VRS Stress Test and Sensitivity Analysis

Report to the General Assembly of Virginia

December 2022 Virginia Retirement System

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STRESS TEST AND SENSITIVITY ANALYSIS MANDATE

Section 51.1-124.30:1 of the *Code of Virginia* requires the Virginia Retirement System (VRS) to formally adopt a policy to regularly report sensitivity and stress testing analyses for members of the General Assembly (Appendix) . The analyses shall include projections of benefit levels, pension costs, liabilities, and debt reduction under various economic and investment scenarios.

Stress testing, also known as scenario testing, is an analysis or simulation designed to measure the effect on the plans of various projected, generally adverse, investment and actuarial events.

Sensitivity testing examines the effect on the plan of different actuarial assumptions and methods.

This report provides an analysis of the potential impact of various scenarios and hypothetical situations on VRS-administered retirement plans and supports transparency with regard to the future health of the retirement system.

It should be noted that when VRS examines future potential outcomes for the plans, probabilities exist for both positive and negative scenarios. This report focuses primarily on the negative scenarios as they help to identify areas of risk and generally provide the most challenges to plan sponsors.

In addition to the mandate set forth in the *Code of Virginia* above, the Actuarial Standards Board requires actuaries to perform assessments of risk through Actuarial Standard of Practice No. 51: Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions". The risk analysis herein complements and enhances the risk measures shown in VRS' annual actuarial reports.

EXECUTIVE SUMMARY

The purpose of this report is to assist the VRS Board of Trustees, the Virginia General Assembly, the Governor, stakeholders, and the public to better understand and assess the risks inherent in the funding of the pension system. This year's report investigates various possible risks faced by VRS and measures their potential impact on the defined benefit programs.

Although market returns for fiscal year 2021 exceeded expectations, an increase in gloomy developments during 2022 has caused several risks to materialize in the economy which could impact retirement plans. This highlights the need to explore opportunities to further strengthen the health of the plans, particularly the statewide retirement and OPEB plans.

Key results and findings of this report:

- Following robust market returns in fiscal year 2021, future investment performance in the near term may be materially lower than both historic norms as well as projected returns over longer timeframes. This was true for fiscal year 2022 in which VRS had an investment return of 0.6%.
- New valuation assumptions were reflected in the June 30, 2021 rate-setting valuation including generational mortality assumptions that will help counter longevity risk by increasing contribution requirements to cover expected long-term costs.
- Significant resources must remain dedicated to addressing the amortization of the legacy unfunded liabilities.
- Analysis suggests that accelerating the payback of the legacy unfunded liabilities could provide significant long-term savings and better position the statewide plans to weather future volatility in investment returns, thereby serving to reduce investment risk.
    - In recognition of the importance of reducing long-term liabilities with the benefit of achieving savings over time, the Governor and legislature provided a one-time infusion of $750 million prior to June 30, 2022 with an additional $250 million expected to be provided in FY 2023. In addition, the Governor and General Assembly also expect to provide $80.4 million split between June 2023 and June 2024 to certain Health Insurance Credit programs.

    - In order to provide additional funds into the plans, the Governor and General Assembly maintained the contribution rates in FY 2023 and FY 2024 at the same level as the previous biennium which improves plan health by lowering unfunded liabilities and generating savings over time. (Due to exceptional FY 2021 investment performance, the rate would have otherwise declined.)
- As roughly two-thirds of benefits are funded by investment income, receiving 100% of the Board-certified actuarially determined contributions not only avoids adding unfunded liabilities to the plans, but also ensures timely availability of assets to be invested and take advantage of compound interest. Of note, the Governor and General Assembly met and even accelerated the statutory requirement to fund 100% of the Board-certified contribution rates.
- Pension reforms, specifically plan design changes over the past decade, have reduced the future costs of benefits. In addition, these reforms have reduced employers' risk by introducing shared risk through the defined contribution component of the Hybrid Retirement Plan. Approximately 30% of a hybrid plan member's benefit has no future investment or longevity risk for employers.

This report is intended to assist policymakers and stakeholders in assessing the soundness of the System. To better understand the risks associated with funding the System, this report examines a range of potential outcomes that could endanger the long-term funding of the System and prevent the System from reaching full funding. Again, this report focuses primarily on analyzing negative outcomes, since such outcomes would result in the greatest challenges for the plan sponsors and System.

This report is based on the June 30, 2021 Annual Actuarial Valuation and reflects the changes to actuarial assumptions adopted by the VRS Board of Trustees in April 2021. In this report, the focus is on:

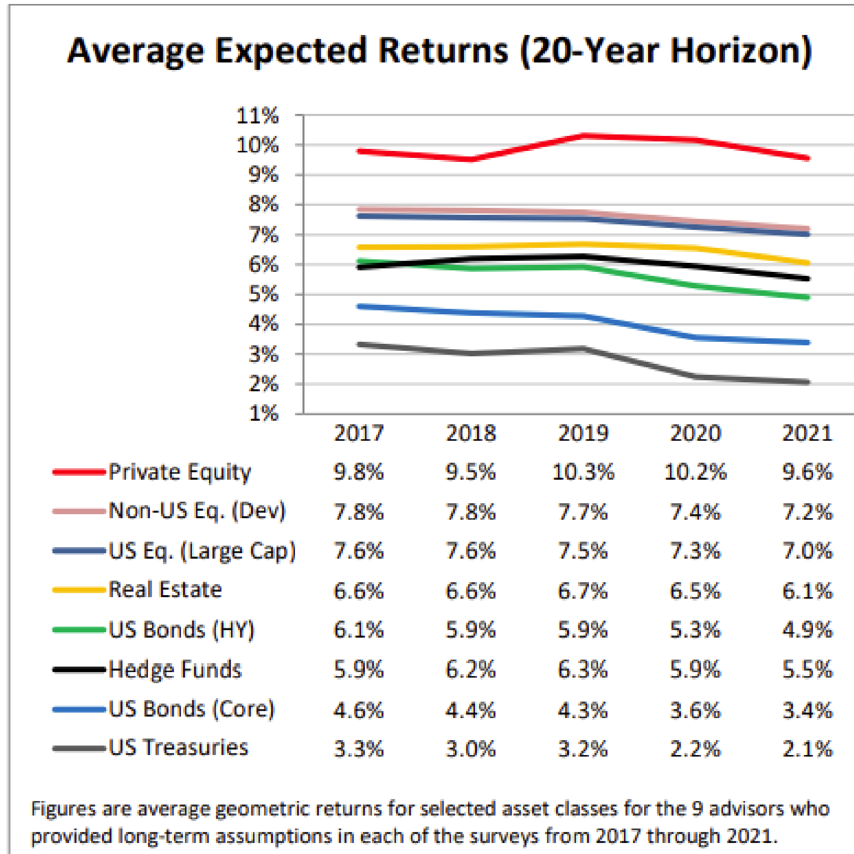
- Muted economic forecasts including higher than expected inflation and more volatility in the markets.
- Risks to long-term funding, including investment volatility, contribution risk, and longevity risk.

Investment Rate of Return Assumption

Pension plans are generally prefunded, meaning money is invested during a member's career so that by the time the member retires adequate funds will exist to pay benefits throughout the member's retirement. Investment earnings on plan contributions currently account for nearly two-thirds of pension benefit payment funding. The discount rate – the rate used to determine the present value of future benefit payments – influences the level of contributions required, assuming they (in combination with invested assets) will generate investment income throughout a member's career and into retirement. VRS uses the long-term rate of return as the plan discount rate and these terms are used interchangeably in this report.

The discount rate assumption is one of the most influential and sensitive assumptions used in determining the liability of plan benefits. Market conditions, including the protracted period of low interest rates , resulted in public pension funds reviewing their expected long-term rates of return with many plans lowering future expectations. One challenging facet of setting the investment return assumption that has emerged more recently is a divergence between expected returns over the near term, i.e., the next five to 10 years, and over the longer term, i.e., 20 to 30 years. Following robust market returns in fiscal year 2021, future investment performance in the near term may be materially lower than both historic norms as well as projected returns over longer timeframes. This was true for fiscal year 2022 in which VRS had an investment return of 0.6%. Exhibit 1 shows public pension plan market return expectations have generally declined over time for various asset classes.

Exhibit 1



	2017	2018	2019	2020	2021
Private Equity	9.8%	9.5%	10.3%	10.2%	9.6%
Non-US Eq. (Dev)	7.8%	7.8%	7.7%	7.4%	7.2%
US Eq. (Large Cap)	7.6%	7.6%	7.5%	7.3%	7.0%
Real Estate	6.6%	6.6%	6.7%	6.5%	6.1%
US Bonds (HY)	6.1%	5.9%	5.9%	5.3%	4.9%
Hedge Funds	5.9%	6.2%	6.3%	5.9%	5.5%
US Bonds (Core)	4.6%	4.4%	4.3%	3.6%	3.4%
US Treasuries	3.3%	3.0%	3.2%	2.2%	2.1%

Horizon Actuarial Services

The discount rate reflects expectations of what investment earnings the markets will deliver in the future, and it is calculated based on two components: expected price inflation and real rate of return[1]. A change in either of those components over the long term would necessitate further evaluation of the discount rate.

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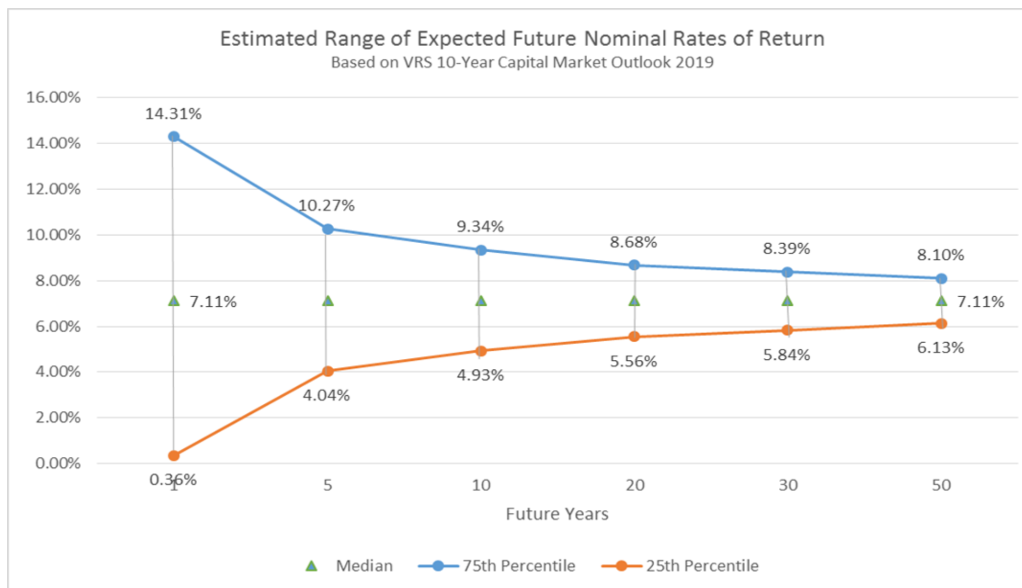
[1] The Real Rate of Return measures the percentage return earned on an investment after adjusting for the inflation rate, unlike the nominal rate. The nominal rate of return is the amount of money generated by an investment before factoring in expenses such as investment fees and inflation. If an investment generated a 10% return, the nominal rate would equal 10%. After factoring in inflation during the investment period, the actual "real" return would likely be lower.

FUTURE RISK ANALYSIS

Fund long-term health requires careful management and decision making for the asset allocation needed to fund members' pensions and Other Post-Employment Benefits (OPEBs), such as group life insurance and the health insurance credit, over the long term. The VRS Board of Trustees conducted an Asset Liability Study during 2019 to ensure prudent and responsible investment practices and strategies are being used in recommending and deploying investment allocations. (The Board of Trustees will be conducting another Asset Liability Study in Spring 2023.)

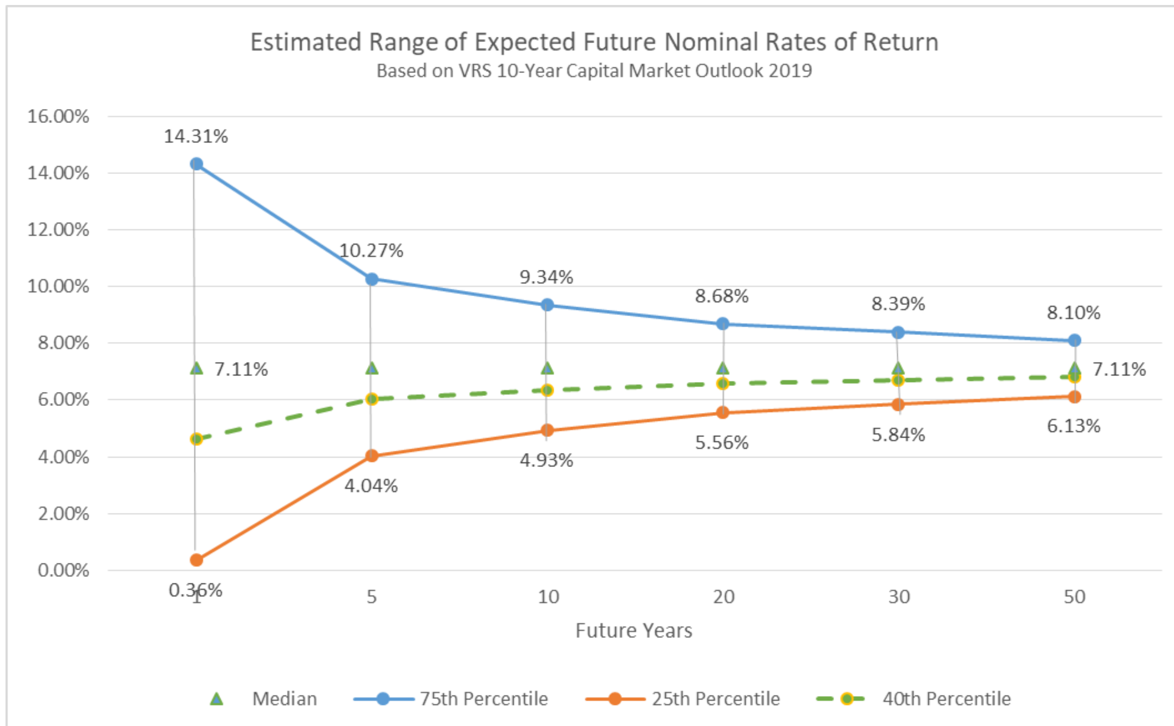
As shown in Exhibit 2, using the plan's 2.5% assumed rate of inflation and the 10-year forward looking capital market estimates and policy investment targets provided by the VRS investment staff, a statistical analysis of the plan's assumed investment rate of return provided an expected median nominal rate of return of 7.11%, with a range of 6.13% to 8.10%, representing the 25th and 75th percentiles, respectively. The nominal rate of return is the total rate of return earned on an investment before adjusting for any deductions and premiums, such as investment fees, trading costs, tax expenses, and inflation.

