



TENNESSEE CONSOLIDATED RETIREMENT SYSTEM
2012 ASSET/LIABILITY STUDY SUMMARY

STRATEGIC INVESTMENT SOLUTIONS, INC.

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Asset/Liability Study Outline

- I. Asset allocation: develop a range of risk-efficient alternative asset mixes

- II. Asset-liability integration
 - A. Examine simulated outcomes
 - B. Select asset mix that matches fiduciary risk tolerance

Asset Allocation Based on SIS Asset Class Expected Performance

- Long-Term Looking Forward (2-3 Market Cycles)
- Based on Available Histories
- Tendency to Utilize Mean Reversion
- Must “Behave” in an Optimization
 - Reasonable Portfolios
 - Stable Frontier
- Capital Asset Pricing Model (CAPM) Used to Price Difficult Assets
- Economic Forecasts
- Investment Policy Committee
- Return Estimates
 - Based upon Passive Index Returns
- Risk Estimates (Standard Deviation)
 - Monthly Observations Since 1976
 - Monthly Observations Since 1985 (Smoothed)
- Correlation Estimates
 - Monthly Observations Since 1985 (Smoothed)

Building-Block Approach to Standard Asset Class Expected Returns

ASSET CLASS	DERIVATION
Inflation	Consensus of Economists' Forecasts, TIPS
Cash	Inflation + 1% to 2% Premium
US Large Cap	CAPM, 3% to 6% Equity Premium, Macroeconomic Dividend Discount Model
US Fixed	Yield to Worst on Aggregate (Compare to Historic Bond Risk Premium, Adjust if Necessary)
US Small Cap	CAPM, (Beta of ~1.2)
Private Markets	CAPM, (Beta of ~1.6)
International Equity	Weighted Sum of Local Market Premium + Local Risk Free Rate
International Bond	US Fixed Return, Adjusted for Quality and Duration (Potential Currency Effects Based on Purchasing Power Parity)
Real Estate	Historical Behavior of Equity REITs; Current Appraisal Cap Rates; CAPM
High Yield	Historical Ratio: Spread of High Yield Over US Fixed Income Divided By Spread of Large Cap Over US Fixed Income

Asset Class Expectations Customized for TCRS

ASSET CLASS	DERIVATION
Core Bonds	Adjusted for differences between SIS & LPF index sector weights
Real Estate	30% opportunistic (SIS expected return + 200 bp)
Strategic Lending	50/50 blend of SIS high yield and bank loan expectations
Long Treasuries	Based on differences between SIS & BC Long Treasury index yields and historical risk

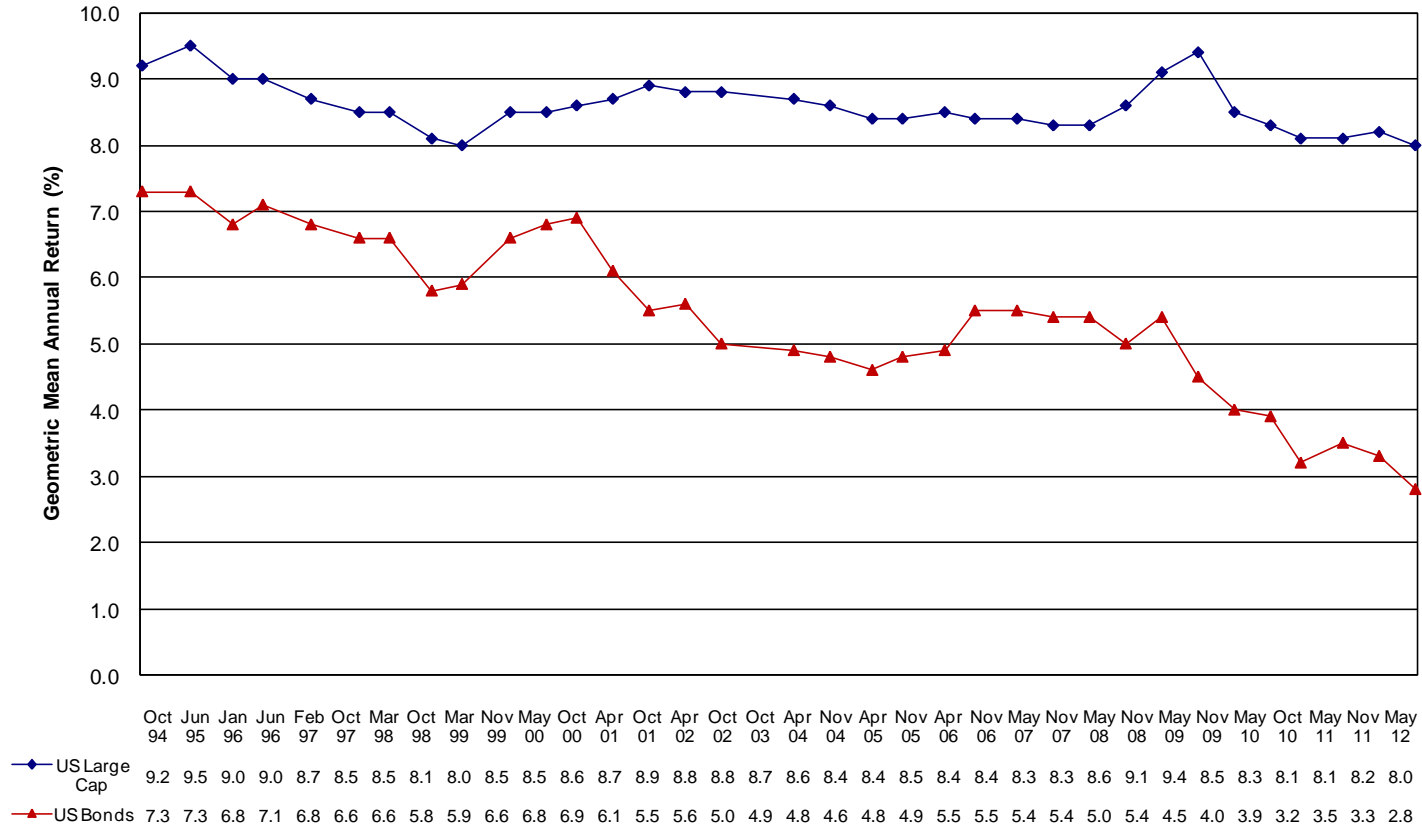
Current Asset Class Expected Returns & Risks

