

# **2019 Q3 INVESTMENT SUMMARY: BOARD REPORT**

## **MODOT & PATROL EMPLOYEES' RETIREMENT SYSTEM**

**November, 2019**

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BOSTON | ATLANTA | CHARLOTTE | CHICAGO | DETROIT | LAS VEGAS | PORTLAND | SAN FRANCISCO

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# NEPC UPDATE

NEPC, LLC

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# HIGHLIGHTS OF 2019 THIRD QUARTER HAPPENINGS AT NEPC

## NEPC INSIGHTS

- 2019 Second Quarter Market Thoughts
- White Paper: "Determining Spending Levels for an Individual Portfolio"
- White Paper: "Are you Getting Independent and Objective Investment Advice?"
- "What a Long, Strange Trip It's Been – The Journey of the First 401(k) Participants"
- "Dollars and Cents: Transitioning Decisions into Dollars for Defined Contribution Participants"
- Taking Stock: "What is the Yield Curve Signaling? Part 2"
- Taking Stock: "What Happened to the Data-Dependent Fed?"
- Taking Stock: "A Multi-Asset Strategy That's the Right Fit For You"
- Taking Stock: "Healthcare Organizations Maintain Economic Optimism Despite Geopolitical Concerns"
- Taking Stock: "Getting Those Dollars and Cents to Add Up in Retirement Planning"
- Taking Stock: "Dear Millennials, What Do You Want from Your Investment Portfolio?"
- Taking Stock: "Is Help on the Way for Struggling Multiemployer Pensions?"
- Taking Stock: "Pension Liabilities Rise in Q2"

## WEBINAR REPLAYS

- NEPC's 2019 Q2 Quarterly Market Thoughts Call

To download NEPC's recent insights and webinar replays, visit: [www.NEPC.com/insights](http://www.NEPC.com/insights)



# HIGHLIGHTS OF 2019 THIRD QUARTER HAPPENINGS AT NEPC

## NEPC GIVES BACK

- NEPC sponsored a volunteer day with the Greater Boston chapter of Habitat for Humanity. Our volunteers spent their day helping to build homes for low-income families in need of decent and affordable housing.
- NEPC employees volunteered at the Greater Boston Food Bank (GBFB) on October 3<sup>rd</sup>. GBFB is the largest hunger-relief organization in New England and among the largest food banks in the country. The food banks are committed to increasing food distribution to provide at least one meal a day to every person in need, while supporting healthy lives and healthy communities. We had a group of about 20 volunteers who sorted and packed a total of 6,961 pounds of food and drink, which came to a total of 5,801 meals.















# MARKET THOUGHTS & EDUCATION

NEPC, LLC

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# PERFORMANCE OVERVIEW

## Q3 Market Summary

Macro			Equity			Credit			Real Assets		
US Dollar	VIX	US 10-Yr	S&P 500	MSCI EAFE	MSCI EM	US Agg.	High Yield	Dollar EMD	Oil	Gold	REITS
											
3.4%	1.4	-32 bps	1.7%	-1.1%	-4.2%	2.3%	1.3%	1.5%	-7.0%	4.4%	7.4%

**Global central banks shifted toward easier monetary policy, providing support for risk-assets, even as uncertainty around trade and slowing global growth continue to temper returns**

**The decline in global yields also reflected these concerns – leading to positive returns across safe-haven fixed income. Within credit, spreads were relatively flat, but broadly remain below medians**

**Oil experienced a volatile month as geopolitical concerns influenced spot prices following a bombing of Saudi Arabia’s oil infrastructure**

Market segment (index representation) as follows: US Dollar (DXY Index), VIX (CBOE Volatility Index), US 10-Year (US 10-Year Treasury Yield), S&P 500 (US Equity), MSCI EAFE Index (International Developed Equity), MSCI Emerging Markets (Emerging Markets Equity), US Agg (Barclays US Aggregate Bond Index), High Yield (Barclays US High Yield Index), Dollar EMD (JPM EMBI Global Diversified Index), Crude Oil (WTI Crude Oil Spot), Gold (Gold Price Spot), and REITs (NAREIT Composite Index). Source: FactSet



# MACRO PERFORMANCE OVERVIEW

## Q3 Macro Market Summary

The Fed and ECB enacted easier monetary policy programs in an attempt to counter growing downside risks