Exhibit 2



Long-term practice has been to set the investment rate of return expectation at the median assumed rate of return, but there are reasons to alter past practice. Due to the divergence between expected returns over the near term, i.e., the next five to 10 years, and over the longer term, i.e., 20 to 30 years, reflecting a blended discount rate to incorporate near-term uncertainty in the markets would require selecting a discount rate below the median expected long-term rate. As displayed in Exhibit 3, while the median return of 7.11% is expected to be achieved 50% of the time, selecting a discount rate of 6.75% would move the assumption closer to the 40th percentile, providing approximately a 60% chance of achieving the long-term rate of return over time.

Exhibit 3



In effect, the downside tail risk (i.e., the chance of a loss occurring due to a rare event, as predicted by a probability distribution) is partially mitigated by selecting a rate at the 40th percentile rather than the median.

FUTURE RISK ANALYSIS

VRS annually assesses the capital market outlooks. Beginning in 2020 the VRS capital market outlooks include both a 10-year and 20-year outlook. Since the discount rate is based on a long-term outlook, VRS also focuses on the 20-year outlook in addition to shorter-term market expectations. While the 20-year outlooks for 2021 and 2022 continue to show support for the current 6.75% discount rate, Exhibit 4 below shows that volatility has increased in the 20-year forward returns from 11.4% in 2021 to 13.8% for 2022.

Exhibit 4

VRS 2022 Capital Market Outlooks - Forward Returns & Volatilities

20 Year Outlook

Asset Class	Wt.	Current E(r)	E(σ)
Public Equity	34.0%	6.8%	16.8%
Fixed Income	15.0%	4.4%	4.7%
Credit Strategies	14.0%	7.1%	5.4%
Real Assets	14.0%	6.0%	14.0%
Private Equity	14.0%	8.8%	26.2%
MAPS	6.0%	5.9%	7.9%
PIP	3.0%	7.3%	18.9%
Cash	0.0%	0.0%	0.5%
Currency Return Addition		*0.1%*	
Total Fund		**6.72%**	**13.8%**

VRS 2021 Capital Market Outlooks - Forward Returns & Volatilities

20 Year Outlook

Asset Class	Wt.	Current E(r)	E(σ)
Public Equity	34.0%	6.6%	14.0%
Fixed Income	15.0%	3.0%	4.0%
Credit Strategies	14.0%	6.8%	6.5%
Real Assets	14.0%	6.8%	10.0%
Private Equity	14.0%	10.6%	20.0%
MAPS	6.0%	5.5%	8.0%
PIP	3.0%	8.3%	15.0%
Cash	0.0%	0.0%	0.5%
Currency Return Addition		*0.1%*	
Total Fund		**6.76%**	**11.4%**

Analysis of Discount Rate Sensitivity

Analysis of discount rate sensitivity gives a sense of the long-term risk to the employer contribution rates and funded status. The analysis provides the impact on employer contribution rates assuming discount rates that are up to two percentage points above or below the current valuation discount rate. This analysis gives an indication of the potential required employer contribution rates if the discount rate ranged from 4.75% to 8.75% over the long term. Governmental Accounting Standards Board (GASB) Statement 67 currently requires sensitivity analysis of plus or minus 1% from the plan's discount rate. Adding a wider range of plus or minus 2% around the plan discount rate resulted from discussions during deliberations of the Commission on Employee Retirement Security and Pension Reform, where downside risk was a particular area of focus.

Exhibits 4 and 5 illustrate how various assumed annual rates of return would affect pension contribution rates for the State and Teacher plans had they been applied to the June 30, 2021 valuation results. A lower assumed annual rate of return requires higher contribution rates from employers. A higher assumed annual rate of return requires lower employer contribution rates. Although the assumed rate of return dictates how contribution rates are calculated in the short term, the actual investment returns will determine what portion of pension costs must be covered by contributions in the long term. Note that this analysis is based on the actuarially determined contribution rates from the 2021 valuation. Actual contributions for fiscal years 2023 and 2024 are set equal to the higher rates from the prior biennium for the State and Teacher plans as set forth in the 2022 Appropriation Act.

Exhibit 5 – State Plan

Discount Rate	8.75%	7.75%	Current 6.75%	5.75%	4.75%
Total Normal Cost Rate	6.39%	7.62%	9.29%	11.61%	14.85%
Member Contribution Rate	4.53%	4.53%	4.53%	4.53%	4.53%
Employer Normal Cost Rate	1.86%	3.09%	4.76%	7.08%	10.32%
Administrative Expense Load	0.29%	0.29%	0.29%	0.29%	0.29%
Total Employer Normal Cost Rate	2.15%	3.38%	5.05%	7.37%	10.61%
Total Amortization Rate	0.86%	4.40%	8.02%	11.73%	15.53%
Defined Contribution Hybrid Plan	1.06%	1.06%	1.06%	1.06%	1.06%
Total Employer Rate	4.07%	8.84%	14.13%	20.16%	27.20%
Change in Employer Rate	(10.06)%	(5.29)%	0.00%	6.03%	13.07%
Estimated Change in Annual Funding	(462,191)	(243,041)		277,039	600,481
Unfunded Liability	1,171,017	3,428,843	6,112,670	9,316,998	13,154,218
Funded Status	94.6%	85.7%	77.1%	68.9%	61.0%

Results based on June 30, 2021 actuarial valuation. Funded status shown on an actuarial value of assets basis.

Exhibit 6 – Teacher Plan

Discount Rate	8.75%	7.75%	Current 6.75%	5.75%	4.75%
Total Normal Cost Rate	6.57%	8.13%	10.25%	13.15%	17.13%
Member Contribution Rate	4.62%	4.62%	4.62%	4.62%	4.62%
Employer Normal Cost Rate	1.95%	3.51%	5.63%	8.53%	12.51%
Administrative Expense Load	0.28%	0.28%	0.28%	0.28%	0.28%
Total Employer Normal Cost Rate	2.23%	3.79%	5.91%	8.81%	12.79%
Total Amortization Rate	-0.14%	3.88%	8.04%	12.40%	16.99%
Defined Contribution Hybrid Plan	0.81%	0.81%	0.81%	0.81%	0.81%
Total Employer Rate	2.90%	8.48%	14.76%	22.02%	30.59%
Change in Employer Rate	(11.86)%	(6.28)%	0.00%	7.26%	15.83%
Estimated Change in Annual Funding	(1,014,860)	(537,379)		621,238	1,354,573
Unfunded Liability	1,235,369	6,125,484	12,021,814	19,191,062	27,981,858
Funded Status	97.1%	86.9%	77.2%	68.0%	59.3%

Results based on June 30, 2021 actuarial valuation. Funded status shown on an actuarial value of assets basis.

IMPACT OF 2022 APPROPRIATIONS ACT

The 2022 Appropriation Act had several provisions that provided additional funding to the VRS plans through:

- cash infusions,
- maintaining prior contribution rates in cases where they would have reduced due to investment performance and
- deferred contributions from the 2010-12 biennium in the Teacher plan being fully paid off and no longer needing to be financed through payments included in the contribution rate.

The chart below shows that the Board-Certified Rates as of June 30, 2021 for both the State and Teacher plans were lower than the previous year. Maintaining the prior biennium rates will provide an additional $32 million in funding for the State plan and $345 million for the Teacher plan.

Exhibit 7

State Plan		Teacher Plan	
VRS Board Certified Rates FY 23/24	Appropriation Act Rates FY 23/24	VRS Board Certified Rates FY 23/24	Appropriation Act Rates FY 23/24
14.13%	**14.46%**	**14.78%**	**16.62%**

State Plan

- **Requires $32 million in additional contributions:**
  - **$13.9 million General Fund**
  - **$18.1 million Non-General Fund**
- **Lowers Unfunded Liability by nearly $34 million over two years**
- **Lowers future rates annually by approximately 5 basis points.**
  - **Approximately $48 million in additional savings over next 15 years**

Teacher Plan

- **Requires $345 million in additional contributions:**
  - **$138 million General Fund**
  - **$207 million Non-General Fund**
- **Lowers Unfunded Liability by nearly $382 million over two years**
- **Lowers future rates annually by approximately 30 basis points.**
  - **Approximately $500 million in additional savings over next 15 years**

In addition to the maintaining contribution rates, the Appropriation Act also included significant cash infusions which will bolster the funded status as well as have a positive impact on future employer contribution rates.

The $1 billion infusion when complete will increase the funded status of each statewide plan by approximately 1.0%.

Exhibit 8

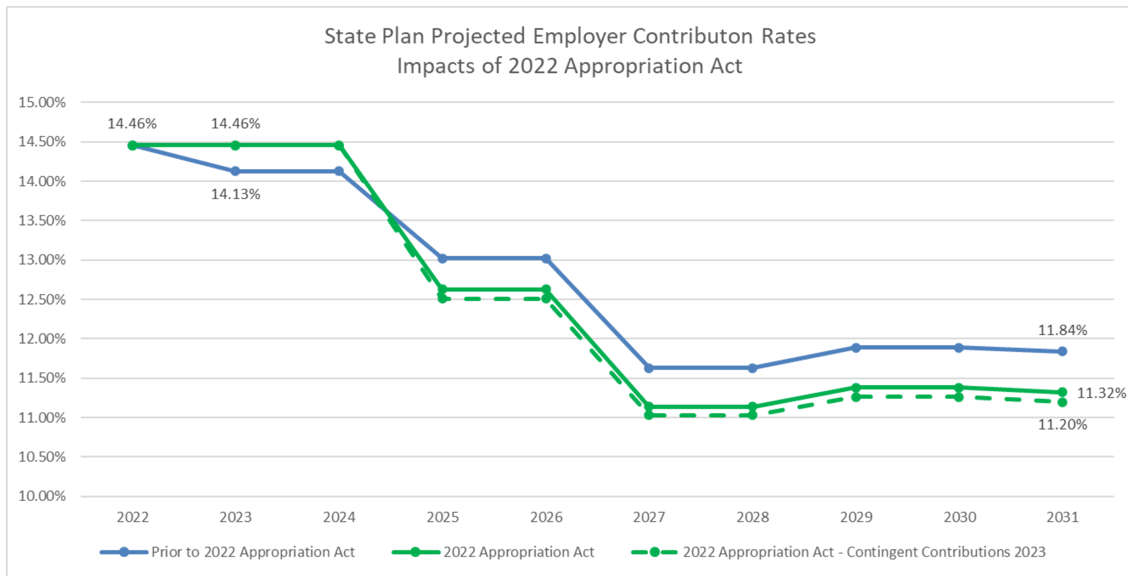
The Appropriation Act provides over $1 billion to reduce unfunded liabilities of state pension and OPEB plans.

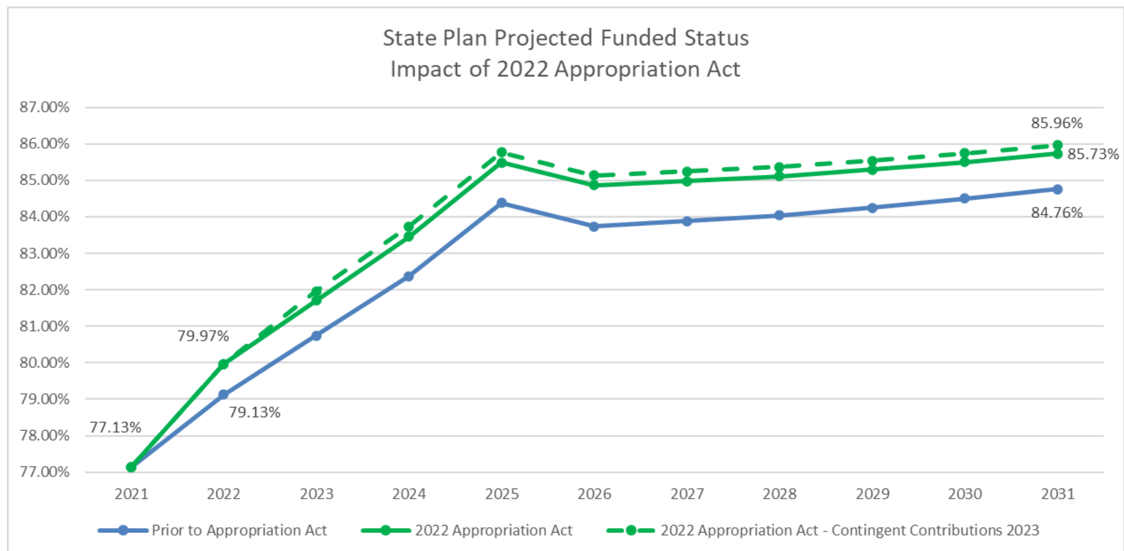
- $750 million appropriation in June 2022
  - Estimated cost savings of $1.4 billion over next 20 years
- $250 million contingent appropriation in June 2023*
  - Estimated cost savings of $509 million over next 20 years
- $80.4 million appropriation in total for State HIC plans paid in two installments (June 2023 and June 2024)
  - Estimated cost savings of $99 million over next 20 years

** Allocation of contingent $250 million appropriation has not been set forth in the Act. Savings estimate assumes the contingent $250 million will be allocated in similar fashion to the $750 million appropriation.*

Exhibit 9 below shows the estimated impact the 2022 Appropriation Act funding measures are expected to have on the State plan employer contribution rates and funded status, given that all assumptions are met. The cash infusion is expected to increase the funded status by approximately 1.0% while employer rates are expected to be approximately 65 basis points lower, which equates to a savings of approximately $32.5 million for FY 2025 based on estimated 2025 payroll of $5 billion for State plan.