	Return	Risk
N. American Equity (Incl. 5% Canadian)	8.0%	18.0%
US Fixed Income	(see below)	
International Equity	8.0%	18.5%
Real Estate	7.2%	20.9%
Private Equity	10.5%	33.0%
Short Term	2.0%	1.0%
Emerging Market Equity	8.5%	27.5%
Strategic Lending	5.1%	8.5%
Hedge Funds	5.3%	10.0%
US Fixed Income	3.1%	5.9% *
Core Bonds	3.2%	6.8%
Inflation Hedged Bonds	2.7%	2.7%
Long Treasuries	3.4%	7.7%

* Assumes Inflation Hedged Bonds and Core Bonds in current proportions

Historical Downward Pressure on Expected Returns

History of SIS Expected Returns for US Stocks & Bonds



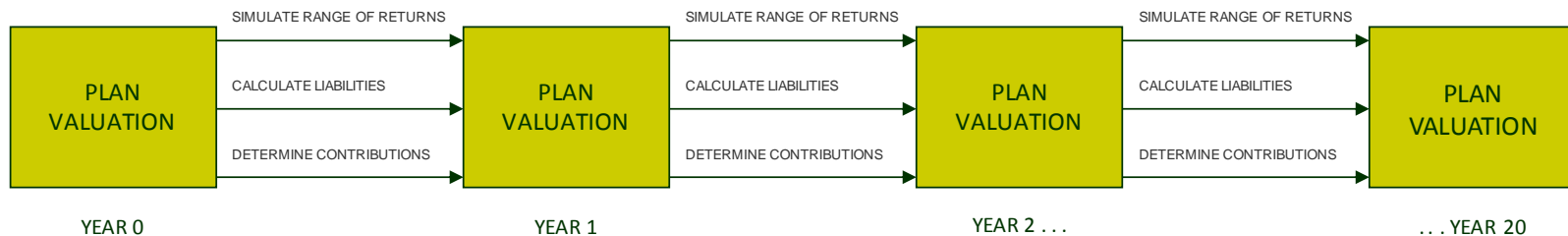
Specified Mixes

	Existing Normal	As-Allocated	Low Risk Normal	Median Normal	Median Mixed As-Allocated	Median Equity As-Allocated	High Return Normal	Constrained High Return	Modified As-Allocated	Long Run
N. American Equity (Incl. 5% Canadian)	40%	42%	32%	37%	40%	41%	40%	44%	49%	15%
US Fixed Income	34%	37%	34%	29%	30%	29%	25%	20%	20%	16%
International Equity	15%	16%	13%	13%	14%	14%	15%	15%	15%	15%
Real Estate	7%	4%	7%	7%	4%	4%	7%	7%	4%	11%
Private Equity	3%	0%	3%	3%	1%	1%	3%	3%	1%	11%
Short Term	1%	1%	1%	1%	1%	1%	0%	1%	1%	0%
Emerging Market Equity			5%	5%	5%	5%	5%	5%	5%	4%
Strategic Lending			5%	5%	5%	5%	5%	5%	5%	17%
Hedge Funds										11%
Return	6.9%	6.6%	6.8%	7.1%	6.9%	6.9%	7.3%	7.5%	7.3%	7.5%