The market value of negative-yielding debt increased to over \$18T

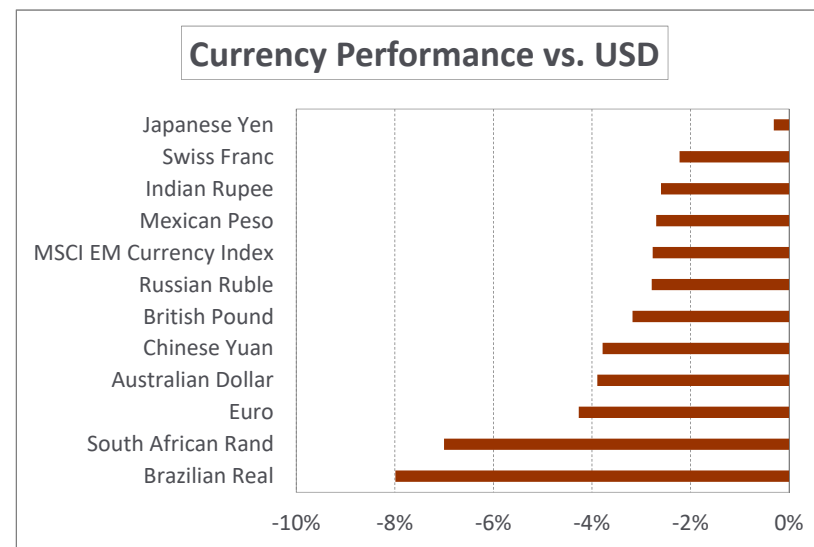
The dollar strengthened, reflecting a flight-to-quality amid ongoing growth concerns

	Yield 6/30/19	Yield 9/30/19	Δ
US 10-Yr	2.00%	1.68%	-0.32%
US 30-Yr	2.53%	2.12%	-0.40%
US Real 10-Yr	0.31%	0.15%	-0.16%
German 10-Yr	-0.31%	-0.58%	-0.27%
Japan 10-Yr	-0.16%	-0.23%	-0.07%
China 10-Yr	3.30%	3.17%	-0.13%
EM Local Debt	5.69%	5.21%	-0.48%

Source: FactSet

Central Banks	Current Rate	CPI YOY	Notes from the Quarter
Federal Reserve	1.75% - 2.00%	1.8%	The Fed cut interest rates twice this quarter to a range of 1.75% - 2.00%
European Central Bank	0.00%	1.0%	The ECB cut its deposit rate to -0.50% from -0.40% and announced it would restart bond purchases in November.
Bank of Japan	-0.10%	0.3%	The BoJ will continue its ultra-easy QE program with inflation remaining well below target

Source: FactSet



Source: FactSet





# EQUITY PERFORMANCE OVERVIEW

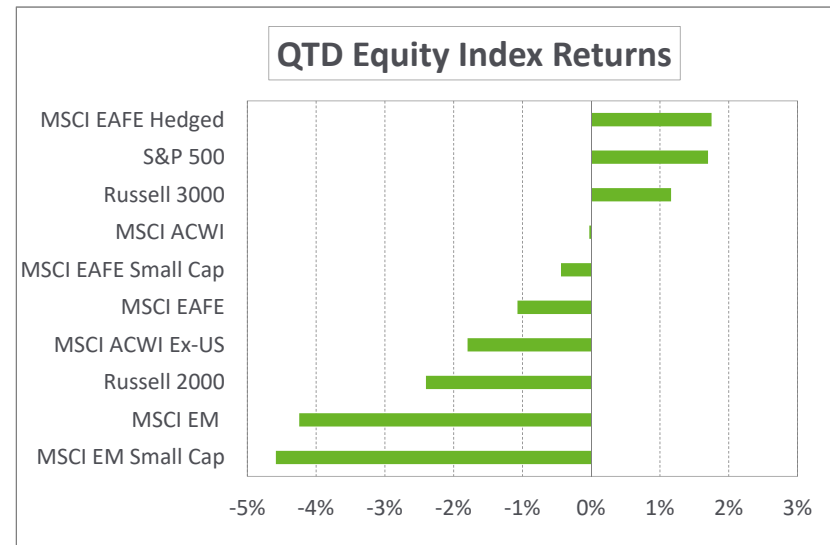
## Q3 Equity Market Summary

**US equities ended the quarter modestly higher on the back of more accommodative monetary policy**

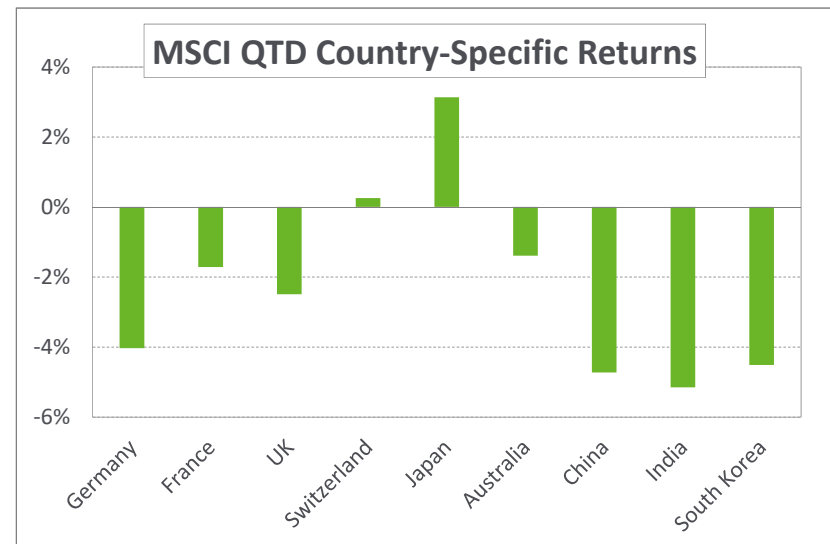
**Trade concerns and currency weakness versus the dollar broadly weighed on international and emerging market local equity returns**

