

2018 – 2019 Investment Plan

Commonwealth of Pennsylvania
State Employees' Retirement System

Prepared by SERS' Investment Office – in consultation with the State Employees' Retirement Board and its investment consultants. Adopted by SERS' Board on April 25, 2018.

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Investment Plan Purpose

SERS' Statement of Investment Policy established two objectives for SERS' investment program:¹

- Achieve a net total return equivalent to the actuarial interest rate assumption, or preferably, in excess of this rate in order to improve the funded ratio of the fund through investment earnings and favorably impact future employer and employee contribution rates.
- Achieve a net, total long-term return that meets or exceeds an appropriate composite plan benchmark index on a five to 10-year rolling time horizon. The composite benchmark index is based on the asset allocation set forth in this investment plan, as approved by the SERS Board.

This plan provides a clear strategic direction for SERS' investment program. The State Employees' Retirement Board ("Board") seeks to pursue five key objectives in this investment plan.

1. Formulate an asset allocation policy that provides a high expected probability of achieving SERS' actuarially assumed long-term rate of return, consistent with the Board's tolerance for risk, while continuing to meet obligations to beneficiaries.
2. Define the primary strategic objectives that are central to a successful investment program for the total SERS fund at this point in time.
3. Define, in general terms, the strategies and methods to be pursued at both the total fund and the individual asset class levels to achieve those objectives.
4. Provide a tool for integrating key aspects of SERS' pension plan attributes with the investment strategy and, similarly, for integrating Board decisions and staff execution of that strategy.
5. Embed the pursuit of fund returns in a comprehensive risk monitoring and mitigation program which emphasizes transparency in both the execution of investment policy and the outcomes in varying capital market environments encountered over time.

SERS' investment office staff, in consultation with the Board and investment consultants, updates the investment plan every other year. If economic, fiscal, or capital market conditions change significantly, SERS' investment office staff and consultants may recommend changes to

¹ SERS Statement of Investment Policy (amended 03/08/2017) (p.8).

this investment plan for the Board's approval on an interim basis. Approval of this investment plan by SERS' Board authorizes SERS' investment office staff to:

- Execute the asset class changes
- Strive towards asset allocation policy targets
- Begin researching and implementing initiatives

SERS' investment office staff will report its recommendations to SERS' Board for consideration.

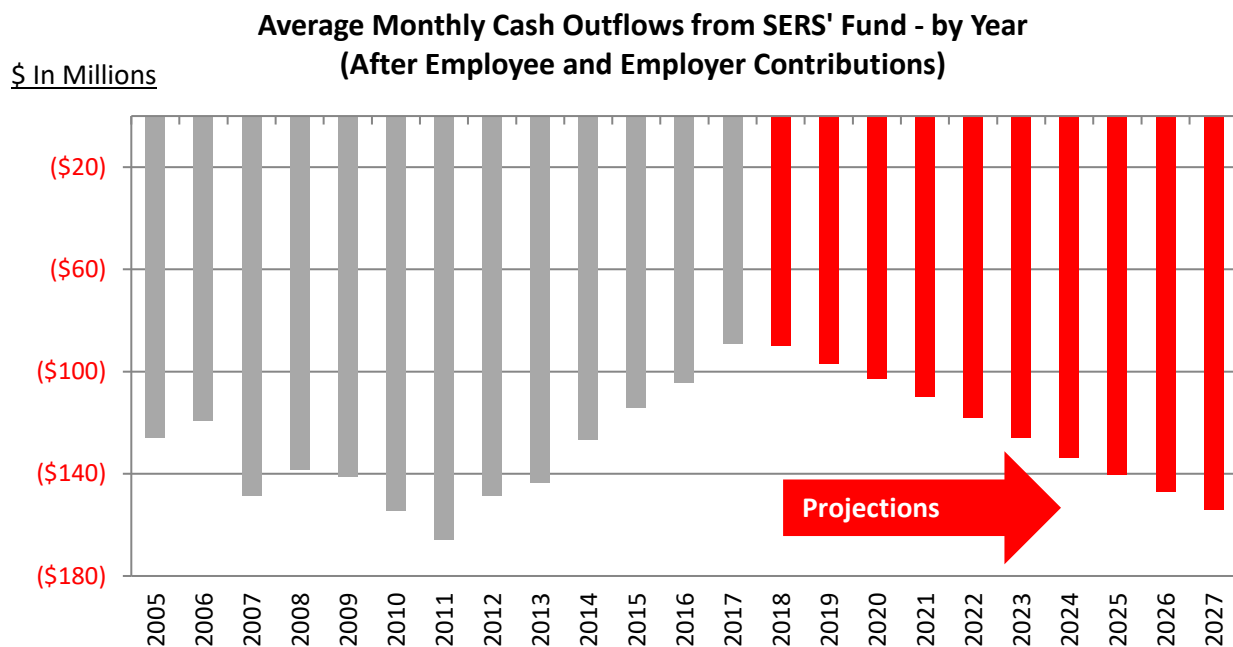
Liquidity Requirements

SERS is a mature pension plan with negative cash flows – retirement benefit payments are greater than contributions from employees and employers. Over the past decade, SERS paid over \$26 billion in retirement benefits to over 105,000 members. During the same period, SERS received contributions of \$3.5 billion from employees and \$6.8 billion from employers.²

Over the next 10 years, SERS’ projected monthly retirement benefit payments will increase from just under \$100 million to over \$140 million (net of contributions from employees and employers under Act 2010-120 assumptions).³

A critical risk factor to consider is the potential for prolonged suppressed cash payments from employers during difficult state government budget cycles. Over the next 10 years, the average annual employer contribution is expected to be approximately 31% of payroll. Figure 1 shows the average monthly cash outflows from SERS after employee and employer contributions.

Figure 1



² 10-years ending December 31, 2016.

