Liquidity Analysis

Pennsylvania Public School Employees' Retirement System (PSERS)
August 7, 2019

Empower Results®

Table of Contents

Overview
Background

- PSERS' liquidity analysis is performed under its **Proposed Long-Term Target** portfolio
  - Intended as a stress-testing model, incorporating the profile of the liabilities as well as expected future contributions
  - Uses different scenarios for economic environments and other relevant events
  - Shows how the portfolio's liquidity profile could evolve with a given investment strategy

- We categorized investments by liquidity into five buckets
  - ***Liquid (Risk-Reducing Assets):*** less than 3 months needed for return of capital (e.g. publicly traded securities)
  - ***Liquid (Return-Seeking Assets):*** less than 3 months needed for return of capital (e.g. publicly traded securities)
  - ***Quasi-Liquid:*** Typical lock-up of 3–12 months. Conservatively, we assumed a 1-year lock-up in most economic environments, 2 years in a Recession scenario, and 3 years in a Black Skies scenario (e.g. many hedge funds, core real estate)
  - ***Illiquid: Potential lock-up of 5–10 years***, depending on economic environment (e.g. closed-ended real estate)
  - ***Illiquid: Potential lock-up of 10+ years*** (e.g. typical private equity)

- This is intended to be a <u>conservative</u> approximation of the actual liquidity properties of the assets

- Not surprisingly, varying economic scenarios would lead PSERS' percentage allocation to alternative assets to differ from its targets due to liquidity differences in asset classes

Overview
Asset Allocation and Liquidity Category (Proposed Long-Term Target)

	Asset Class	Target Asset Allocation				
		Liquid	*Quasi-Liquid*	*Illiquid 5-10 Years*	*Illiquid 10+ Years*	*Total*
Return-Seeking	Public Equities	18.0%	2.0%			20.0%
	Private Equity				15.0%	15.0%
	Infrastructure (Public / Private)	4.0%			4.0%	8.0%
	REITs	2.0%				2.0%
	Private Real Estate			8.0%		8.0%
	Private Credit		1.0%	9.0%		10.0%
	Commodities	4.5%		0.5%		5.0%
	Gold	3.0%				3.0%
	Emerging Market Debt	2.0%				2.0%
	Risk Parity	7.0%	1.0%			8.0%
	Subtotal	40.5%	4.0%	17.5%	19.0%	**81.0%**
Risk-Reducing / Safety	Hedge Funds	0.5%	9.5%			10.0%
	U.S. / Non-U.S. Inflation Protection	15.0%				15.0%
	Cash	3.0%				3.0%
	U.S. Core Fixed Income	4.5%	0.5%			5.0%
	U.S. Long-Term Treasury	6.0%				6.0%
	Non-US Dev. Fixed Income	1.0%				1.0%
	LIBOR - Financing	-21.0%				-21.0%
	Subtotal	9.0%	10.0%	0.0%	0.0%	**19.0%**
	Total	**49.5%**	**14.0%**	**17.5%**	**19.0%**	**100.0%**

Empower Results®

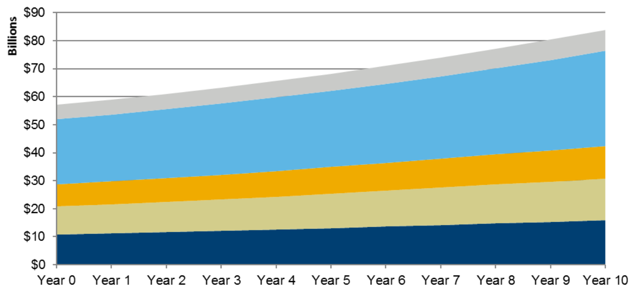
Liquidity Analysis

Summary of Results | Proposed Long-Term Target (Full Actuarial Contributions)

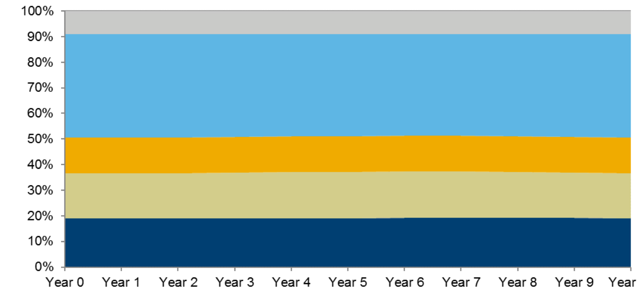
■ Illiquid: 10+ Years ■ Illiquid: 5-10 Years ■ Quasi-Liquid ■ Liquid (Return-Seeking Assets) ■ Liquid (Risk-Reducing Assets)

Base Case

Scenario: Base - PSERS (in Dollars)

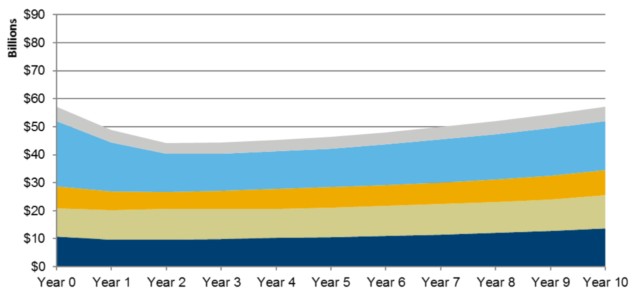


Scenario: Base - PSERS (in Percentages)

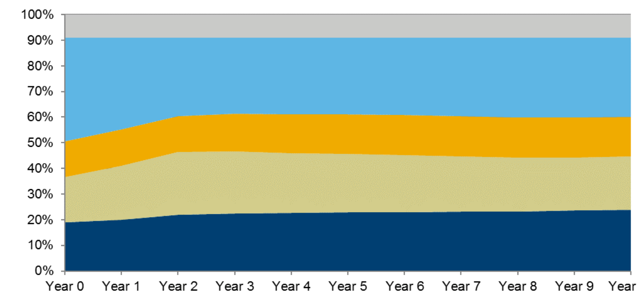


Recession

Scenario: Recession - PSERS (in Dollars)

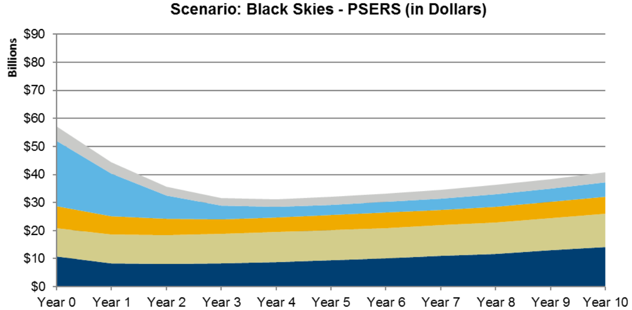


Scenario: Recession - PSERS (in Percentages)

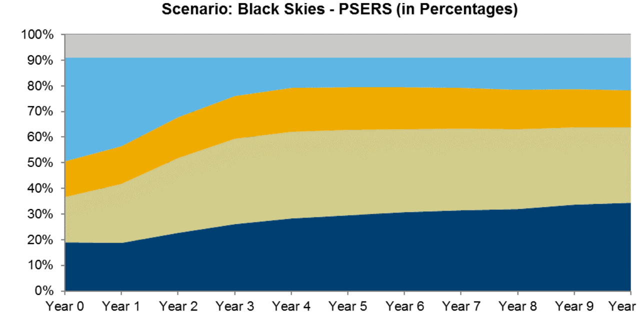


Black Skies

Scenario: Black Skies - PSERS (in Dollars)



Scenario: Black Skies - PSERS (in Percentages)