Risk	11.8%	11.2%	11.4%	12.1%	11.8%	12.0%	12.9%	13.5%	13.4%	12.9%
Total Public Equity	55%	58%	50%	55%	59%	60%	60%	64%	69%	34%
Total Private Equity + Strategic Lending	3%	0%	8%	8%	6%	6%	8%	8%	6%	28%
US Fixed Income										
Core Bonds	26%	29%	26%	22%	23%	22%	18%	15%	15%	
Inflation Hedged Bonds	8%	8%	8%	7%	7%	7%	7%	5%	5%	
Long Treasuries										17%

Optimized Mixes (Risk Levels for Simulation)

	Existing Normal	6½% Mix	6¾% Mix	7% Mix	7¼% Mix	7½% Mix	Constraints
N. American Equity (Incl. 5% Canadian)	40%	25%	29%	32%	37%	42%	
US Fixed Income	34%	41%	36%	31%	24%	19%	
International Equity	15%	15%	15%	15%	15%	15%	Max 15%
Real Estate	7%	5%	6%	8%	10%	10%	Max 10%
Private Equity	3%	3%	3%	3%	3%	3%	
Short Term	1%	1%	1%	1%	1%	1%	Min 1%
Emerging Market Equity		5%	5%	5%	5%	5%	ACWIxUS weight
Strategic Lending		5%	5%	5%	5%	5%	Min 5%
Hedge Funds							
Return	6.9%	6.5%	6.7%	7.0%	7.3%	7.5%	
Risk	11.8%	10.3%	11.1%	11.9%	12.7%	13.6%	
Total Public Equity	55%	45%	49%	52%	57%	62%	
Total Private Equity + Strategic Lending	3%	8%	8%	8%	8%	8%	Max 8%
US Fixed Income							
Core Bonds	26%	31%	27%	23%	18%	14%	
Inflation Hedged Bonds	8%	10%	9%	8%	6%	5%	Min Current Proportion of USFI
Long Treasuries							

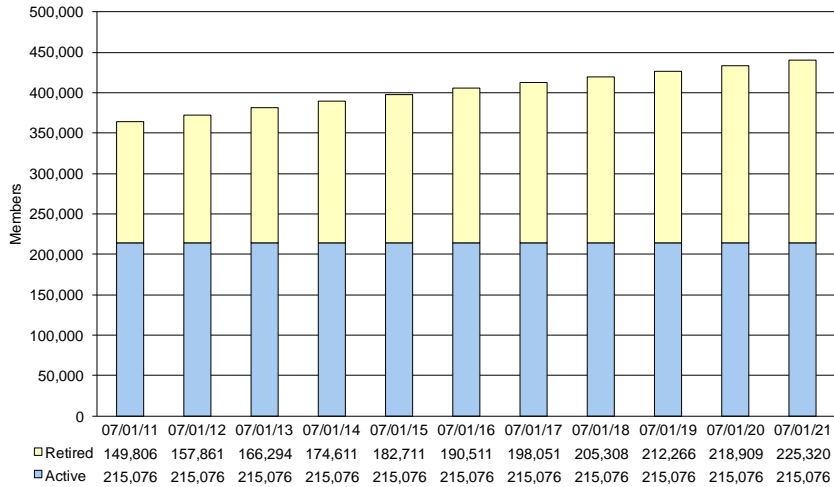
Simulating the Performance of Existing & Alternative Asset Mixes