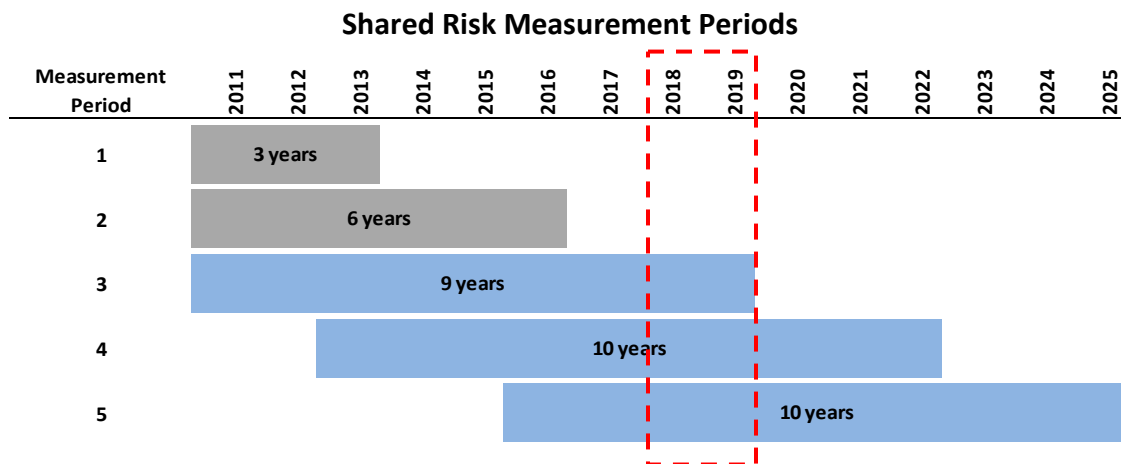
³ SERS’ 2016 Actuarial Report (p.32), Projection of Expected Contributions and Benefits.

Shared Risk – Potential Impact on Employee Contributions

Under the shared risk provision of Act 2010-120, employee contributions will increase if SERS underperforms its actuarial assumed rate of return by greater than 100 basis points (>1.0%) over a measurement period. The shared risk provision highlights the importance of SERS’ investment decision-making process, including:

- The appropriateness of the actuarial assumed rate of return established by the Board
- The probability that a Board-approved asset allocation can achieve the actuarial assumed rate of return within an appropriate level of expected risk
- The process of how investment managers and funds are selected and hired by the Board

Figure 2



There were no increases to employee contributions for measurement periods 1 and 2. As shown in Figure 2, the third measurement period will be from January 1, 2011, to December 31, 2019 (9 years). All measurement periods thereafter are calculated every three years using the prior 10-year rolling annualized return. It is important to note that employee contributions may increase by a maximum of 50 basis points (0.5%) as a result of any one measurement period outcome and is subject to a maximum cumulative cap of 200 basis points (2.0%).⁴

In addition to the existing shared risk provision, Act 2017-5 provides that Class A-3 and Class A-4 members will share in the gains (50 basis points reduction in contribution rates with a cumulative maximum reduction of 200 basis points) if SERS outperforms its actuarial assumed rate of return by greater than 100 basis points (>1.0%) over the measurement periods.

⁴ SERS’ 2016 Actuarial Valuation Report – Schedule D (pgs.19-20).

A Well-Defined Investment Philosophy and Process

SERS' investment program has a critical requirement to pay retirement benefits in perpetuity and the Board, investment office staff, and external consultants spend a considerable amount of time evaluating liquidity, shared risk, capital markets, expected returns, and expected risks. To avoid a permanent loss of capital during potentially prolonged periods of market decline, SERS' investment program has a continuing commitment to ensure that:

- **The fund is diversified, which serves as a foundation of risk management.**
- **Investment strategies embrace risk in order to achieve returns since a risk-free investment strategy does not exist.**
- **A disciplined rebalancing process is executed to adhere as closely as possible to the Board's chosen target asset allocation.**
- **Every dollar invested must align to an initiative or an asset class structure of the Board-approved investment plan.**
- **Every dollar invested must have the potential to add exceptional value relative to its competing investment opportunities with similar risk/return, fee, and liquidity profiles.**

SERS' investment program has a continuing commitment to conduct thorough due diligence and intensive manager monitoring, and to continuously enhance its disciplined investment decision-making process. Although it requires extensive time and resources, the goals of SERS' disciplined investment process are to:

- **Improve the probability of achieving long-term expected return objectives;**
- **Ensure confidence that all investment opportunities recommended by investment staff and consultants are the best available opportunities; and**
- **Enhance accountability of investment recommendations from investment office staff.**

SERS' investment program is structured with a long-term focus and is based on a combination of academic theory, market and economic assumptions, and state budgetary assumptions. The theoretical framework relies on a mean-variance optimization analysis which combines expected returns, volatility, and covariance of investment combinations. A long-term asset allocation target policy is constructed to provide a high probability of achieving SERS' long-term actuarially assumed rate of return, consistent with the Board's tolerance for risk, while continuing to meet retirement benefit payment obligations in perpetuity.

SERS' investment program endeavors to maintain an appropriate level of cash to pay benefits through prolonged periods of market and economic decline.

Key Objectives

After assessing the current status of the pension plan, the fund's existing structure, and the studies/recommendations of SERS' staff, general consultant, and specialist consultants, the Board adopted four key objectives.

Objective #1

Pursue the highest returns possible at the level of risk deemed prudent by the Board.

The Board takes note of its current long-term assumed rate of return of 7.25% (lowered from 7.5% in 2017) in both setting its asset allocation—the largest determinant of both risk and return in the fund—as well as in executing individual investments in each asset class. The Board recognizes that at any point in time, however, depending on market conditions and the Board's assessment of risk, the probability of achieving the assumed rate will vary.

Objective #2

Align the percentage of fund assets committed to long-term illiquid investments with expected net cash outflows.

After reviewing the system's increasing maturity, the results of the asset/liability study, and the risks associated with the forced sale of liquid assets at undesirably low valuations in market declines, the Board successfully executed its plan to decrease the allocation to illiquid investments to an appropriate level better aligned with the system's expected net cash outflows and assumed rate of return. As such, the Board will continue to incorporate future liquidity requirements into its investment decisions in pursuit of achieving or exceeding the assumed rate of return.

Objective #3

Continue to maintain vigorous performance monitoring and a comprehensive risk monitoring and mitigation program.

The challenges facing fiduciaries to manage responsibly and prudently the investment of more than \$29 billion across multiple asset classes, scores of investment mandates, and other assets are immense. To this end, the Board will work with SERS' staff and consultants to maintain and enhance, where possible, the ongoing monitoring program. Moreover, the Board will continue to focus on the risks that are likely to have the largest effect on the fund's assets and, in turn, the fund's ability to ensure payment of current and future benefits.

Objective #4

Continue managing and negotiating investment costs across the fund.

It is crucial to focus on the investment management costs of a fund invested in various strategies that collectively targets a risk-adjusted performance that meets or exceeds the assumed rate of return.