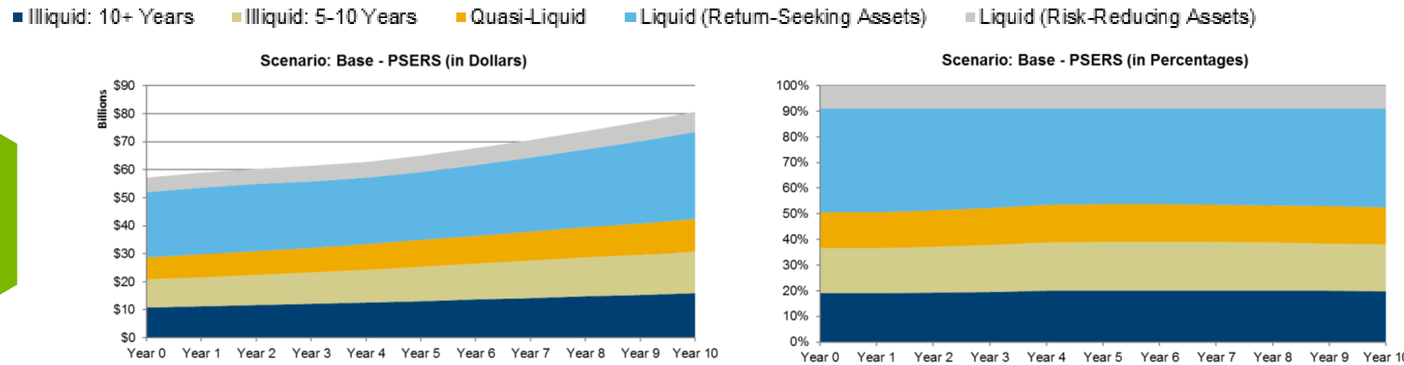


Note: Year 0 represents a starting point of March 31, 2019

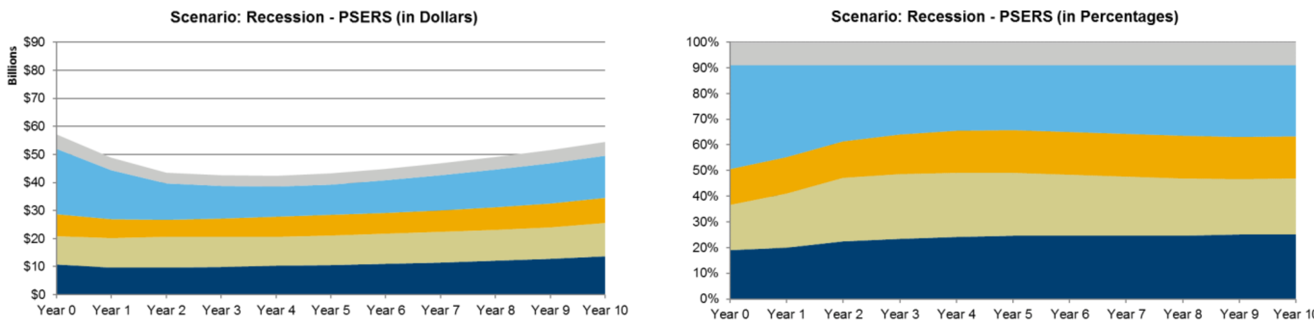
Liquidity Analysis

Summary of Results | Proposed Long-Term Target (3 Years of 80% Actuarial Contributions)

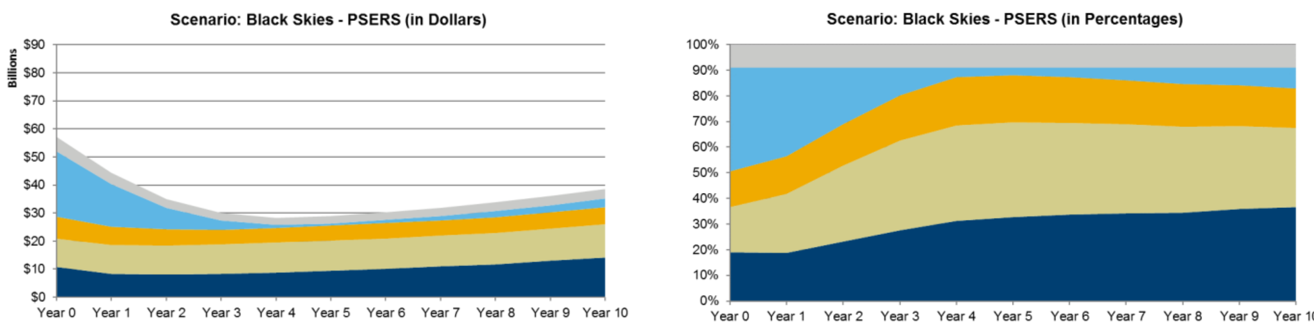
Base Case



Recession



Black Skies



Note: Year 0 represents a starting point of March 31, 2019

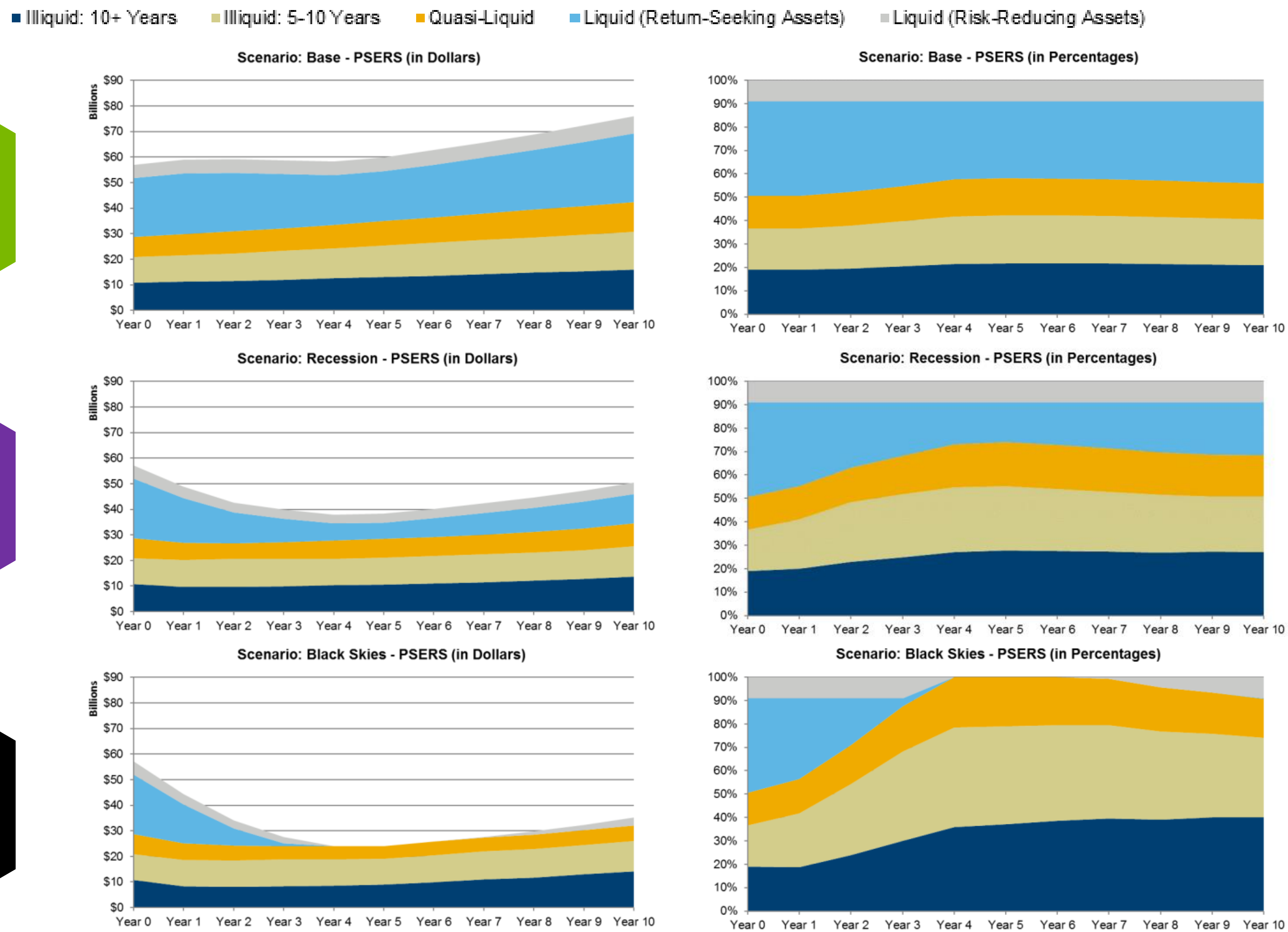
Liquidity Analysis

Summary of Results | Proposed Long-Term Target (3 Years of 50% Actuarial Contributions)