Exhibit 9

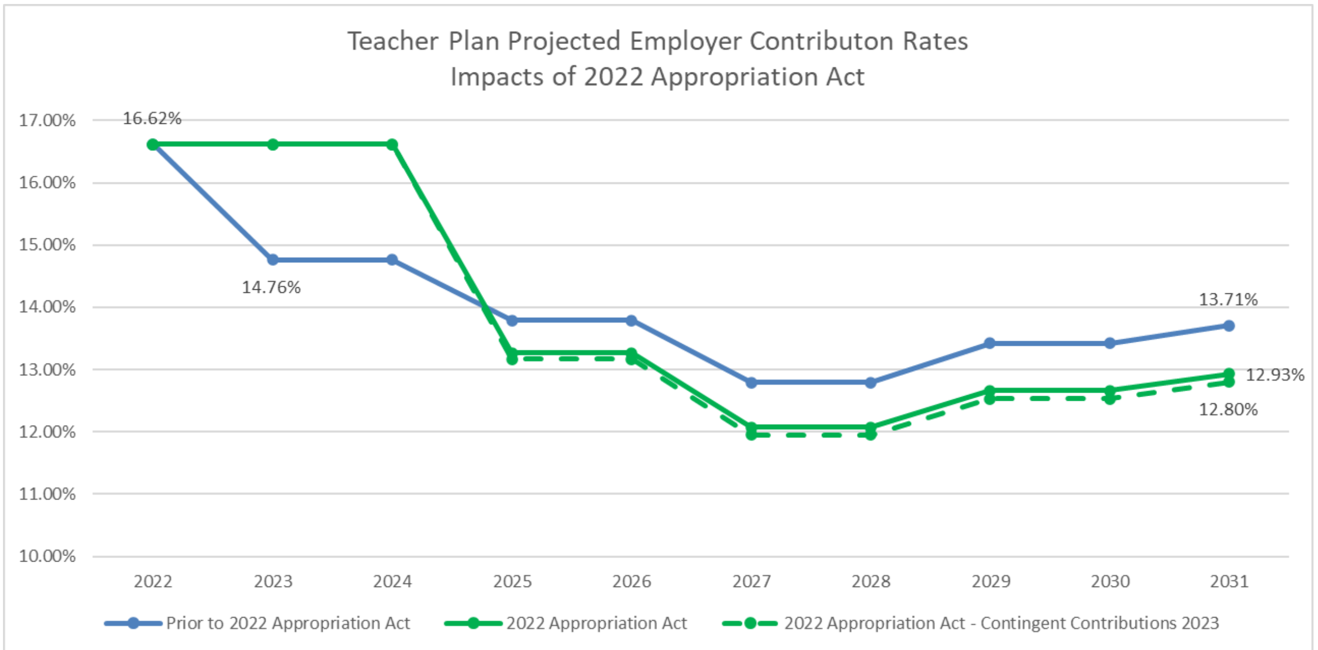


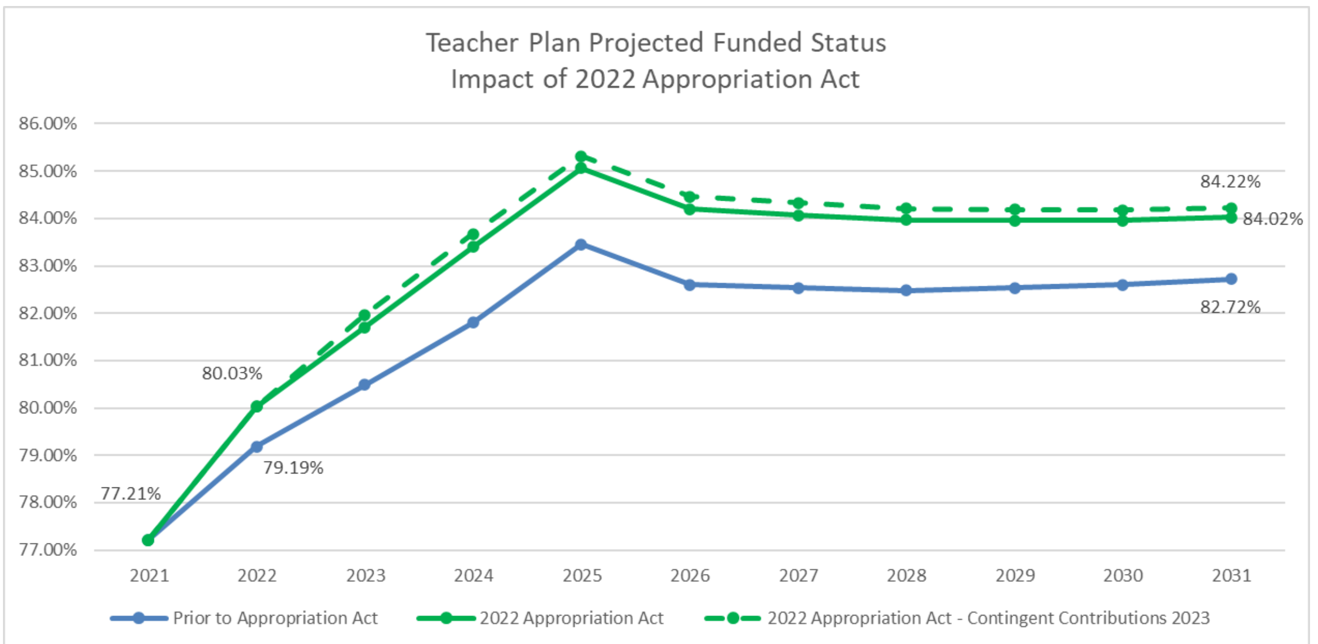


Similarly Exhibit 10 shows the estimated impact the 2022 Appropriation Act funding measures are expected to have on the Teachers plan employer contribution rates and funded status. The cash infusion is expected to increase the funded status by approximately 1.0% while employer rates are expected to be approximately 90 basis points lower, which equates to a savings of approximately $90 million for FY 2025 based on estimated 2025 payroll of $10 billion for the Teacher plan.

FUTURE RISK ANALYSIS

Exhibit 10





The remaining analysis in this report related to contribution rates and funded status will reflect the provisions of the 2022 Appropriation Act where applicable.

INVESTMENT RISK

Possible Future Outcomes

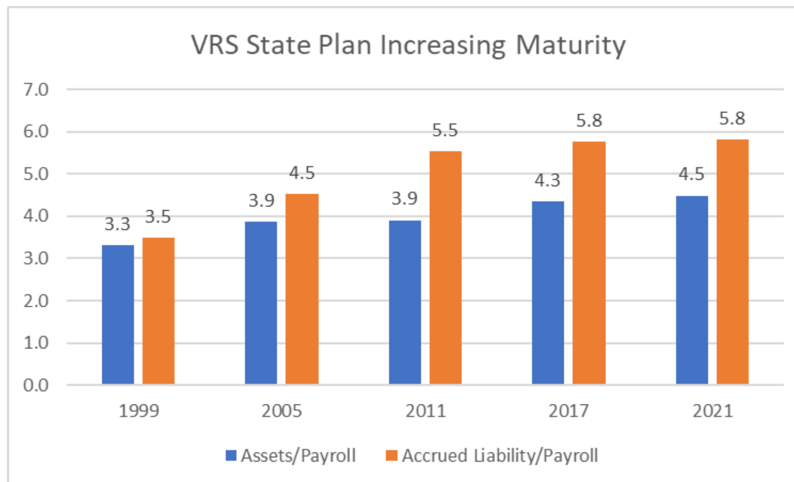
Investment returns will have a greater impact on the funding of the plans as the VRS plans continue to mature. When investment returns are below expectations, the unfunded actuarial accrued liability increases and additional contributions are needed, which historically have been funded by employers. Greater maturity creates greater sensitivity to gains and losses and bigger challenges related to underfunding. "Pension plan maturity" does not have a precise definition. The most commonly cited measures use various plan population metrics. However, measures that compare a plan's size to its financial resources are more directly related to risk and outcomes. Some typical measures of pension plan maturity are expressed by the following ratios:

- Retirees to active members
- Plan liability to revenue
- Assets to payroll
- Retiree liability to total plan liability
- Liabilities to contributions

However measured, a plan's level of maturity affects its ability to recover from a negative investment shock, resulting in different levels of funding and investment risk. Greater maturity creates greater sensitivity to gains and losses and bigger challenges from underfunding. The two measures below show that the VRS plans continue to mature which indicates that the plans could be more susceptible to negative shocks than they were 10 – 15 years ago.

FUTURE RISK ANALYSIS

Exhibit 11



Within this report we project future outcomes under two sets of analyses, deterministic or stochastic. Note that under both sets of analyses, plan liabilities are projected based on a 6.75% discount rate.

Deterministic analysis assumes full certainty about future outcomes, particularly with future plan experience and assumptions including investment returns. The deterministic approach is useful for:

- gauging the general direction of change and associated consequences,
- when trying to assess best case or worst-case scenarios, or
- isolating the impacts of a single assumption such as lowering the plan discount rate.

Stochastic analysis reflects the realistic view that pension plan investment returns, like the market itself, may be volatile and uncertain. Rather than using exact assumptions, the model uses probability distributions to provide a range of possible results based on these probabilities. The projections are intended to present general contribution rate trends under varying economic scenarios and help to quantify the likelihood and magnitude of possible future outcomes.

The deterministic projection shown in Exhibit 12 provides a range of expected employer contribution rates under varying rates of return from 4.75% - 8.75% over the next eight

years. The projections incorporate the 2022 fiscal year investment return of 0.6%. Note, that due to asset smoothing[2], only a portion of the 2021 investment gain was recognized in the 2021 valuation. Investment gains and losses will continue to be recognized over the next four years, which is why there is a downward trend in employer rates over the eight-year period. If the fund earned 5.75% each year for the next five years, employer contribution rates for the State plan would still decrease from 14.46% initially to 13.21% beginning in 2031. Conversely, if the fund earned 7.75% each of the next five years, employer contribution rates would decrease further from 14.46% initially to 9.36% beginning in 2031.

If all assumptions are met, employer contribution rates are inherently expected to trend lower in the future due to blending in the lower cost hybrid plan as new members are enrolled into the plan as well as recognizing the large investment gain from fiscal year 2021. This can be seen most clearly in the 6.75% return scenario in Exhibit 12 below, which assumes no additional investment gains or losses over the projection period but shows the downward trend in contribution rates.

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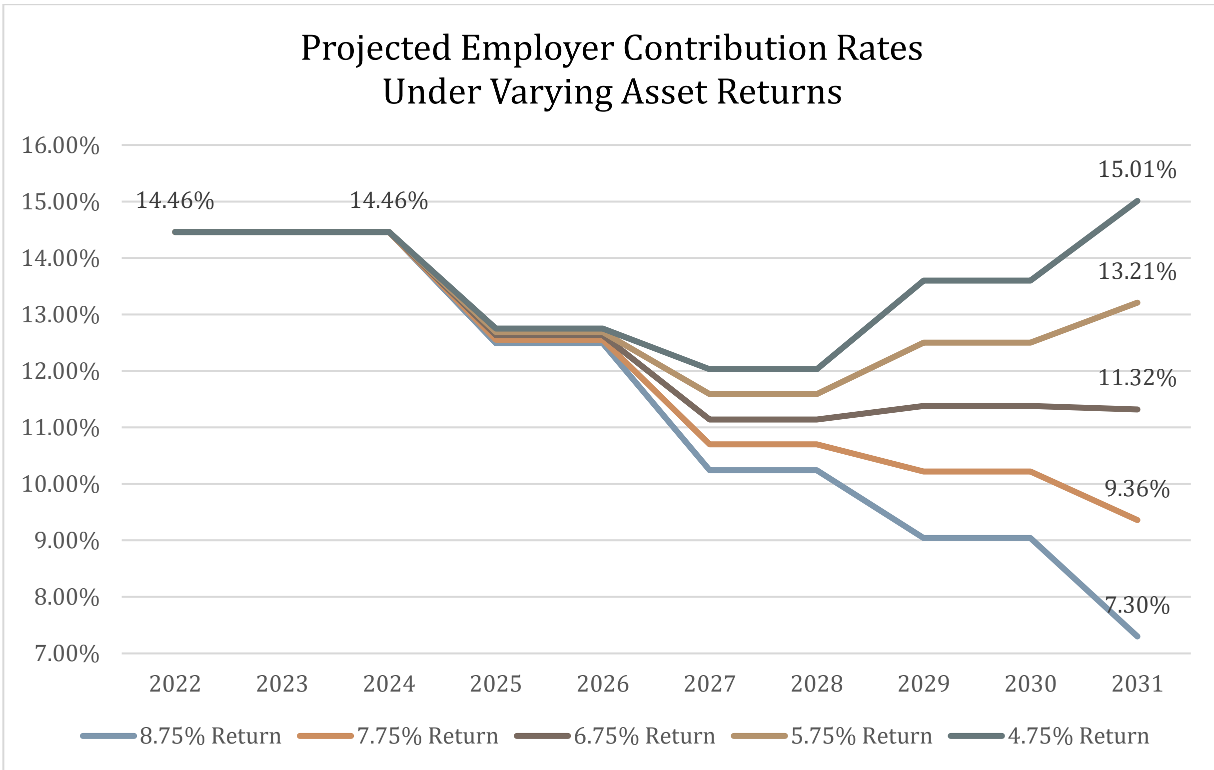
[2] Actuaries set assumptions that should be reasonable over a long timeframe, not meant to estimate individual yearly experience. Actuarial smoothing spreads the difference between the yearly assumed and actual investment return over a longer time horizon. VRS uses an actuarial smoothing period of five years in order to provide more stable contribution rates. By Code, VRS must develop contribution rates that remain relatively level from year to year.

Exhibit 12 - State Plan – Deterministic Basis



Results based on June 30, 2021 actuarial valuation and the 0.6% fiscal year 2022 fund return.

Exhibit 13 shows probabilistic or stochastic projections of future investment returns and the impact on future contribution rates for the State plan. These stochastic projections are based on VRS' 2022 capital market outlook and target asset allocation. Capital market outlooks are heavily influenced by the starting valuations, and after robust returns in 2021, 10-year capital market outlooks have trended downward assuming further gains will be harder to come by in the near term. A longer-term outlook over 20 years serves to moderate investment returns and provides a median return of approximately 6.75% based on the VRS target allocation. Under the "baseline" scenario, there is a 50% probability that employer contribution rates will be between 7.82% and 17.42% by fiscal year 2030 with an expected employer rate of 11.38%.

The 20-year capital market assumptions will be the "baseline" scenario used in the scenario testing that follows later in the report.

