



December 2016

**2016 Asset-Liability Study
Results**

Capital Markets Research
Group

Scope of the Project

Asset/Liability Study

● Phase 1

- Review MCERA’s current investment program.
 - *Strategic allocation to broad asset classes.*
 - *Important to distinguish between “strategy” (i.e.—the target asset class/benchmark) and “implementation” (i.e.—the way the manager constructs the portfolio).*
- Set asset class, portfolio expectations.
 - *Return, risk, correlation, and other considerations.*
 - *Evaluate potential new asset classes/strategies.*

● Phase 2

- Build integrated asset-liability model:
 - *Reflect 6/30/2015 valuation results; confirm model assumptions, review with actuary. Roll valuation results forward to 6/30/16 to begin projections.*
 - *Deterministic projections – assume valuation assumptions are achieved.*
 - *Simulation – apply Callan’s capital market projections, insert capital market uncertainty, evaluate alternative investment strategies.*

● Phase 3

- Develop preliminary asset-liability results.
 - *Confirm decision variables; ascertain risk tolerance and effective investment time horizon.*
 - *Callan internal peer review of the study’s results. Ongoing review and interaction with staff.*
- Develop the final asset-liability study.
 - *Present finalized asset-liability results to MCERA Board of Trustees.*
 - *MCERA Board selects an appropriate asset allocation.*

Timeline

- August/September 2016
 - Construct liability model in ProVal, starting with 2015 valuation results.
- October 2016
 - Callan presentation: Overview of study process, review of current program, set capital market expectations, evaluate potential new strategies (Phase 1).
 - Complete liability model, integrate asset mixes and develop projections and simulations (Phase 2).
- December 2016
 - Callan presentation: Deliver refined asset-liability study results. Complete study, adoption by Board.



Process Overview

Why Conduct an Asset and Liability Study?

- The cornerstone of a prudent process for pension plan, endowment, and foundation trustees (and any individual investor) is a careful and thorough examination of their long-term strategic plan.
- Explicitly acknowledge change and uncertainty in the capital markets.
- Establish reasonable rate-of-return and risk expectations.
- Incorporate material changes in strategic plan policies and demographics
 - Funding policy, benefit formula, eligibility, early retirement, COLA, decrement tables
- Reflect changes in regulations
 - Public pension: GASB 67 and 68
- Project and evaluate impact on assets, liabilities and funded status.
- Confirm an investment policy to meet return and risk objectives in relation to funding, accounting and policy goals.
- If no material changes have occurred, an asset allocation review should still be conducted every 3 – 5 years.

Where Does Asset Allocation Fit in Strategic Planning?

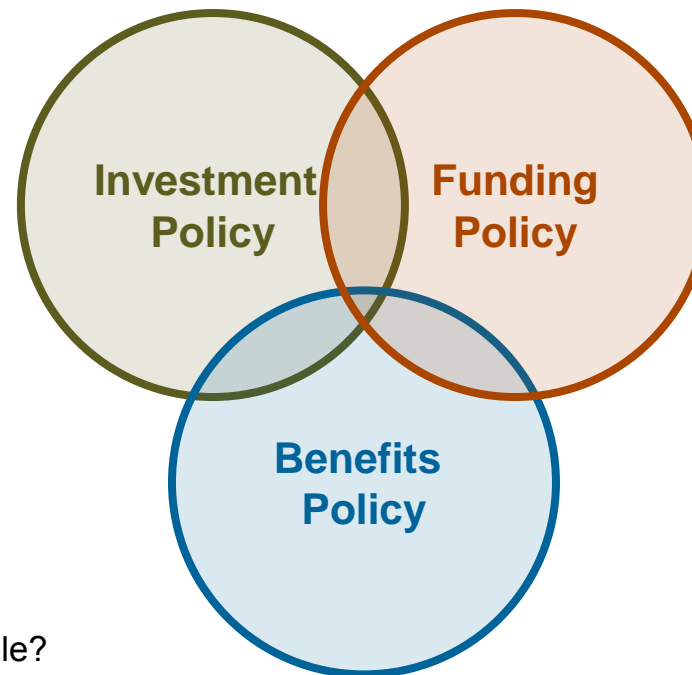
Evaluating the interaction of the three key policies that govern a defined benefit plan with the goal of establishing the best investment policy

Investment Policy

- How will the assets supporting the benefits be invested?
- What risk/return objectives?
- How to manage cash flows?

Benefits Policy

- What type/kind of benefits?
- What level of benefit?
- When and to whom are they payable?



Funding Policy

- How will the benefits be funded?
- What assumed investment return?
- How are deficits amortized?
- What actuarial methodologies are applied to dampen contribution volatility?

Defining MCERA's Risk Tolerance

Factors Critical to Decision-Making

- Size of the Plan
- Current funded status
- Expected funding requirements
- Plan status (open to new participants; existing members still accrue benefits)
- Time horizon
- Liquidity needs:
 - Benefit payment less contributions
 - Funding policy can impact liquidity needs
- Liability growth rates
- Willingness to take risk:
 - Sensitivity to size of contribution or contribution volatility
- Financial ability to take risk



Liability Model

Asset/Liability Study Process

Liability Model and Projected Cash Flows

- Pension Plan Equation: $\text{Benefits} + \text{Expenses} = \text{Investment Return} + \text{Contributions}$
- Callan builds the liability model
 - Uses data from plan actuary (Cheiron)
- Liability Assumptions
 - Funding Policy
 - *Employee contributions*
 - *Employer contributions*
 - Benefit Policy
 - *Benefit formulas*
 - *Cost of living increases*
 - Demographics
 - *Ratio of Active vs Retirees*
 - *Average age*
 - *Population growth*
 - *Salary increases*
 - *Mortality table – longevity risk management*
 - *Discount rate*

Liability Model and Key Actuarial Assumptions

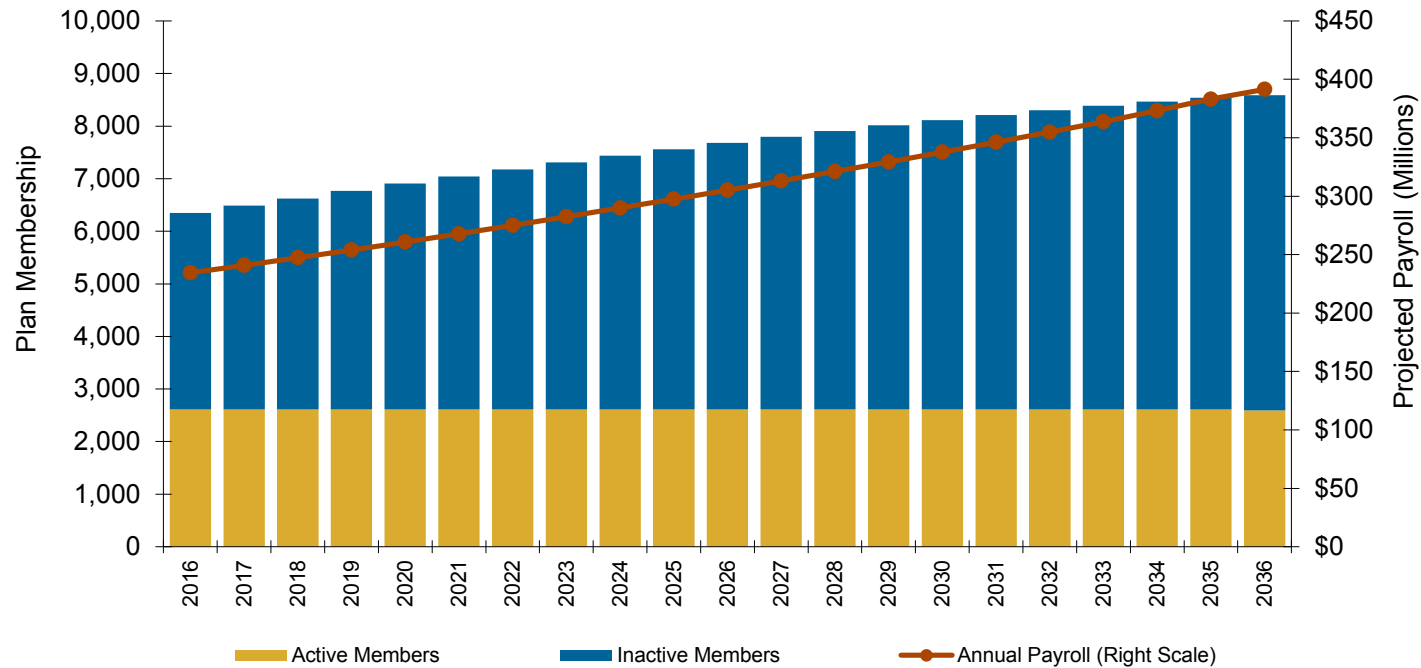
Variable	Value
As of 6/30/2015	
Total Actuarial Liability	\$2,469.1mm
Market Value of Assets	\$2,066.2mm
Unfunded Actuarial Liability	\$402.8mm
Market Funded Status	83.7%
Employer Contribution for FYE 2016	32.63%
Employer Contribution for FYE 2017	32.22%

Key Actuarial Assumptions	Description
Investment Return	7.25%
Price Inflation	2.75%
Salary Scale	3.0%, plus longevity & promotion
COLA	2%-4% caps, vary by plan and tier

- Asset-liability projections are based on the 6/30/2015 actuarial report for the MCERA Plan.
 - 2015-16 investment experience is reflected in projections.
 - Total plan return July 2015 – June 2016 = 2.26%; CPI = 1.0%
- Employer contributions shown above are blended rates incorporating multiple plan groups and tiers, and reflect the employers' share of normal cost plus substantial contributions to pay down the unfunded actuarial liability.
- Employee contributions are in addition to the rates shown above, and vary by plan group.