Forward Vision

Although significant accomplishments to enhance returns and reduce fees have been achieved, SERS' investment program strives for continuous improvement to utilize best practices to achieve or exceed its expected return while controlling costs.

As a long-term investor, SERS remains committed to utilizing best practices in governance, asset allocation, and risk management. Accordingly, SERS will continue to enhance its efficiency, while simultaneously allocating resources to low-cost passive strategies or best-in-class actively managed opportunities where the Board, investment office, and external consultants have the highest conviction that the opportunities can generate excess return.

All of the 2018 – 2019 Investment Plan initiatives listed below focus on achieving SERS' long-term expected return of 7.25%.

Strategic Initiatives

Private Equity and Real Estate

1. Target the annual pacing of up to \$650 million in new Private Equity commitments (currently \$750 million) to meet its long-term target allocation of 16% of the total fund.
2. Target Private Equity fund commitments of \$75 million or more, in best-in-class funds to build long-term strategic partnerships, improve operational efficiency by reducing the number of funds, and improve SERS' leverage to negotiate lower management fees. Certain commitments under \$75 million to high conviction relationships such as venture capital and emerging markets may be considered on a case-by-case basis.
3. Target the annual pacing of up to \$600 million in new Real Estate commitments to meet its long-term target allocation of 12% of the total fund.
4. Target Real Estate fund commitments of \$50 million or more with best-in-class managers/funds to build long-term strategic partnerships and improve SERS' leverage to negotiate lower fees. Certain commitments of under \$50 million may be considered to tactical sectors on a case-by-case basis.
5. Research Private Equity co-investment options to lower SERS' management fees.
6. Improve Real Estate's risk/return profile by establishing clear long-term target allocation ranges designed to increase the expected return, liquidity, diversification, and inflation hedging characteristics of the Real Estate portfolio, while decreasing expected risk.

Multi-Strategy

7. Target up to \$350 million in the Private Credit Funds sub-strategy to meet its long-term target allocation.
8. Target Private Credit fund commitments of \$75 million or more in best-in-class funds to build long-term strategic partnerships, and improve SERS' leverage to negotiate lower management fees.

Global Public Equity and Fixed Income

9. Research and implement optimal active and passive allocations within SERS' Global Public Equity and Fixed Income programs.
10. Implement optimal structures to enhance global mandate and emerging market equity investment opportunities.
11. Implement an emerging investment manager program for public equities.

Legacy Hedge Funds (in liquidation)

12. Continue with the liquidation of SERS' legacy hedge fund portfolios.

Total Fund Level

13. Enhance investment-related governance policies (e.g., Statement of Investment Policies, Investment Advisor Monitoring Policy, Rebalancing Policy, Proxy Voting Policies, Derivatives Policy, etc.).
14. Provide SERS' Board with educational opportunities to discuss global market and economic conditions, and their impact on SERS' investment program.
15. Implement investment-related governance policies approved by the Board.
16. Take into account the Pennsylvania Department of the Auditor General's 2017 audit recommendations while implementing this plan.
17. Conduct an in-depth benchmark review.

Asset Liability Study

SERS performs a comprehensive asset liability study every three to five years to examine the probable future consequences, over extended periods of time, of applying alternative asset allocation strategies to SERS' investment assets in order to fund the liabilities created by the benefit provisions of the pension plan. Asset liability studies are unique in their ability to combine, in a single analysis, the three critical factors that drive the financial health of the pension plan: 1) benefit policy (liabilities), 2) contribution policy, and 3) investment strategy (asset allocation).

The results of the 2015 Asset Liability Study indicate that SERS currently is underfunded but improvements in financial health are possible. SERS can best meet its objectives through the continued use of a well-diversified investment portfolio. **However, positive outcomes are extremely dependent on the employer contribution policy.**⁵

Asset Allocation Policy

Asset allocation is widely accepted as the primary determinant of any pension plan's long-term return and risk. It is substantially more influential than the mandates deployed in individual asset classes, the managers selected to implement the mandates, or the tactical asset allocation decisions. A significant and often-cited study on this topic demonstrates that asset allocation explained 93.6% of the variation in quarterly returns for a typical large pension fund.⁶

SERS' historical adherence to its asset allocation process generated investment returns that contributed 51% of the assets added to its portfolio over the past decade. Of the remaining 49%, employer contributions added 32% and employee contributions added 17%.⁷

In developing long-term asset allocation policy targets, SERS' investment team must consider:

- Maintaining an appropriate level of cash to pay retirement benefits and covenants during prolonged periods of market decline and potential state budgetary constraints.
- Maintaining an appropriate liquidity profile of the total fund to align with the projected increase in retirement benefit payments.
- Pursuing the highest returns possible at the level of risk deemed prudent by SERS' Board.

⁵ RVK Asset Liability Study Executive Summary dated September 16, 2015.

⁶ Brinson, Hood, and Beebower, "Determinants of Portfolio Performance," *Financial Analysts Journal*, July/August 1986

⁷ SERS' 2016 CAFR (p.5).

SERS' asset allocation structure was developed and weighted by considering each asset class' expected return, volatility, and correlation with other asset classes. SERS' investment office staff, in consultation with the Board and external investment consultants, combines asset classes in such a way to provide the highest expected return for a given level of risk, subject to the fundamental liquidity and diversification constraints.

SERS' updated asset allocation is positioned to maintain the current liquidity profile of the total fund, improve staff, consultant, and investment manager accountability, leverage staff and consultant skill sets, and improve transparency. The Board selected the 10-year target asset allocation policy as shown below (Figure 3).

Figure 3

SERS 2018 – 2019 Asset Allocation Policy⁸

	Current Exposure 12/31/2017	2018 – 2019 Asset Allocation Policy	Policy Ranges
Private Equity	14%	16%	
Global Equity	53%	48%	
<i>Total Equity</i>	67%	64%	+/-5%
Real Estate	8%	12%	+/-3%
Multi-Strategy	8%	10%	+/-3%
Fixed Income	14%	11%	+/-3%
Cash	3%	3%	+/-3%
Total	100%	100%	
Expected Return	7.17%	7.35%	
Risk (Standard Deviation)	14.27%	14.45%	
RVK Liquidity Metric	67	61	

⁸ Source: SERS' Investment Office and RVK

As a result of the Board’s selected target asset allocation policy, SERS’ investment program is positioned to achieve the actuarial assumed rate of return over the long-term. These returns are inclusive of expected total excess performance over benchmarks while ensuring there is sufficient liquidity to pay retirement benefits.