Exhibit 13 – Stochastic Basis

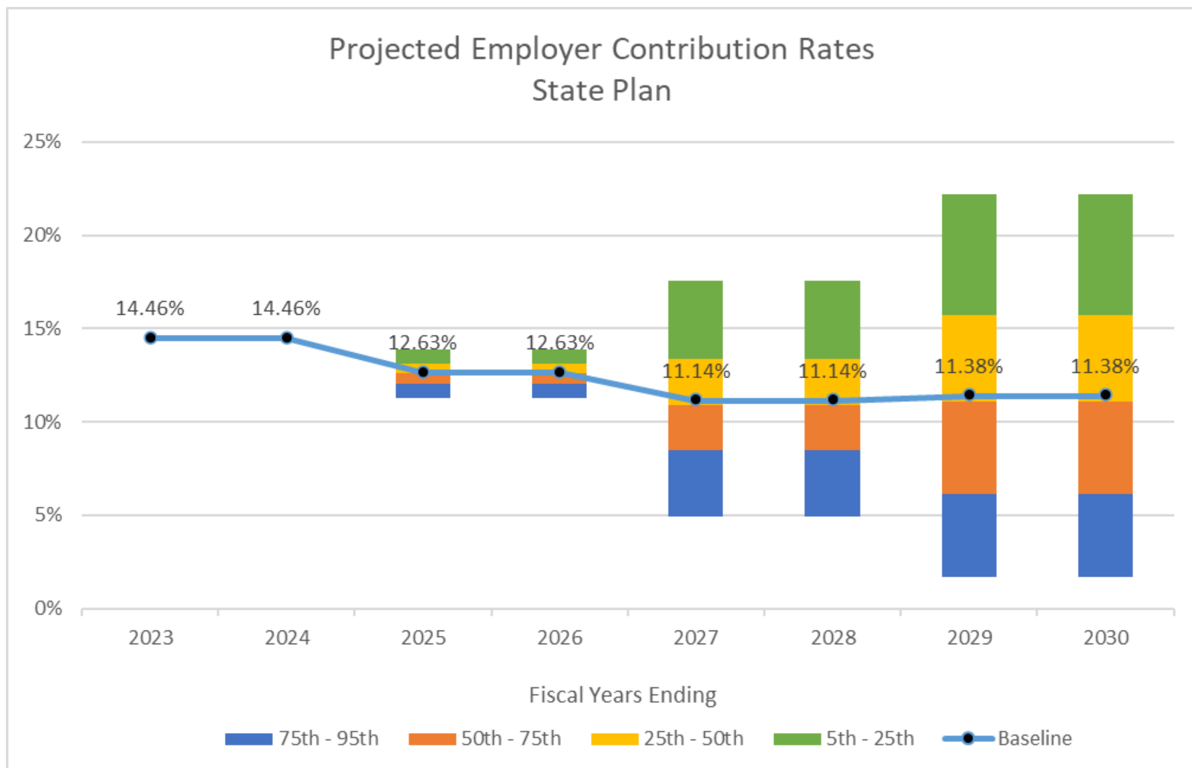
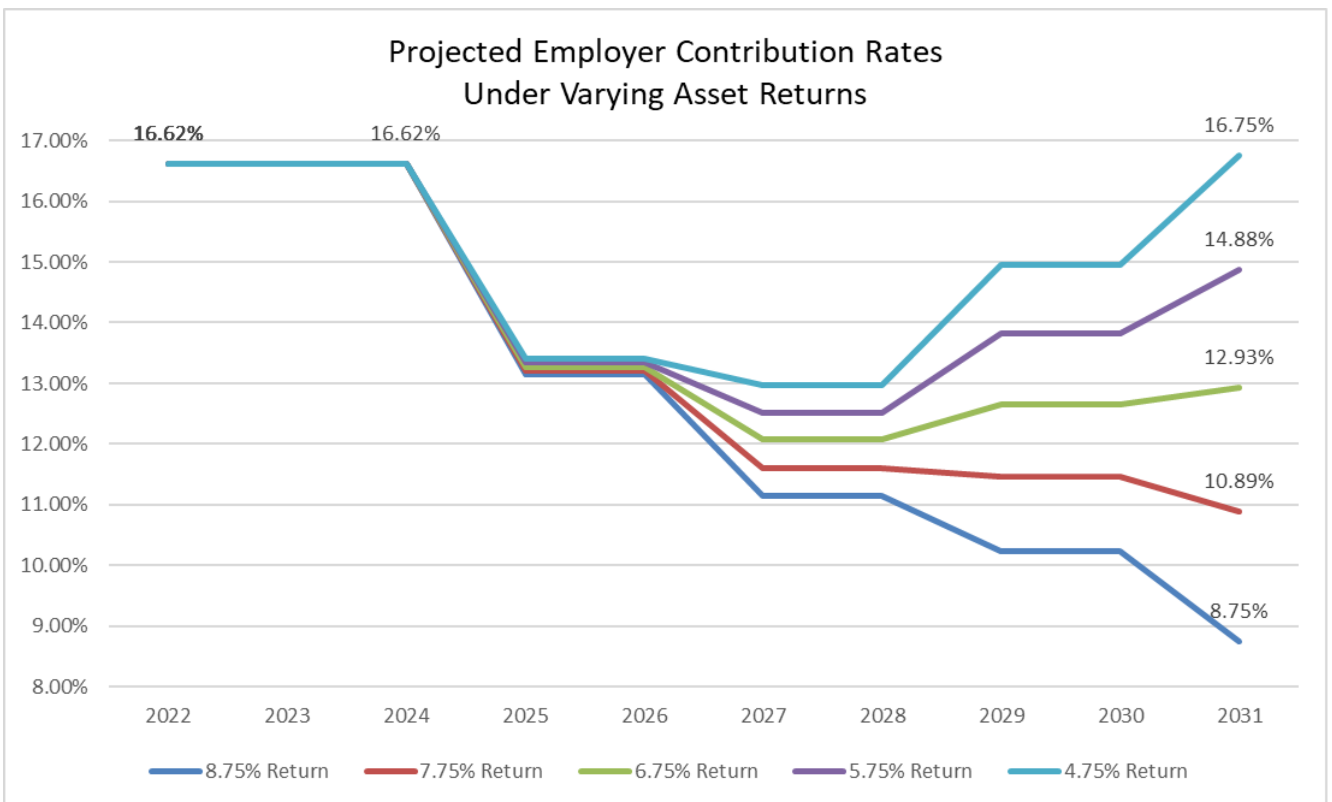


Exhibit 14 provides similar deterministic analysis for the Teacher plan. As with the State plan, the Teacher plan also trends downward due to incorporating the 2021 investment return through asset smoothing. In addition, the Teacher plan also reflects a sizable decrease in 2023 due to 10-year deferred contributions being paid off with an accelerated payment in June 2021 offered by the Governor and approved by the General Assembly.

Exhibit 14 – Teacher Plan – Deterministic Basis

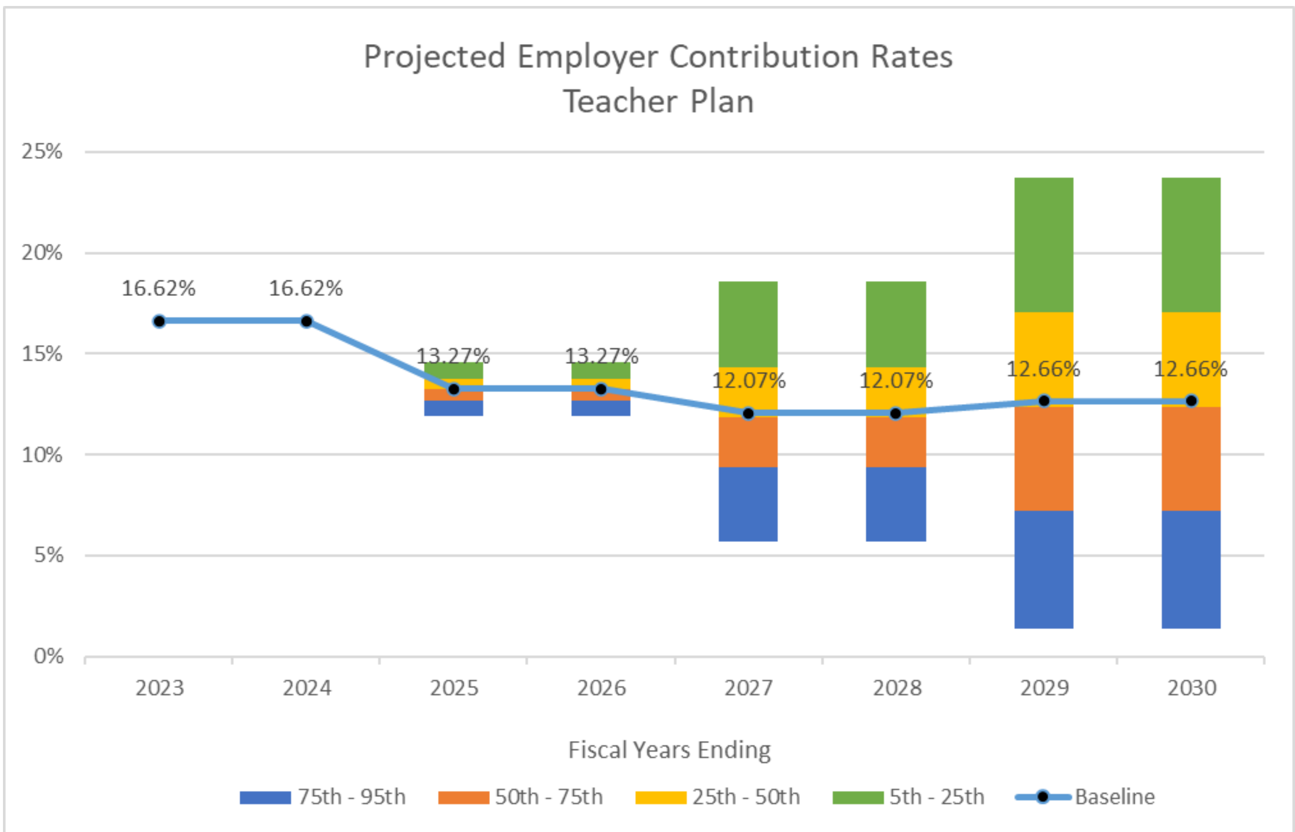


Results based on June 30, 2021 actuarial valuation and the 0.6% fiscal year 2022 fund return.

FUTURE RISK ANALYSIS

Exhibit 15 shows the probabilistic or stochastic projections of future investment returns and the impact on future contribution rates for the Teacher plan. There is a 50% probability that by fiscal year 2030 employer rates will be between 8.60% and 18.44%, with an expected contribution rate of 12.66%.

Exhibit 15 – Stochastic Basis



Scenario Testing (Unexpected or Unpredictable Economic Events)

Fiscal year 2022 saw a decline in the markets following the major rebound in 2021. An increase in gloomy developments during 2022 has caused market risks to materialize. Global output contracted in the second quarter of this year, owing to downturns in China and Russia, while U.S. consumer spending undershot expectations. Several shocks have hit a world economy already weakened by the pandemic: higher-than-expected inflation worldwide––especially in the United States and major European economies––triggering tighter financial conditions; a worse-than-anticipated slowdown in China, reflecting COVID-19 outbreaks and lockdowns; and further negative spillovers from the war in Ukraine.

With the risks tilted to the downside, the VRS investment team compiled three economic scenarios that provide a framing of global economic outcomes that could possibly occur over the next several years. The following three illustrative scenarios are designed to show the potential magnitude of the impacts on plan funding. There is no degree of certainty that any of these three scenarios will correctly simulate what will actually occur over the next several years. Each scenario is front-loaded, meaning that the impact is modeled to occur over the next several years.

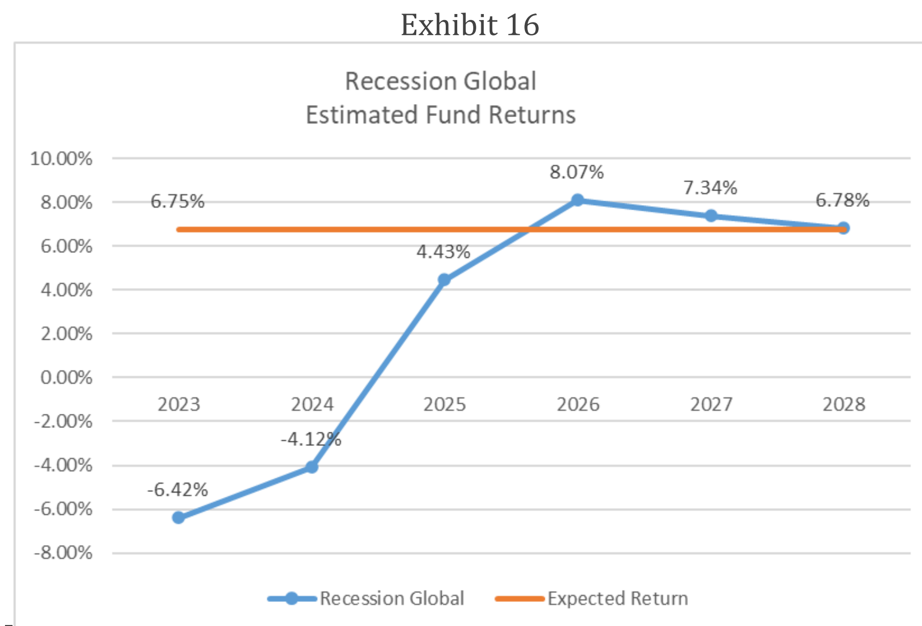
Keep in mind that VRS still has considerable legacy unfunded liabilities. As a result, the plans are subject to greater risk than plans that have smaller unfunded liabilities.

Although merely illustrations, the stress testing scenarios help to highlight the vulnerability of the fund to unexpected market shocks and the magnitude by which these scenarios can quickly degrade funded status and accelerate employer contributions requirements.

- **Recession Global:** A recession occurs when the economy stops growing and starts shrinking. The decline in economic activity is widespread and lasts several months and includes declining incomes, employment, industrial production and retail sales.

- Growth expectations retract, weakening oil prices, and higher nominal rates (e.g., mortgages) result in a significant slowdown in housing sales and valuations.
- Households continue to spend down savings inventoried during the pandemic while real incomes continue to fall off.
- The economy contracts by fourth quarter 2022 reaching bottom in 2023.
- The recovery in asset valuations extends through 2024.
- Risk assets hit hardest in years 1–3.

Exhibit 16

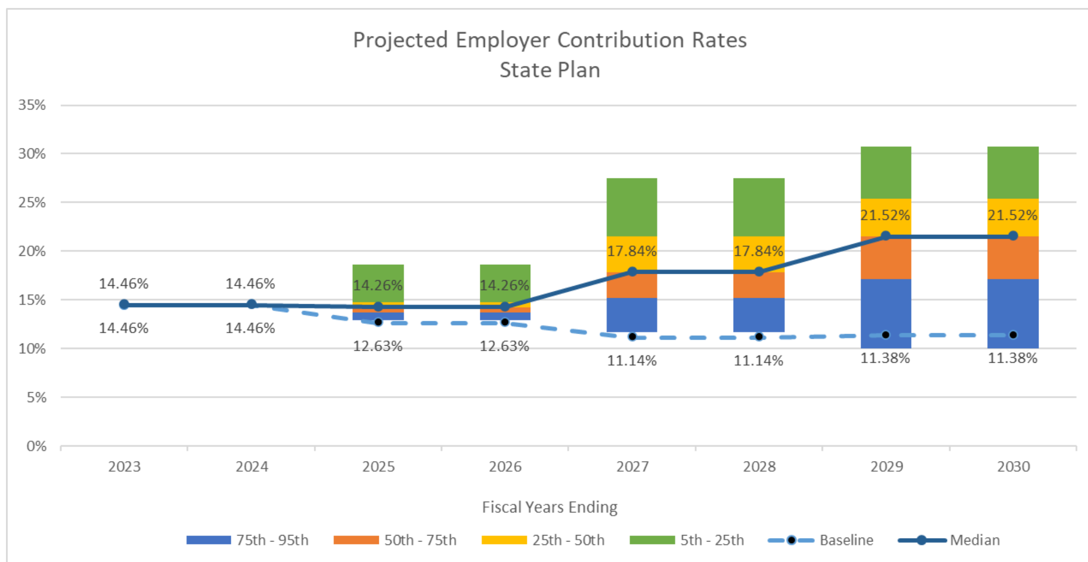


The expected cumulative investment return from 2023–2028 would be 2.51% as compared to the 6.75% assumed return over this period.

