54.34	$37.61	$16.73	($1.28)	69.2%	$0.68	$5.01	3.3%
2035	2036/2037	$3.37	$10.26	32.8%	$54.23	$38.88	$15.35	($1.38)	71.7%	$0.69	$5.07	3.3%
2036	2037/2038	$3.40	$10.54	32.3%	$54.11	$40.25	$13.86	($1.49)	74.4%	$0.71	$5.11	3.2%
2037	2038/2039	$3.43	$10.84	31.6%	$53.94	$41.68	$12.26	($1.60)	77.3%	$0.72	$5.19	3.2%
2038	2039/2040	$3.46	$11.14	31.1%	$53.74	$43.20	$10.54	($1.72)	80.4%	$0.74	$5.23	3.1%
2039	2040/2041	$3.03	$11.45	26.5%	$53.51	$44.81	$8.70	($1.84)	83.7%	$0.75	$5.30	3.6%

Table 3 – Limited Funding Scenario Projection of Results

(Dollars in Billions)

Calendar Year	Fiscal Year	Employer Contrib.	Payroll	Employer Contrib. Rate	Actuarial Accrued Liability	Assets	Unfunded Actuarial Accrued Liability	Change in Unfunded Liability from Prior Year	Funded Ratio	Service Cost	Benefit Payments	Ratio of Net Cash Flow to Assets
2019	2020/2021	$2.24	$6.66	33.6%	$52.94	$29.91	$23.04	-	56.5%	$0.11	$3.59	3.3%
2020	2021/2022	$2.32	$6.78	34.2%	$54.68	$29.53	$25.15	$2.11	54.0%	$0.10	$3.70	3.4%
2021	2022/2023	$2.40	$6.97	34.4%	$51.52	$29.12	$22.40	($2.75)	56.5%	$0.56	$3.82	3.6%
2022	2023/2024	$2.48	$7.16	34.6%	$52.07	$28.12	$23.94	$1.54	54.0%	$0.57	$3.94	3.9%
2023	2024/2025	$2.57	$7.36	34.9%	$52.59	$27.66	$24.93	$0.99	52.6%	$0.57	$4.06	4.1%
2024	2025/2026	$2.66	$7.57	35.1%	$53.07	$26.46	$26.60	$1.68	49.9%	$0.58	$4.17	4.3%
2025	2026/2027	$2.75	$7.78	35.3%	$53.46	$26.80	$26.66	$0.06	50.1%	$0.59	$4.27	4.3%
2026	2027/2028	$2.84	$8.00	35.5%	$53.80	$27.19	$26.60	($0.06)	50.5%	$0.60	$4.37	4.3%
2027	2028/2029	$2.93	$8.22	35.6%	$54.06	$27.66	$26.40	($0.21)	51.2%	$0.60	$4.48	4.3%
2028	2029/2030	$3.03	$8.45	35.9%	$54.25	$28.19	$26.05	($0.34)	52.0%	$0.61	$4.58	4.2%
2029	2030/2031	$3.13	$8.69	36.0%	$54.36	$28.79	$25.57	($0.48)	53.0%	$0.62	$4.69	4.1%
2030	2031/2032	$3.24	$8.93	36.3%	$54.45	$29.48	$24.97	($0.61)	54.1%	$0.63	$4.74	3.8%
2031	2032/2033	$3.35	$9.18	36.5%	$54.48	$30.26	$24.23	($0.74)	55.5%	$0.64	$4.82	3.6%
2032	2033/2034	$3.46	$9.44	36.7%	$54.47	$31.13	$23.34	($0.89)	57.1%	$0.66	$4.89	3.4%
2033	2034/2035	$3.57	$9.71	36.8%	$54.42	$32.12	$22.30	($1.04)	59.0%	$0.67	$4.95	3.1%
2034	2035/2036	$3.69	$9.98	37.0%	$54.34	$33.25	$21.09	($1.21)	61.2%	$0.68	$5.01	2.8%
2035	2036/2037	$3.81	$10.26	37.1%	$54.23	$34.54	$19.69	($1.40)	63.7%	$0.69	$5.07	2.5%
2036	2037/2038	$3.94	$10.54	37.4%	$54.11	$35.99	$18.12	($1.57)	66.5%	$0.71	$5.11	2.2%
2037	2038/2039	$4.07	$10.84	37.5%	$53.94	$37.55	$16.39	($1.73)	69.6%	$0.72	$5.19	2.0%
2038	2039/2040	$4.20	$11.14	37.7%	$53.74	$39.23	$14.51	($1.88)	73.0%	$0.74	$5.23	1.6%
2039	2040/2041	$4.34	$11.45	37.9%	$53.51	$41.02	$12.49	($2.02)	76.7%	$0.75	$5.30	1.4%