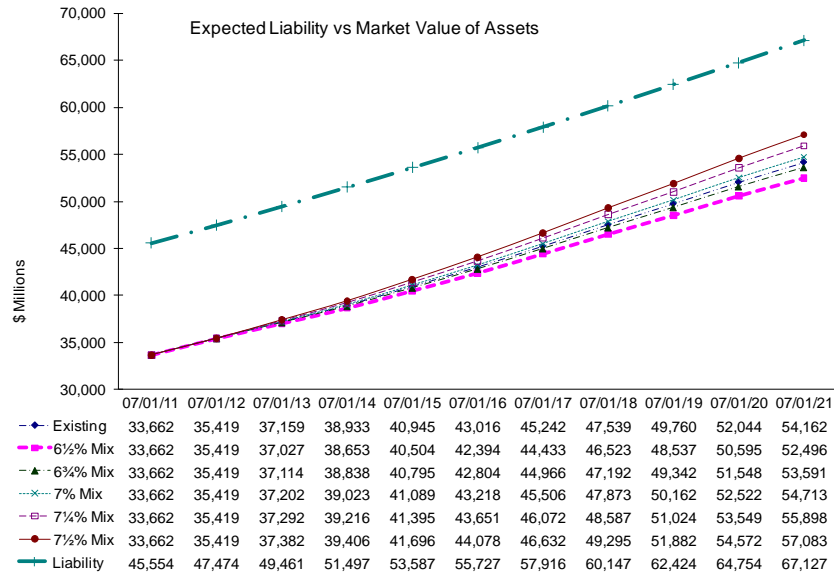
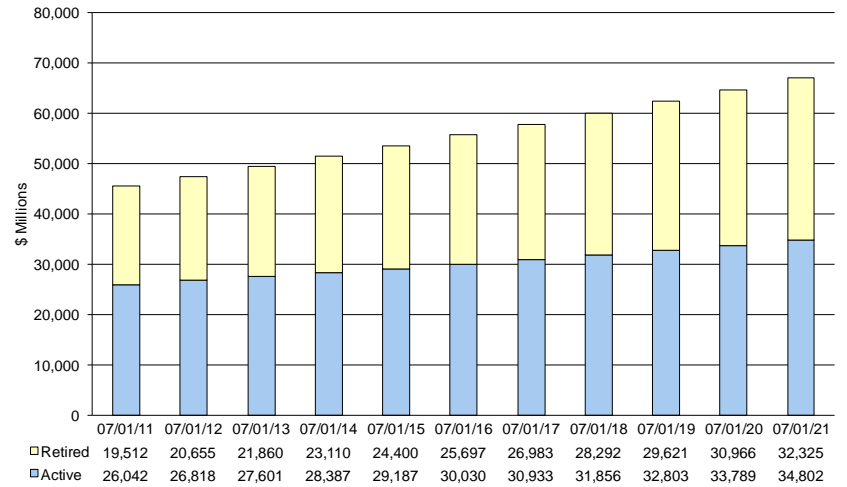
- Monte Carlo: 5000 random multi-year outcomes
- Start with July 1, 2011 actuarial valuation date
- Calibrated to actuary's benefit & liability projections
- Default annual workforce growth assumption of 0%
- Assume continuation of existing 7.5% discount rate
- Discount rate need not match SIS expected return:
 - Difference in forecast horizon: SIS = long-term, discount rate = very long term
 - SIS expected returns assume index-like investments
- Focus on outcomes at five-year planning horizon (July 1, 2017)

Constant-Rate Projections

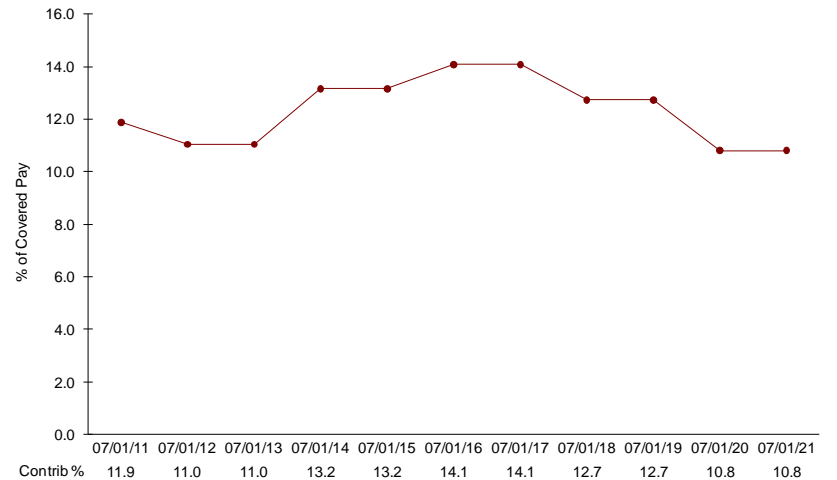
Expected Plan Membership



Expected Liability (PVB)

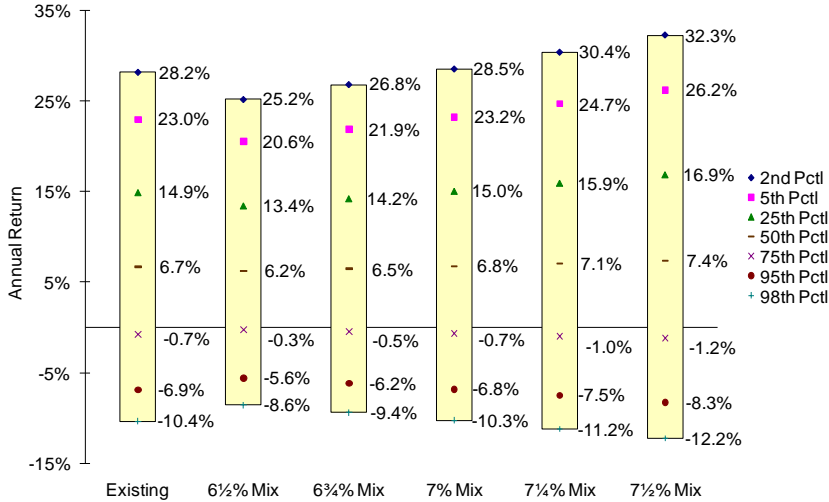


Expected Employer Contribution as % of Pay (Existing Normal)