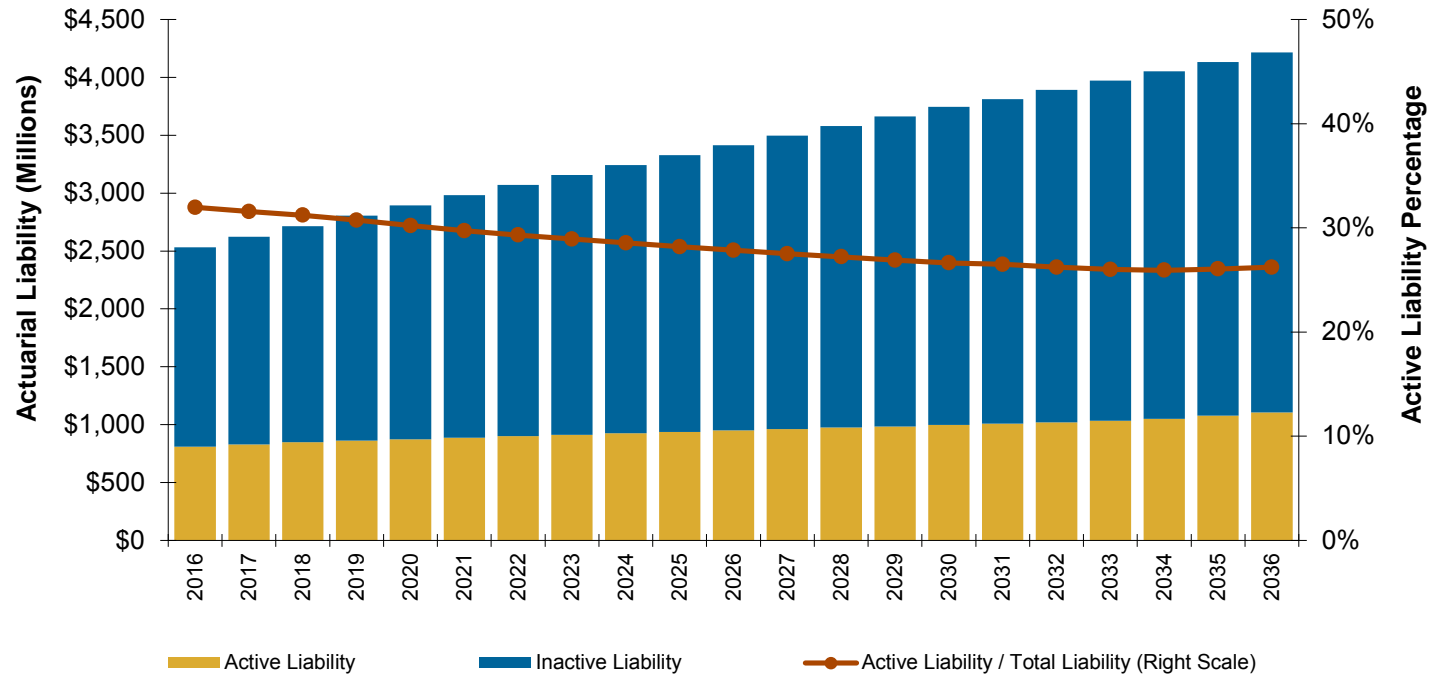
Plan Membership

Active & Inactive Member Count, Annual Payroll



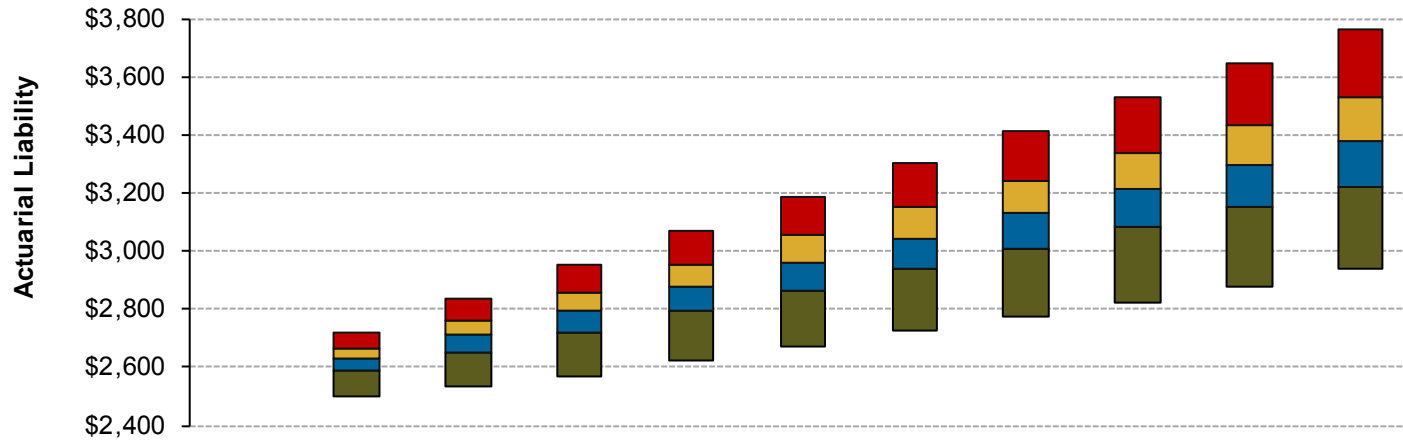
- Active members are held constant.
 - Future new hires replace exits due to retirement, death, disability, and withdrawal.
 - Active membership is constant (implies 0% workforce growth).
- Payroll adjusted to be consistent with Callan’s capital market assumptions.

Actuarial Liability



- Total plan liability grows by 3% annually over the next 10 years. Inactive liabilities grow faster than active liabilities (3.6% vs. 1.6%).
- Active liability falls from 33% of total liability to 28% by 2026, and to 26% by 2036.

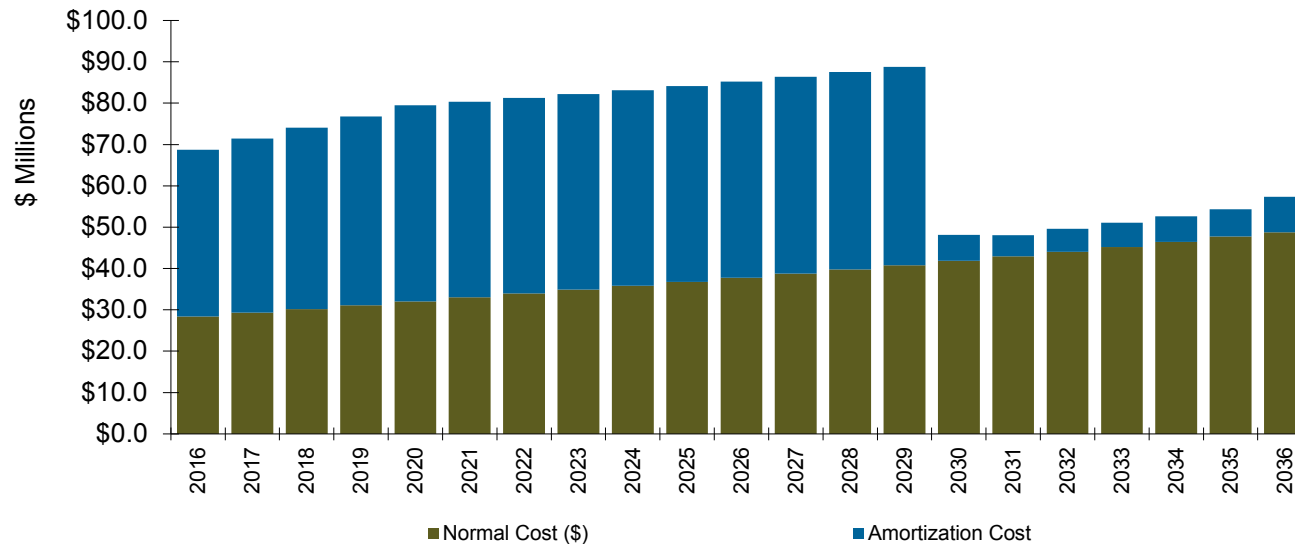
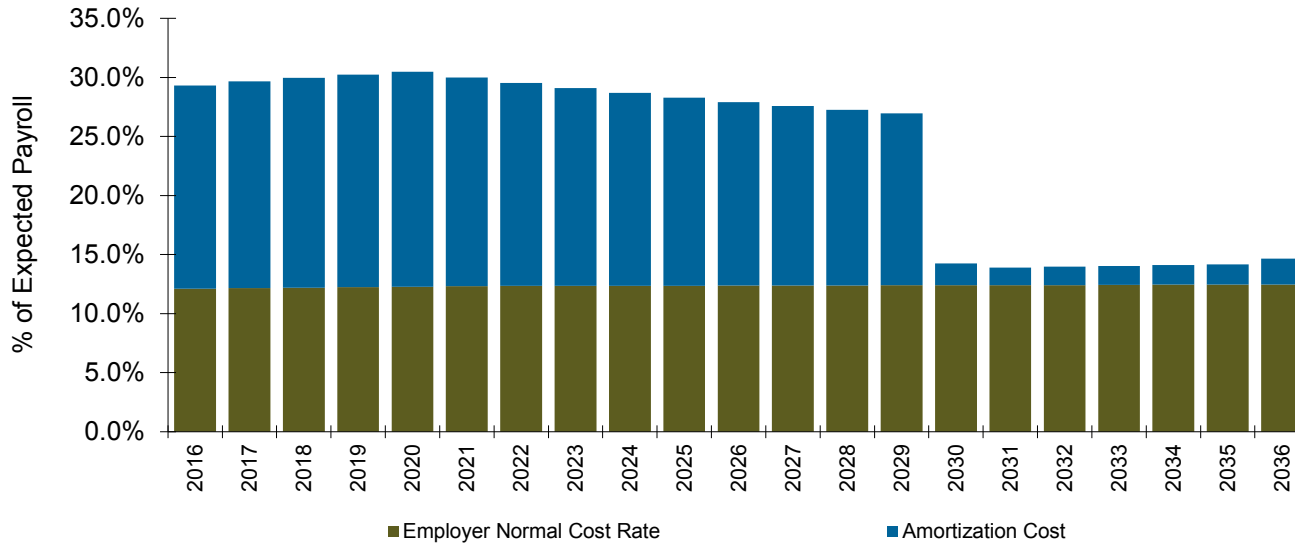
Actuarial Liability - Simulation



Percentile	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	5-Year Growth	10-Year Growth
97.5th	\$2,552	\$2,720	\$2,838	\$2,952	\$3,069	\$3,182	\$3,303	\$3,413	\$3,529	\$3,643	\$3,759	4.5%	4.0%
75th	2,552	2,664	2,761	2,858	2,956	3,055	3,151	3,242	3,340	3,436	3,529	3.7%	3.3%
50th	2,552	2,630	2,711	2,795	2,879	2,963	3,044	3,128	3,212	3,295	3,380	3.0%	2.9%
25th	2,552	2,586	2,651	2,721	2,796	2,865	2,937	3,007	3,086	3,155	3,223	2.3%	2.4%
2.5th	2,552	2,496	2,531	2,568	2,625	2,670	2,727	2,776	2,821	2,874	2,939	0.9%	1.4%
Range	0	224	307	384	444	513	576	636	708	769	820	3.6%	2.5%