Below are estimated impacts on funding measures over the next eight years for the State and Teacher plans under the recession global economic scenario. Due to depressed returns as well as actuarial losses, the median contribution rate would slowly increase over the eight-year period to roughly 21% of covered payroll for the State plan and just over 23% for the Teacher plan. The funded status would also suffer in this scenario, dropping below 70% for both the State and Teacher plans in a relatively short period of

time and adding approximately $3.6 billion in unfunded liability to the State and $8.4 billion to the Teacher plan over the first five years.

Exhibit 17 – State Plan Impacts (Recession Global)



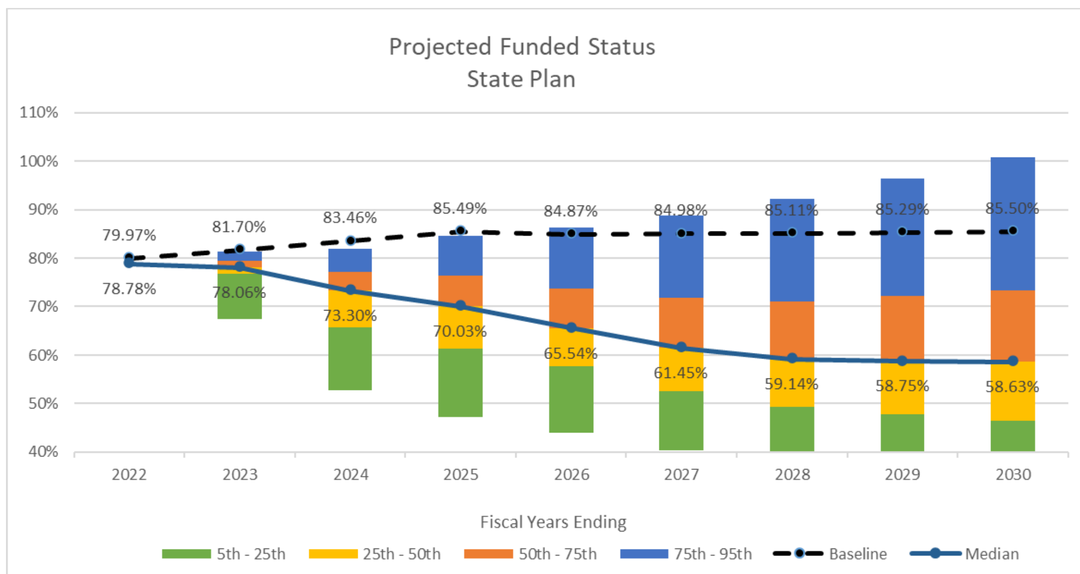
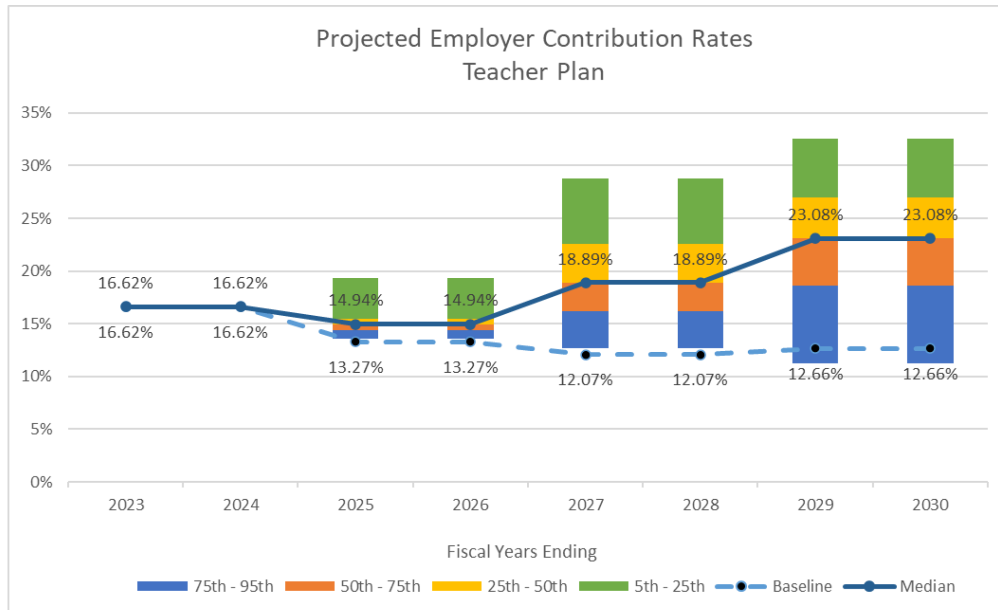
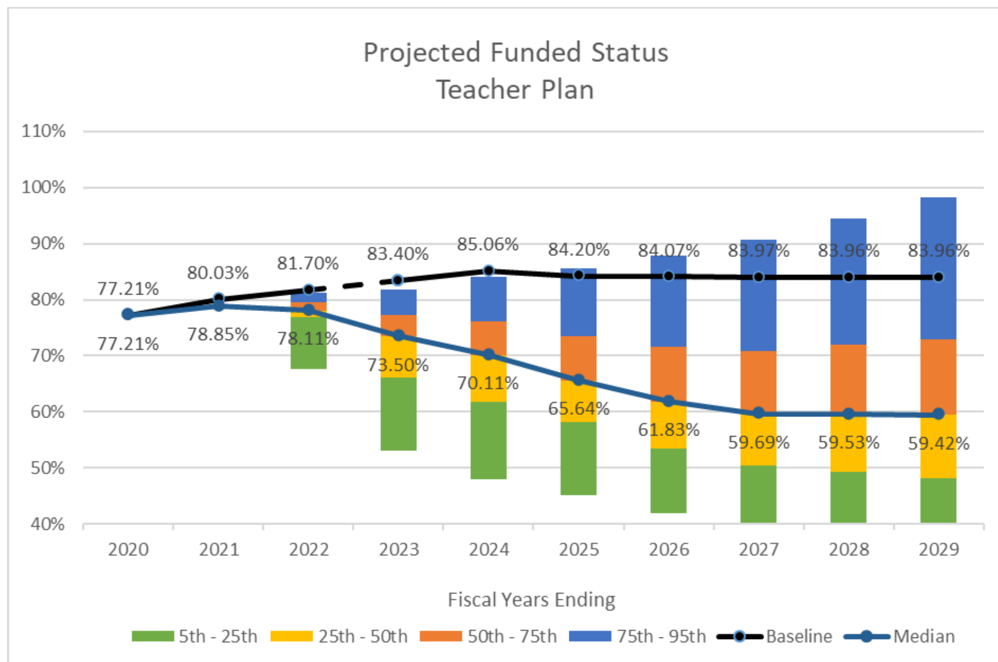


Exhibit 18 – Teacher Plan Impacts (Recession Global)

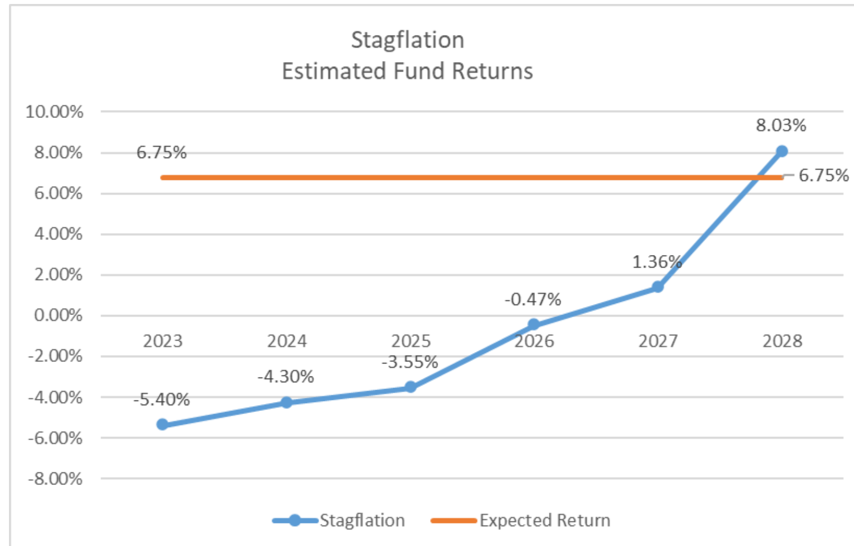




- **Stagflation:** Stagflation is characterized by slow economic recovery and relatively high unemployment, or economic stagflation, which at the same time is accompanied by rising inflation. The inflation modeled under this scenario will fluctuate between 3.7% and 12.0% during the first six years, averaging 8.2%, which is well above the 2.5% assumed rate of inflation.

    - Although nominal returns are relatively high for equity, real returns (nominal returns adjusted for inflation) reflect much slower growth and are negative for years 1-5 in this scenario, implying that this period of stagflation is front-loaded, then tapers off and reverts to the baseline thereafter.
    - Fixed income is hit hardest initially in years 1-4, but then stagnates slightly below the baseline for the remainder of the scenario.
    - Credit Strategies' rate-sensitive exposure is adversely affected.
    - Liabilities and benefit payments are also impacted in this scenario as inflation exceeds the assumed 2.5% level during most years causing liability losses and higher cash flow requirements due to cost of living increases applicable to pension benefits. Salaries would also be expected to be impacted by inflation, however the extent and timing of such increases is difficult to anticipate given the varied timing of historical increases provided to the state workforce.. Therefore, salary impacts related to higher-than-expected inflation are not included in the projections.

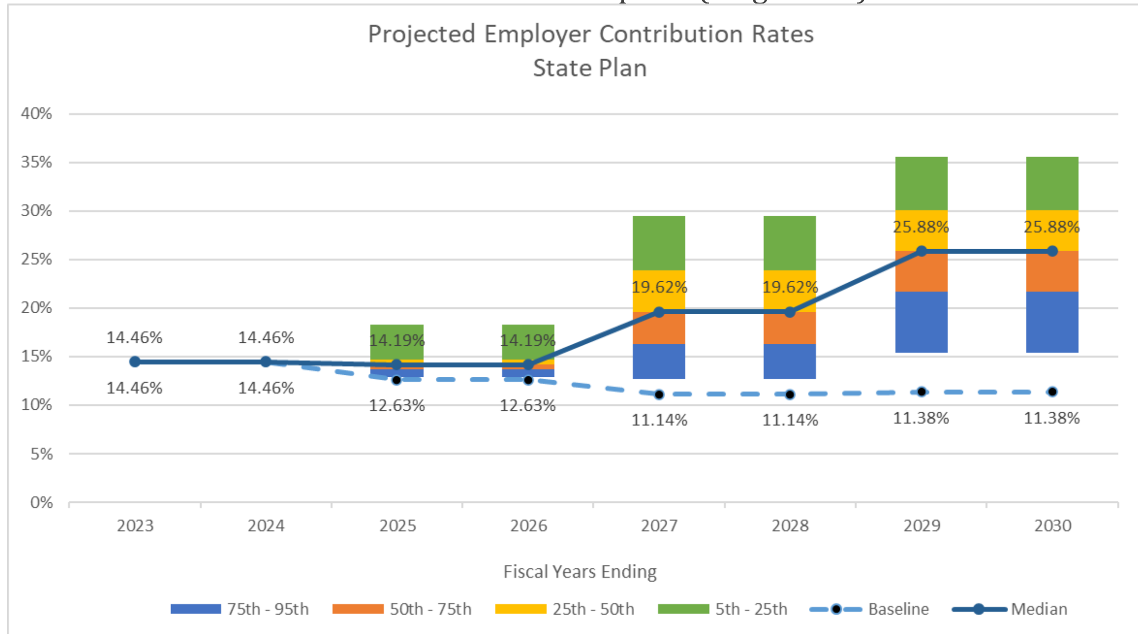
Exhibit 19



The expected cumulative investment return from 2023–2028 would be -0.82% as compared to the 6.75% assumed return over this period.

Below are estimated impacts on funding measures over the next eight years for the State and Teacher plans under the stagflation economic scenario. Due to depressed returns as well as actuarial losses, the median contribution rate would slowly increase over the eight-year period to above 25% of covered payroll for the State plan and over 27% for the Teacher plan. The funded status would also suffer in this scenario, dropping below 70% for both the State and Teacher plans in a relatively short period of time and adding approximately $5.6 billion in unfunded liability to the State and $12.2 billion to the Teacher plan over the first five years.