Base Case

Recession

Black Skies



Note: Year 0 represents a starting point of March 31, 2019

Conclusions

- **Base Scenario**
  - The total illiquid and quasi-liquid assets can be maintained near the target (50.5% illiquid assets) with no cash flow problems
- **Recession Scenario**
  - We do not foresee potential cash flow issues occurring in the Recession scenario, but the allocation could drift enough from the targets (50.5% illiquid assets) that PSERS may want to rebalance
- **Black Skies Scenario**
  - The asset allocation could drift far from the target allocation (50.5% illiquid assets)
    - Given the extension of the time horizon for the realization of the illiquid assets, there will not be enough liquidity even with the redemption of quasi-liquid assets to re-balance back to target
    - Under this scenario, PSERS may want to pare back future commitments to stay closer to the target allocations
      - PSERS may be scaling back its alternative asset allocations at a time when the opportunity is greatest
- **Reduced Actuarial Contribution Scenarios**
  - Lower contributions put more pressure on liquidity
    - In such scenarios, PSERS can look to manage the pace of commitments
- This analysis is highly sensitive to the assumed contributions
  - If PSERS receives less contributions than assumed, especially in a Black Skies environment, then the potential liquidity issue could be worse than projected here

Empower Results®

Appendix

Background
AHIC Approach to Analyzing Liquidity Risk from Alternatives

- Intended as a stress-testing model
- Develops multi-year projections of assets and spending needs
- Uses different scenarios for economic environments and other relevant events
- Shows how the portfolio’s liquidity profile could evolve with a given investment strategy
- Incorporates the profile of the liabilities as well as expected future contributions

Background
Process Inputs and Outputs

Background

Modeling Parameters – Degrees of Illiquidity

- We categorized investments by liquidity into five buckets
  - **Liquid (Risk-Reducing Assets):** less than 3 months needed for return of capital (e.g. publicly traded securities)
  - **Liquid (Return-Seeking Assets):** less than 3 months needed for return of capital (e.g. publicly traded securities)
  - **Quasi-Liquid:** Typical lock-up of 3–12 months. Conservatively, we assumed a 1-year lock-up in most economic environments, 2 years in a Recession scenario, and 3 years in a Black Skies scenario (e.g. many hedge funds, core real estate)
  - **Illiquid: Potential lock-up of 5–10 years**, depending on economic environment (e.g. closed-ended real estate)
  - **Illiquid: Potential lock-up of 10+ years** (e.g. typical private equity)

- This is intended to be a <u>conservative</u> approximation of the actual liquidity properties of the assets

- We started with the Proposed Long-Term Target allocation, then see how the actual allocations would change in different economic scenarios, continuing new commitments to private assets, as expected.

- Assumptions
  - Starting assets based the June 30, 2018 actuarial valuation report
  - Asset figures reflect actual performance for the period July 1, 2018 – March 31, 2019 (3.39% return)
  - The plan's contribution policy is actuarially based, leveraging projections from the plan actuary based on the 2019 asset-liability study
  - Assumes the portfolio starts at the target asset allocation levels for illiquid assets, maintaining close to the Proposed Long-Term Target portfolio targets over the next 10 years

Background
Economic Scenarios

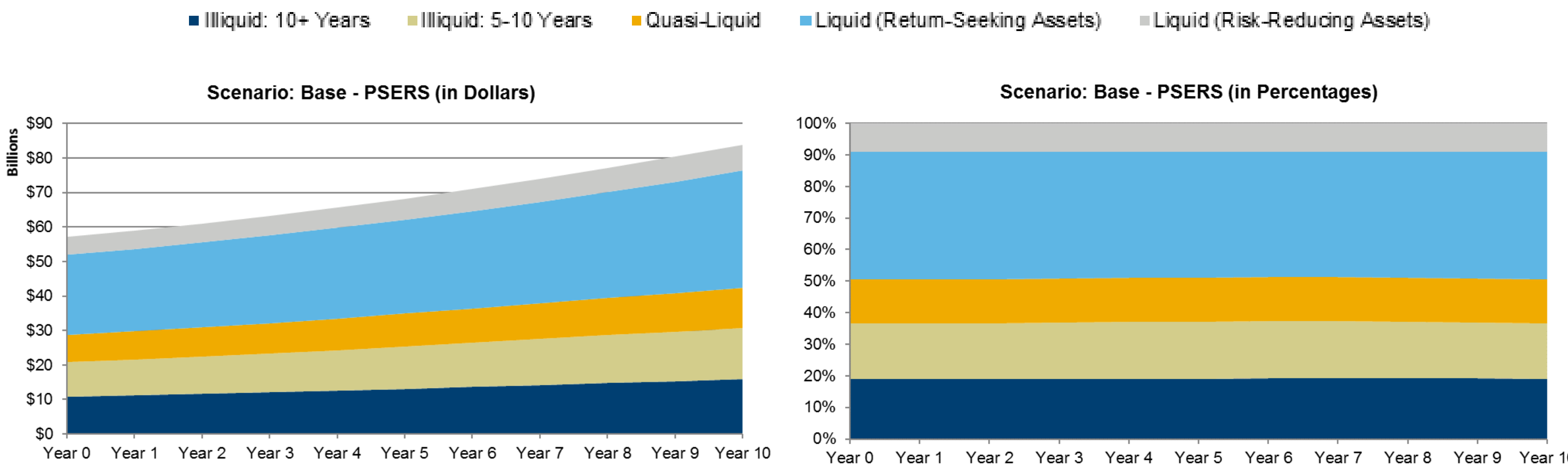
- **Base Scenario**
  - Markets perform consistent with Aon's Capital Market Assumptions (~50th percentile)

- **Recession Scenario**
  - Somewhat pessimistic outlook for the markets (~95th percentile)
  - Return-seeking assets decline in the first two years with a modest rebound in later years.