Russell 3000 QTD Sector Returns	
Technology	3.4%
Health Care	-3.6%
Consumer Discretionary	-0.4%
Consumer Staples	5.7%
Energy	-7.6%
Materials & Processing	-0.3%
Producer Durables	0.5%
Financial Services	2.6%
Utilities	8.5%

Source: FactSet



Source: FactSet



Source: FactSet



# CREDIT PERFORMANCE OVERVIEW

## Q3 Credit Market Summary

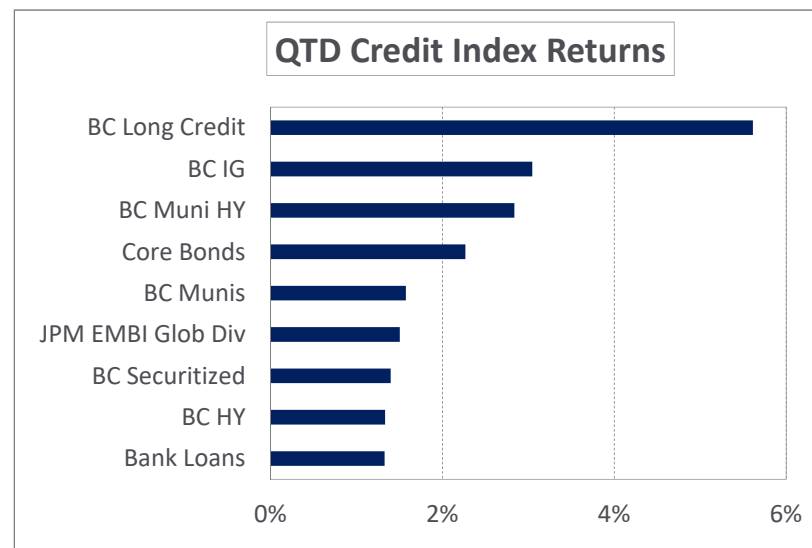
**Demand for safe-haven assets increased with ongoing trade and global growth uncertainties**

**Spreads across the credit complex remained relatively flat during the quarter, but remain below medians**

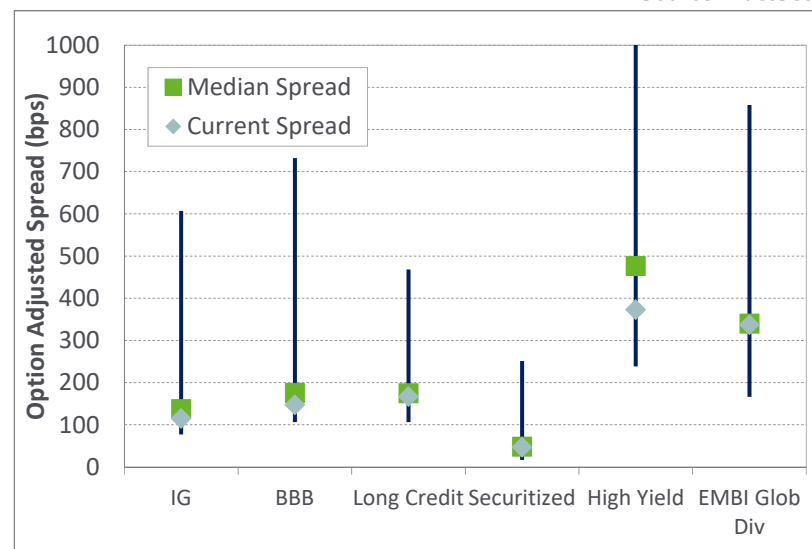
**Long duration assets benefitted from a significant decline in rates on the long-end of the yield curve**

Credit Spread (Basis Points)	6/30/2019	9/30/2019	Δ
BC IG Credit	113	115	+2
BC Long Credit	159	167	+8
BC Securitized	48	47	-1
BC High Yield	367	373	+6
Muni HY	255	246	-9
JPM EMBI	337	337	-
Bank Loans - Libor	391	398	+7