Exhibit 20 – State Plan Impacts (Stagflation)



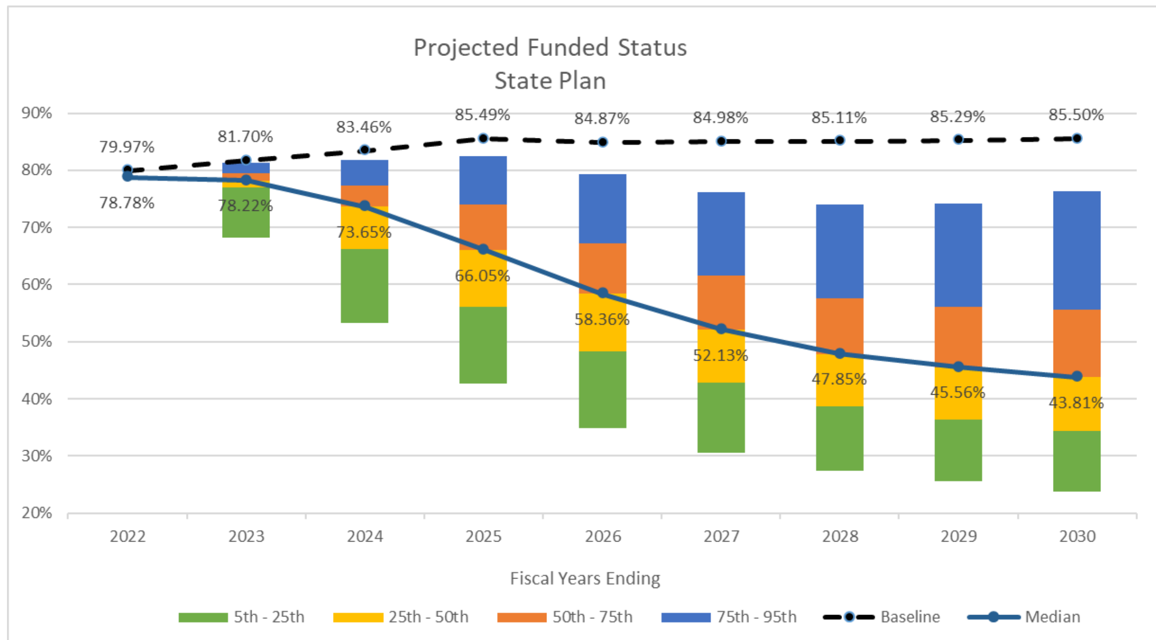
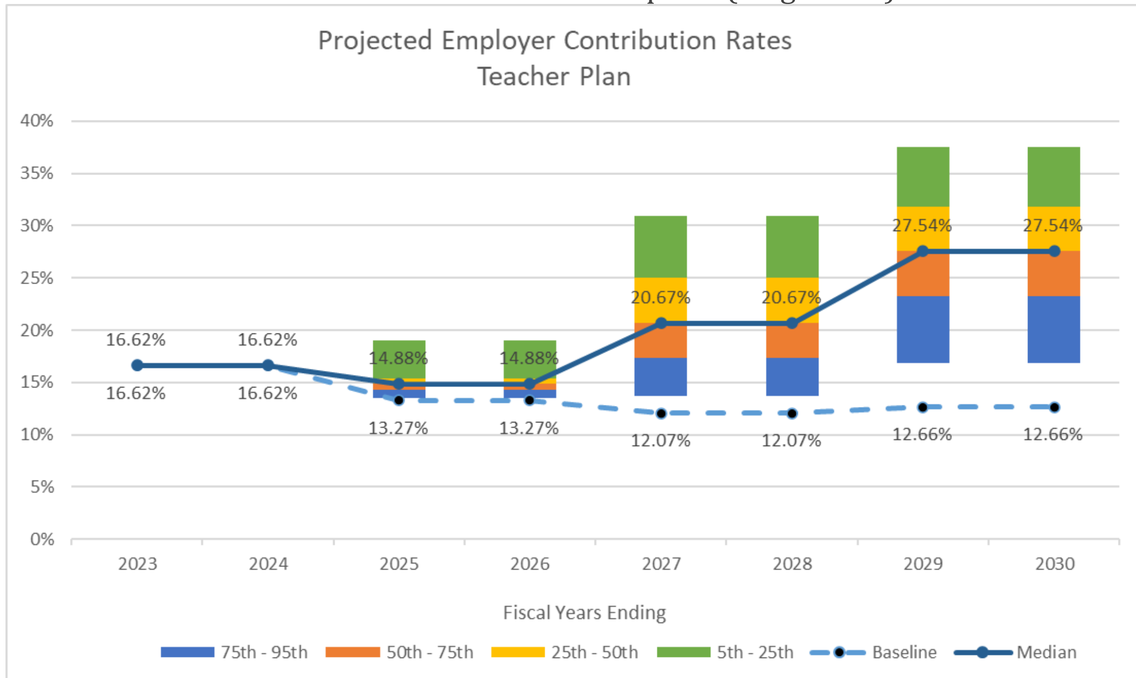
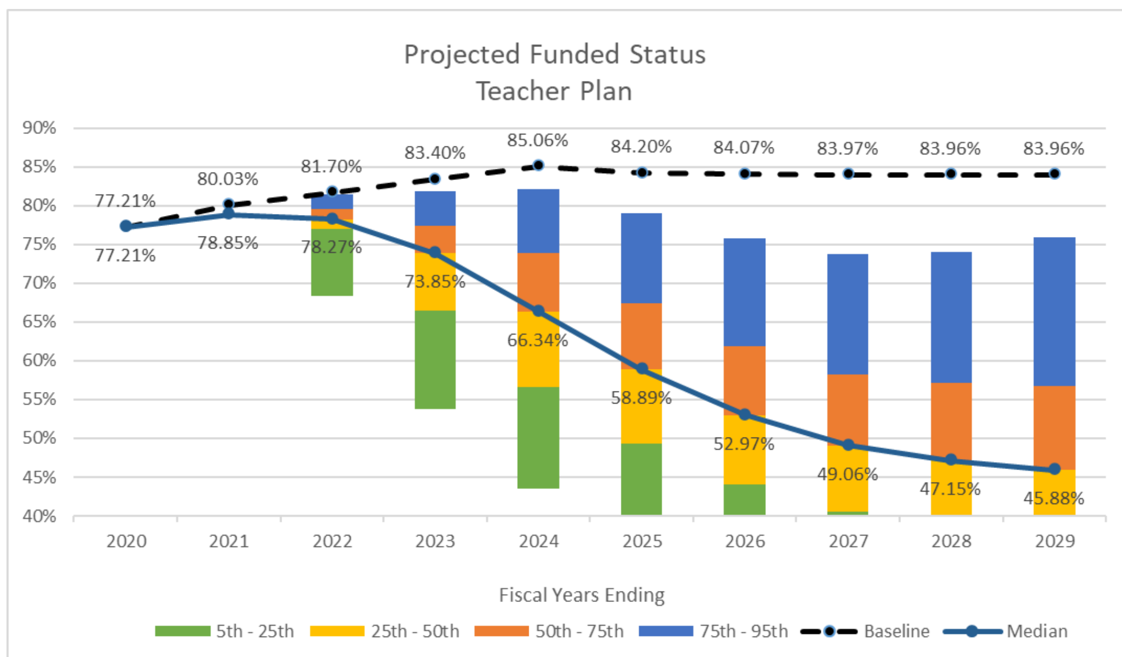


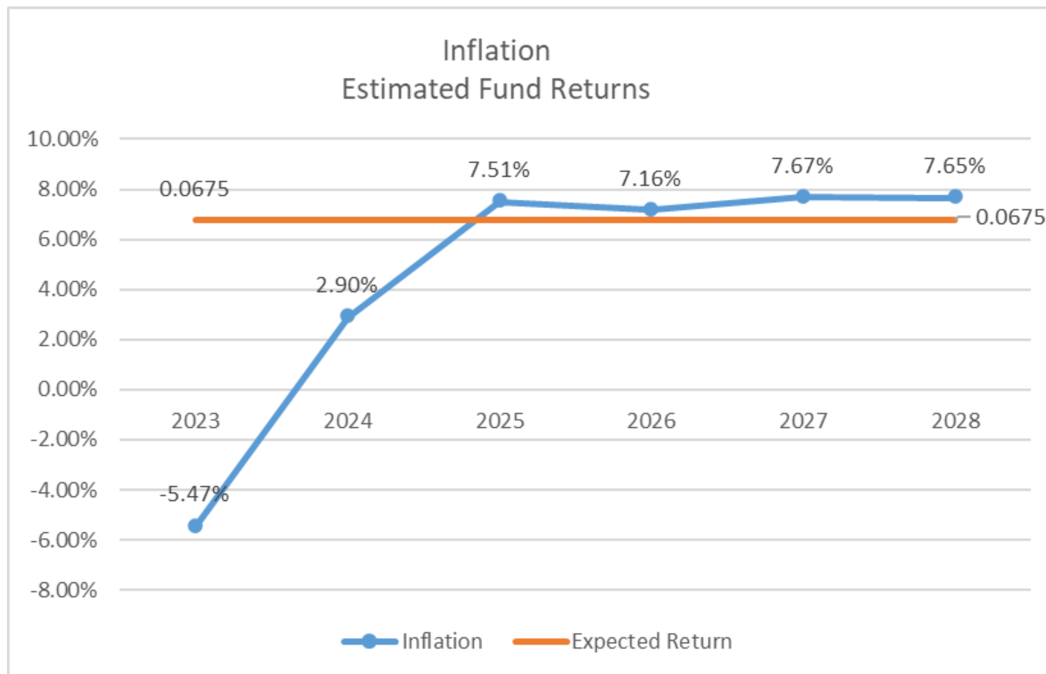
Exhibit 21 – Teacher Plan Impacts (Stagflation)





- **Inflation:** This scenario incorporates continued upward trends in both wage and commodity inflation. The inflation modeled under this scenario will fluctuate between 2.5% and 9.1% during the first six years averaging 5.9%, which is well above the 2.5% assumed rate of inflation over the first six years.
    - Inflation spikes for years 1-2 and persists as the Federal Reserve finds its policy tools to be ineffective over that time period.
    - Period of inflation is followed by elevated interest rates that negatively affect discounted cash flows.
    - Inflation is under control after two years and then all asset classes return to the baseline scenario.
    - Liabilities and benefit payments are also impacted as inflation exceeds the assumed 2.5% level during the earlier years of this scenario causing liability losses due to cost of living increases applicable to pension benefits.

Exhibit 22

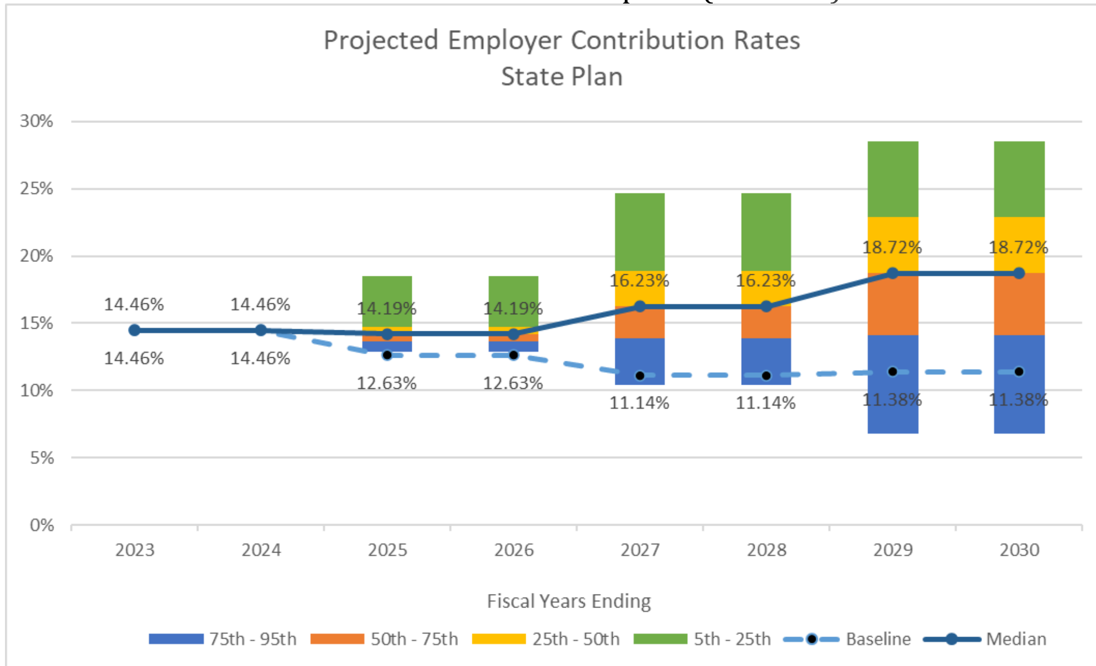


The expected cumulative return from 2023–2028 would be 4.45% as compared to the 6.75% assumed return over this period.

Below are estimated impacts on funding measures over the next eight years for the State and Teacher plans under the Inflation economic scenario.

Due to depressed returns in the first two years as well as actuarial losses due to higher-than-expected inflation, the contribution rate would slowly increase over the eight-year period to just above 18% of covered payroll for the State plan and just over 20% for the Teacher plan. The funded status would also suffer in this scenario dropping into the low 70s for both the State and Teacher plans in a relatively short period of time adding approximately $3.2 billion in unfunded liability to the State and $7.6 billion to the Teacher plan over the first five years.

Exhibit 23 – State Plan Impacts (Inflation)



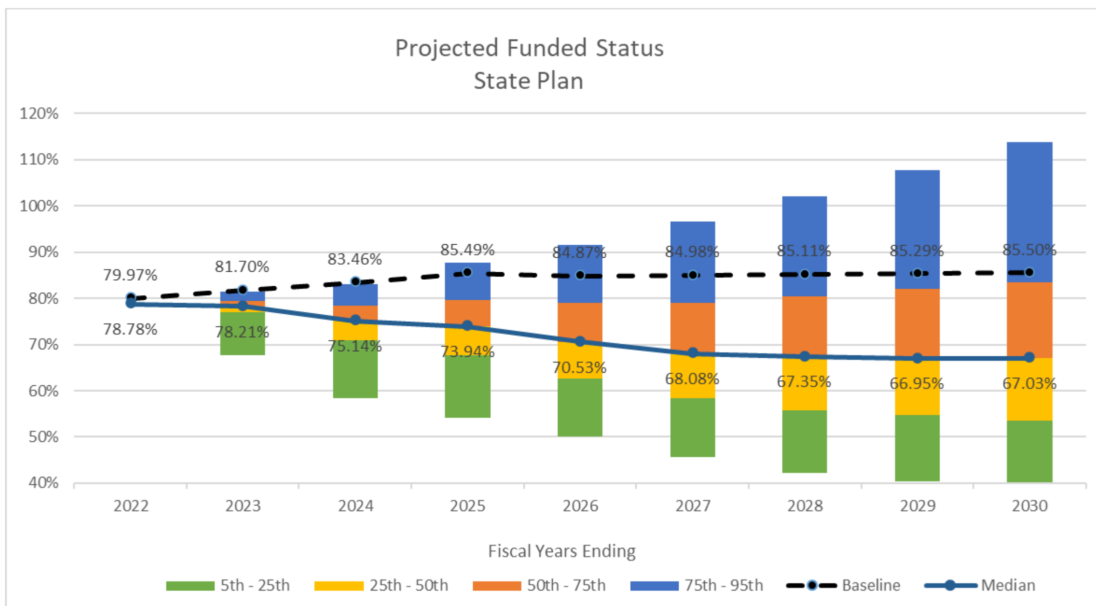
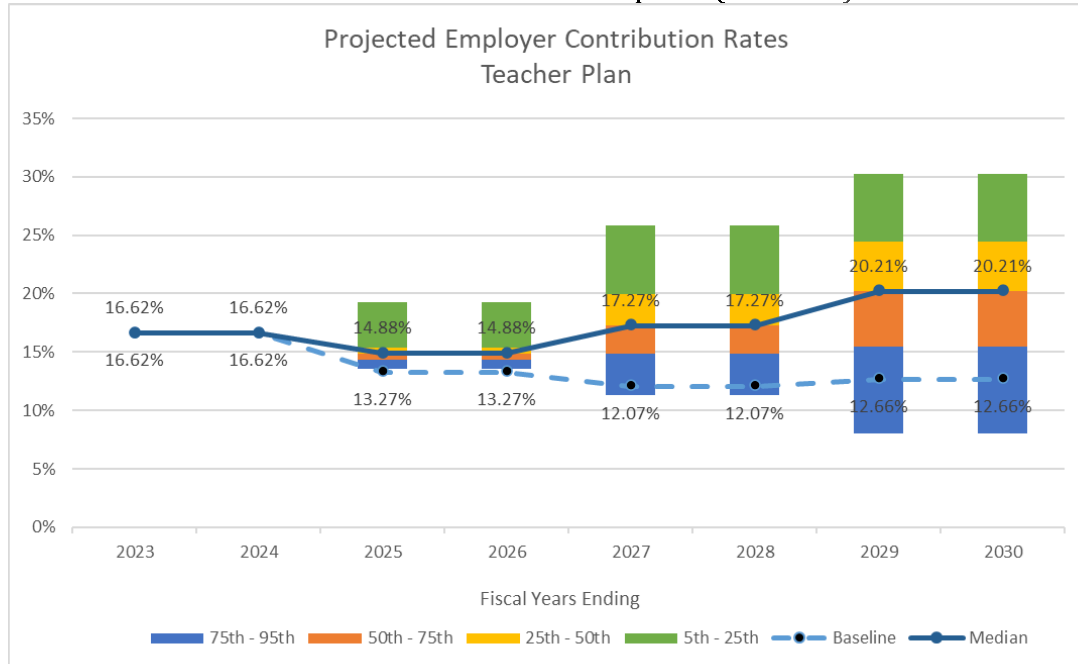
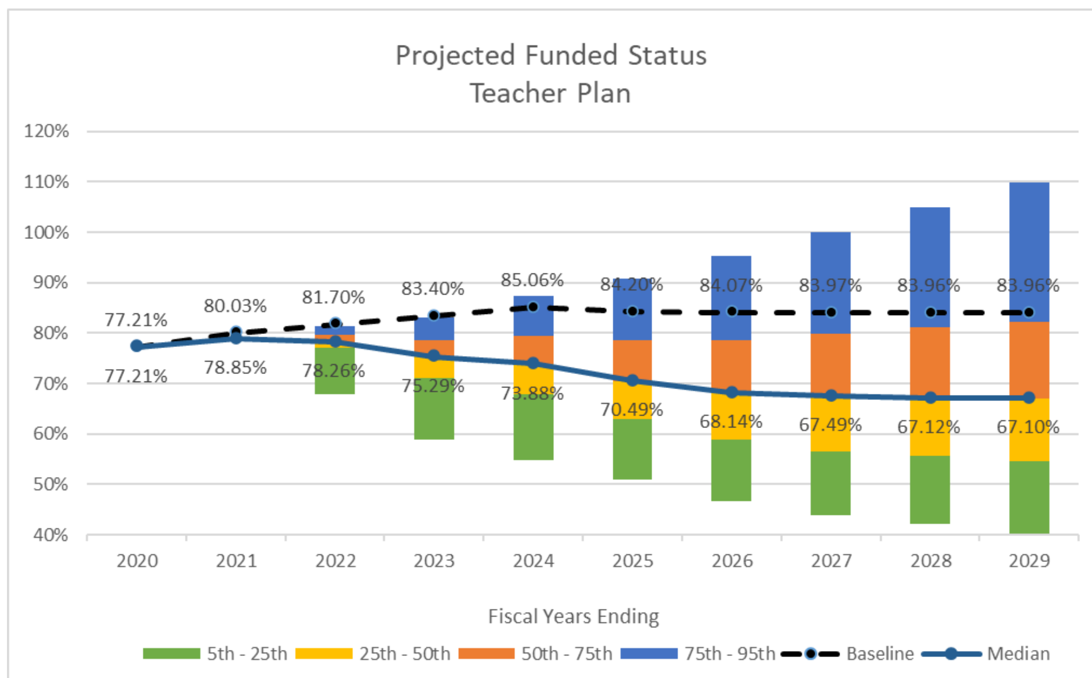