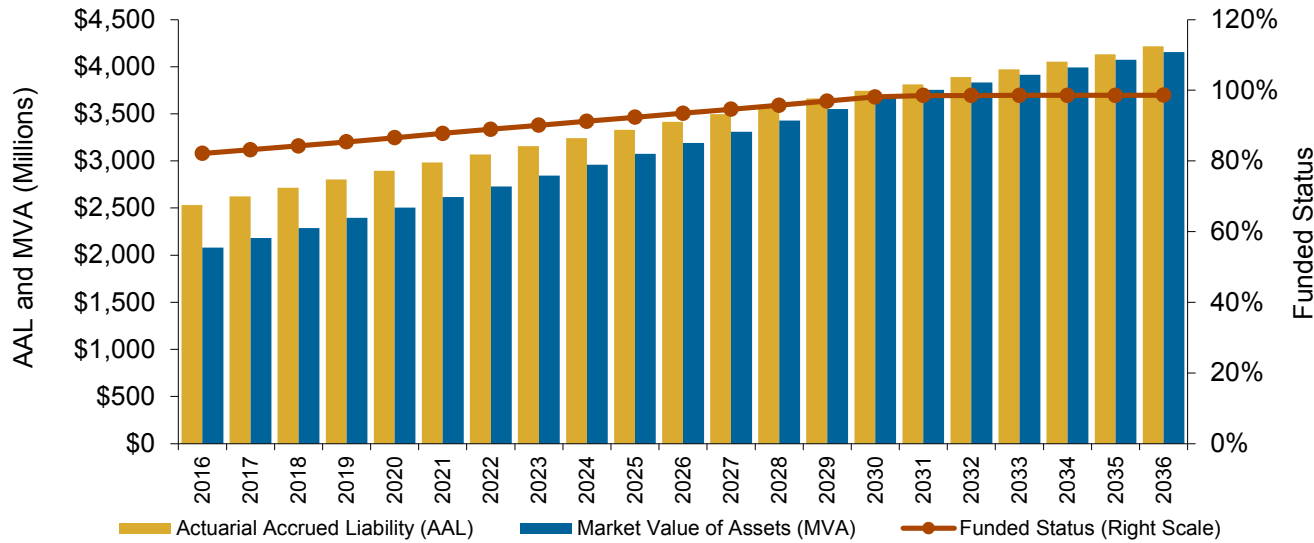
- The actuarial liability increases 2.5% per year over the 10 year forecast horizon.
- The Plan's liabilities are sensitive to changes in inflation and the resulting impact on salaries.
- Based on Callan's 10-year capital market expectations, the expected liability return is 6.8%.
 - The liabilities are growing at a rate slower than the full interest cost of 7.25% since Callan's inflation expectation of 2.25% is lower than the actuary's assumed inflation of 2.75%

Contributions – Assuming 6.9% Return

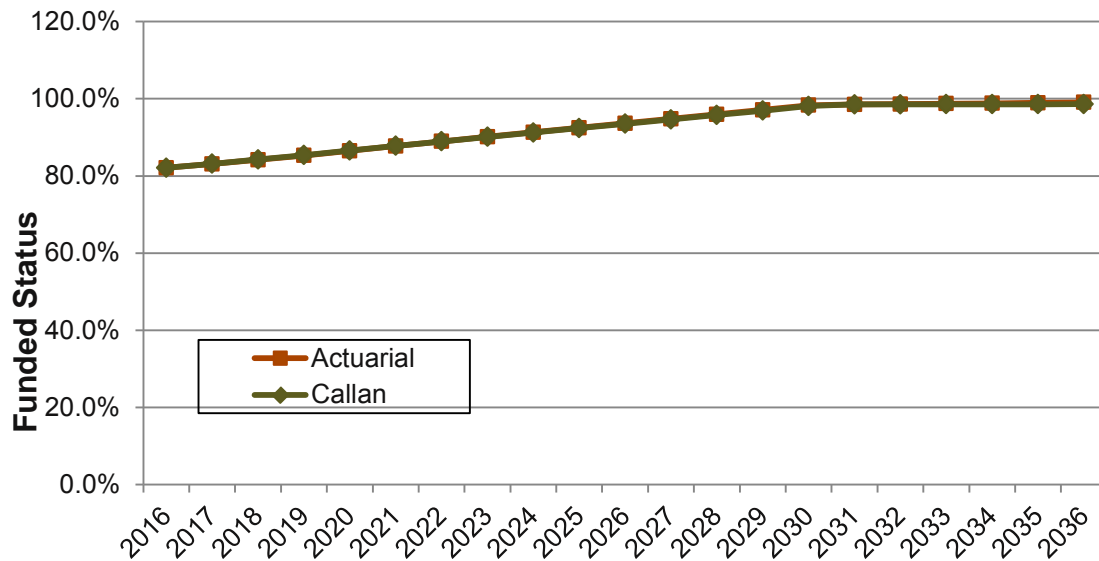


- Charts assume plan earns a 6.87% return, consistent with Callan’s capital market projections (Current Target mix).
- Normal cost as % of payroll rises gradually from 12% to 12.4% by 2026, remains constant for the following ten years.
- Normal cost in dollars increases 2.9% per year over next ten years, as payroll increases.
- Closed-period amortization of Unfunded Liability at 6/30/2013 ends in 2030, resulting in sharp drop in amortization cost. Remaining cost is for UAL from 2009 (22 years remaining).
- Contribution projection is very similar to that calculated using 7.25% return and 2.75% inflation assumed in the actuarial valuation.

Funded Status

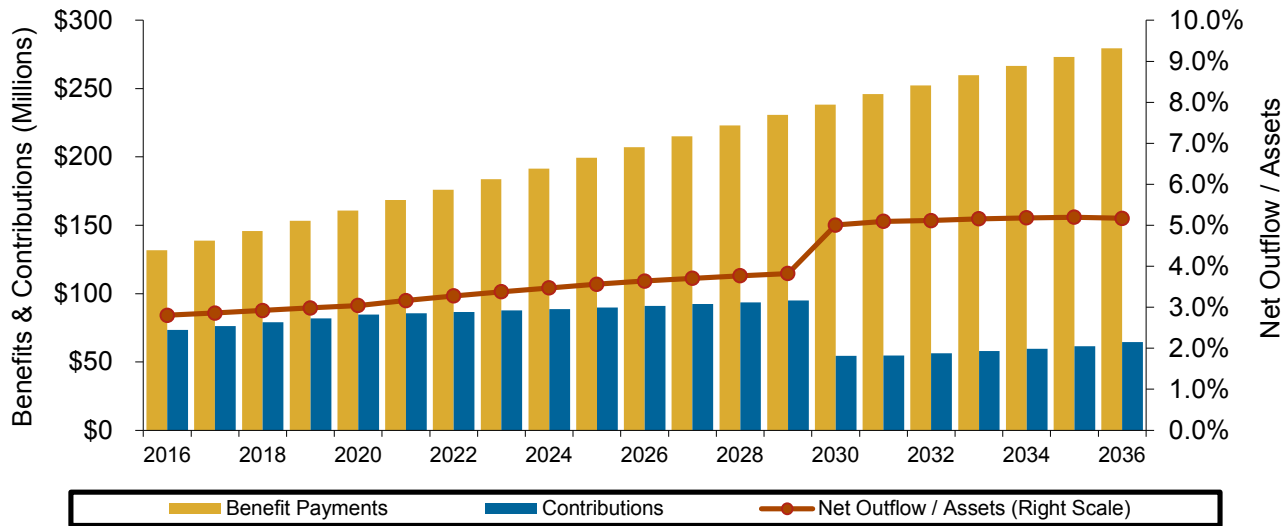


- Top chart assumes plan earns a 6.9% return, consistent with Callan's capital market assumptions.
- Funded status returns to 100% over 20 year projection period.



- Bottom chart compares funded status using Callan's capital market assumptions versus actuarial assumptions; projections are virtually identical.

Liquidity Needs



- Chart assumes plan earns a 6.9% return.
- Net Outflow Flow = Funding Contributions – Benefit Payments – Expenses
- Liquidity needs help define the appropriate time horizon for investments and shape the ability to commit to volatile and/or illiquid asset classes.
- Net cash flow as a % of plan assets is a useful indicator of liquidity needs. A ratio below 5% is viewed as manageable and should not impact asset allocation. A ratio between 5% and 10% bears careful watch and may necessitate strategies to manage cash flow needs, and could impact asset allocation, especially exposure to illiquid assets.
- Net cash flow is negative and rises from 2.8% of plan assets to 3.6% in 10 years (2026). Liquidity needs in this range are manageable under the current investment policy for the next 10 years.
- We project net outflow to rise to 5.2% of assets in 20 years.



Asset Modeling

2016 Capital Market Expectations—Return and Risk

Summary of Callan's Long-Term Capital Market Projections (2016 – 2025)

Asset Class	Index	PROJECTED RETURN			PROJECTED RISK			2015 - 2024		Geometric* Delta
		1-Year Arithmetic	10-Year Geometric*	Real	Standard Deviation	Sharpe Ratio	Projected Yield	10-Year Geometric*	Standard Deviation	
Equities										
Broad Domestic Equity	Russell 3000	8.85%	7.35%	5.10%	18.70%	0.353	2.40%	7.60%	19.00%	-0.25%
Large Cap	S&P 500	8.60%	7.25%	5.00%	17.95%	0.354	2.50%	7.50%	18.30%	-0.25%
Small/Mid Cap	Russell 2500	9.85%	7.55%	5.30%	22.75%	0.334	1.90%	7.85%	22.95%	-0.30%
Global ex-U.S. Equity	MSCI ACWI ex USA	9.55%	7.55%	5.30%	21.30%	0.343	2.70%	7.80%	21.45%	-0.25%
International Equity	MSCI World ex USA	9.00%	7.25%	5.00%	20.05%	0.337	3.00%	7.50%	20.20%	-0.25%
Emerging Markets Equity	MSCI Emerging Markets	11.15%	7.60%	5.35%	27.85%	0.320	1.70%	7.90%	27.95%	-0.30%
Fixed Income										
Short Duration	Barclays G/C 1-3	2.60%	2.60%	0.35%	2.25%	0.156	2.80%	2.40%	2.25%	0.20%
Domestic Fixed	Barclays Aggregate	3.05%	3.00%	0.75%	3.75%	0.213	4.60%	3.00%	3.75%	0.00%
Long Duration	Barclays Long G/C	4.30%	3.70%	1.65%	11.40%	0.197	5.30%	3.20%	11.40%	0.50%
TIPS	Barclays TIPS	3.10%	3.00%	0.75%	5.30%	0.160	4.20%	3.00%	5.30%	0.00%
High Yield	Barclays High Yield	5.40%	5.00%	2.75%	10.50%	0.300	8.00%	5.00%	11.10%	0.00%
Non-U.S. Fixed	Barclays Global Aggregate ex US	1.80%	1.40%	-0.85%	9.20%	-0.049	4.00%	2.30%	9.40%	-0.90%
Emerging Market Debt	EMBI Global Diversified	5.00%	4.60%	2.35%	9.90%	0.278	6.50%	4.70%	10.00%	-0.10%
Other										
Real Estate	Callan Real Estate	7.20%	6.00%	3.75%	16.45%	0.301	5.00%	6.15%	16.50%	-0.15%
Private Equity	TR Post Venture Cap	13.15%	8.15%	5.90%	32.80%	0.322	0.00%	8.50%	33.05%	-0.35%
Hedge Funds	Callan Hedge FOF Database	5.55%	5.25%	3.00%	9.30%	0.355	2.25%	5.25%	9.30%	0.00%
Commodities	Bloomberg Commodity	4.40%	2.75%	0.50%	18.50%	0.116	2.25%	2.75%	18.50%	0.00%
Cash Equivalents	90-Day T-Bill	2.25%	2.25%	0.00%	0.90%	0.000	2.25%	2.25%	0.90%	0.00%
Inflation	CPI-U		2.25%		1.50%			2.25%	1.50%	0.00%

* Geometric returns are derived from arithmetic returns and the associated risk (standard deviation).