Source: FactSet



Source: FactSet



Source: FactSet; Ranges calculated since 11/30/2000



# REAL ASSETS PERFORMANCE OVERVIEW

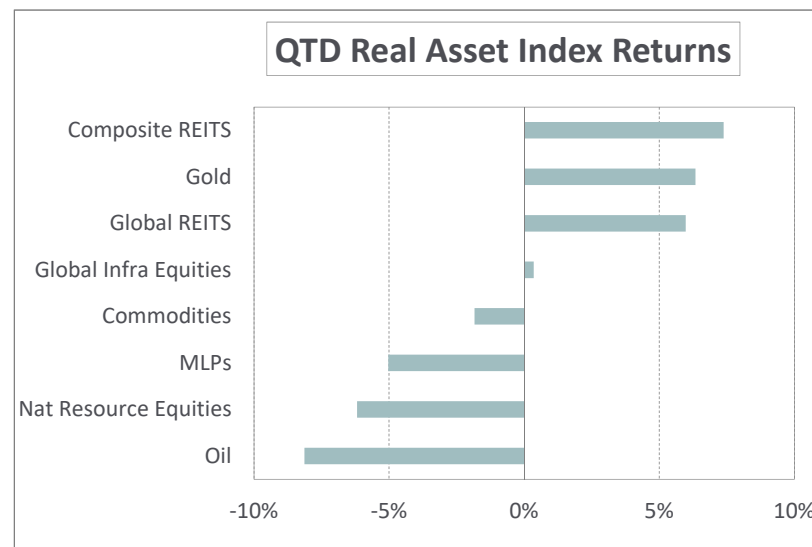
## Q3 Real Assets Market Summary

**Oil experienced a negative quarter with an attack on Saudi Arabia's oil facilities coupled with global growth concerns pushing volatility higher**

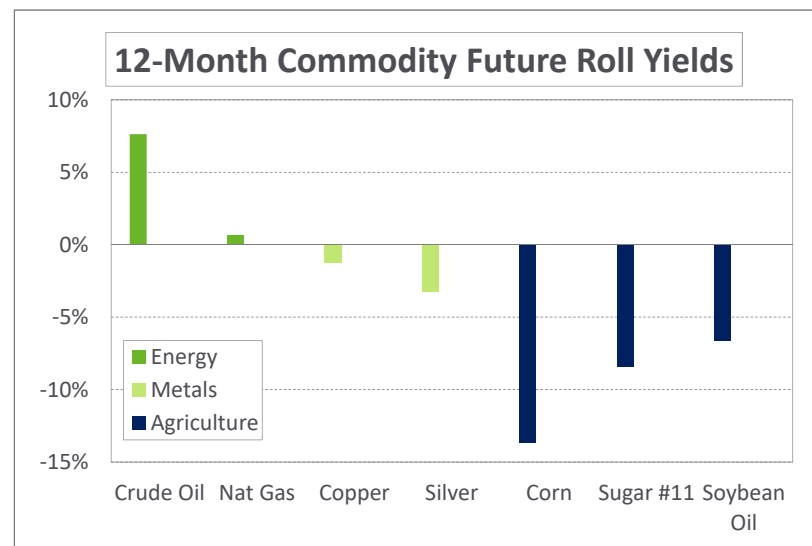
**Gold increased 4.4% during the quarter reflecting concerns around global growth and a lower-yield environment**

Real Asset Yields	6/30/19	9/30/19
MLPs	7.7%	7.8%
Core Real Estate	4.6%	4.5%
Composite REITs	4.2%	3.9%
Global REITs	4.2%	4.1%
Global Infrastructure Equities	4.3%	4.2%
Natural Resource Equities	4.2%	4.3%
US 10-Year Breakeven Inflation	1.73%	1.53%
Commodity Index Roll Yield	-2.0%	-3.0%
10-Year TIPS Real Yield	0.3%	0.2%