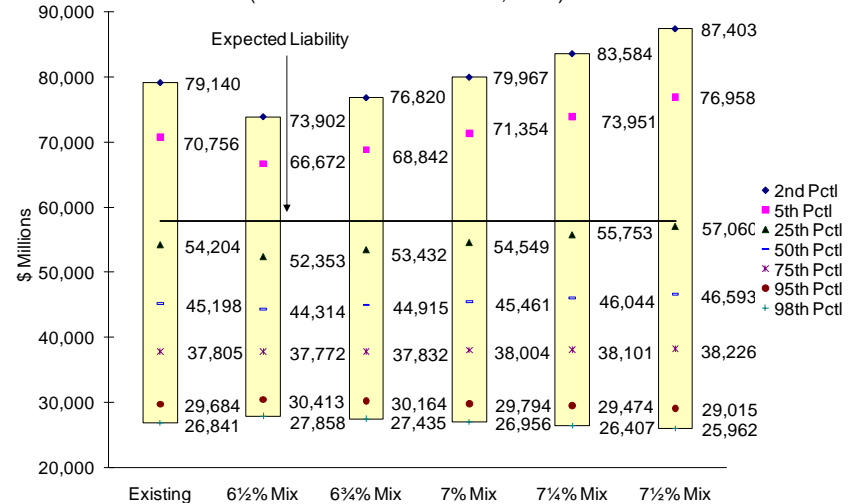


Range of Returns, Market Value, & Contributions

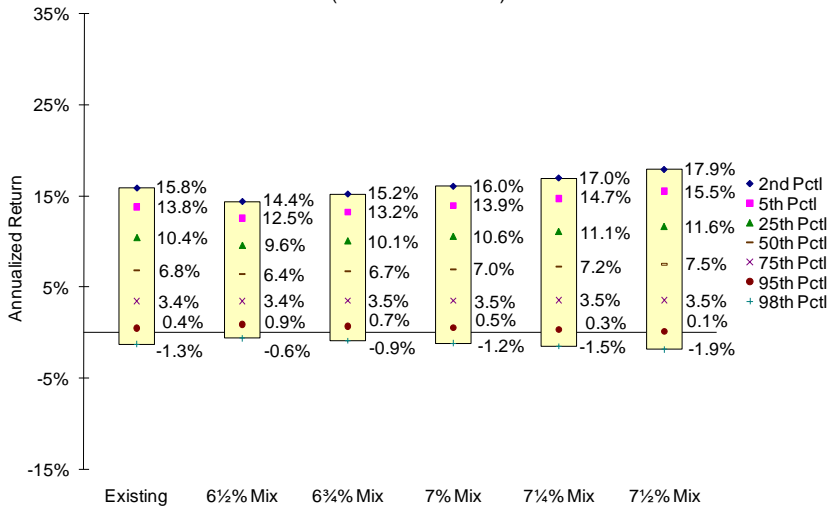
Range of Returns
(One Year Horizon)



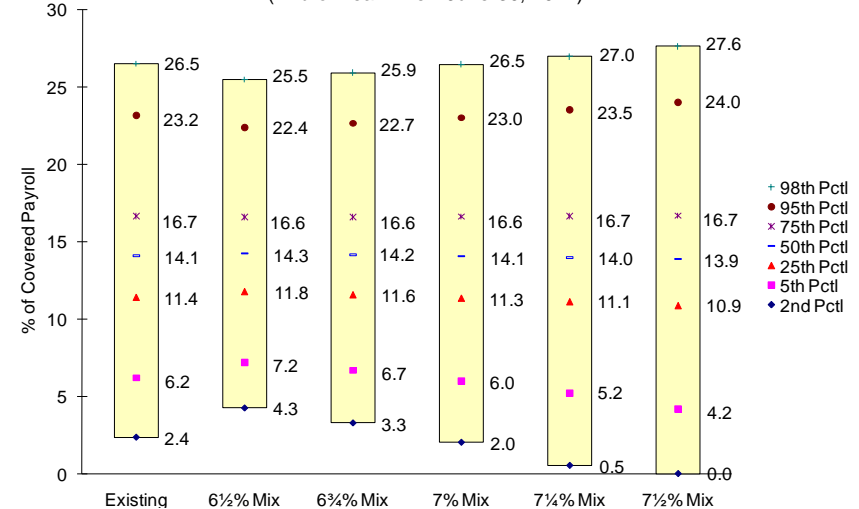
Range of Asset Market Value
(End of Year Five - June 30, 2017)