4.4 Effect of Funding in Excess of the Actuarially Determined Contribution

It is the SERS funding policy to fully fund the Actuarially Determined Contribution (ADC), the annual employer contribution calculated by the actuary based on a defined actuarial cost method, asset valuation method and amortization method. Developing an ADC each year serves two primary purposes:

1. Ensures assets are accumulated to pay all benefits when due to members

2. Provides a relatively predictable and stable pattern of contributions to assist with budgeting

If, in any year, SERS employers fund amounts in excess of the ADC, the excess contribution amount is treated as an actuarial experience gain. Although the excess contribution amount is immediately recognized in the SERS assets, the gain is combined with all other sources of actuarial gains and losses that occurred in that same period, and the net amount is amortized over 30 years.

Contributing amounts in excess of the ADC results in numerous advantages, including:

- Immediate dollar-for-dollar increase in the SERS assets, and therefore a reduction of the same magnitude in the unfunded actuarial accrued liability,
- Decrease in future ADC amounts, thus providing some degree of relief for future budgets and
- Immediate increase in future funded ratios

Although funding in excess of the ADC is not generally expected, the following scenarios provide the projected effects of temporarily funding in excess of the ADC:

Baseline – All employers contribute the ADC in each year of the 20-year period.

Scenario Contribution – Employers collectively contribute $100 million in excess of the ADC in each of the first 10 years of the projection, then contribute the ADC for the remainder of the period. The contributions made are summarized in the following schedule:

Fiscal Year	Amount Contributed
2020/2021 through 2029/2030	ADC + $100 million
2030/2031 through 2040/2041	ADC

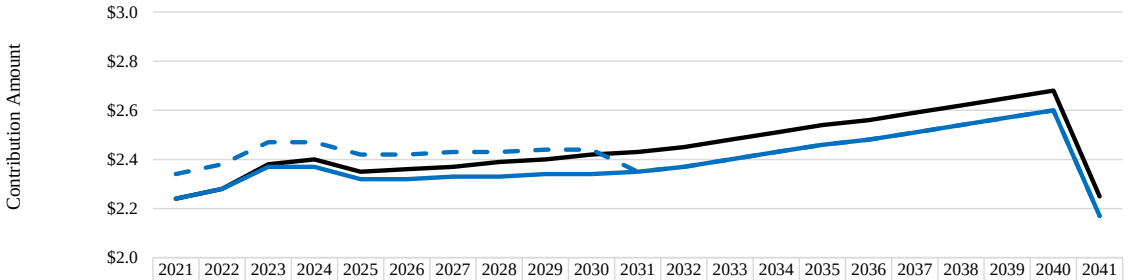
This scenario reflects 10 years of contributions in excess of the ADC followed by 10 years of contributions equal to the ADC.

Scenario ADC – The Actuarially Determined Contribution (ADC) reflecting the additional funding provided in the Scenario Contribution.

Effect on Actuarially Determined Contribution (ADC)

Chart 1 provides the sensitivity of the Actuarially Determined Contribution (ADC) to contributing amounts in excess of the ADC. The additional funding during Fiscal Year 2020/2021 through Fiscal Year 2029/2030 in this scenario increases SERS assets and decreases the SERS unfunded actuarial liabilities relative to the baseline. These lower unfunded liabilities cause the Scenario ADC to decrease relative to the baseline.