- **Black Skies Scenario**
  - Very pessimistic outlook for markets (~99th percentile)
  - Return-seeking assets decline significantly
  - The value of public equities is cut in half over three years, without an immediate rebound

Liquidity Analysis: Base Economic Scenario
Proposed Long-Term Target (Full Actuarial Contributions)

- The exhibit below shows the projected liquidity lock-up of the Proposed Long-Term Target allocation in the Base economic scenario, assuming commitments are continued as expected



- **Key Takeaway:**
  – Total illiquid and quasi-liquid assets are projected to stay near 50.5% of the Plan and can be maintained near the target with no cash flow problems

Note: Year 0 represents a starting point of March 31, 2019

Liquidity Analysis: Base Economic Scenario (continued)
Proposed Long-Term Target (Full Actuarial Contributions)

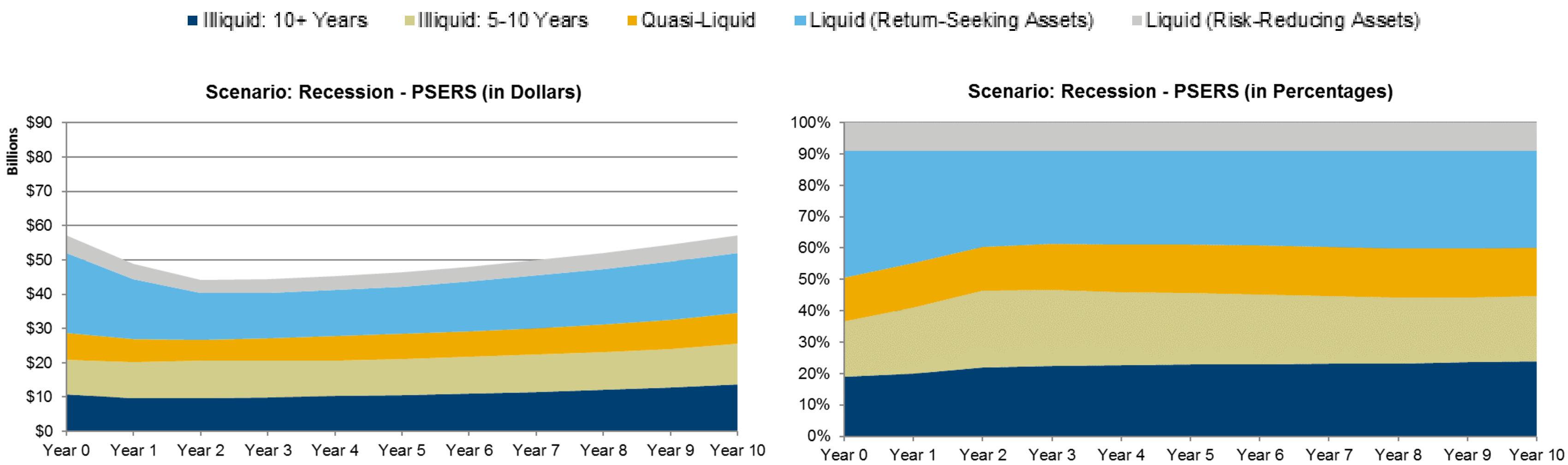
- The exhibit below shows the projected liquidity lock-up of the Proposed Long-Term Target allocation in a Base scenario

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Risk-Reducing Assets	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%
Liquid Return-Seeking	41	41	40	40	40	40	40	40	40	40	40
Total Liquid	**50%**	**50%**	**49%**	**49%**	**49%**	**49%**	**49%**	**49%**	**49%**	**49%**	**49%**
Quasi-Liquid	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Illiquid: 5-10 Year Lock-up	18	18	18	18	18	18	18	18	18	18	18
Illiquid: 10+ Year Lock-up	19	19	19	19	19	19	19	19	19	19	19
Total Quasi + Illiquid	**51%**	**51%**	**51%**	**51%**	**51%**	**51%**	**51%**	**51%**	**51%**	**51%**	**51%**

Note: Year 0 represents a starting point of March 31, 2019; Percentages may not sum to 100% due to rounding

Liquidity Analysis: Recession Economic Scenario
Proposed Long-Term Target (Full Actuarial Contributions)

- The exhibit below shows the projected liquidity lock-up of the Proposed Long-Term Target allocation in the Recession economic scenario, assuming commitments are continued as expected



- **Key Takeaways:**
  - Commitments to illiquid alternatives are maintained at the steady state level, but recessionary markets cause the total portfolio to shrink
  - Total illiquid and quasi-liquid assets are projected to reach as high as 61% of the Plan due to the shrinking market value of the total Plan in this scenario
  - There would not be a concern with the ability to pay benefits
  - PSERS may need to redeem some quasi-liquid assets to stay close to its target allocation (50.5% illiquid assets)

Note: Year 0 represents a starting point of March 31, 2019

Liquidity Analysis: Recession Economic Scenario (continued)
Proposed Long-Term Target (Full Actuarial Contributions)

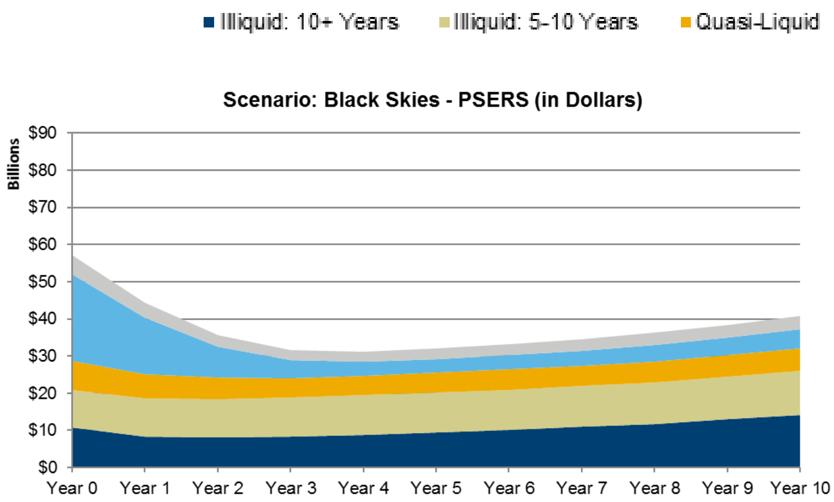
- The exhibit below shows the projected liquidity lock-up of the Proposed Long-Term Target allocation in a Recession scenario

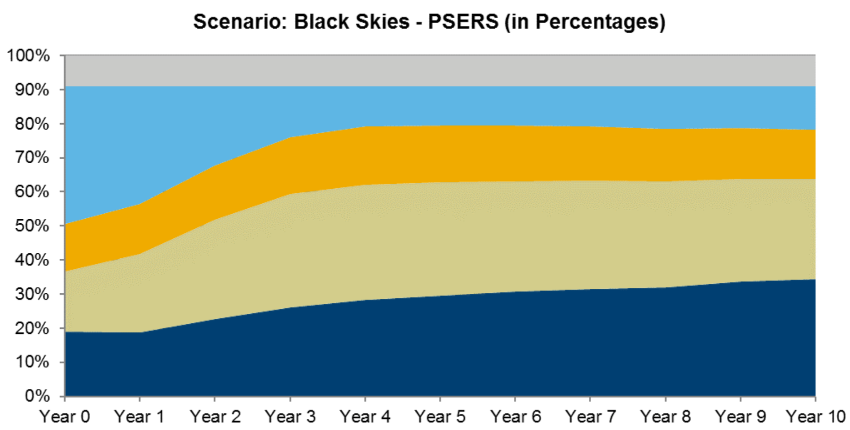
Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Risk-Reducing Assets	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%
Liquid Return-Seeking	41	36	31	30	30	30	30	31	31	31	31
Total Liquid	**50%**	**45%**	**40%**	**39%**	**39%**	**39%**	**39%**	**40%**	**40%**	**40%**	**40%**
Quasi-Liquid	14%	14%	14%	15%	15%	16%	16%	16%	16%	16%	15%
Illiquid: 5-10 Year Lock-up	18	21	24	24	23	23	22	22	21	21	21
Illiquid: 10+ Year Lock-up	19	20	22	22	23	23	23	23	23	24	24
Total Quasi + Illiquid	**51%**	**55%**	**60%**	**61%**	**61%**	**61%**	**61%**	**60%**	**60%**	**60%**	**60%**

Note: Year 0 represents a starting point of March 31, 2019; Percentages may not sum to 100% due to rounding

Liquidity Analysis: Black Skies Economic Scenario
Proposed Long-Term Target (Full Actuarial Contributions)

- The exhibit below shows the projected liquidity lock-up of the Proposed Long-Term Target allocation in a Black Skies scenario, assuming commitments are continued as expected





- **Key Takeaways:**
  - Commitments to illiquid alternatives are maintained at the steady state level, but subpar markets cause the total portfolio to shrink
  - Total illiquid and quasi-liquid assets are projected to reach as high as 80% of the Plan due to the shrinking market value of the total Plan in this scenario
  - In this Black Skies scenario, PSERS may want to redeem some quasi-liquid assets and pare back future commitments to stay closer to the target allocations (50.5% illiquid assets). However, the allocation would still be significantly different from target.