To explain the primary risk and return contributors, the chart below (Figure 4) shows the major asset class components of SERS’ asset allocation, with expected return on the vertical axis, and expected risk along the horizontal axis.

Figure 4

SERS’ 10-Year Target Asset Allocation

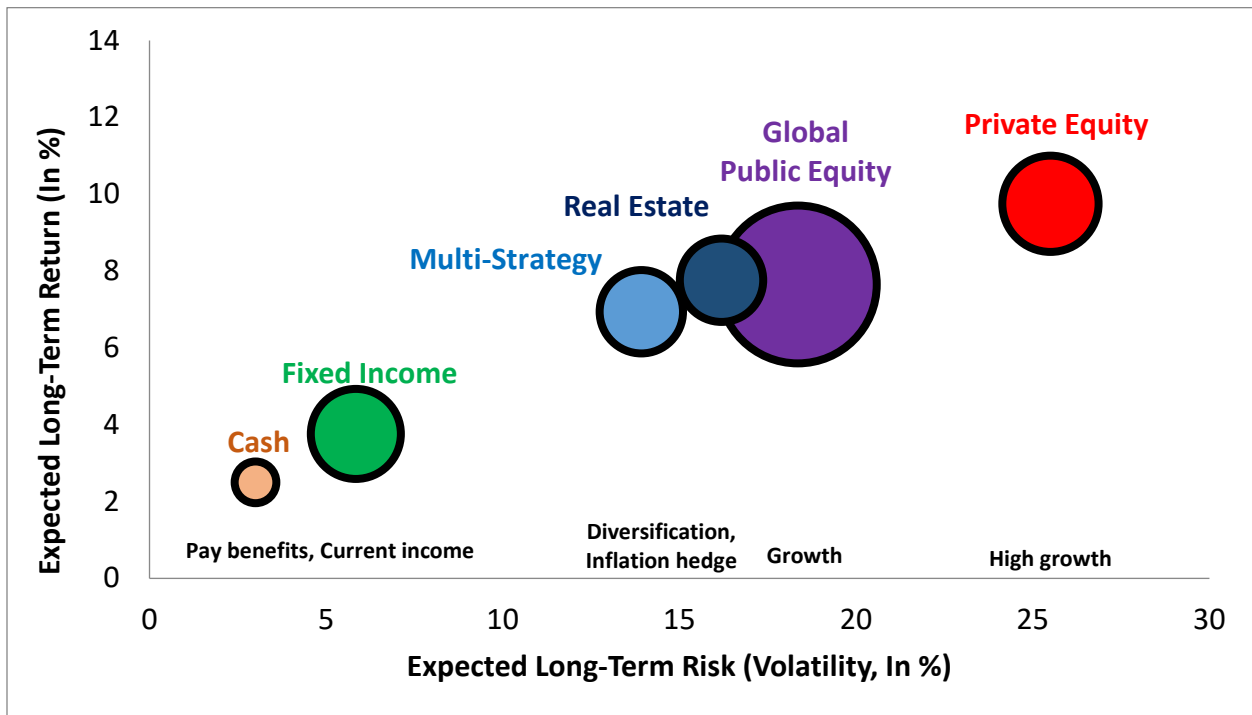
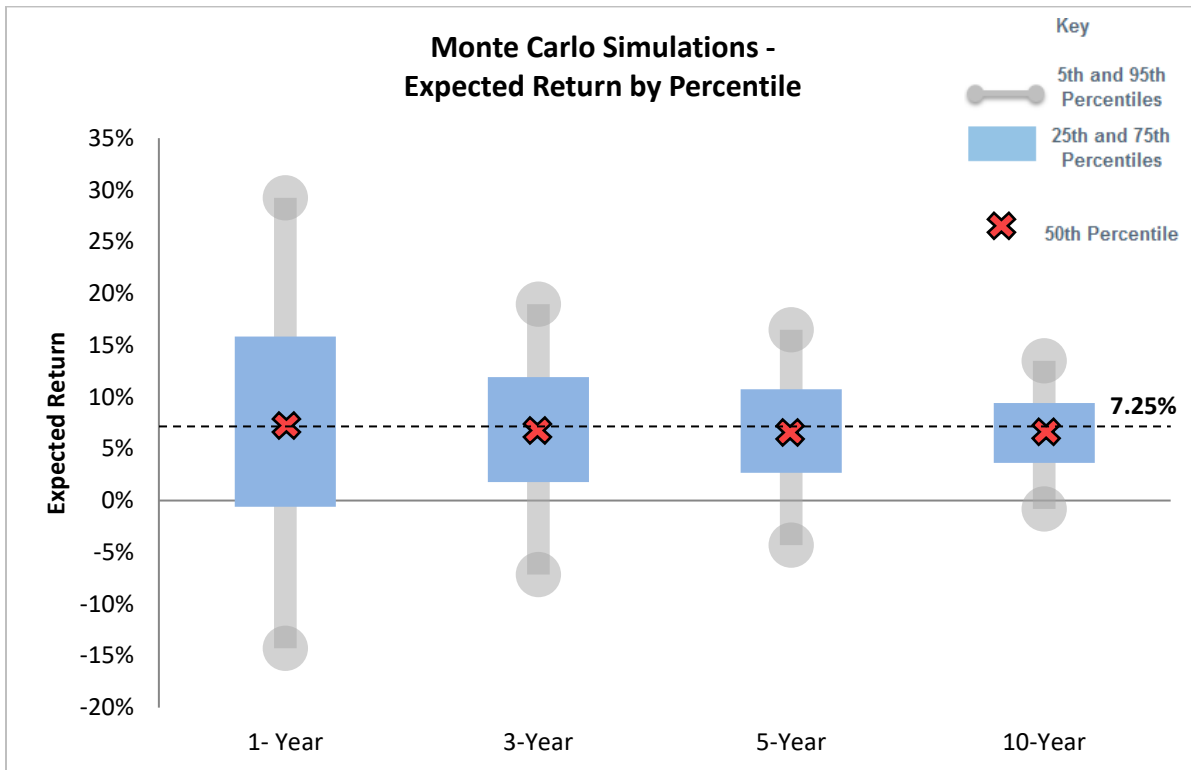


Figure 5 below depicts a range of possible distribution of returns over one, three, five, and 10-year horizons. Note that the dispersion of possible returns narrows significantly as the length of time covered by the analysis increases; extreme returns in any given year may tend to offset each other over a longer timeframe.