Source: FactSet



Source: FactSet



Source: FactSet

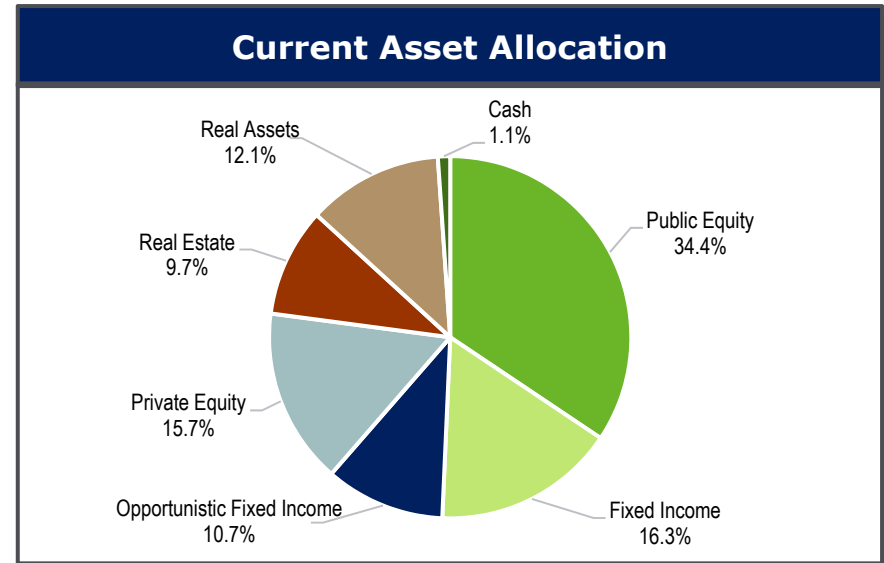
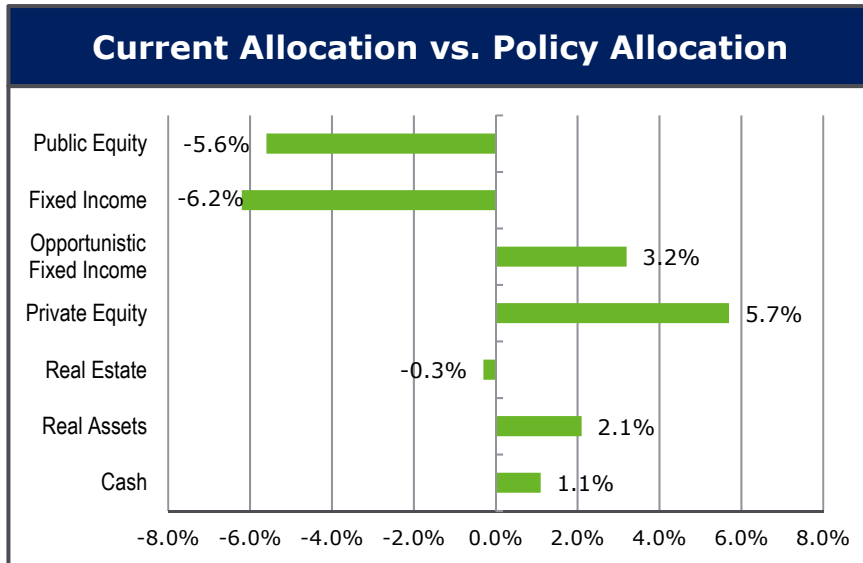


# EXECUTIVE SUMMARY

NEPC, LLC

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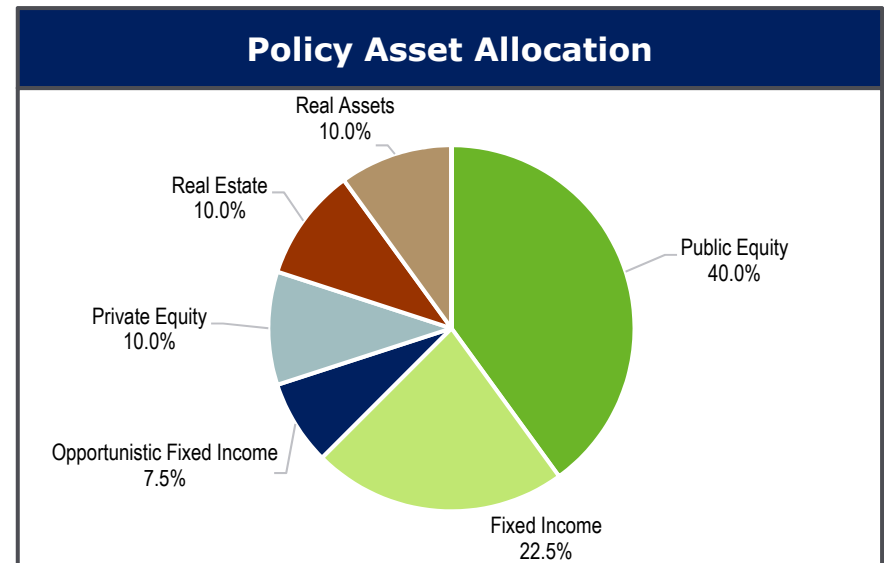
# ASSET ALLOCATION VS. CURRENT ALLOCATION



### Current Allocation vs. Policy Allocation

	Current	Policy	Current	Difference*
Public Equity	\$841,852,937	40.0%	34.4%	-5.6%
Fixed Income	\$399,245,123	22.5%	16.3%	-6.2%
Opportunistic Fixed Income	\$262,240,972	7.5%	10.7%	3.2%
Private Equity	\$383,798,073	10.0%	15.7%	5.7%
Real Estate	\$238,156,310	10.0%	9.7%	-0.3%
Real Assets	\$295,607,837	10.0%	12.1%	2.1%
Cash	\$26,587,954	--	1.1%	1.1%
<b>Total</b>	<b>\$2,447,489,206</b>	<b>100.0%</b>	<b>100.0%</b>	