Note: Year 0 represents a starting point of March 31, 2019

Liquidity Analysis: Black Skies Economic Scenario (continued)

Proposed Long-Term Target (Full Actuarial Contributions)

- The exhibit below shows the projected liquidity lock-up of the Proposed Long-Term Target allocation in a Black Skies scenario

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Risk-Reducing Assets	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%
Liquid Return-Seeking	41	35	23	15	12	12	11	12	13	12	13
Total Liquid	**50%**	**44%**	**32%**	**24%**	**21%**	**21%**	**20%**	**21%**	**22%**	**21%**	**22%**
Quasi-Liquid	14%	15%	16%	17%	17%	17%	16%	16%	15%	15%	14%
Illiquid: 5-10 Year Lock-up	18	23	29	33	34	33	33	32	31	30	29
Illiquid: 10+ Year Lock-up	19	19	23	26	28	30	31	32	32	34	35
Total Quasi + Illiquid	**51%**	**56%**	**68%**	**76%**	**79%**	**79%**	**80%**	**79%**	**78%**	**79%**	**78%**

Note: Year 0 represents a starting point of March 31, 2019; Percentages may not sum to 100% due to rounding

Liquidity Analysis: Black Skies Economic Scenario (continued)

Proposed Long-Term Target (3 Years of 80% Actuarial Contributions)

- The exhibit below shows the projected liquidity lock-up of the Proposed Long-Term Target allocation in a Black Skies scenario

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Risk-Reducing Assets	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%
Liquid Return-Seeking	41	35	22	11	4	3	4	5	6	7	8
Total Liquid	**50%**	**44%**	**31%**	**20%**	**13%**	**12%**	**13%**	**14%**	**15%**	**16%**	**17%**
Quasi-Liquid	14%	15%	16%	18%	19%	19%	18%	17%	17%	16%	15%
Illiquid: 5-10 Year Lock-up	18	23	30	35	37	37	36	35	33	32	31
Illiquid: 10+ Year Lock-up	19	19	23	28	31	33	34	34	35	36	37
Total Quasi + Illiquid	**51%**	**56%**	**69%**	**80%**	**87%**	**88%**	**87%**	**86%**	**85%**	**84%**	**83%**

Note: Year 0 represents a starting point of March 31, 2019; Percentages may not sum to 100% due to rounding

Liquidity Analysis: Black Skies Economic Scenario (continued)

Proposed Long-Term Target (3 Years of 50% Actuarial Contributions)

- The exhibit below shows the projected liquidity lock-up of the Proposed Long-Term Target allocation in a Black Skies scenario

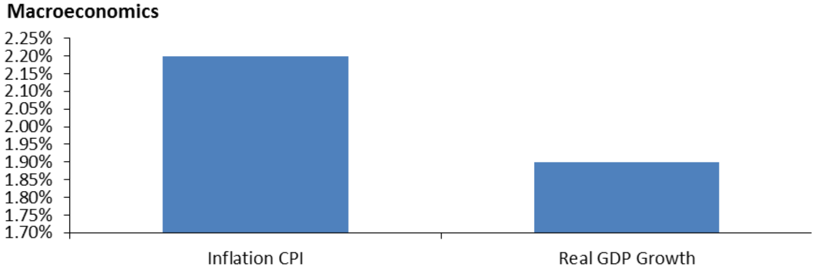
Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Risk-Reducing Assets	9%	9%	9%	9%	0%	0%	0%	1%	4%	6%	9%
Liquid Return-Seeking	41	35	20	4	0	0	0	0	0	0	0
Total Liquid	**50%**	**44%**	**29%**	**13%**	**0%**	**0%**	**0%**	**1%**	**4%**	**6%**	**9%**
Quasi-Liquid	14%	15%	17%	19%	22%	21%	21%	20%	19%	18%	17%
Illiquid: 5-10 Year Lock-up	18	23	31	38	43	42	41	40	38	36	34
Illiquid: 10+ Year Lock-up	19	19	24	30	36	37	39	40	39	40	40
Total Quasi + Illiquid	**51%**	**56%**	**71%**	**87%**	**100%**	**100%**	**100%**	**99%**	**96%**	**94%**	**91%**

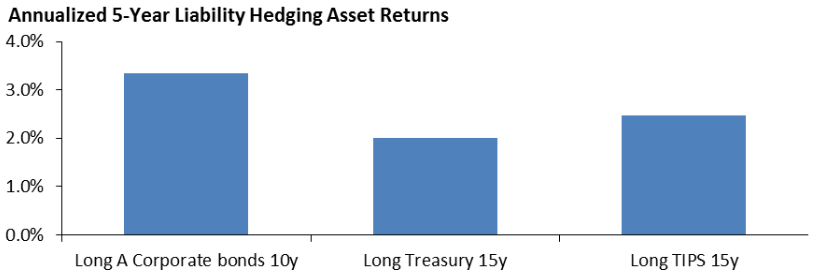
Note: Year 0 represents a starting point of March 31, 2019; Percentages may not sum to 100% due to rounding

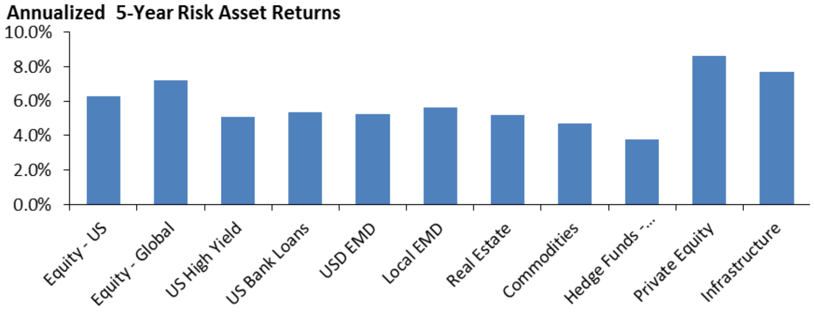
Base Case Scenario

World Events Unfold In A Fashion Consistent With Our Capital Market Assumptions

- Yield and bond return series reflect our average estimates. These estimates represent our benchmark view.
- The US economy continues to grow slightly above trend over the next 12 months, as the US is buoyed by previous fiscal stimulus and a good global economic outlook. However, US growth moderates to trend growth in later years as stimulus fades and global growth slows.
- Consumer price inflation, measured by the Consumer Price Index, remains modestly above 2% over the next five years, supported by global growth prospects.
- Government and corporate bond yields gradually rise. Robust profit margins sustain stable corporate spreads.
- Risk asset returns are in line with our long term assumptions.







Returns from 31 March 2019
Source: Aon

The opinions referenced are as of the date of publication and are subject to change due to changes in the market or economic conditions and may not necessarily come to pass. Information contained herein is for informational purposes only and should not be considered investment advice.