Source: Callan Associates

2016 Capital Market Expectations—Correlation Coefficient Matrix

Key to Constructing Efficient Portfolios

Broad US Equity	1.000																			
Large Cap	0.997	1.000																		
Small/Mid Cap	0.965	0.940	1.000																	
Global ex-US Equity	0.882	0.879	0.853	1.000																
Non-US Equity	0.852	0.850	0.820	0.986	1.000															
Em Mkts Equity	0.861	0.855	0.840	0.933	0.860	1.000														
Defensive	-0.240	-0.230	-0.260	-0.254	-0.230	-0.280	1.000													
US Fixed	-0.108	-0.100	-0.130	-0.123	-0.105	-0.150	0.870	1.000												
Long Duration	0.136	0.138	0.121	0.106	0.119	0.069	0.729	0.925	1.000											
TIPS	-0.050	-0.045	-0.065	-0.053	-0.045	-0.065	0.530	0.580	0.527	1.000										
High Yield	0.640	0.640	0.610	0.629	0.610	0.610	-0.170	0.020	0.220	0.060	1.000									
Non-US Fixed	0.014	0.050	-0.100	0.013	0.060	-0.090	0.480	0.510	0.542	0.340	0.120	1.000								
Em Mkt Debt	0.579	0.580	0.550	0.550	0.530	0.540	-0.120	0.030	0.159	0.150	0.600	0.010	1.000							
Real Estate	0.735	0.730	0.715	0.669	0.650	0.645	-0.140	-0.020	0.190	0.005	0.560	-0.050	0.450	1.000						
Private Equity	0.948	0.945	0.915	0.934	0.905	0.905	-0.240	-0.190	0.062	-0.100	0.640	-0.060	0.560	0.710	1.000					
Hedge Funds	0.797	0.795	0.765	0.760	0.735	0.740	-0.120	0.080	0.303	0.055	0.570	-0.080	0.540	0.600	0.770	1.000				
Commodities	0.167	0.165	0.165	0.177	0.170	0.175	-0.220	-0.120	-0.042	0.100	0.100	0.050	0.190	0.200	0.180	0.210	1.000			
Cash Equivalents	-0.043	-0.030	-0.080	-0.040	-0.010	-0.100	0.300	0.100	-0.049	0.070	-0.110	-0.090	-0.070	-0.060	0.000	-0.070	0.070	1.000		
Inflation	-0.011	-0.020	0.020	0.010	0.000	0.030	-0.200	-0.280	-0.284	0.180	0.070	-0.150	0.000	0.100	0.000	0.200	0.400	0.000	1.000	
	Broad US Eq	Large Cap	Sm/Mid Cap	Global ex-US	Non-US Equity	Em Mkt Eq	Defens	US Fixed	Long Duration	TIPS	High Yield	Non-US Fixed	Em Mkt Debt	Real Estate	Private Equity	Hedge Funds	Comm	Cash Equiv	Inflation	

- Relationships between asset classes is as important as standard deviation.
- To determine portfolio mixes, Callan employs mean-variance optimization.
- Return, standard deviation and correlation determine the composition of efficient asset mixes.

Source: Callan Associates

MCERA Asset Classes - Return and Risk

Asset Class	10-Year Compound Return	Projected Standard Deviation
Broad Domestic Equity	7.35%	18.70%
Global ex-US Equity	7.55%	21.30%
Domestic Fixed Income	3.00%	3.75%
Private Equity	8.15%	32.80%
Real Assets	6.10%	13.75%
Cash Equivalents	2.25%	0.90%

- Total Real Assets portfolio:
 - 8% private real estate, 7% public real assets
 - Public real assets = 25% TIPS, 25% Commodities, 25% REITs, 25% Natural Resource Equity.

MCERA Asset Classes - Correlation

	Broad Dom Equity	GlobalxUS Equity	Domestic Fixed	Real Assets	Private Equity	Cash Equivalents	Inflation
Broad Domestic Equity	1.00						
Global Ex-US Equity	0.88	1.00					
Domestic Fixed	-0.11	-0.12	1.00				
Real Assets	0.80	0.76	-0.05	1.00			
Private Equity	0.95	0.93	-0.19	0.78	1.00		
Cash Equivalents	-0.04	-0.04	0.10	-0.02	0.00	1.00	
Inflation	-0.01	0.01	-0.28	0.23	0.00	0.00	1.00

- Total Real Assets portfolio:
 - 8% private real estate, 7% public real assets
 - Public real assets = 25% TIPS, 25% Commodities, 25% REITs, 25% Natural Resource Equity

MCERA - 2016 Efficient Mixes

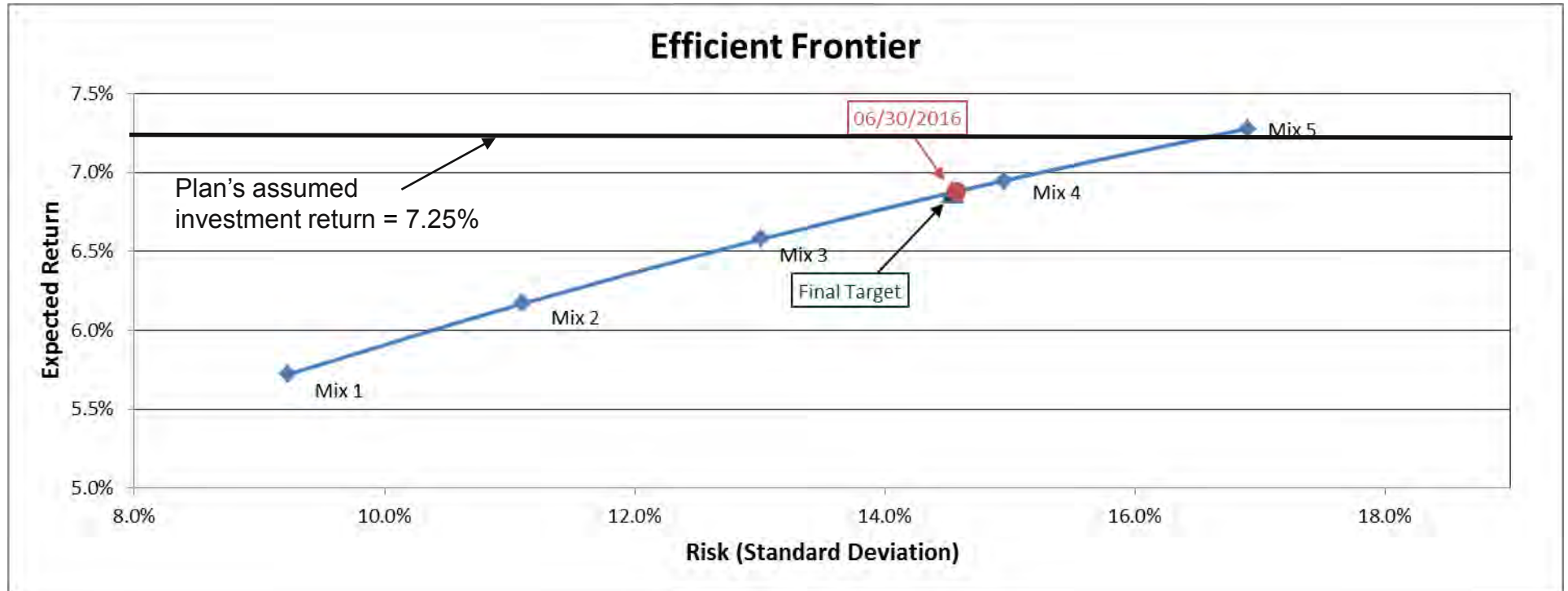
Maximum Real Asset Allocation of 15%

Alternative Asset Mixes - 15% Real Assets Maximum									
Asset Class	6/30/2016	Final Target	Min Alloc	Max Alloc	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
Broad US Equity	31.4%	32%	0%	100%	18%	22%	27%	32%	36%
Broad International Equity	19.8%	22%	0%	100%	14%	17%	20%	23%	27%
Broad US Fixed Income	22.8%	23%	0%	100%	50%	40%	31%	22%	12%
Real Assets	16.9%	15%	0%	15%	13%	15%	15%	15%	15%
Private Equity	9.1%	8%	0%	100%	5%	6%	8%	9%	10%
Totals	100%	100%			100%	100%	100%	100%	100%
Expected Return	6.88%	6.87%			5.72%	6.17%	6.58%	6.95%	7.28%
Real Return	4.63%	4.62%			3.47%	3.92%	4.33%	4.70%	5.03%
Risk (Standard Deviation)	14.57%	14.55%			9.23%	11.10%	13.02%	14.95%	16.91%
% equity	60%	62%			37%	45%	54%	64%	73%
% fixed income	23%	23%			50%	40%	31%	22%	12%
% real assets	17%	15%			13%	15%	15%	15%	15%

- Mixes are constrained to hold a maximum of 15% real assets.
- No new asset classes included.
- The current target mix is efficient and lies on the efficient frontier.
- Real assets expands the real estate allocation category to include other real assets, all publicly traded: TIPS, commodities, natural resource equity and REITs. Real estate remains the core, with added diversification.