Figure 5

Potential Dispersion of Returns by Percentile for Target Allocation Policy⁹



⁹ Source: SERS' Investment Office and RVK

Asset Classes

Private Equity

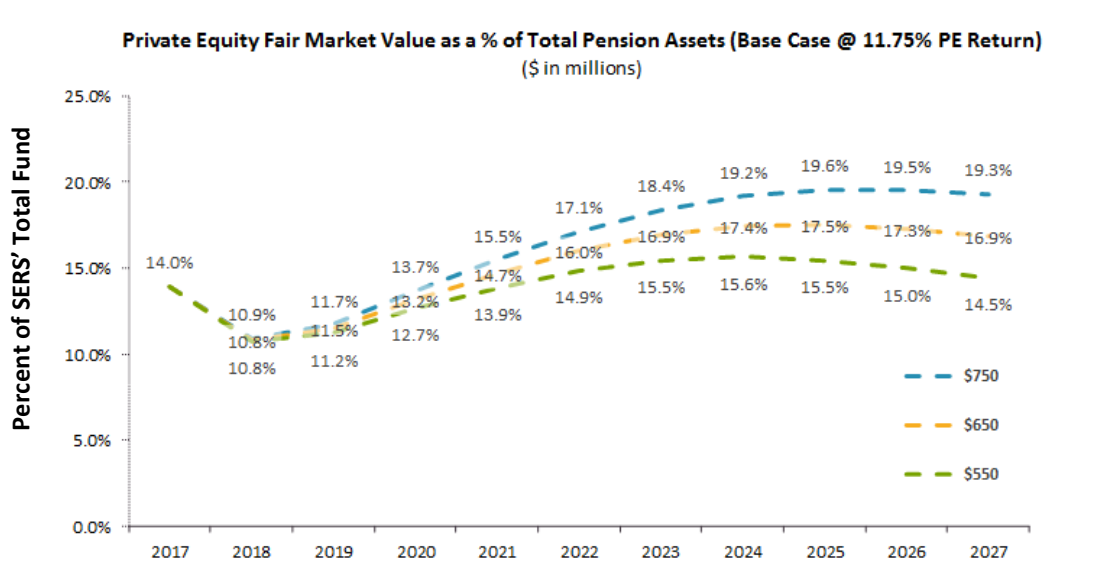
Role: SERS’ Private Equity program is structured to generate the highest return and growth opportunities that capture market inefficiencies through active management in the private markets.

Objective: The objective of the Private Equity program is to generate annualized net-of-fee returns that exceed the total return of public equity markets by at least 3% (illiquidity premium) and exceed the mean return for the asset class over a seven- to 10-year period (see Benchmarks section).

Structure: Private Equity investments are in the form of closed-end limited partnership interests. As an investor, SERS is a limited partner and does not have control of distributions. The investment horizon is typically seven or more years. SERS’ Private Equity program endeavors to continue to build long-term strategic partnerships by investing in world class top-quartile funds. Private equity investments typically require commitments of greater than seven years and, therefore, must target premium returns to compensate for illiquidity and risks.

This plan establishes an annual pacing target for Private Equity of up to \$650 million. Figure 6 shows the 10-year (Year 2027) expected allocation to Private Equity as a percent of the total fund from 14.5% to 19.3% at multiple annual commitment pacing levels.

Figure 6



NOTE: Any significant change in expected employer contributions and returns will require review and possible revision of the pacing target.

SERS' Private Equity program is categorized into three strategies.

Strategy	Description
Buyouts	A specialized form of private equity, characterized chiefly by investments in established private or publicly listed firms that are undergoing a fundamental change in operations or strategy.
Special Situations	Investments in funds which acquire distressed companies or companies in need of restructuring, funds from the secondary market, and funds providing mezzanine financing.
Venture Capital	Investments in specialized forms of private equity, characterized chiefly by high-risk investments in new or young companies following a growth path (early, late, balanced stage funds) in technology and other value-added sectors.

Global Public Equity

Role: SERS' Global Public Equity program is structured to generate high returns through capital appreciation and income from dividend payments while also improving the total fund's liquidity. SERS' Global Public Equity program contributes a high expected long-term return to the fund but also may be the greatest contributor to near-term volatility.

Objective: The objective of the Global Public Equity program is to generate annualized net-of-fee returns that meet or exceed its benchmark over a three- to five-year period (see Benchmarks section).

Structure: Investments in public equity are achieved through buying and holding publicly-traded securities of companies throughout the developed world and in emerging markets. These companies exhibit a wide range of market capitalizations in many industries and sectors.

SERS' Global Public Equity program is categorized into four strategies.

Strategy	Description
Global Mandate	U.S., non-U.S. developed markets, and emerging markets, large/mid/small cap
U.S.	U.S. broad market, large/mid/small cap
Non-U.S. Developed Markets	Non-U.S. developed markets, large/mid/small cap
Emerging Markets	Emerging markets, large/mid/small cap

Real Estate

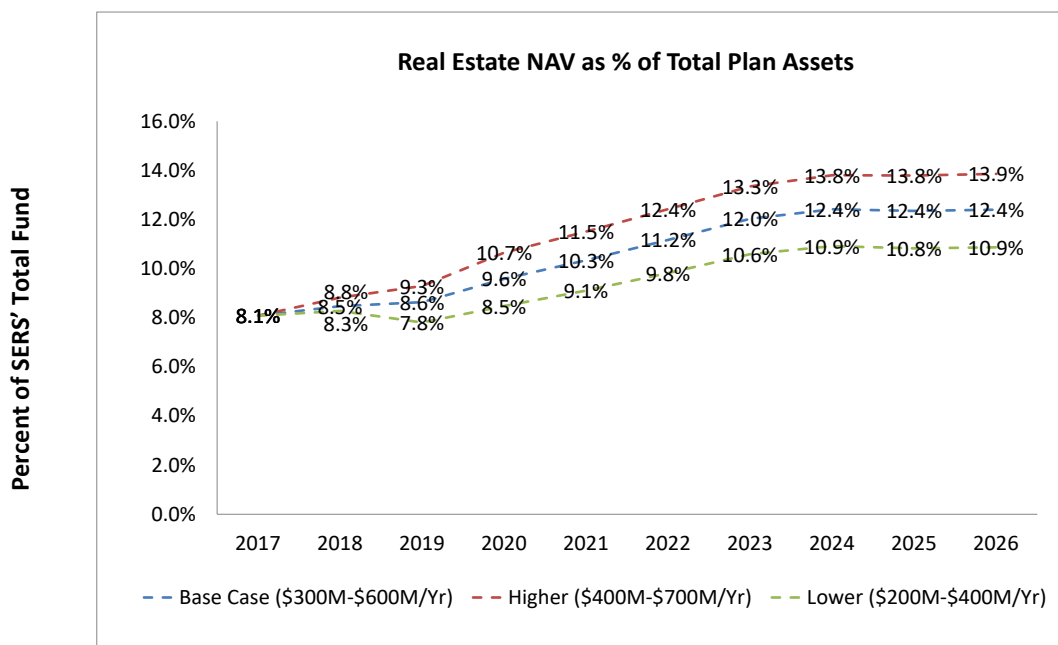
Role: Real Estate has several roles within SERS’ overall investment portfolio, including enhancing returns and providing diversification, income, and an inflation hedge. As in the past, SERS has emphasized a balance between value-add/opportunistic real estate strategies which can provide competitive total returns through capital appreciation, with core/core plus strategies, which have a larger emphasis on income, and in many cases, increased liquidity. SERS will seek to achieve this balanced risk profile by focusing on top-tier managers in each aspect of real estate, which is expected to result in attractive, long-term risk-adjusted returns.