Base Case Scenario
Data Table

BASE SCENARIO

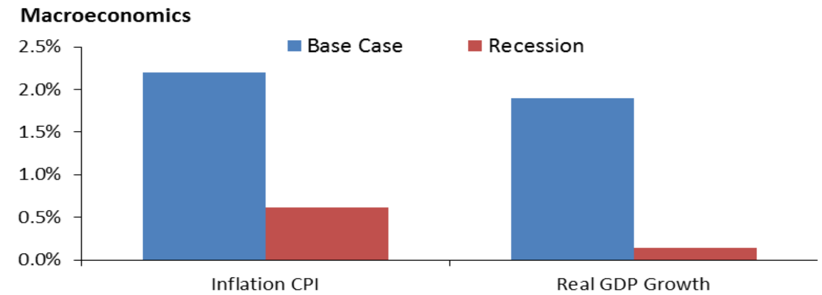
	Year 0	1	2	3	4	5	6	7	8	9	10
Yields (BOY)											
Treasury yield 5y	2.3%	2.3%	2.4%	2.5%	2.6%	2.7%	2.9%	3.0%	3.1%	3.1%	3.2%
Long Treasury yield 15y	2.7%	2.7%	2.8%	2.9%	3.0%	3.1%	3.2%	3.3%	3.4%	3.4%	3.5%
TIPS yield 5y	0.4%	0.5%	0.6%	0.6%	0.7%	0.8%	0.9%	0.9%	1.0%	1.0%	1.1%
Long TIPS yield 15y	0.7%	0.8%	0.8%	0.9%	1.0%	1.0%	1.1%	1.1%	1.2%	1.2%	1.3%
Breakeven price inflation 15y	1.9%	1.9%	2.0%	2.0%	2.0%	2.1%	2.1%	2.2%	2.2%	2.2%	2.2%
A Corporate bond yield 5y	3.2%	3.4%	3.6%	3.7%	3.9%	4.1%	4.3%	4.4%	4.5%	4.6%	4.7%
Long A Corporate bond yield 10y	3.8%	3.9%	4.1%	4.2%	4.4%	4.5%	4.7%	4.8%	4.9%	5.0%	5.1%
A Corporate spread 5y	0.9%	1.0%	1.1%	1.2%	1.3%	1.3%	1.4%	1.4%	1.4%	1.4%	1.4%
Long A Corporate spread 10y	1.2%	1.3%	1.4%	1.4%	1.5%	1.5%	1.6%	1.6%	1.6%	1.6%	1.6%
Expected nominal return on assets											
Equity - US		6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%
Equity - Global		7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%
A Corporate bonds 5y		3.0%	3.0%	3.1%	3.2%	3.4%	3.6%	3.7%	4.0%	4.1%	4.3%
Long A Corporate bonds 10y		3.3%	3.2%	3.3%	3.4%	3.6%	3.9%	4.1%	4.3%	4.5%	4.8%
Treasury 5y		2.4%	2.2%	2.3%	2.3%	2.4%	2.5%	2.6%	2.7%	2.9%	3.1%
Long Treasury 15y		2.2%	2.0%	1.9%	1.9%	2.0%	2.0%	2.1%	2.2%	2.7%	2.7%
TIPS 5y		2.5%	2.6%	2.7%	2.7%	2.8%	2.9%	2.9%	3.1%	3.1%	3.2%
Long TIPS 15y		2.4%	2.4%	2.5%	2.4%	2.6%	2.8%	2.6%	2.9%	3.0%	3.0%
US High Yield		5.8%	5.1%	4.7%	4.9%	4.8%	4.5%	4.6%	5.0%	4.8%	5.2%
Bank Loans		5.1%	5.2%	5.5%	5.4%	5.6%	5.7%	5.7%	5.6%	5.5%	5.7%
USD Emerging Market Debt		5.8%	5.1%	5.0%	5.1%	5.2%	5.1%	5.3%	5.5%	5.4%	5.4%
Local Emerging Market Debt		5.7%	5.8%	5.6%	5.4%	5.7%	5.2%	5.0%	5.3%	6.3%	5.4%
Real Estate		5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%
Commodities		4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%
Hedge Funds - FoHF - Universe		3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%
Private Equity		8.6%	8.6%	8.6%	8.6%	8.6%	8.6%	8.6%	8.6%	8.6%	8.6%
Infrastructure - Europe		7.7%	7.7%	7.7%	7.7%	7.7%	7.7%	7.7%	7.7%	7.7%	7.7%
Cash		2.4%	2.2%	2.2%	2.3%	2.4%	2.5%	2.6%	2.8%	2.9%	3.0%
CPI		2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%

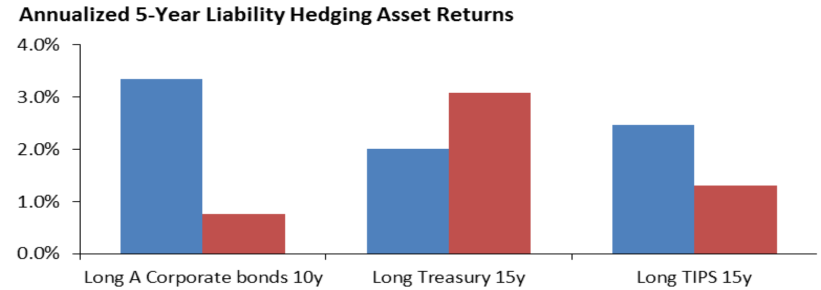
Scenario information as of March 31, 2019

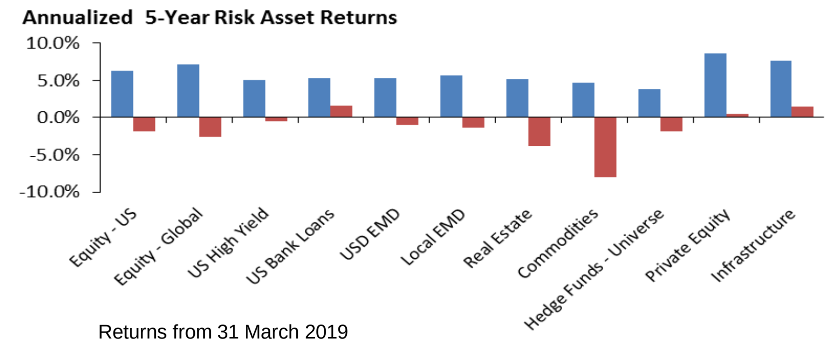
Recession Scenario

The US Economy Slips Back Into Recession In 2020

- Global growth is much slower than under the base case scenario.
- The US experiences a recession in 2020, due to subdued global growth.
- Inflation turns slightly negative in 2020. However, the period of deflation is short lived and inflation starts to rise in later years as an economic recovery begins to establish itself.
- Treasury yields fall while TIPS yields remain at low levels as the US enters recession. Yields rise in later years as a recovery gets underway.
- Corporate spreads rise significantly due to the poor economic situation and increased risks of downgrades or defaults.
- Most risk assets make losses in the first two years but rebound in later years as the economy recovers.







Returns from 31 March 2019
Source: Aon

The opinions referenced are as of the date of publication and are subject to change due to changes in the market or economic conditions and may not necessarily come to pass. Information contained herein is for informational purposes only and should not be considered investment advice.