MCERA - 2016 Efficient Frontier – Nominal Return

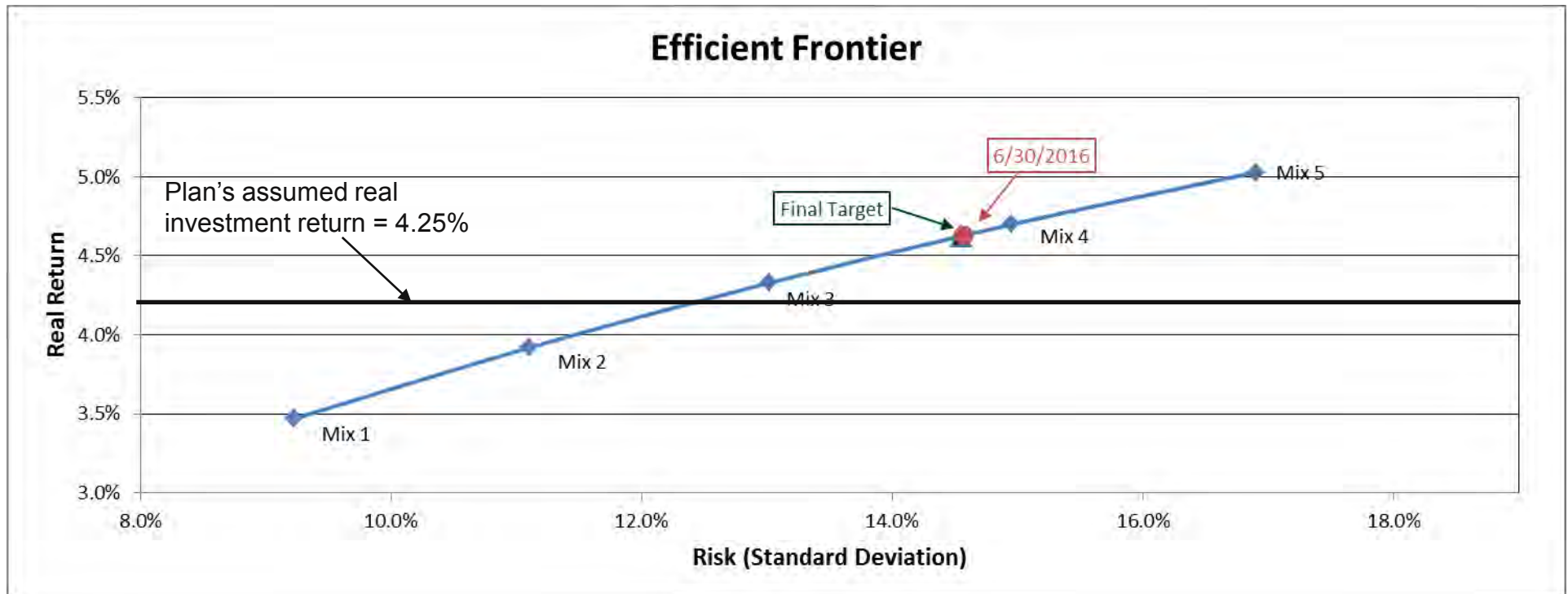
Maximum Real Asset Allocation of 15%



- MCERA's asset allocation target is an optimal allocation, since it lies on the efficient frontier depicting risk and return.
- Current target is a well-diversified portfolio that includes fixed income, public equity, private equity and real assets, including private real estate.

MCERA - 2016 Efficient Frontier – Real Return

Maximum Real Asset Allocation of 15%

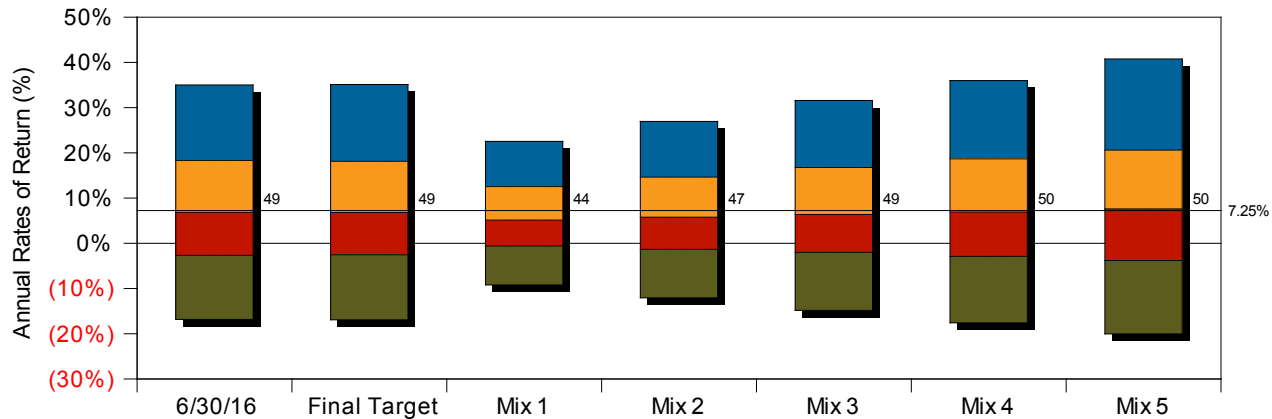


- MCERA's long term nominal return assumption of 7.25%, inflation assumption of 2.75% and real wage growth of 0.25% suggest a long term real return target of 4.25%.
- Callan's 10-year return expectation for the target asset allocation is 6.87%, and combined with our inflation assumption of 2.25%, yields a real return expectation of 4.62%, higher than that assumed in the actuarial valuation.

Projected Rates of Return – One Year

Maximum Real Asset Allocation of 15%

Range of Projected Rates of Return
 Projection Period: 1 Year
 Optimization Set: 2016 Real Assets const 15

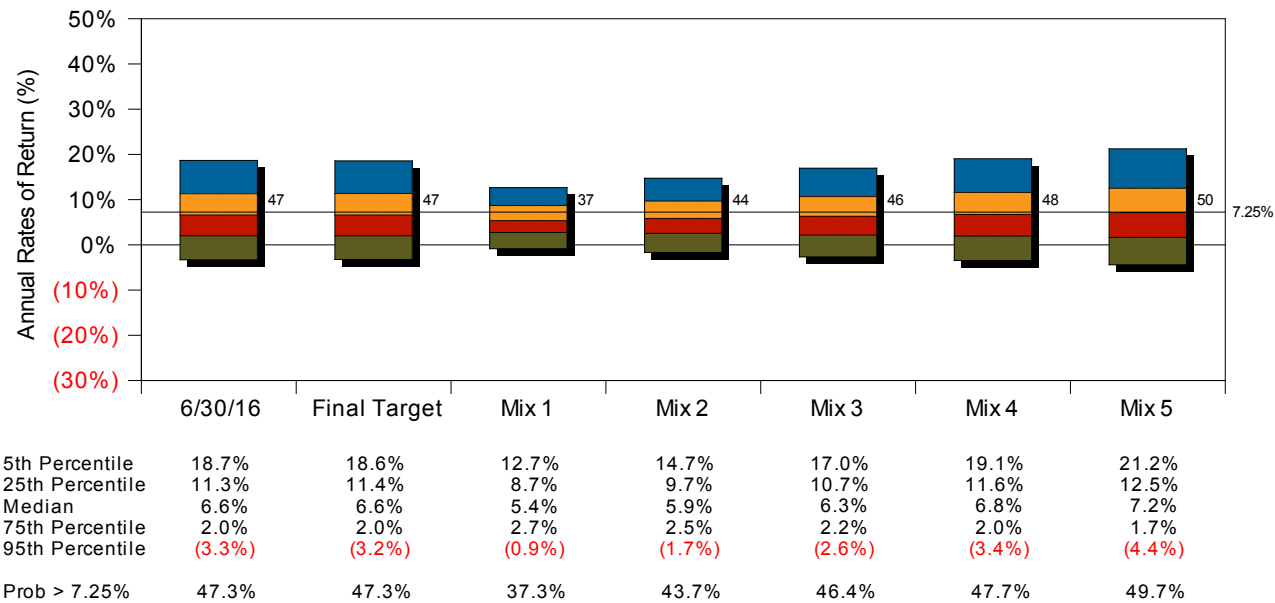


	6/30/16	Final Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
5th Percentile	35.0%	35.1%	22.6%	27.0%	31.6%	36.0%	40.8%
25th Percentile	18.3%	18.1%	12.6%	14.6%	16.8%	18.7%	20.6%
Median	6.9%	6.8%	5.2%	5.8%	6.4%	6.9%	7.6%
75th Percentile	(2.6%)	(2.5%)	(0.6%)	(1.3%)	(2.0%)	(2.9%)	(3.8%)
95th Percentile	(16.8%)	(16.9%)	(9.2%)	(12.0%)	(14.8%)	(17.6%)	(20.0%)
Prob > 7.25%	49.3%	49.5%	44.4%	46.9%	48.8%	49.6%	50.4%

Projected Rates of Return – Five Years

Maximum Real Asset Allocation of 15%

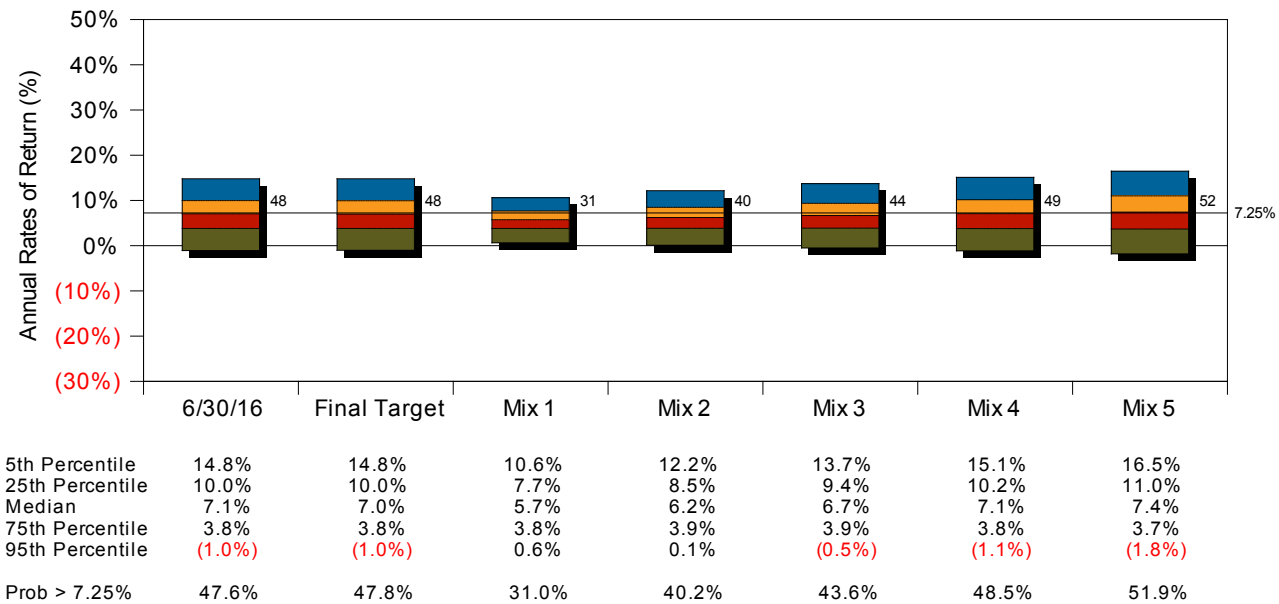
Range of Projected Rates of Return
 Projection Period: 5 Years
 Optimization Set: 2016 Real Assets const 15



Projected Rates of Return – Ten Years

Maximum Real Asset Allocation of 15%

Range of Projected Rates of Return
 Projection Period: 10 Years
 Optimization Set: 2016 Real Assets const 15