\*Difference between Policy and Current Allocation

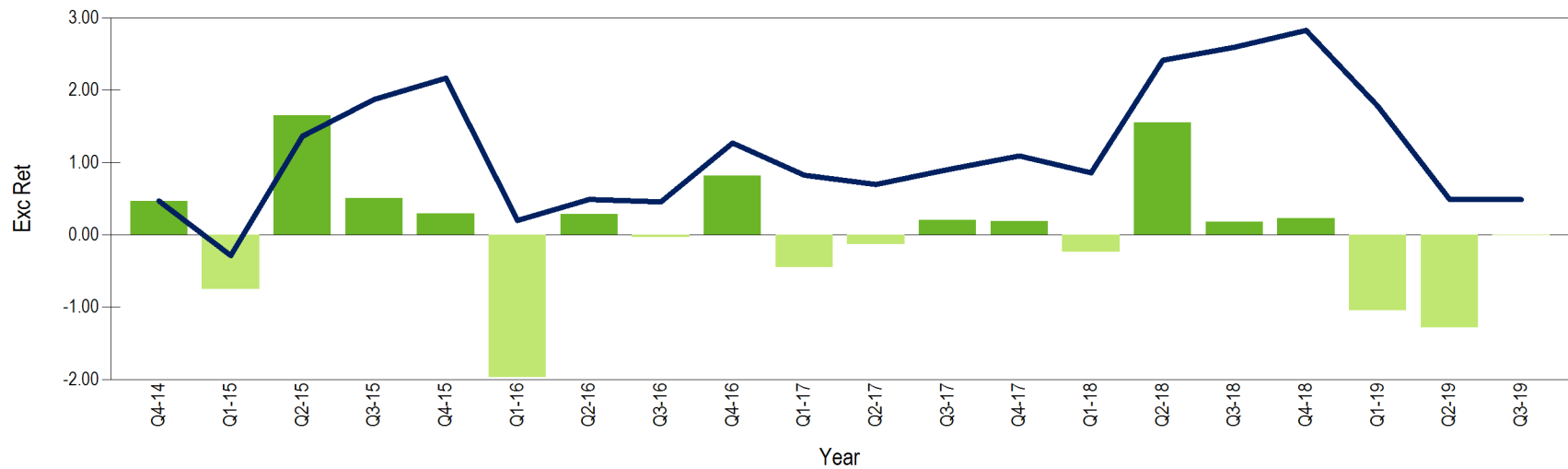


**MPERS**

# TOTAL FUND PERFORMANCE SUMMARY

	Market Value	3 Mo	YTD	1 Yr	3 Yrs	5 Yrs	10 Yrs
<b>Total Composite</b>	<b>\$2,447,489,206</b>	<b>1.49%</b>	<b>8.73%</b>	<b>5.68%</b>	<b>8.66%</b>	<b>7.16%</b>	<b>9.28%</b>
<i>Policy Index</i>		1.49%	11.21%	7.83%	8.62%	7.03%	8.29%
<i>InvMetrics Public DB Net Median</i>		0.78%	13.33%	3.98%	7.90%	6.27%	7.91%

Quarterly and Cumulative Excess Performance



# TOTAL FUND ATTRIBUTION ANALYSIS

**Attribution Effects**  
3 Months Ending September 30, 2019



Attribution Summary							
3 Months Ending September 30, 2019							
	Wtd. Actual Return	Wtd. Index Return	Excess Return	Selection Effect	Allocation Effect	Interaction Effects	Total Effects
Equity Beta	0.4%	1.0%	-0.6%	-0.3%	0.0%	0.0%	-0.3%
Rates and Credit Beta	3.3%	2.5%	0.7%	0.2%	0.0%	0.0%	0.2%
Real Asset Beta	1.8%	1.2%	0.6%	0.1%	0.0%	0.0%	0.1%
Cash Composite	0.6%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%
<b>Total</b>	<b>1.5%</b>	<b>1.6%</b>	<b>-0.1%</b>	<b>0.0%</b>	<b>-0.1%</b>	<b>0.0%</b>	<b>-0.1%</b>

Note: Plan attribution calculations are returns based and the results shown reflect the composites shown. As a result, the total returns shown may vary from the calculated return shown on the performance summary.

The target return shown for each composite is a custom index, based on aggregated policy indices. This policy index asset weights the underlying policy indices of each option in the plan and the respective benchmark return.

The allocation, selection, and interaction effects are calculated using the custom index described above along with the policy or target weight of each composite.

May not add due to rounding

Allocation Effect - The return attributable to the asset allocation of the portfolio