Recession Scenario
Data Table

RECESSION SCENARIO

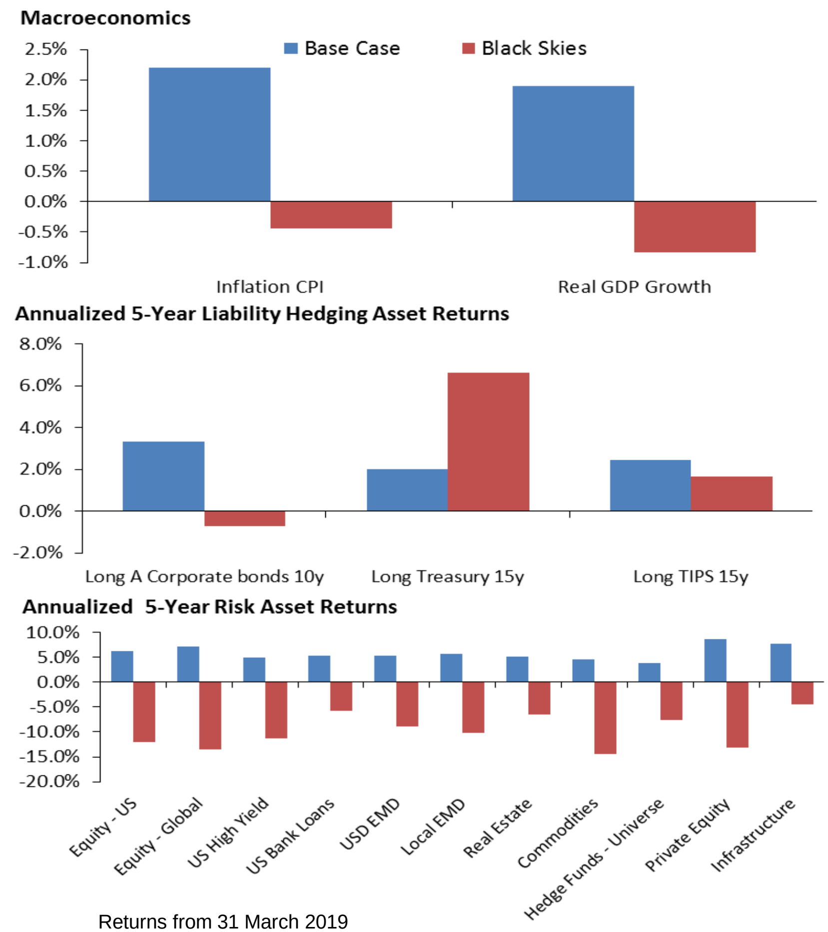
	Year 0	1	2	3	4	5	6	7	8	9	10
Yields (BOY)											
Treasury yield 5y	2.3%	1.0%	0.7%	0.9%	1.4%	2.0%	2.2%	2.3%	2.5%	2.7%	2.8%
Long Treasury yield 15y	2.7%	1.8%	1.5%	1.6%	1.9%	2.5%	2.6%	2.8%	2.9%	3.0%	3.2%
TIPS yield 5y	0.4%	-0.5%	-0.5%	-0.2%	0.2%	0.7%	0.7%	0.8%	0.9%	1.0%	1.0%
Long TIPS yield 15y	0.7%	0.3%	0.2%	0.2%	0.5%	0.8%	0.8%	0.9%	1.0%	1.1%	1.1%
Breakeven price inflation 15y	1.9%	1.5%	1.3%	1.4%	1.5%	1.7%	1.8%	1.8%	1.9%	2.0%	2.0%
A Corporate bond yield 5y	3.2%	4.1%	4.6%	4.6%	4.9%	5.0%	5.0%	5.1%	5.1%	5.1%	5.1%
Long A Corporate bond yield 10y	3.8%	4.4%	4.7%	4.8%	5.0%	5.2%	5.2%	5.3%	5.3%	5.4%	5.4%
A Corporate spread 5y	0.9%	3.1%	3.9%	3.7%	3.5%	3.0%	2.9%	2.7%	2.6%	2.4%	2.3%
Long A Corporate spread 10y	1.2%	3.0%	3.7%	3.5%	3.3%	2.9%	2.8%	2.7%	2.6%	2.4%	2.3%
Expected nominal return on assets											
Equity - US		-18.1%	-10.1%	10.6%	5.7%	5.7%	5.7%	5.8%	5.9%	5.9%	6.0%
Equity - Global		-20.8%	-11.5%	11.5%	6.0%	6.0%	6.1%	6.2%	6.4%	6.5%	6.6%
A Corporate bonds 5y		0.3%	1.6%	3.5%	2.9%	3.7%	4.1%	4.2%	4.4%	4.5%	4.7%
Long A Corporate bonds 10y		-2.2%	0.1%	2.5%	1.4%	2.1%	3.3%	3.5%	3.9%	4.2%	4.5%
Treasury 5y		8.5%	2.6%	0.4%	-0.5%	-0.4%	1.5%	1.7%	1.9%	2.2%	2.4%
Long Treasury 15y		16.3%	7.4%	-0.3%	-2.1%	-4.5%	0.4%	0.6%	0.8%	1.3%	1.4%
TIPS 5y		4.6%	0.3%	-0.4%	-0.6%	-0.5%	1.7%	1.8%	2.1%	2.3%	2.5%
Long TIPS 15y		7.8%	2.2%	1.0%	-2.4%	-1.8%	1.3%	1.3%	1.7%	1.9%	2.0%
US High Yield		-10.7%	-6.0%	7.4%	4.0%	3.9%	3.7%	3.9%	4.4%	4.3%	4.7%
Bank Loans		-5.1%	-1.8%	6.3%	4.3%	4.7%	4.9%	5.0%	5.0%	5.0%	5.2%
USD Emerging Market Debt		-13.3%	-7.4%	8.3%	4.5%	5.0%	4.8%	5.1%	5.3%	5.2%	5.3%
Local Emerging Market Debt		-15.5%	-8.2%	9.3%	4.7%	5.4%	4.9%	4.8%	5.1%	6.1%	5.2%
Real Estate		-13.0%	-7.9%	-2.7%	0.7%	4.6%	4.7%	4.7%	4.8%	4.8%	4.9%
Commodities		-27.6%	-21.7%	7.3%	3.9%	3.9%	4.0%	4.1%	4.1%	4.2%	4.3%
Hedge Funds - FoHF - Universe		-14.1%	-8.9%	6.6%	5.5%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%
Private Equity		-18.6%	-6.1%	13.4%	8.6%	8.8%	8.8%	8.7%	8.7%	8.7%	8.7%
Infrastructure - Europe		-5.0%	-0.7%	2.8%	3.6%	7.2%	7.3%	7.3%	7.4%	7.4%	7.5%
Cash		2.4%	0.3%	0.3%	0.7%	1.1%	1.3%	1.6%	1.9%	2.1%	2.3%
CPI		-0.3%	0.4%	0.7%	1.0%	1.3%	1.4%	1.5%	1.6%	1.7%	1.8%

Scenario information as of March 31, 2019

Black Skies Scenario

A Deep Recession Followed By A Longer Period Of Stagnant Growth

- There is a sharp deterioration in the global economic outlook, as the Eurozone crisis flares up and there is a sharp slowdown in emerging market economies.
- The US experiences a protracted deep recession.
- Inflation is pushed into negative territory in 2020 and remains there in 2021, while continued sluggish growth over the following years means that inflation stays close to zero.
- Treasury yields fall and remain at low levels as the US enters recession.
- Corporate spreads rise significantly due to the poor economic situation and increased risks of downgrades or defaults.
- Risk assets make losses in the first few years. There is no pronounced bounce in growth and the economic situation remains poor for a long time, which weighs on returns in later years.



Returns from 31 March 2019
Source: Aon

The opinions referenced are as of the date of publication and are subject to change due to changes in the market or economic conditions and may not necessarily come to pass. Information contained herein is for informational purposes only and should not be considered investment advice.