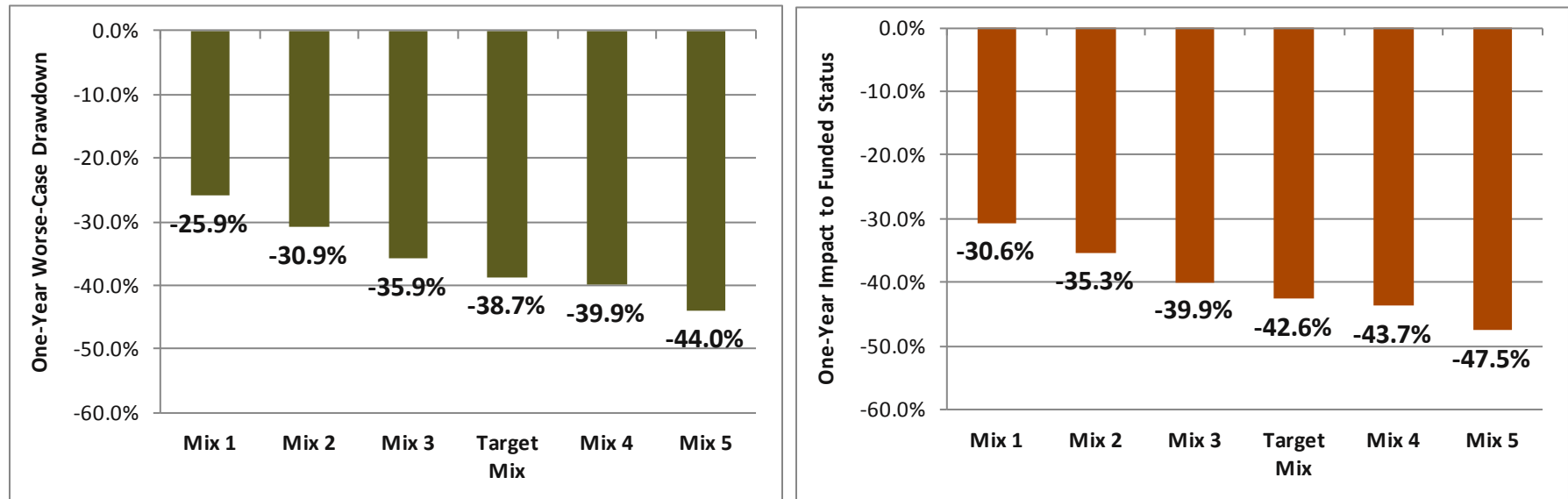


2016 Capital Market Expectations – Nominal vs Real

Return Expectations Reduced Across All Asset Classes

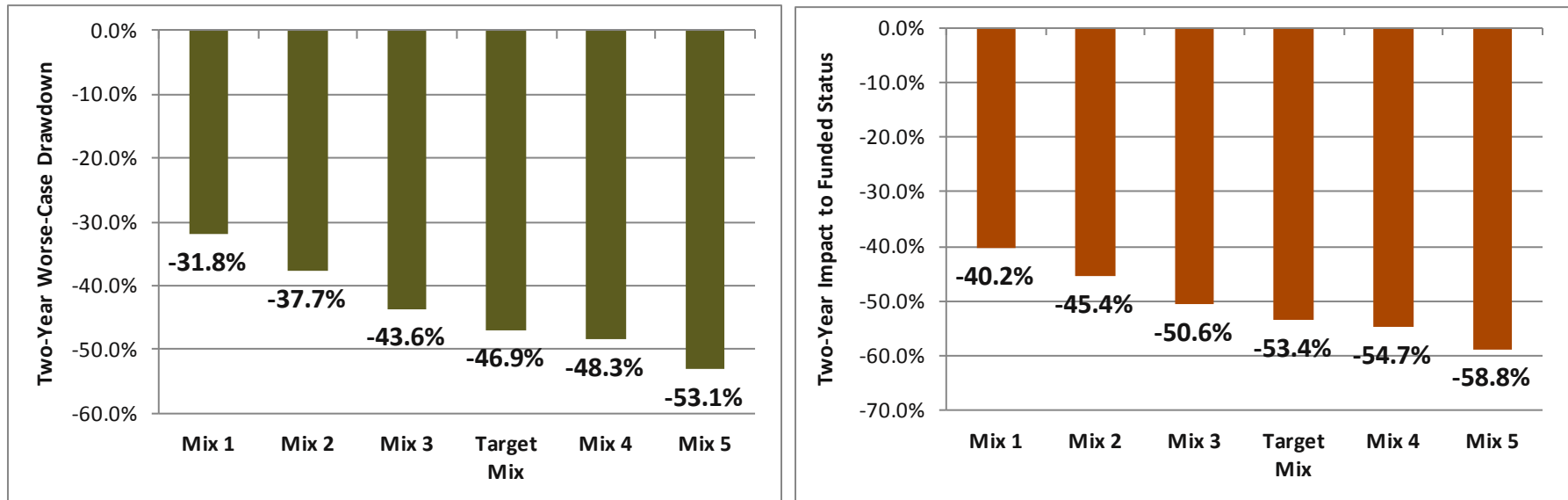
- The expected return for the MCERA Policy Target Mix is 6.87%, below the 7.25% return assumed in the actuarial valuation. However, the Plan still had a reasonable chance of achieving this result over 10 years (almost 50% probability). In addition, the real return embedded in the valuation ($7.25\% - 2.75\% \text{ inflation} - 0.25\% \text{ wage growth} = 4.25\%$) is actually lower than Callan's expected real return ($6.87\% - 2.25\% \text{ inflation} = 4.62\%$).
- While return expectations are lower for the next five- to ten-year horizon, MCERA will need to retain a strong orientation toward risk assets (equity) in pursuit of return to achieve its funding goals.
- Whether the plan should pursue more or less exposure to risk assets than the current policy target mix should not be unduly influenced by subdued expectations for the shorter-term 5-10 year horizon. We do not believe investors are likely to be compensated for greater risk taking in the shorter term.

One-Year Drawdown Analysis – Current Asset Classes



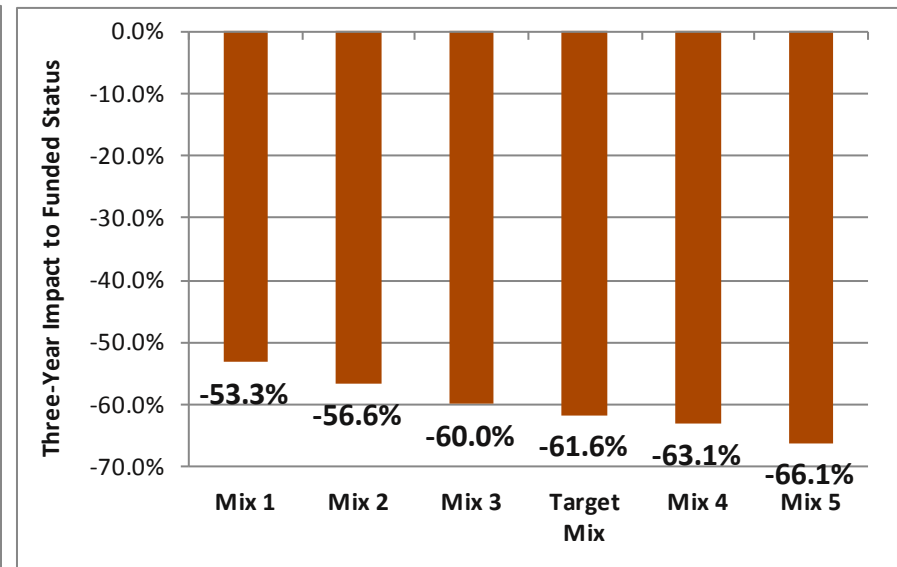
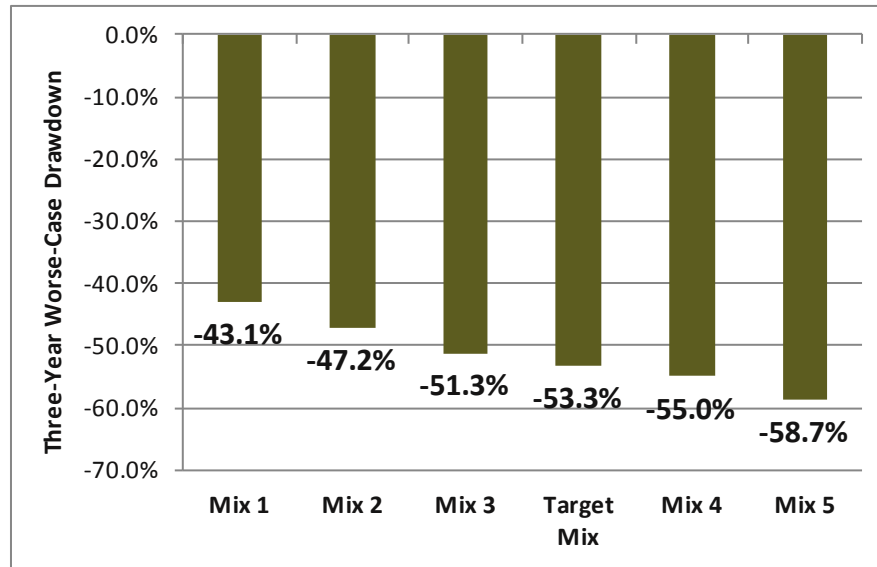
- The graph on the left depicts the worse-case (97.5th percentile) drawdown based on simulated annual returns over the next 10 years.
- The graph on the right depicts the impact to funded status given a one-year worse-case drawdown and an expected liability return of 6.8%. Benefits and contributions are not reflected.
 - E.g. Mix 1 Impact to Funded Status = $(1 - 0.259) / 1.068 - 1 = -30.6\%$

Two-Year Drawdown Analysis – Current Asset Classes



- The graph on the left depicts the worse-case (97.5th percentile) drawdown based on two years of simulated returns.
 - Drawdown is the cumulative return from peak to trough. Thus, the above chart reflects two years of consecutive negative returns.
- The graph on the right depicts the impact to funded status given a two-year worse-case drawdown and an expected liability return of 6.8%. Benefits and contributions are not reflected.
 - E.g. Mix 1 Impact to Funded Status = $(1 - 0.318) / 1.068^2 - 1 = -40.2\%$

Three-Year Drawdown Analysis – Current Asset Classes



- The graph on the left depicts the worse-case (97.5th percentile) drawdown based on three years of simulated returns.
 - Drawdown is the cumulative return from peak to trough. Thus, the above chart reflects three years of consecutive negative returns.
- The graph on the right depicts the impact to funded status given a three-year worse-case drawdown and an expected liability return of 6.8%. Benefits and contributions are not reflected.
 - E.g. Mix 1 Impact to Funded Status = $(1 - 0.431) / 1.068^3 - 1 = -53.3\%$