Objective: The objective of the Real Estate program is to generate annualized net-of-fee returns that exceeds its benchmark over a seven- to 10-year period, with the various components weighted according to long-term allocation targets within the asset class (see Benchmarks section).

Structure: SERS will build its Real Estate allocation towards its long-term target by steadily increasing investments in both relatively stable, core/core plus investments as well as value-add and opportunistic strategies. New target allocations within the Real Estate program are designed to balance expected return, liquidity, diversification, and inflation hedging, while decreasing expected risk. SERS’ Real Estate program is subject to the investment pacing established by this investment plan to help manage the liquidity profile of the total fund to align with the projected increase in retirement benefit payments.

This plan sets the annual pacing target of up to \$600 million for the Real Estate program.

Figure 7



Commitment ranges pertain to initial three years of pacing model.

NOTE: Any significant change in expected employer contributions and/or returns will require review and possible revision of the pace of commitments.

SERS' Real Estate program is categorized into four specific strategies.

Strategy	Description
Core/Core Plus	Core and Core Plus investments are long-term investments in high-quality real estate that generate returns primarily from stable income producing properties.
Value-Add and Opportunistic	Value-Add and Opportunistic investments have higher risk/return expectations than Core/Core Plus investments. Value-Add and Opportunistic strategies utilize greater leverage and active real estate strategies including leasing, repositioning, renovation and/or rehabilitation in addition to development, thereby taking higher risks but demanding higher returns. Returns are primarily generated from capital appreciation from opportunistic investments.
Real Estate Securities	Investments in publicly-traded securities of companies whose primary business is to own real estate. Real Estate Securities provide SERS with direct exposure to U.S. and non-U.S. real estate markets and offer high dividend yield and liquidity.
Natural Resources/Infrastructure	In general, Natural Resources and Infrastructure investments differ from real estate in that they focus on other real assets other than real estate, but maintain the characteristics of collateralization by hard assets and income-producing potential.

Multi-Strategy

Role: SERS' Multi-Strategy program is structured to provide attractive long-term returns which capture market inefficiencies through active management in multiple markets. Multi-Strategy increases investment flexibility to invest in strategies with high return generating potential which may not fit the characteristics of other asset classes.

Objective: The objective of the Multi-Strategy program is to generate annualized net-of-fee returns that exceed the public equity market over a long-term period but with lower volatility and beta to traditional markets (measured by recession to recession) (see Benchmarks section).

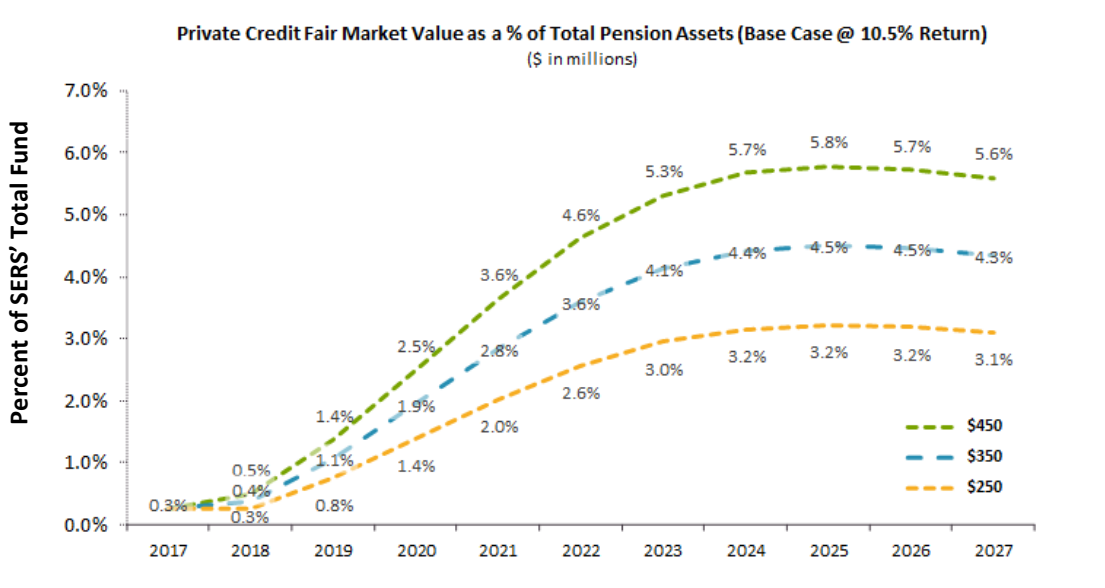
Structure: SERS' Multi-Strategy program invests in a diverse set of strategies including distressed debt, direct lending, structured credit, niche credit, and opportunistic equity. The program will be less liquid than traditional strategies.

SERS' Multi-Strategy program is categorized into three strategies.

Strategy	Description
Private Credit Funds	Private credit funds are generally closed-end (drawdown) limited partnership structures with liquidity events in five years or more, which may include investment strategies such as direct lending, specialty lending, mezzanine, and distressed investing.
Credit-Focused Strategies	Credit-Focused Strategies include directional and relative value investments through various structures, excluding closed-end funds, that may include debt securities, credit derivatives and related instruments, and/or multi-sector fixed income funds.
Opportunistic Equity & Fixed Income	Opportunistic equity and fixed income investments include non-traditional public market strategies.