Black Skies Scenario

Data Table

BLACK SKIES SCENARIO

	Year 0	1	2	3	4	5	6	7	8	9	10
Yields (BOY)											
Treasury yield 5y	2.3%	0.1%	-0.1%	0.0%	0.1%	0.3%	0.6%	1.0%	1.3%	1.6%	2.0%
Long Treasury yield 15y	2.7%	1.1%	0.8%	0.8%	0.9%	1.1%	1.4%	1.7%	2.0%	2.2%	2.5%
TIPS yield 5y	0.4%	-0.6%	-0.7%	-0.6%	-0.5%	-0.3%	-0.2%	0.0%	0.2%	0.4%	0.5%
Long TIPS yield 15y	0.7%	0.0%	-0.1%	0.0%	0.1%	0.2%	0.3%	0.5%	0.6%	0.7%	0.9%
Breakeven price inflation 15y	1.9%	1.1%	0.9%	0.8%	0.8%	0.9%	1.1%	1.2%	1.4%	1.5%	1.6%
A Corporate bond yield 5y	3.2%	4.2%	5.0%	5.0%	5.0%	4.7%	4.8%	4.9%	4.9%	5.0%	5.0%
Long A Corporate bond yield 10y	3.8%	4.5%	5.0%	5.0%	5.0%	4.8%	4.9%	5.0%	5.1%	5.2%	5.2%
A Corporate spread 5y	0.9%	4.1%	5.1%	5.0%	4.9%	4.4%	4.1%	3.9%	3.6%	3.3%	3.0%
Long A Corporate spread 10y	1.2%	3.9%	4.7%	4.6%	4.5%	4.1%	3.9%	3.6%	3.4%	3.1%	2.9%
Expected nominal return on assets											
Equity - US		-28.8%	-20.9%	-11.6%	2.5%	2.5%	2.9%	3.3%	3.7%	4.0%	4.4%
Equity - Global		-31.7%	-22.9%	-12.6%	2.6%	2.6%	3.1%	3.5%	4.0%	4.5%	4.9%
A Corporate bonds 5y		-0.3%	-1.5%	1.5%	1.9%	3.0%	1.5%	1.7%	2.2%	2.5%	2.8%
Long A Corporate bonds 10y		-3.1%	-4.2%	0.6%	0.8%	2.6%	0.3%	0.7%	1.3%	1.8%	2.4%
Treasury 5y		12.4%	1.2%	0.1%	-0.1%	-0.1%	-0.7%	-0.4%	0.0%	0.4%	0.7%
Long Treasury 15y		28.4%	6.2%	2.1%	0.1%	-1.1%	-2.4%	-2.1%	-1.8%	-1.3%	-1.0%
TIPS 5y		3.2%	-1.0%	-0.3%	-0.3%	-0.4%	0.0%	0.3%	0.7%	1.0%	1.3%
Long TIPS 15y		10.0%	0.3%	0.2%	-1.2%	-0.7%	-0.5%	-0.4%	0.1%	0.4%	0.6%
US High Yield		-25.4%	-19.5%	-11.2%	1.4%	1.5%	1.5%	1.9%	2.7%	2.8%	3.5%
Bank Loans		-15.5%	-11.2%	-5.5%	2.3%	2.6%	3.0%	3.3%	3.5%	3.7%	4.2%
USD Emerging Market Debt		-21.2%	-16.3%	-8.7%	1.9%	2.3%	2.4%	3.0%	3.4%	3.6%	4.0%
Local Emerging Market Debt		-24.4%	-18.1%	-9.7%	1.9%	2.5%	2.3%	2.4%	3.1%	4.3%	3.7%
Real Estate		-15.6%	-11.1%	-5.2%	-0.7%	1.6%	1.9%	2.3%	2.7%	3.0%	3.4%
Commodities		-36.7%	-28.3%	-3.6%	2.4%	2.4%	2.6%	2.9%	3.1%	3.3%	3.5%
Hedge Funds - FoHF - Universe		-18.1%	-12.6%	-6.7%	0.6%	0.6%	0.9%	1.2%	1.6%	1.9%	2.2%
Private Equity		-32.5%	-23.5%	-12.3%	4.3%	4.3%	4.8%	5.2%	5.6%	6.0%	6.5%
Infrastructure - Europe		-12.8%	-8.4%	-4.4%	0.9%	3.6%	4.0%	4.4%	4.8%	5.2%	5.7%
Cash		2.4%	0.1%	0.1%	0.1%	0.1%	0.4%	0.8%	1.2%	1.5%	1.8%
CPI		-1.8%	-1.3%	0.1%	0.3%	0.5%	0.7%	0.8%	1.0%	1.2%	1.4%

Scenario information as of March 31, 2019

About This Material

This material includes a summary of calculations and consulting related to the finances of Pennsylvania Public School Employees' Retirement System (PSERS). The following variables have been addressed:

- Contributions
- Funded Ratio
- Net Outflow

This analysis is intended to assist the Investment Committee with a review of the associated issues and options, and its use may not be appropriate for other purposes. This analysis has been prepared solely for the benefit of the Investment Committee. Any further dissemination of this report is not allowed without the written consent of Aon Hewitt Investment Consulting, Inc.

Our calculations were generally based on the methodologies identified in the actuary's valuation report for PSERS. We believe the methodology used in these calculations conforms to the applicable standards identified in the report.

Experience different than anticipated could have a material impact on the ultimate costs of the benefits. In addition, changes in plan provisions or applicable laws could have a significant impact on cost. Actual experience may differ from our modeling assumptions.

Our calculations were based on data provided by the plan actuary. The actuarial assumptions and methods and plan provisions reflected in these projections are the same as those used for the 2018 actuarial valuation for PSERS as noted in the actuarial reports, except where noted in this report. Unless specifically noted, our calculations do not reflect any other changes or events after June 30, 2018.

In conducting these projections, we have relied on plan design, demographic and financial information provided by other parties, including the plan's actuary and plan sponsor. While we cannot verify the accuracy of all of the information, the supplied information was reviewed for consistency and reasonableness. As a result of this review, we have no reason to doubt the substantial accuracy or completeness of the information and believe that it has produced appropriate results.

These projections have been conducted in accordance with generally accepted actuarial principles and practices, including applicable Actuarial Standards of Practice as issued by the Actuarial Standards Board. The undersigned actuary is familiar with the near-term and long-term aspects of pension valuations and meet the Qualification Standards of the American Academy of Actuaries necessary to render the actuarial opinions contained herein. All sections of this report are considered an integral part of the actuarial opinions.

To our knowledge, no colleague of Aon Hewitt Investment Consulting, Inc. providing services to PSERS has any direct financial interest or indirect material interest in PSERS. Thus, we believe there is no relationship existing that might affect our capacity to prepare and certify this report for PSERS.

Aon Hewitt Investment Consulting, Inc.

Phil Kivarkis, FSA, CFA

Legal Disclosures and Disclaimers

Investment advice and consulting services provided by Aon Hewitt Investment Consulting, Inc. (“AHIC”). The information contained herein is given as of the date hereof and does not purport to give information as of any other date. The delivery at any time shall not, under any circumstances, create any implication that there has been a change in the information set forth herein since the date hereof or any obligation to update or provide amendments hereto.

This document is not intended to provide, and shall not be relied upon for, accounting, legal or tax advice. Any accounting, legal, or taxation position described in this presentation is a general statement and shall only be used as a guide. It does not constitute accounting, legal, and tax advice and is based on AHIC’s understanding of current laws and interpretation.

AHIC disclaims any legal liability to any person or organization for loss or damage caused by or resulting from any reliance placed on that content. AHIC reserves all rights to the content of this document. No part of this document may be reproduced, stored, or transmitted by any means without the express written consent of AHIC.

Aon Hewitt Investment Consulting, Inc. is a federally registered investment advisor with the U.S. Securities and Exchange Commission. AHIC is also registered with the Commodity Futures Trading Commission as a commodity pool operator and a commodity trading advisor, and is a member of the National Futures Association. The AHIC ADV Form Part 2A disclosure statement is available upon written request to:

Aon Hewitt Investment Consulting, Inc.
200 E. Randolph Street
Suite 1500
Chicago, IL 60601
ATTN: AHIC Compliance Officer