Range of Returns
(Five Year Horizon)

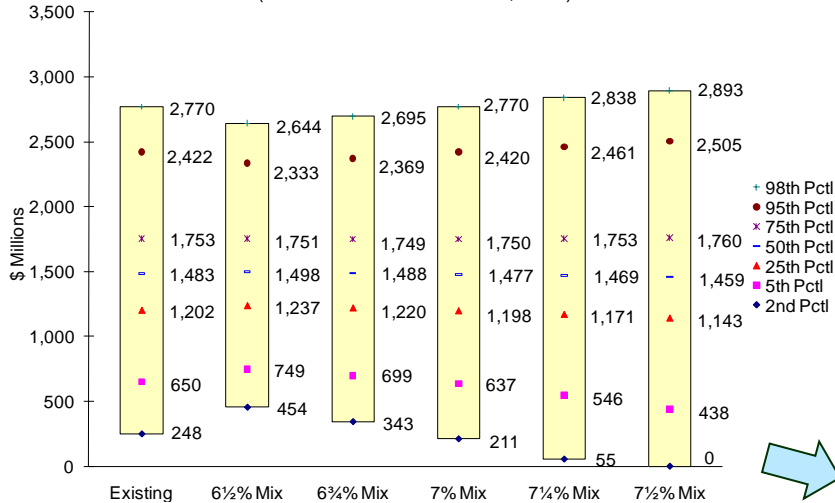


Range of Employer Contributions as % of Pay
(End of Year Five - June 30, 2017)

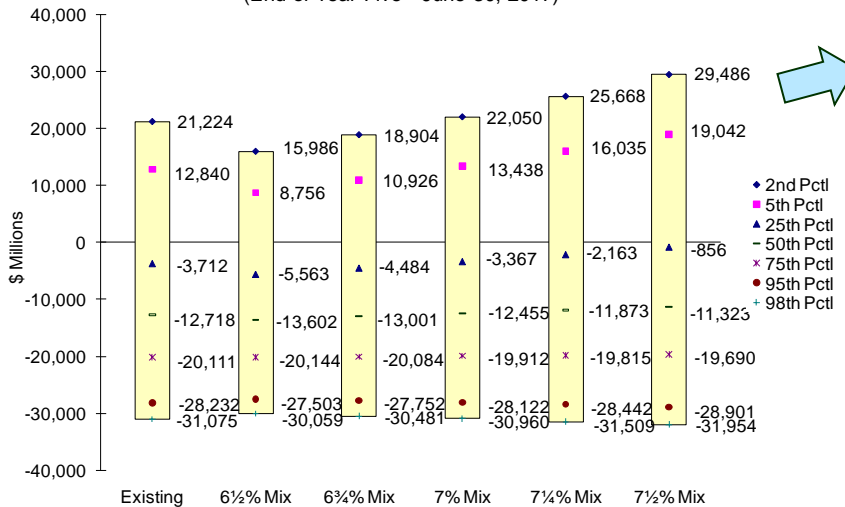


"Ultimate Net Cost" = Present Value of Contributions & Unfunded Liability

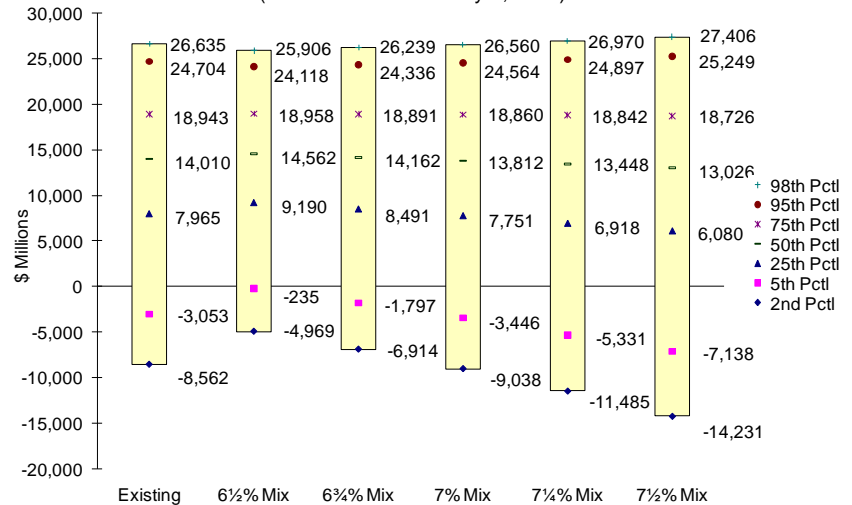
Range of Employer Contributions
(End of Year Five - June 30, 2017)