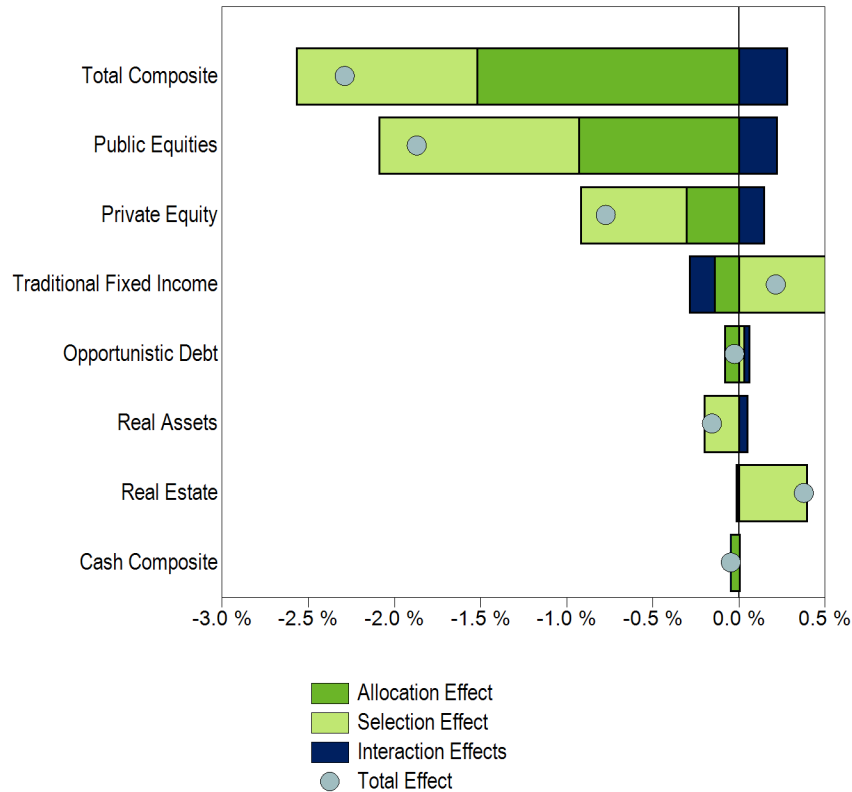
Selection Effect - The return attributable to the managers' security selection

Interaction Effect - The return attributable to the interaction between the Allocation and Selection Effects



# TOTAL FUND ATTRIBUTION ANALYSIS

**Attribution Effects Relative to Policy Index  
1 Year Ending September 30, 2019**



	Wtd. Actual Return	Wtd. Index Return	Excess Return	Selection Effect	Allocation Effect	Interaction Effects	Total Effects
Public Equities	-1.0%	1.4%	-2.4%	-1.2%	-1.0%	0.2%	-1.9%
Private Equity	11.5%	13.7%	-2.2%	-0.6%	-0.3%	0.1%	-0.8%
Traditional Fixed Income	13.6%	11.3%	2.3%	0.5%	-0.1%	-0.1%	0.2%
Opportunistic Debt	6.9%	6.4%	0.5%	0.0%	-0.1%	0.0%	0.0%
Real Assets	4.6%	5.8%	-1.2%	-0.2%	0.0%	0.0%	-0.2%
Real Estate	9.2%	5.3%	3.9%	0.4%	0.0%	0.0%	0.4%
Cash Composite	2.3%	2.3%	0.0%	0.0%	-0.1%	0.0%	-0.1%
<b>Total</b>	<b>5.7%</b>	<b>8.4%</b>	<b>-2.7%</b>	<b>-1.0%</b>	<b>-1.5%</b>	<b>0.2%</b>	<b>-2.4%</b>

Note: Plan attribution calculations are returns based and the results shown reflect the composites shown. As a result, the total returns shown may vary from the calculated return shown on the performance summary.

The target return shown for each composite is a custom index, based on aggregated policy indices. This policy index asset weights the underlying policy indices of each option in the plan and the respective benchmark return.

The allocation, selection, and interaction effects are calculated using the custom index described above along with the policy or target weight of each composite.

May not add due to rounding

Allocation Effect - The return attributable to the asset allocation of the portfolio

Selection Effect - The return attributable to the managers' security selection

Interaction Effect - The return attributable to the interaction between the Allocation and Selection Effects