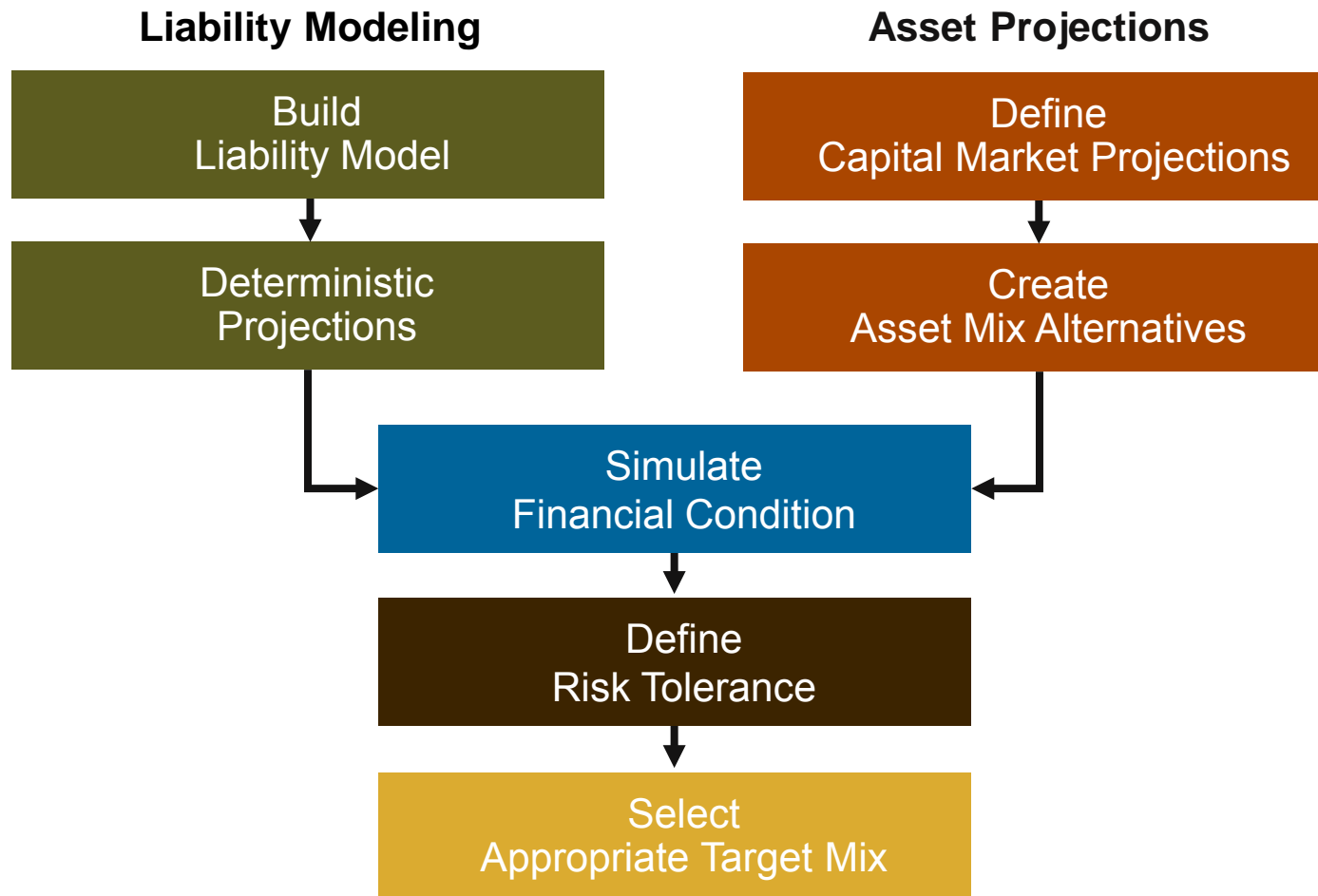
Time Horizon for Capital Market Expectations and Asset-Liability Analysis ^{C1}

- Open, active pension plans have very long term liabilities, and necessarily should maintain a long term perspective for investment strategy.
- Callan's asset-liability analysis typically focuses on a planning cycle of 5-10 years, incorporating current market conditions and the path from these short term conditions to long term expectations.
- Over much of Callan's history, the difference between our shorter-term expectations and our long term numbers was modest; for most planning purposes our short term and long term expectations were the same.
- Current conditions, particularly in the fixed income markets, suggest substantial difference in capital market expectations depending on time horizon, and the path from the current conditions to the long term expectations.
- Theme of the current Callan 10-year projections: The path to a rational set of long-term capital market outcomes is likely through an ugly shorter term period of rising interest rates, capital losses in fixed income, and volatile equity markets.



**Integration of Assets and
Liabilities**

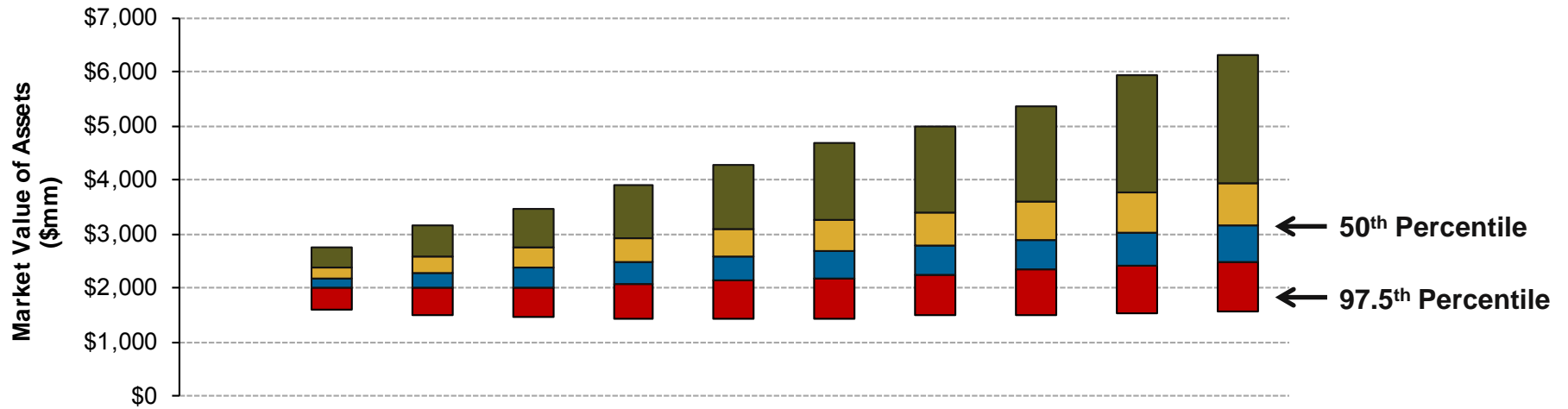
Simulate Financial Condition



After the Modeling – How to Make a Decision?

- Potential decision variables include:
 - The range of actuarial liability
 - Present value of future contributions
 - Range of the market (or actuarial) value of Plan assets
 - Funded Ratio
 - Liquidity and cash flow needs
 - Present value of future unfunded liability
 - Ultimate Net Cost
 - *Ultimate net cost combines contributions paid in over the planning horizon plus the value of the unfunded liability at the end of the projection period.*
- A discussion of goals and objectives for MCERA's financial future will inform all three major policies: benefits, funding and investments.

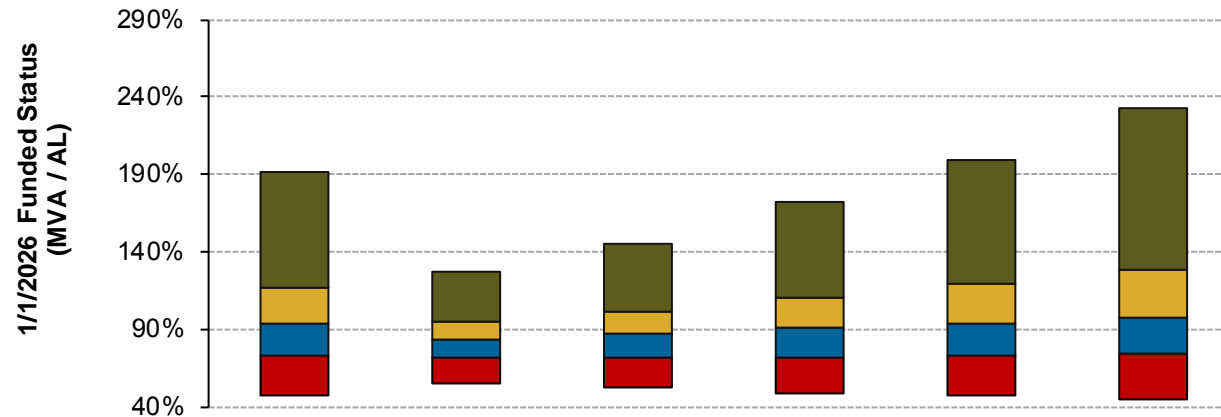
Market Value of Assets for Current Target Mix



Percentile	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2.5th	\$2,079	\$2,749	\$3,163	\$3,459	\$3,894	\$4,269	\$4,668	\$4,973	\$5,353	\$5,946	\$6,314
25th	2,079	2,370	2,571	2,766	2,925	3,074	3,246	3,405	3,595	3,765	3,922
50th	2,079	2,188	2,285	2,372	2,485	2,581	2,665	2,777	2,895	3,007	3,148
75th	2,079	1,991	1,998	2,020	2,064	2,130	2,182	2,253	2,346	2,424	2,471
97.5th	2,079	1,581	1,486	1,458	1,412	1,412	1,432	1,491	1,502	1,529	1,574
Range	0	1,167	1,677	2,001	2,482	2,857	3,236	3,482	3,850	4,417	4,739

- The expected outcome is the 50th percentile, a 50/50 chance of occurrence.
- The worse case scenario is the 97.5th percentile; a 1 in 40 chance of occurrence.
 - For example, there is a 1 in 40 chance (2.5% probability) that the 6/30/2026 market value of assets will be \$1,574 mm or less.

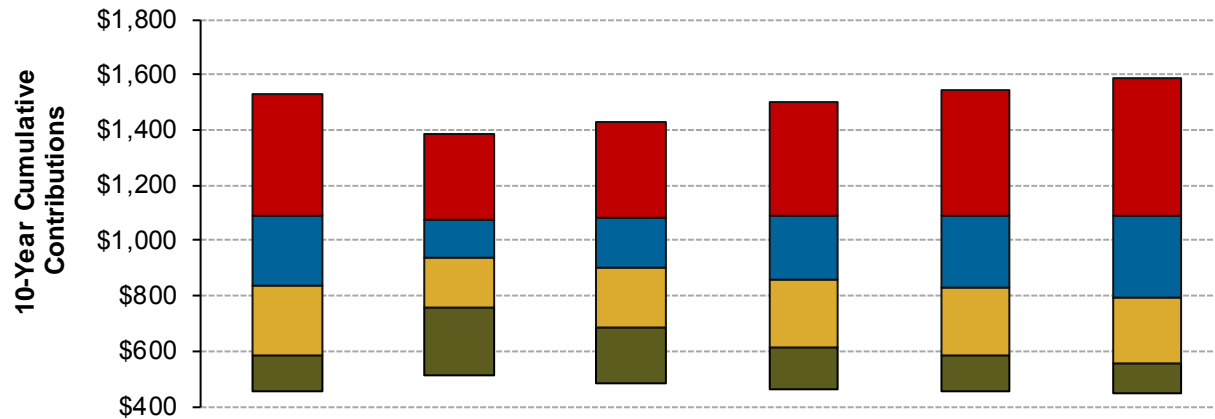
6/30/2026 Market Funded Status by Policy Mix



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
2.5th	192%	127%	145%	172%	199%	233%
25th	116%	95%	102%	110%	119%	128%
50th	93%	84%	87%	90%	94%	98%
75th	73%	72%	72%	72%	73%	74%
97.5th	48%	54%	52%	49%	47%	45%
Expected Return	6.9%	5.7%	6.2%	6.6%	7.0%	7.3%
Standard Deviation	14.6%	9.2%	11.1%	13.0%	15.0%	16.9%

- More aggressive mixes are **expected** to have a higher funded status at the end of 10 years but will have a lower funded status in a worse-case scenario (97.5th percentile).
- All mixes except Mix 2 are expected to improve the plan's funded status at 6/30/15 of 83.7%.