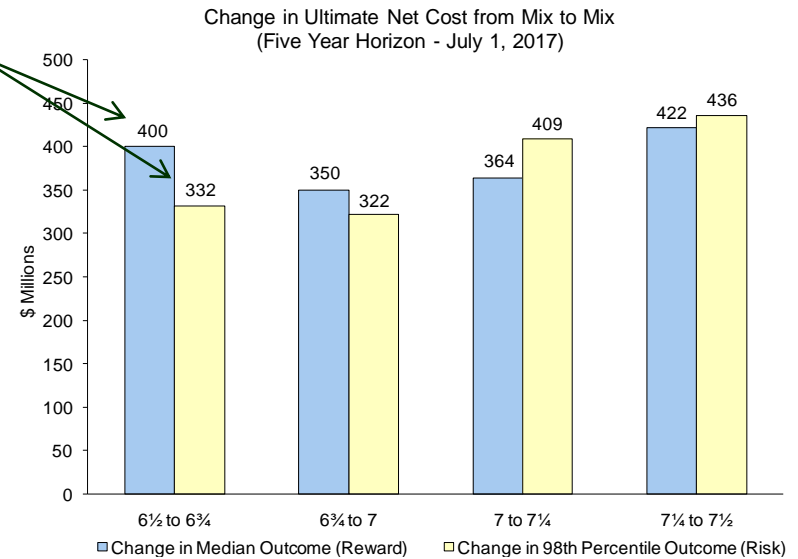
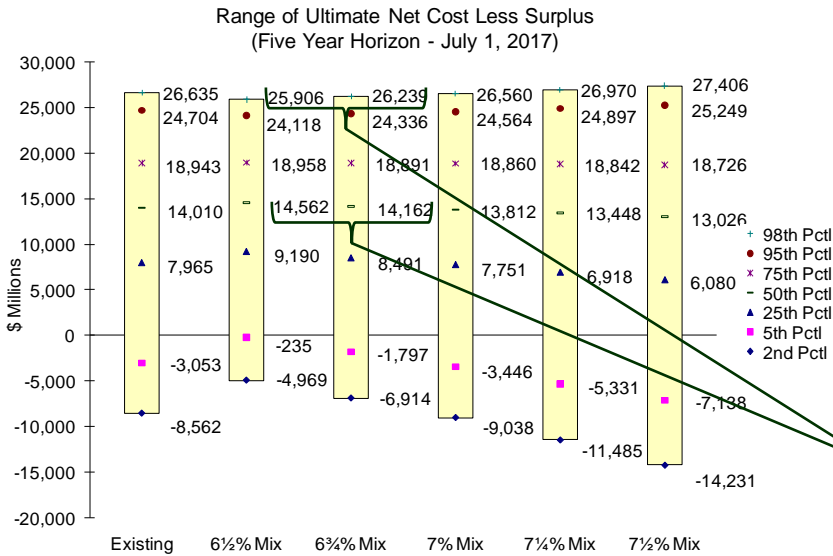
Range of Market Value Surplus
(End of Year Five - June 30, 2017)