Chart 1
Funding in Excess of the Actuarially Determined Contribution (ADC)
Effect on ADC
($ Billions; ADC for Fiscal Year Ending)



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Baseline	2.24	2.28	2.38	2.40	2.35	2.36	2.37	2.39	2.40	2.42	2.43	2.45	2.48	2.51	2.54	2.56	2.59	2.62	2.65	2.68	2.25
Scenario Contribution	2.34	2.38	2.47	2.47	2.42	2.42	2.43	2.43	2.44	2.44	2.35	2.37	2.40	2.43	2.46	2.48	2.51	2.54	2.57	2.60	2.17
Scenario ADC	2.24	2.28	2.37	2.37	2.32	2.32	2.33	2.33	2.34	2.34	2.35	2.37	2.40	2.43	2.46	2.48	2.51	2.54	2.57	2.60	2.17

The accumulated effect of the extra funding for Fiscal Year 2020/2021 through Fiscal Year 2029/2030 results in:

- An increase of about $1 billion (or about 2.4%) in SERS assets and, therefore, a decrease of about $1 billion in the SERS unfunded actuarial liability relative to the baseline.
- A decrease in the Fiscal Year 2030/2031 ADC by about $80 million (or about 3.3%), from $2.43 billion under the baseline to $2.35 billion under the Scenario ADC. The decreased ADC continues throughout the projection period.

The extra funding also reduces the future burden for employers since the Scenario ADC represents a smaller percentage of member funding payroll in future periods. Table 1 provides the effect of the extra funding on the future contribution rates (ADC Rate) as a percentage of payroll.

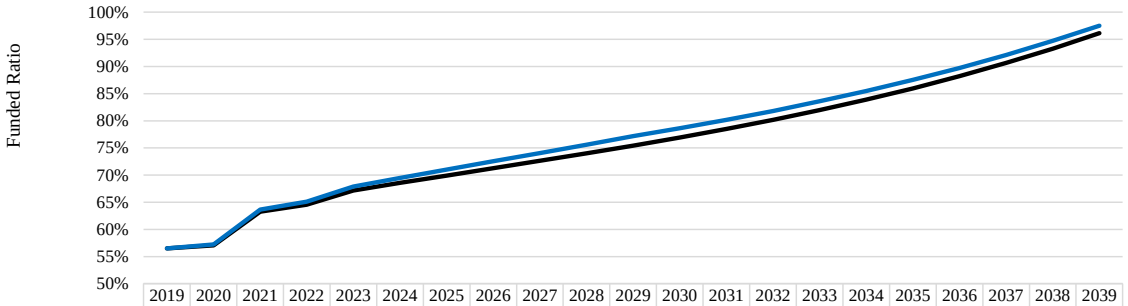
Table 1 –Projected ADC, Funding Payroll and Contribution Rates (ADC Rate)
(Dollars in Billions)

	Baseline			Scenario ADC		
Fiscal Year Ending (1)	ADC (2)	Payroll (3)	ADC Rate (4)	ADC (5)	Payroll (6)	ADC Rate (7)
2021	$2.24	$6.66	33.6%	$2.24	$6.66	33.6%
2022	$2.28	$6.78	33.6%	$2.28	$6.78	33.6%
2023	$2.38	$6.97	34.1%	$2.37	$6.97	34.0%
2024	$2.40	$7.16	33.5%	$2.37	$7.16	33.1%
2025	$2.35	$7.36	31.9%	$2.32	$7.36	31.5%
2026	$2.36	$7.57	31.2%	$2.32	$7.57	30.6%
2027	$2.37	$7.78	30.5%	$2.33	$7.78	29.9%
2028	$2.39	$8.00	29.9%	$2.33	$8.00	29.1%
2029	$2.40	$8.22	29.2%	$2.34	$8.22	28.5%
2030	$2.42	$8.45	28.6%	$2.34	$8.45	27.7%
2031	$2.43	$8.69	28.0%	$2.35	$8.69	27.0%
2032	$2.45	$8.93	27.4%	$2.37	$8.93	26.5%
2033	$2.48	$9.18	27.0%	$2.40	$9.18	26.1%
2034	$2.51	$9.44	26.6%	$2.43	$9.44	25.7%
2035	$2.54	$9.71	26.2%	$2.46	$9.71	25.3%
2036	$2.56	$9.98	25.7%	$2.48	$9.98	24.8%
2037	$2.59	$10.26	25.2%	$2.51	$10.26	24.5%
2038	$2.62	$10.54	24.9%	$2.54	$10.54	24.1%
2039	$2.65	$10.84	24.4%	$2.57	$10.84	23.7%
2040	$2.68	$11.14	24.1%	$2.60	$11.14	23.3%
2041	$2.25	$11.45	19.7%	$2.17	$11.45	19.0%