Exhibit 24 – Teacher Plan Impacts (Inflation)





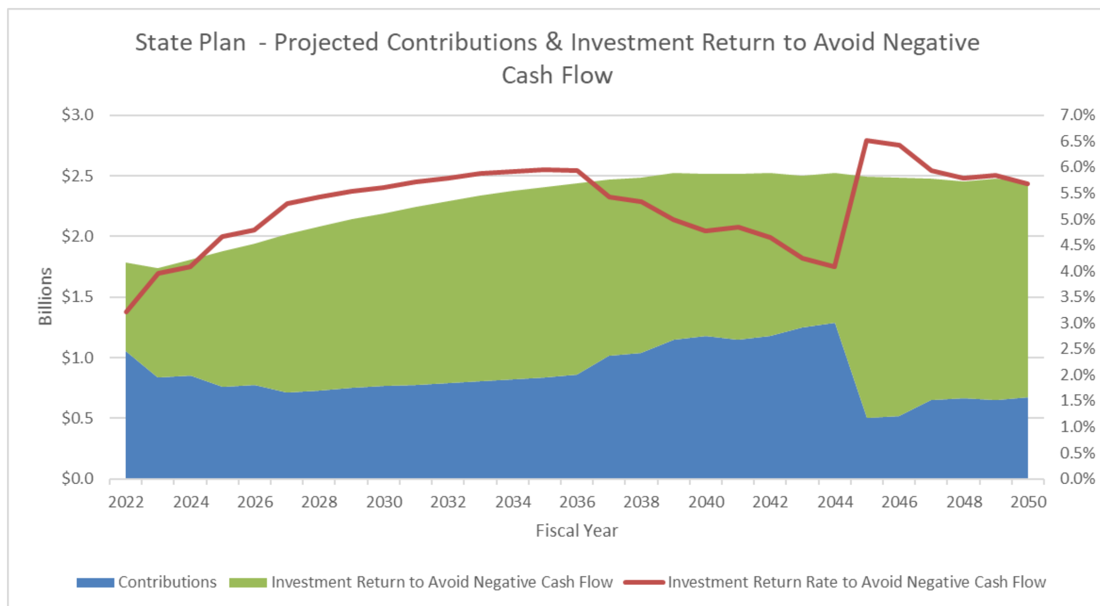
Cash Flow Projections

Defined benefit pension plans are designed to provide employees with a guaranteed income stream upon retirement. Contributions to VRS plans are generally shared by employees and their employer and are a systematic way of prefunding the system's costs. The benefit of prefunding is that investment returns on the prefunded plan assets reduce the employer's long-term contributions.

Retirement plans that have been in operation for a number of years generally have contributions coming into the plan and benefits being paid out. The net (non-investment) cash flow is the difference between the contributions collected (inflows) and the benefits and expenses (outflows) of the fund. These cash flows will vary for each plan because all plans have different demographics and maturities.

Mature plans often have negative cash flows over time, which is considered the normal cycle of pension plans. Negative cash flows do not necessarily imply a plan is in trouble. In fact, part of the benefit and efficiency of prefunding derives from investment returns paying a significant portion of the benefit payments.

Exhibit 25



Results based on June 30, 2021 actuarial valuation.

Exhibit 25 above shows the projected contributions and investment returns needed by the State plan to avoid negative cash flows over the next 30 years. The blue portion of the chart represents the contributions that are expected to be made each year. The green portion of the chart represents the level of investment return that is needed, while the blue and green added together represent the expected benefit payments from the plan.

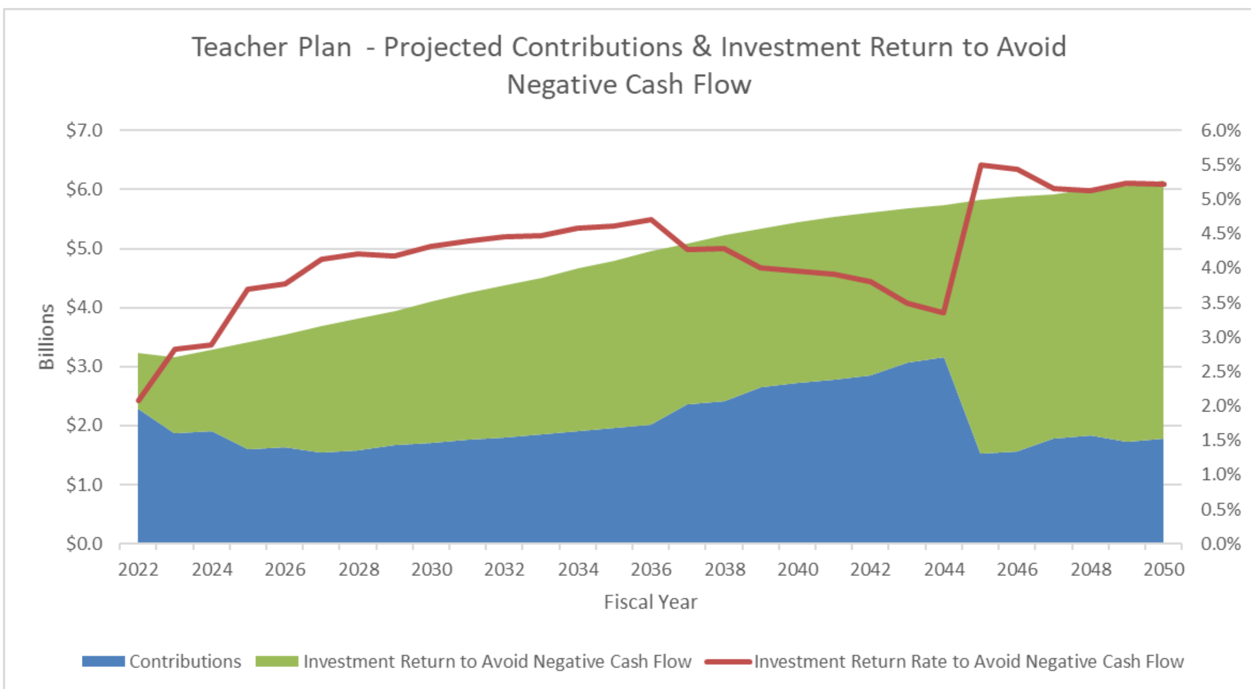
The red line is the level of investment return needed (scale on right of the chart) to generate the investment return (green portion of chart) to keep the incoming cash flow (contributions plus investment return) equal to the plan's expected benefit payments and expenses. Benefit payments in the State plan are expected to peak in 2037 before beginning to reduce as more members are covered by the Hybrid Retirement Plan. The overall employer cost of the hybrid plan is lower than Plan 1 or Plan 2, which means that as the population covered by the hybrid plan grows, fewer employer contributions will go into the plan. Note that the drop off in contribution requirements in 2044 coincides with the payoff of the legacy unfunded liabilities. Despite the lower cost of the Hybrid Retirement Plan, fewer contribution dollars flowing into the plan generally causes more reliance on investment returns to cover cash flow requirements in later years. As a reminder, at present the portion of the contribution rate associated with amortizing the legacy unfunded liabilities represents approximately 2/3 of the employer contribution rate.

The investment return needed over this period to avoid negative cash flow ranges from 3.21% to 6.51%, with an average return of approximately 5.25% to stay cash flow positive to the fund.

Exhibit 26 below shows the projected contributions and investment returns needed by the Teacher plan to avoid negative cash flows over the next 30 years. Benefit payments in the Teacher plan are expected to peak in 2048 compared to 2037 for the State plan as turnover in this plan is less than in the State plan. Note that a similar drop off in contribution requirements in 2044 also coincides with the payoff of the legacy unfunded liabilities in the Teacher plan. Despite the lower cost of the Hybrid Retirement Plan, fewer contribution dollars flowing into the plan will require higher investment returns to cover cash flow requirements in later years.

The investment return needed over this period to avoid negative cash flow ranges from 2.08% to 5.50%, with an average return of approximately 4.21% to stay cash flow positive. The average return needed for the Teacher plan is less than the State plan due to higher contribution requirements for the Teacher plan during much of the projection period, which offsets the need for additional investment return to cover plan costs during those years.

Exhibit 26



Results based on June 30, 2021 actuarial valuation.

During periods of continued volatility, assets in plans with less liquidity are likely to be sold at a loss and as a result may contribute to decreasing funded ratios. In the U.S., public sector pension generally hold some portion of the fund in in cash and short-term investments to pay ongoing expenses, such as benefit payments and administrative costs. A liquidity-to-assets ratio can be useful in determining the liquidity risk, if any, of a pension plan.

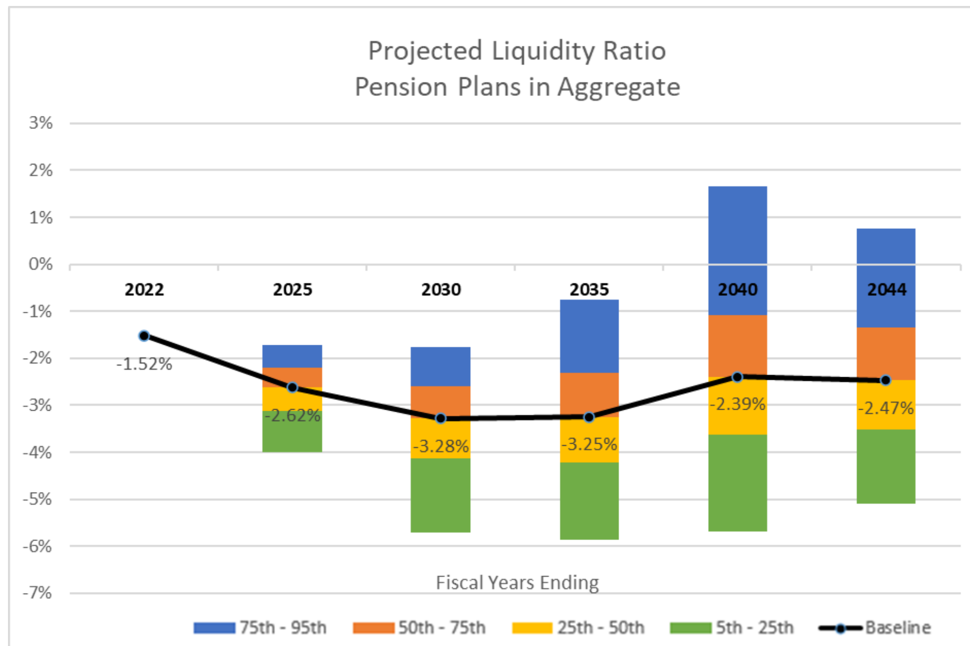
$$\textbf{Liquidity to Assets Ratio} = \frac{\text{Cash + Contributions - Benefit Payments \& Expenses}}{\text{Market Value of Assets}}$$

A negative liquidity-to-assets ratio indicates the pension plan requires additional money to maintain operations and make all benefit payments. The further the ratio is below zero, the higher the percentage of assets that may have to be converted to cash. In a typical year, cash flows may be supplemented by realizing positive investment returns.

Currently VRS is targeting 1.0% of the portfolio to be held in cash and short-term investments to pay ongoing expenses. As of June 30, 2021, the liquidity to asset ratio for all VRS pension plans in aggregate was -1.00%. This means that in addition to the cash allocation of 1% of assets and member and employer contributions, an investment return of approximately 1.00% is required to generate enough funds to pay benefits and expenses without requiring further liquidation of investments.