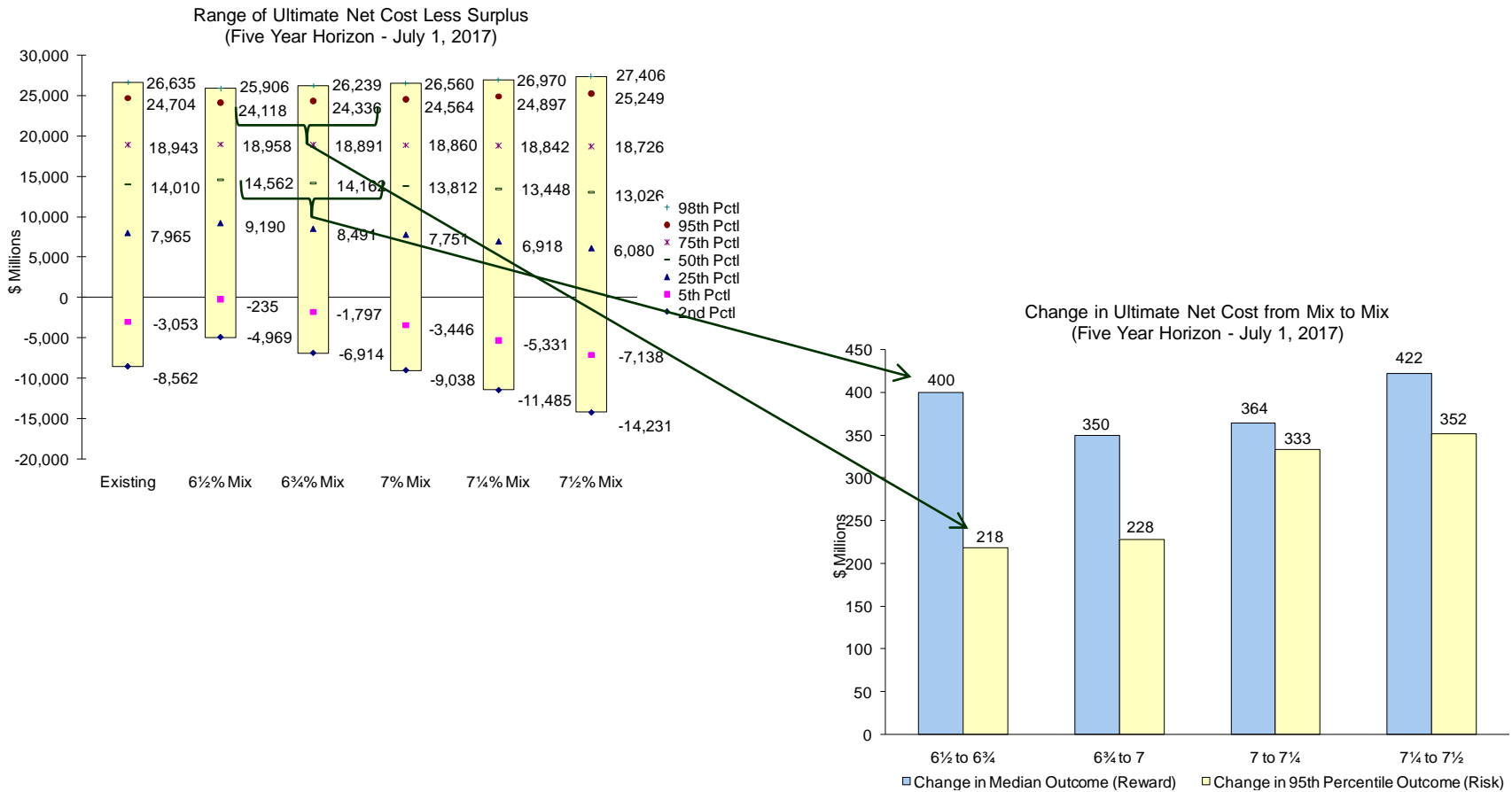
Range of Ultimate Net Cost Less Surplus
(Five Year Horizon - July 1, 2017)



Ultimate Net Cost Trade-Off from Mix to Mix Is Favorable Up to the 7% Mix at a Five-Year Horizon, Given a Conservative Risk Tolerance (98th Percentile)



Ultimate Net Cost Trade-Off from Mix to Mix Is Favorable Up to the 7½% Mix, Given a More Typical Risk Tolerance (95th Percentile)



Conclusions

- 1) At the current expected return level (7%), the fund would be a bit more risk-efficient (higher Sharpe Ratio), and with a slightly higher expected return, with less allocated to North American Equity and TIPS, and with new allocations to Emerging Market Equity and Strategic Lending.
- 2) Keeping the fund at the current expected return level (7%) has a favorable risk/reward tradeoff given a conservative risk tolerance.
- 3) Raising the fund's expected return to 7½% has a favorable risk/reward tradeoff (with a more typical risk tolerance level), and retains all of the North American Equity exposure, but requires a large increase in Real Estate, which may not be implementable in the near term, and large reduction in US Fixed Income.

	Existing Normal	Rec Mix	7¼% Mix	7½% Mix
N. American Equity (Incl. 4% Canadian)	40%	37%	37%	42%
US Fixed Income	34%	29%	24%	19%
International Equity	15%	13%	15%	15%
Real Estate	7%	7%	10%	10%
Private Equity	3%	3%	3%	3%
Short Term	1%	1%	1%	1%
Emerging Market Equity		5%	5%	5%
Strategic Lending		5%	5%	5%
Hedge Funds				
Return	6.9%	7.1%	7.3%	7.5%
Risk	11.8%	12.1%	12.7%	13.6%
Total Public Equity	55%	55%	57%	62%
Total Private Equity + Strategic Lending	3%	8%	8%	8%
US Fixed Income				
Core Bonds	26%	25%	18%	14%
Inflation Hedged Bonds	8%	4%	6%	5%