Effect on Funded Ratio

Chart 2 provides the sensitivity of the funded ratio to funding in excess of the ADC. The extra funding for Fiscal Year 2020/2021 through Fiscal Year 2029/2030 in this scenario increases the SERS assets relative to the baseline. These larger asset values cause the Scenario Funded Ratio to increase relative to the baseline funded ratio.

Chart 2
Funding in Excess of the Actuarially Determined Contribution (ADC)
Effect on Funded Ratio
(Funded Ratio as of December 31)



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Baseline	56%	57%	63%	65%	67%	69%	70%	71%	73%	74%	75%	77%	78%	80%	82%	84%	86%	88%	91%	93%	96%
Scenario Funded Ratio	56%	57%	64%	65%	68%	69%	71%	73%	74%	76%	77%	79%	80%	82%	84%	85%	88%	90%	92%	95%	98%

The extra funding for Fiscal Year 2020/2021 through Fiscal Year 2029/2030 in this scenario causes the December 31, 2030 funded ratio to increase to 79%, higher than the baseline December 31, 2030 funded ratio of 77% and the December 31, 2019 funded ratio of 56% before the extra funding began.

The effect on the funded ratio continues until the extra funding is fully amortized over the 30-year period. The December 31, 2039 funded ratio reflecting the extra funding is 98%, slightly higher than the baseline December 31, 2039 funded ratio of 96%. The Scenario Funded Ratio would not return to the baseline value until December 31, 2061, when the amortization credit for the extra funding is fully amortized.

Conclusions

Even temporary periods of contributing amounts in excess of the ADC can have favorable effects on both the future contribution burden and the funded ratio. This hypothetical scenario of extra contributions has shown:

1. The $1.0 billion of extra contributions over the 10-year period decreased future annual employer contributions by as much as $80 million (or 1.0% of payroll) in a single year and decreased the total future contributions by about $2.4 billion.

2. Each dollar of excess between the amount contributed and the baseline ADC immediately decreases the unfunded liability and increases the funded ratio. The funded ratio is expected to steadily increase in the baseline scenario from 56% in 2019 to 96% in 2039. In the extra funding scenario, the funded ratio is expected to exceed the baseline funded ratio by 1-2% throughout the period from December 31, 2021 through December 31, 2039.

3. The ADC is designed to provide relatively predictable and stable contribution patterns. When actual contributions exceed the ADC, the resulting decrease in future ADC amounts provides a degree of relief to employers in meeting future budgets.

   A noteworthy example of SERS employers contributing in excess of the ADC comes from one of the provisions of Act 2017-5, the recent Pennsylvania pension reform legislation. Act 2017-5 (Act 5) included a "plow-back" financing feature whereby, in order to accelerate the funding of SERS, in any future year in which there was projected to be savings as a result of this legislation, additional employer contributions equal to the amount of that annual savings would be assessed as a percentage of all covered compensation. By "plowing back" into the SERS fund many years of projected savings, rather than using that savings to meet non-pension obligations, the funding of SERS is enhanced, in the form of an accelerated decline in the SERS unfunded actuarial accrued liability and an accelerated increase in the SERS funded ratio. Therefore, out of a period of 23 fiscal years following the enactment of Act 5 (through Fiscal Year 2041/2042), additional employer contribution amounts (ranging from as low as 0.10% to as high as 0.93% of covered payroll) are now mandated under law for 13 of those fiscal years.

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