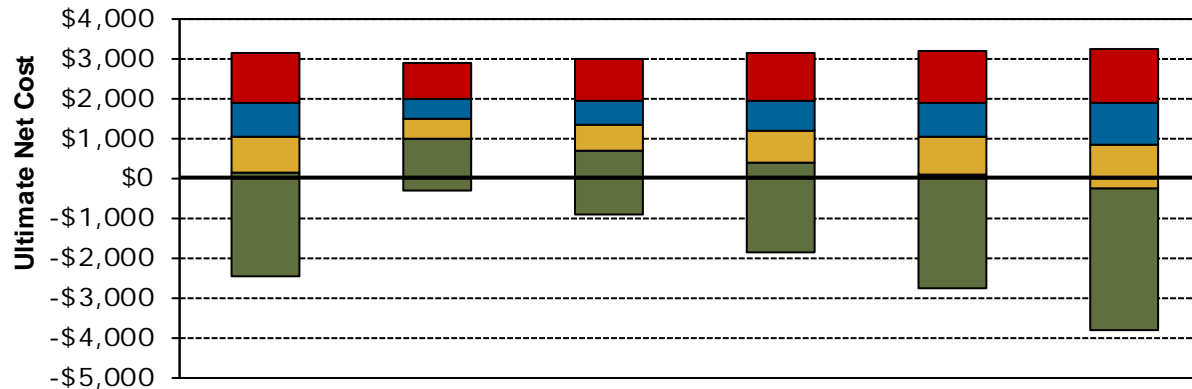
Cumulative Contributions (\$) – Ten Years



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
97.5th	\$1,527	\$1,384	\$1,432	\$1,497	\$1,542	\$1,590
75th	1,087	1,077	1,081	1,090	1,088	1,089
50th	834	937	900	859	826	791
25th	587	754	685	615	581	553
2.5th	455	510	481	465	452	444
97.5th-50th	693	447	531	638	716	799

- The graph illustrates the reward-risk trade-off of the alternative mixes in contribution space.
 - The median shows expected contributions and the reward for taking more risk.
 - The 97.5th percentile shows the worse-case contribution, the cost of taking on risk. In a worse-case scenario, contributions are higher for a more aggressive asset mix.
- Contributions in the best-case result are held at normal cost plus the amortization of unfunded liability.
 - Outsized returns may reduce the UAL to zero, but the normal cost is assumed to be contributed in all instances. The result is that the best-case cumulative contributions cannot be driven below normal cost.

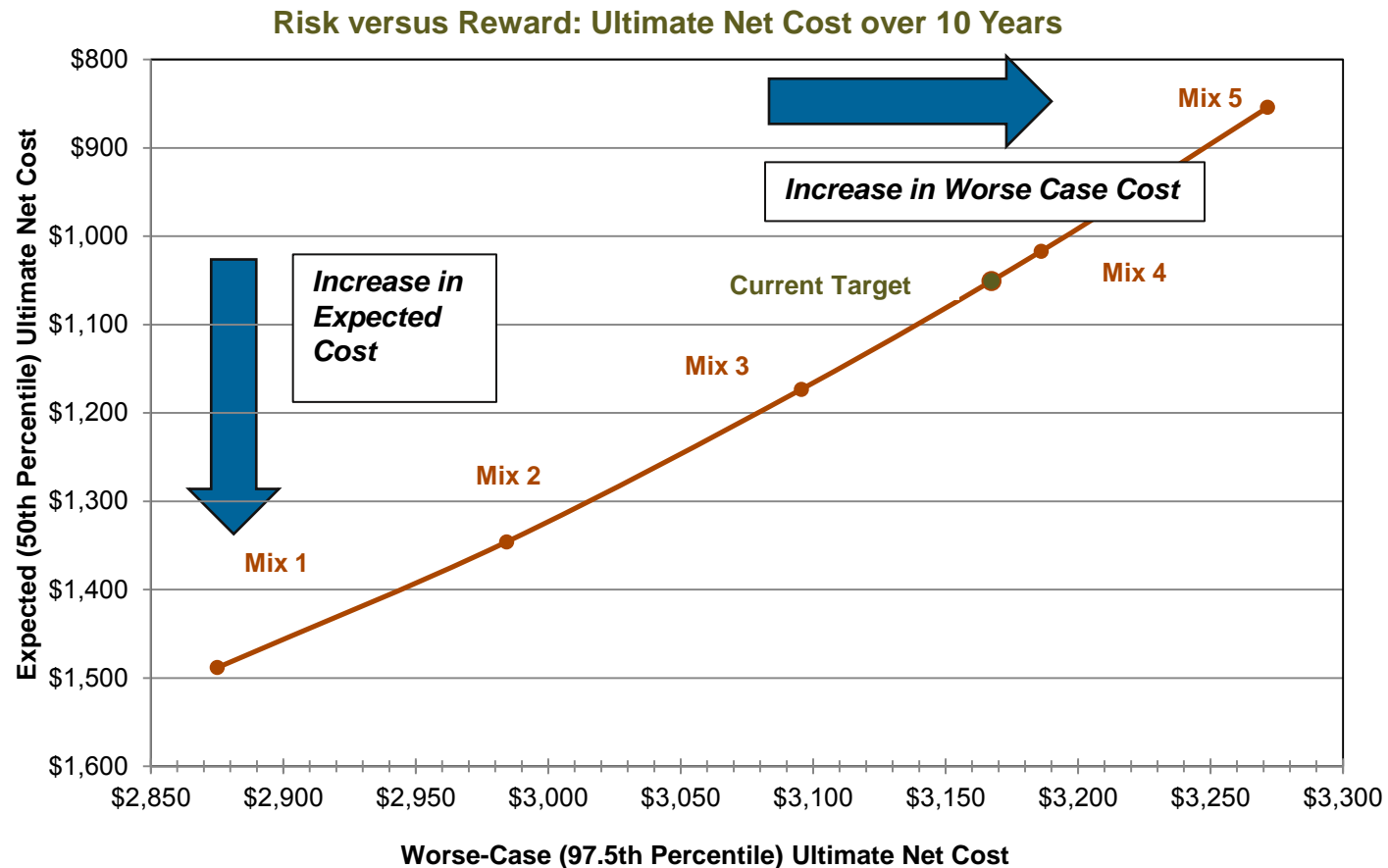
Ultimate Net Cost – 6/30/2016



Percentile	Target	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
97.5th	\$3,167	\$2,875	\$2,984	\$3,096	\$3,186	\$3,272
75th	1,905	1,986	1,952	1,929	1,904	1,880
50th	1,051	1,488	1,346	1,173	1,016	854
25th	156	962	706	377	69	-270
2.5th	-2,481	-291	-933	-1,855	-2,760	-3,789

- Ultimate Net Cost (UNC) = 10-Year Cumulative Contributions + 6/30/2026 Unfunded Actuarial Liability
- UNC captures what is expected to be paid over 10 years plus what is owed at the end of the 10 year period. The majority of UNC for MCERA is comprised of contributions.
- More aggressive mixes lower UNC in the expected case but result in greater UNC in a worse case scenario.

Ultimate Net Cost



- Ultimate Net Cost (UNC) = 10 year cumulative contributions (2016 - 2025) + 1/1/2026 Unfunded Liability
 - What you paid over 10 years + what you owe at the end of 10 years
- An approximate linear risk-reward trade-off exists between the alternative mixes.
- The current Target mix is optimal based on Callan's 10-year capital market expectations.

Decision Factors

Factor	Description
Return Objective	<ul style="list-style-type: none"> Current actuarial assumed investment return is 7.25%. Only Mix 5, with 12% in fixed income, is projected to attain 7.25% over 2016-2025. However, the real return expectation for the fund is 4.25%, which is lower than Callan's real return expectation for the current target.
Time Horizon	<ul style="list-style-type: none"> Indefinite (plan is open)
Liquidity Needs	<ul style="list-style-type: none"> Liquidity needs are moderate and will remain below 5% over the next 10 years, so not a material concern to the plan's investment strategy.
Actuarial Methodology	<ul style="list-style-type: none"> Normal Cost plus closed period amortization of any UAL. Assets are not smoothed; actuarial value = market value
Contribution Risk	<ul style="list-style-type: none"> Trade-off between lower median contribution rates and higher worse case contribution rates. Contributions are responsive to asset performance, especially on the downside. Normal cost contribution limits how far good performance can reduce contribution.
Risk Tolerance	<ul style="list-style-type: none"> Risk tolerance is the ability and willingness to take risk. Consider worse-case results for projected funded status, ultimate net cost and annual returns.
Liability Growth	<ul style="list-style-type: none"> Liabilities are growing steadily (3% over next 10 years). Liability return is 6.8%, using Callan's 2.25% inflation assumption.
Funded Status	<ul style="list-style-type: none"> Plan funding is projected to rise to 94% in 10 ten years and reach 100% by 2030, under current benefit and funding policy.

Recommendation

- Substantial changes have been made to MCERA funding and benefit policy since the last asset/liability study in 2011.
 - Elimination of asset smoothing and closed period amortization of the UAL makes contribution rates responsive to asset performance.
 - Size of plan assets relative to payroll also heightens sensitivity of plan sponsor to adverse market results and the impact on supplemental cost to cover an unfunded liability.
 - Normal cost contribution policy limits how far good investment performance can reduce contributions.
- Liability growth is linked to the actuarial discount rate (7.25%) and implies a nominal return target for the Plan.
 - Capital markets will be challenged to generate a long-term return of 7.25%; however, the real return target of 4.25% embedded in the valuation is actually below Callan's expectation for the current Target, countering the pressure to pursue a higher nominal return.
 - The plan has taken significant steps to close the funding deficit through contribution policy. Pursuing a higher expected return to further assist with closing the Plan deficit will expose it to greater contribution volatility.
 - Liability return is projected to average 6.8% over the next 10 years, in line the nominal return expectation for the current target.
- Taking less risk than the current target would reduce contribution volatility and worse case outcomes, at the cost of lower expected return.
 - The current target is a well-diversified portfolio that includes exposure to stocks, bonds, private equity and real estate and real assets, and can be retained as a reasonable policy.
 - MCERA will need to retain a strong orientation toward growth in pursuit of return to achieve its funding goals
 - Our analysis suggests that the return and risk position of the target can be expected to meet the funding needs of the Plan as articulated in the valuation, given our expectations for capital market performance.