Exhibit 27 below shows the expected liquidity ratio for all VRS plans in aggregate over the next 22 years. Similar to the cash flow exhibits above, the liquidity ratios show increased reliance on investment returns over the next 10 to 15 years if contributions remain level and benefit payments continue to increase. Similar to the cash flow projections in Exhibits 25 and 26 above, by 2035 more reliance on investment returns will be required to keep the fund cash flow neutral due to an increasing number of benefit payments being paid. This equates to a liquidity-to-asset ratio of -3.28% in 2030 before moderating as the asset base grows.

Exhibit 27



Contribution Risk

Following the Global Financial Crisis and subsequent economic fallout, there was renewed focus by rating and oversight agencies on financial reporting and funding of employer-sponsored benefit plans. Except for limited cases, VRS political subdivision plans are required by statute to contribute the full Board-certified actuarially determined contribution rate. This has historically kept the political subdivision plans much better funded than the statewide plans. The State committed to fully funding the actuarial required contributions for statewide plans and demonstrated that commitment by achieving full funding of contributions earlier than required in the transition plan codified in § 51.1-145 of the *Code of Virginia,* which was part of the pension reform efforts in 2012. This cultural shift in full funding of actuarial required rates along with the additional focus provided by rating agencies and oversight committees has helped improve funding levels for benefit plans since the last recession.

Even with the positive changes that have been made it is necessary, given the current economic environment, to discuss contribution risk. Contribution risk is the possibility

that actual future contributions deviate from what was expected. This type of risk is typically linked to investment performance, assumption changes, demographic changes, or changes in plan design that unexpectedly impact future contribution rates. The COVID-19 crisis, which had variable impact on state and local economies, has highlighted another facet of contribution risk – the risk that the funding source is disrupted or impacted, causing the possibility of underfunded rates, which would lead to higher future costs for the plans.

While economic shocks are able to be smoothed into the employer contribution rates to manage volatility, budget impacts can continue for several years. Although the Commonwealth's current revenue picture is positive, the reduced revenue that the State and local employers could face due current and near-term economic conditions could potentially continue to be a contributing factor to the risk of underfunding.

Longevity Risk

Longevity risk is a term used to describe the instance in which life expectancies are longer than what the actuarial valuation assumes. In defined benefit plans, longevity risk is the risk that members live for longer than is currently expected. This can result in pensions being paid for longer than expected, thus costing plans more money.

Longevity risk is likely to be one of the most significant risks for most plans and has become increasingly important in assessing the overall risk profile as discount rates have fallen and liabilities have increased.

Mortality assumptions used for the valuation of pension benefits can have a large impact on the calculation of pension liabilities, so the selection of appropriate mortality tables is important.

Following the 2021 quadrennial experience study, the VRS Board of Trustees moved from a static table based on Society of Actuaries RP-2014 mortality table adjusted for margin and based on a head-count weighted basis to a Society of Actuaries public sector mortality table PUB-2010 using a generational mortality approach and a benefits-weighted basis. The benefits-weighted basis weights the age at death of retirees with larger benefits more than the age at death of retirees with smaller benefits. For the VRS population this effectively created longer life expectancies than when using a head-count weighted basis.

The exhibit below highlights the assumed increase in life expectancy associated with the new mortality tables adopted by the VRS Board of Trustees in April 2021.

Exhibit 28

LIFE EXPECTANCY STATE				
	MALE		FEMALE	
Age	Prior Mortality Table	Generational Mortality Table	Prior Mortality Table	Generational Mortality Table
55	83.06	85.07	85.96	87.08
65	84.91	86.06	87.15	87.76
75	87.53	88.04	89.08	89.24

LIFE EXPECTANCY TEACHERS				
	MALE		FEMALE	
Age	Prior Mortality Table	Generational Mortality Table	Prior Mortality Table	Generational Mortality Table
55	84.95	86.26	87.87	88.99
65	86.20	86.77	88.70	89.41
75	88.10	88.32	90.19	90.44

HAZARDOUS DUTY				
	MALE		FEMALE	
Age	Prior Mortality Table	Generational Mortality Table	Prior Mortality Table	Generational Mortality Table
55	82.34	84.13	83.61	83.65
65	84.13	84.92	85.10	84.64
75	86.66	87.03	87.60	86.86

JRS				
	MALE		FEMALE	
Age	Prior Mortality Table	Generational Mortality Table	Prior Mortality Table	Generational Mortality Table
55	83.06	87.34	85.96	90.16
65	84.91	88.18	87.15	90.67
75	87.53	89.83	89.08	91.77

In addition to reflecting increases in life expectancy for current members, generational tables also incorporate additional mortality improvements for future generations. The tables below show the life expectancy of members who attain age 55, 65, and 75 in 2021 as compared to projected life expectancy for members who will attain age 55, 65, or 75 in the year 2041.

Exhibit 29

LIFE EXPECTANCY STATE				
	MALE		FEMALE	
Age	Generational Mortality Table 2021	Generational Mortality Table 2041	Generational Mortality Table 2021	Generational Mortality Table 2041
55	85.07	86.37	87.08	88.26
65	86.06	87.16	87.76	88.76
75	88.04	88.83	89.24	90.01

LIFE EXPECTANCY TEACHERS				
	MALE		FEMALE	
Age	Generational Mortality Table 2021	Generational Mortality Table 2041	Generational Mortality Table 2021	Generational Mortality Table 2041
55	86.26	87.41	88.99	90.04
65	86.77	87.79	89.41	90.33
75	88.32	89.08	90.44	91.18

HAZARDOUS DUTY				
	MALE		FEMALE	
Age	Generational Mortality Table 2021	Generational Mortality Table 2041	Generational Mortality Table 2021	Generational Mortality Table 2041
55	84.13	85.41	83.65	84.99
65	84.92	86.02	84.64	85.76
75	87.03	87.81	86.86	87.67

JRS				
	MALE		FEMALE	
Age	Generational Mortality Table 2021	Generational Mortality Table 2041	Generational Mortality Table 2021	Generational Mortality Table 2041
55	87.34	88.58	90.16	91.24
65	88.18	89.24	90.67	91.62
75	89.83	90.62	91.77	92.53

While the generational mortality tables do not totally eliminate longevity risk, they help reduce the exposure and mitigate the risk by anticipating longer lifetimes and incorporating additional funding to potentially pay benefits for longer periods of time.

Potential Strategies to Enhance Funding

VRS continues to support strategies to lower the legacy unfunded liabilities of the plans. While these various techniques could save employers money on future contributions, increasing contributions during a fiscal crisis, even in order to ultimately save money, might not be a practicable or realistic approach. Nevertheless, when revenues and fiscal conditions allow, these alternatives may serve to reduce future employer expenditures and are worth discussing here.

A decade of bull markets has shown that investment returns alone will not get rid of the legacy unfunded liabilities, which were in part the result of a failure to fund the certified contribution rates. Recent financial crises such as the Global Financial Crisis and impacts of the pandemic in 2020 have shown that plans with greater unfunded liabilities will continue to be more vulnerable to market downturns. This suggests that a dedicated effort to pay down unfunded liabilities on a more accelerated basis may help to cushion any potential uncertainty that could occur with future market downturns. In recognition of the importance of reducing long-term liabilities with the benefit of achieving savings over time, the Governor and legislature provided a one-time infusion of $750 million prior to June 30, 2022 with an additional $250 million expected to be provided in June 2023. In addition, the Governor and General Assembly also expect to provide $80.4 million split between June 2023 and June 2024 to certain Health Insurance Credit programs

Shorten Period for Amortization of Legacy Unfunded Liability

Although the current funding policy puts the plans on a path to full funding by 2044, it is important to understand how the legacy unfunded liability is being amortized and how it is expected to change over time.

As discussed above, to keep plan costs level over time, unfunded liabilities are generally amortized using a "level percentage of payroll" method. This method assumes that payroll will increase over time due to both inflation and merit increases, so it aims to collect roughly the same percentage of payroll each year, which should inherently collect

larger dollars in later years as payrolls increase. "Back-loaded" funding methods are commonly used to fund public sector plans; though some plans opt to use revenue growth rather than growth of payroll as the basis for the growth rate. The alternative would be to amortize unfunded liabilities as a "level dollar" amount, which would collect the same cash contribution each year similar to a home mortgage. This approach generally causes "front-loading" of contributions by paying a higher percentage of contributions as a percent of payroll early in the amortization period and a smaller percentage toward the end of the amortization period.

In 2013 when VRS updated its funding policy, one of the changes was to move from open to closed amortization periods in order to pay down unfunded liabilities. It was decided that all future gains and losses would be amortized over 20-year closed periods. This method would avoid "negative amortization" and also pay down losses more closely related to the working lifetime of members rather than pushing costs beyond their working career. Negative amortization occurs when the amortization payment is set too low to cover the interest payment on the outstanding balance, which results in an increase in the principal balance of the loss.

The legacy unfunded liability established as of 2013 was amortized over a 30-year closed period. This was done in large part to moderate employer rates, which at the time were not being fully funded by the Governor and General Assembly. Using a shorter amortization period would have increased rates even more steeply than the move to the closed amortization period. One issue with amortizing unfunded liabilities over longer periods of time—such as 30 years—is that during the first nine or 10 years, the interest payments on the unfunded liability will be in excess of the amortization payment, which creates "negative amortization." This means that the outstanding balance actually increases during the first eight or nine years of amortization as payments go toward interest rather than principal.

As of June 30, 2022, the State plan legacy unfunded liability has 21 years of the original 30 years remaining to be paid, with an outstanding balance of $7.5 billion. Under the current amortization schedule, $6.8 billion of interest will be paid over the next 21 years on the $7.5 billion outstanding balance. To illustrate, as shown in Exhibit 30, adjusting the remaining period for the legacy unfunded liability down to 20 years beginning with the 2022 valuation would avoid any additional negative amortization and save the State

approximately $450 million in interest payments. The shorter amortization period would increase employer rates by approximately 0.36% of covered payroll each year of the remaining amortization period. The exhibit also shows the additional savings for shortening the amortization by up to five years.

Exhibit 30

Amortization of Legacy Unfunded Liability
State Plan

Unfunded Balance as of 2022 - $7,489,568,100

Amortization Period	Cumulative Payments over Amortization Period	Interest Paid Over Amortization Period	Amortization Payment as Percentage of Payroll	Increase in Annual Payment	Estimated Increase in Funding Initial Year	Estimated Total Savings
21	$14,286,815,900	$6,797,247,700	10.65%			
20	$13,837,180,300	$6,347,612,100	11.00%	0.36%	$16,754,000	$449,635,600
19	$13,401,262,200	$5,911,694,000	11.40%	0.76%	$35,350,000	$885,553,700
18	$12,978,655,500	$5,489,087,300	11.84%	1.20%	$56,095,000	$1,308,160,400
17	$12,568,965,800	$5,079,397,600	12.34%	1.70%	$79,369,000	$1,717,850,100
16	$12,171,810,200	$4,682,242,000	12.90%	2.26%	$105,647,000	$2,115,005,700

Results based on June 30, 2021 actuarial valuation.

Note that any impacts that result in flat or even declining workforce/payroll in the public sector, similar to what occurred after the Global Financial Crisis in 2008-2009, would likely result in increases in amortization payments as a percentage of payroll due to payments to the unfunded liability being less than expected. When actual payroll is less than expected, less dollars are contributed to the fund under the percentage of payroll amortization method. Therefore, future contribution rates will need to increase in order to collect the necessary contributions over a smaller payroll base.

Maintain Current Contribution Rates

Maintaining current contribution levels following years in which the plan experiences actuarial gains could help create a cushion against future actuarial losses while improving the plan funded status. This strategy was used in the 2022 Appropriation Act with details on page 12 of this report.

Limitations on Benefit Enhancements

Another strategy adopted by the VRS Board of Trustees is to require political subdivision plans to meet specific funding measures in order to make modifications or enhancements to benefits. Plans are required to be at least 75% funded after any plan changes, which could require the employer to make lump sum payments at the time of a plan design change in order to maintain the plan funding level. This prevents employers from adding large liabilities to their plans that can cause additional rate volatility and create increased rates that they may not be able to pay for in future years.

Legislatively mandated benefit expansions, however, must be provided by all employers despite the employer's funded status. In addition, some benefit enhancements can create immediate liabilities. As benefits enhancements are considered, focus should not only be placed on the contribution rates required to fund the benefits, but also the unfunded liabilities generated. Again, unfunded liabilities have the potential to create additional volatility in contribution rates.

FINDINGS & CONCLUSIONS

Although market returns for fiscal year 2021 exceeded expectations, an increase in gloomy developments during FY 2022 and into FY 2023 has caused several risks to materialize in the economy which could impact plans. Changes to assumptions recommended following the 2021 quadrennial experience study, including changing to a generational mortality approach on a benefits-weighted basis, will better position the plan to address longevity risk associated with members living longer in retirement.

As plans mature and assets continue to grow, downside investment risk will have a bigger impact on plan funded status and employer contribution rates.

Opportunities exist to proactively address some of these concerns and to better position the retirement plans to provide the financial stability for current and future members of VRS. Accelerating payback of the legacy unfunded liability has the potential to save billions in future employer contributions while enhancing the funded status of the retirement plans. This could be achieved by:

- Reducing amortization periods for remaining legacy unfunded payments.
- Maintaining current employer contribution rates when positive experience would otherwise allow for a reduction in employer rates.
- Adjusting methodology used to amortize unfunded liabilities.
- Avoiding the expansion of benefits across pension and OPEBs while plans remain underfunded.

Next Steps

- Due to the current economic conditions, including high inflation, slowing growth, and geopolitical developments, analysis of future impacts on the VRS fund will continue as new information becomes available.
- While actions taken by the Governor and General Assembly in 2022 including maintaining higher contribution rates and infusing additional dollars serve to improve plan health, these actions do not immunize the fund from downside risk because unfunded liabilities remain and economic conditions, especially in the near-term, are uncertain.
- VRS will continue to monitor the health of the plans and is committed to providing robust analysis for consideration by the VRS Board of Trustees and other stakeholders.

§ 51.1-124.30:1. Adoption of stress testing and reporting policies.

The Virginia Retirement System (VRS) shall adopt a formal policy to:

1. Develop and regularly report sensitivity and stress test analyses. Such analyses and reporting shall include projections of benefit levels, pension costs, liabilities, and debt reduction under various economic and investment scenarios;
2. Improve investment transparency and reporting policy by (i) providing a clear and detailed online statement of investment policy; (ii) including one-year, three-year, five-year, and 10-year investment performance data in quarterly investment reports; (iii) including 20-year and 25-year investment performance data in annual investment reports; (iv) reporting net investment returns on a quarterly basis; and (v) reporting gross investment returns and returns by asset class on an annual basis; and
3. Regularly report investment performance and expenses such as external manager fees, carried interest fees, and investment department expenses for all asset classes, including private equity, public equity, fixed income, credit strategies, real assets, strategic opportunities, and other investments.

2017, c. 639.