This plan establishes an annual pacing target of up to \$350 million for commitments to Private Credit Funds. Figure 8 shows the 10-year (Year 2027) expected allocation to Private Credit Funds as a percent of the total fund from 3.1% to 5.6% at multiple annual commitment pacing levels.

Figure 8



NOTE: Any significant change in expected employer contributions and/or returns will require review and possible revision of the pace of commitments.

Fixed Income

Role: SERS' Fixed Income program is structured to provide additional liquidity to minimize capital impairment risk, reduce volatility of the total fund, and contribute total return to the fund.

Objective: The objective of the Fixed Income program is to generate annualized net-of-fee returns that meet or exceed its benchmark over a three- to five-year period (see Benchmarks section).

Structure: Fixed income includes investments in publicly-traded debt obligations of sovereign, quasi-sovereign and corporate entities. The asset class generates current income and the repayment of principal at maturity. SERS' Fixed Income program is categorized into four strategies.

Strategy	Description
Core Plus Fixed Income	Investments in sovereign debt, commercial mortgage-backed securities, credit strategies, high yield debt, and asset backed securities which seek to provide excess return when performance conditions are favorable, and offer varying potential return with a corresponding variance in expected risk.
Core Fixed Income	Investments in intermediate duration bonds, which provide capital loss protection in difficult market conditions, and offer risk mitigation due to low correlation with equity.
Global Treasury Inflation-Protected Securities (TIPS)	Investments in U.S. and non-U.S. inflation-linked bonds designed to preserve purchasing power due to high positive correlation to inflation.
Nominal U.S. Treasuries	Investments in securities matching the risk and return profile of 10-year U.S. Treasury Notes.

Cash

Role: SERS' investment program is structured to maintain an appropriate level of cash to pay retirement benefits and covenants during prolonged periods of market decline and state budgetary constraints.

Objective: The objective of Cash is to generate annualized net-of-fee returns that meet or exceed its benchmark over a three-year period (see Benchmarks section).

Structure: Cash investments emphasize the use of higher credit quality debt instruments that are liquid and have short maturities and durations, or have floating rates and have historically been invested in the Pennsylvania Treasury Group Investment Fund, a short-term investment fund.

Benchmarks

The objective of the fund is to generate investment returns that meet, or preferably exceed, the actuarially assumed rate of return over complete market cycles. Performance is measured net-of-fees relative to the following benchmarks according to the long-term target asset allocation weights.

Private Equity	Private Equity Peer Group Comparison and Russell 3000 + a 3% premium
Global Equity	MSCI All Country World Investable Market Index
Real Estate	Custom Index (NCREIF Fund Index - Open End Diversified Core Equity, FTSE NAREIT U.S. Real Estate Index for REITs, & CPI plus a 3% premium for Natural Resources/Infrastructure)
Multi-Strategy	S&P/LSTA Leveraged Loan Index and Russell 3000 Index
Fixed Income	Barclays U.S. Aggregate Bond Index
Cash	90-Day T-Bill Index
Total Fund	Total Fund Custom Index and Public Market Equivalent Index

Private Equity Peer Group Custom Indices – The current Private Equity Peer Custom Indices currently utilize the Burgiss private equity database. They are calculated using the time-weighted returns for a composite of funds based on their specified strategies and with the same vintage dates as SERS' funds. For all Burgiss benchmarks, geographic focus, industry focus, fund size, and currency are all inclusive across countries, industries, funds, and currencies, respectively.

Russell 3000 Index – The Russell 3000 Index measures the performance of the 3,000 largest U.S. companies based on total market capitalization, which represents approximately 98% of the investable U.S. equity market.

MSCI All Country World Investable Market Index – The index captures large, mid and small-cap public equity representation across developed and emerging market countries. With approximately 8,600 constituents, the index covers approximately 99% of the global public equity investment opportunity set.

NCREIF Fund Index – Open-End Diversified Core Equity – The first of the NCREIF Fund Database products and is an index of investment returns reporting on both a historical and

current basis the results of 33 open-end commingled funds pursuing a core investment strategy, some of which have performance histories dating back to the 1970s. The NFI-ODCE Index is capitalization-weighted and is reported gross of fees. Measurement is time-weighted. NCREIF will calculate the overall aggregated Index return.

FTSE NAREIT U.S. Real Estate Index – The FTSE NAREIT U.S. Real Estate Index defines and measures the investable universe of publicly traded property companies domiciled in the United States. The companies in the index are engaged in real estate related activities, such as property ownership, management, development, rental and investment.

The Consumer Price Indexes (CPI) – The CPI program produces monthly data on changes in the prices paid by urban consumers for a representative basket of goods and services. Prices for the goods and services used to calculate the CPI are collected in 87 urban areas throughout the country and from about 23,000 retail and service establishments.

S&P/LSTA Leveraged Loan Index – This index is a capitalization-weighted syndicated loan index based upon market weights, spreads, and interest payments of senior secured institutional loans with a term of one year. The index covers the U.S. market dating back to 1997. S&P and the Loan Syndications & Trading Association, the loan market's trade group, jointly run the index, which utilize real-time market weightings and spreads for the facilities constituting the index.

Barclays U.S. Aggregate Bond Index – The Barclays U.S. Aggregate Bond Index is a comprehensive measure of the entire U.S. taxable bond market. The aggregate includes all publicly issued, non-convertible domestic debt of the U.S. Government and agencies, the three major corporate bond classifications (industrial, utility, and financial), mortgage-backed securities (GNMA, FNMA, FHLMC) and Yankee bonds (U.S. dollar denominated, SEC registered fixed-rate debt issued or guaranteed by sovereign foreign governments). Bonds included are investment grade (Baa rating or higher), have a minimum outstanding principal of \$1 million, and a minimum one-year maturity. The index is a capitalization weighted and includes income calculated on an accrual basis at the end of each month. The universe is screened on the last business day of each month for inclusion in the next month's index. Bonds that decline below the minimum quality or one-year maturity will drop out of the index during the monthly screening.

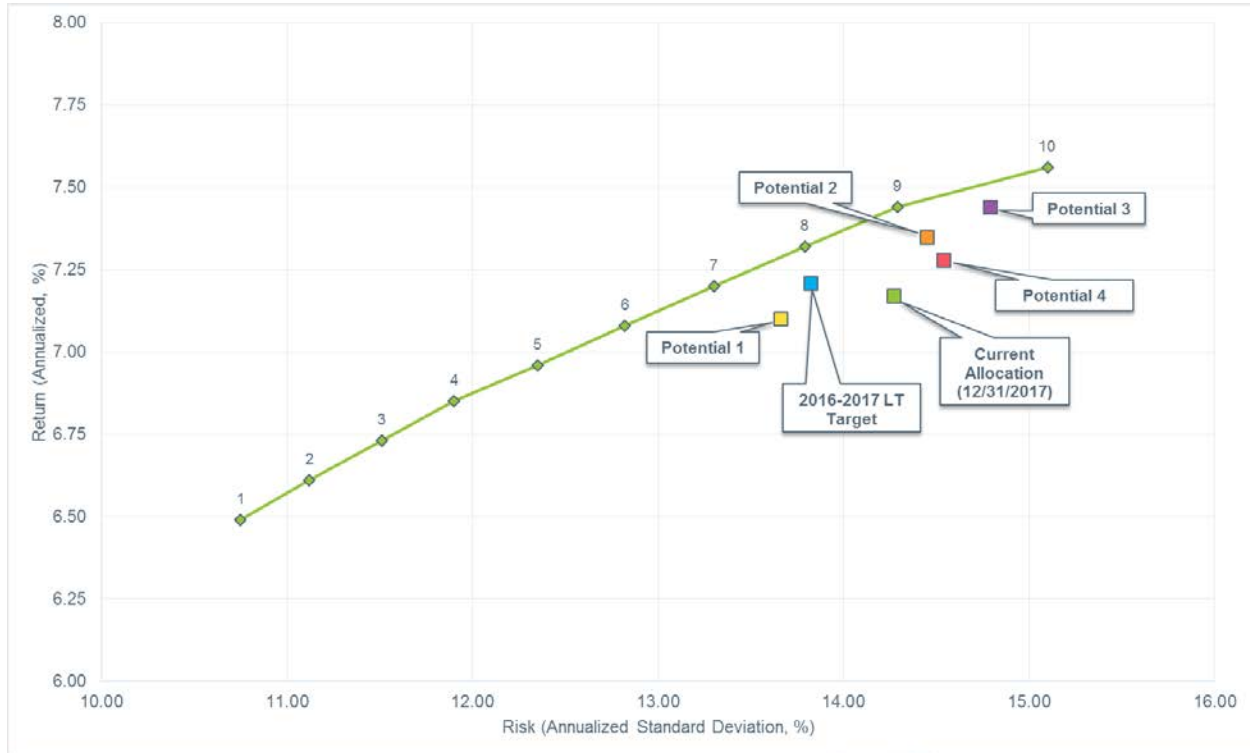
90-Day U.S. T-Bill Index – The index is made up of U.S. Treasury securities maturing in 90 days that assumes reinvestment of all income.

Total Fund Custom Benchmarks – The Total Fund Custom Benchmarks are calculated monthly using target weights for each asset class, applied to corresponding primary and secondary benchmarks.

Appendix 1

RVK Efficient Frontier from Mean Variance Optimization Modeling

All four potential portfolios lie close to the efficient frontier—differences between those and the theoretically efficient portfolios reflect both SERS’ liquidity risk management and reflection of general risk preferences of SERS’ Board.



RVK 2018 Capital Market Assumptions

RVK Return & Risk Assumptions

Asset Class	Arithmetic Return Assumption	Standard Deviation Assumption
Global Equity	7.65	18.35
Custom Fixed Income	3.76	5.84
Custom Real Estate	7.76	16.19
Custom Multi-Strategy	6.94	13.92
Private Equity	9.75	25.50
Cash Equivalents	2.50	3.00

Longest Historical Time Frame

Index	Longest Historical Time Frame	Annualized Arithmetic Return	Annualized Standard Deviation
MSCI ACW IMI (Gross)	Jun 1994 - Dec 2017	7.72	18.89
SERS Custom Fixed Income	Jan 2003 - Dec 2017	4.64	3.88
SERS Custom Real Estate	March 1997 - Sept 2017	11.21	8.83
SERS Custom Multi-Strategy	Jan 1992 - Dec 2017	5.92	5.97
Cambridge US Private Equity Index	Jun 1986 - Jun 2017	13.64	13.20
BofA ML 3 Mo US T-Bill	Jan 1978 - Dec 2017	4.98	4.10

RVK Correlation Assumptions

	Global Equity	Custom Fixed Income	Custom Real Estate	Custom Multi-Strategy	Private Equity	Cash Equivalents
Global Equity	1.00	0.15	0.35	0.75	0.79	-0.03
Custom Fixed Income	0.15	1.00	-0.01	0.12	0.01	0.09
Custom Real Estate	0.35	-0.01	1.00	0.27	0.60	0.16
Custom Multi-Strategy	0.75	0.12	0.27	1.00	0.74	0.07
Private Equity	0.79	0.01	0.60	0.74	1.00	-0.22
Cash Equivalents	-0.03	0.09	0.16	0.07	-0.22	1.00

Appendix 2

The Board selected Target Allocation 2 as the 10-year target asset allocation policy.

Efficient Asset Allocation Targets¹⁰

	Current Exposure 12/31/2017	Current LT Target	Target Allocation 1	Target Allocation 2	Target Allocation 3	Target Allocation 4	Policy Ranges
Private Equity	14%	16%	14%	16%	16%	15%	
Global Equity	53%	43%	48%	48%	50%	53%	
Total Equity	67%	59%	62%	64%	66%	68%	+/- 5%
Real Estate	8%	12%	10%	12%	12%	9%	+/- 3%
Multi-Strategy	8%	12%	8%	10%	10%	7%	+/- 3%
Fixed Income	14%	14%	18%	11%	10%	14%	+/- 3%
Cash	3%	3%	2%	3%	2%	2%	+/- 3%
Total	100%	100%	100%	100%	100%	100%	
Expected Return	7.17%	7.21%	7.10%	7.35%	7.44%	7.28%	
Risk (Standard Deviation)	14.27%	13.82%	13.66%	14.45%	14.79%	14.54%	
RVK Liquidity Metric	67	60	65	61	61	66	

¹⁰ Source: SERS' Investment Office and RVK