## TOTAL COMPOSITE

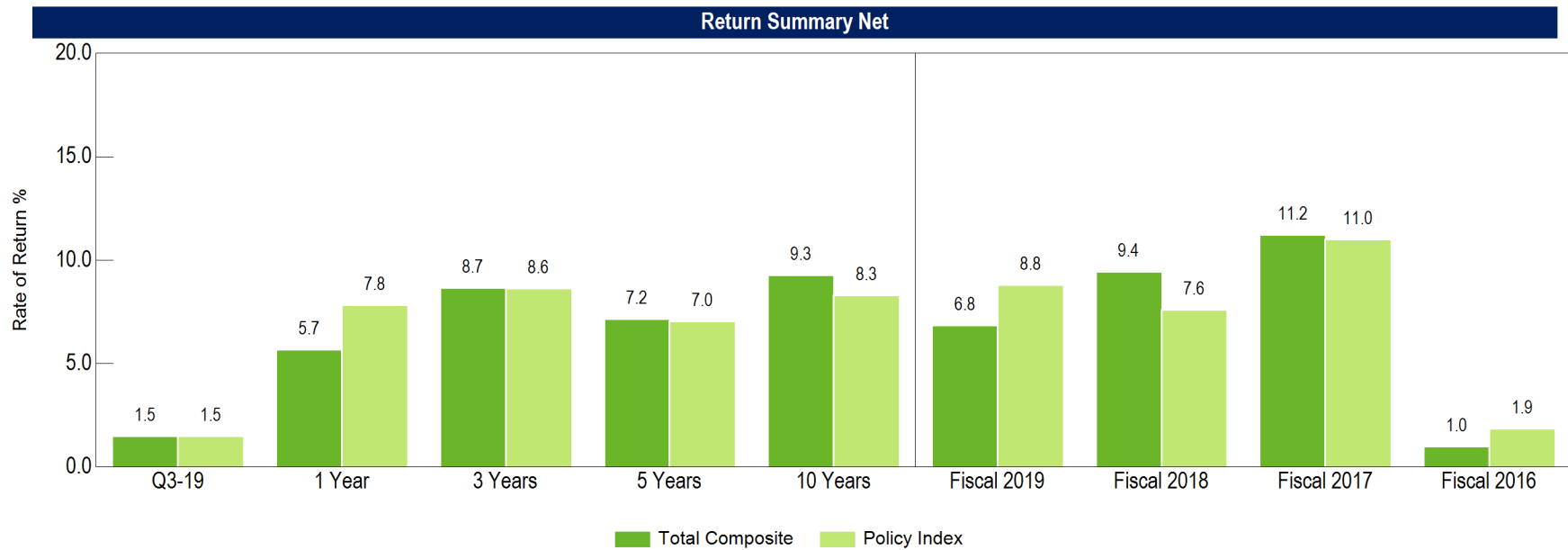
	Policy %	% of Portfolio	Market Value (\$)	3 Mo (%)	Rank	YTD (%)	Rank	1 Yr (%)	Rank	3 Yrs (%)	Rank	5 Yrs (%)	Rank	10 Yrs (%)	Rank
<b>Total Composite</b>	<b>100.00</b>	<b>100.00</b>	<b>2,447,489,206</b>	<b>1.49</b>	<b>6</b>	<b>8.73</b>	<b>89</b>	<b>5.68</b>	<b>9</b>	<b>8.66</b>	<b>22</b>	<b>7.16</b>	<b>13</b>	<b>9.28</b>	<b>5</b>
<i>Policy Index</i>				1.49	6	11.21	82	7.83	1	8.62	22	7.03	17	8.29	31
<b>Equity Beta</b>	<b>50.00</b>	<b>50.08</b>	<b>1,225,651,010</b>	<b>1.02</b>		<b>14.28</b>									
<b>Public Equities</b>	<b>40.00</b>	<b>34.40</b>	<b>841,852,937</b>	<b>-0.59</b>	<b>46</b>	<b>12.76</b>	<b>69</b>	<b>-1.02</b>	<b>56</b>	<b>7.38</b>	<b>65</b>	<b>5.24</b>	<b>61</b>	<b>8.85</b>	<b>48</b>
<i>MSCI ACWI</i>				-0.03	36	16.20	42	1.38	37	9.71	37	6.65	49	8.35	58
<b>Private Equity</b>	<b>10.00</b>	<b>15.68</b>	<b>383,798,073</b>	<b>2.71</b>		<b>7.83</b>		<b>11.50</b>		<b>14.92</b>		<b>12.60</b>		<b>13.20</b>	
<i>MO Hwy Priv. Equ. Index - Lagged</i>				5.07		4.81		13.71		17.58		14.01		18.19	
<b>Rates and Credit Beta</b>	<b>30.00</b>	<b>27.02</b>	<b>661,486,095</b>	<b>3.25</b>		<b>9.10</b>									
<b>Traditional Fixed Income</b>	<b>22.50</b>	<b>16.31</b>	<b>399,245,123</b>	<b>3.66</b>	<b>1</b>	<b>11.09</b>	<b>16</b>	<b>13.61</b>	<b>1</b>	<b>5.59</b>	<b>15</b>	<b>6.03</b>	<b>2</b>	<b>7.46</b>	<b>7</b>
<i>Fixed Income Custom Benchmark</i>				2.64	9	9.72	29	11.32	7	3.44	56	3.74	40	4.20	48
<b>Opportunistic Debt</b>	<b>7.50</b>	<b>10.71</b>	<b>262,240,972</b>	<b>2.68</b>	<b>1</b>	<b>6.30</b>	<b>92</b>	<b>6.86</b>	<b>29</b>						
<i>BBgBarc US High Yield TR</i>				1.33	49	11.41	38	6.36	39	6.07	27	5.37	21	7.94	20
<b>Real Assets Beta</b>	<b>20.00</b>	<b>21.81</b>	<b>533,764,147</b>	<b>1.79</b>		<b>3.43</b>									
<b>Real Assets</b>	<b>10.00</b>	<b>12.08</b>	<b>295,607,837</b>	<b>1.39</b>		<b>0.72</b>		<b>4.57</b>		<b>8.19</b>		<b>2.69</b>			
<i>CPI + 4% (Unadjusted)</i>				1.23		5.24		5.77		6.15		5.58		5.81	
<b>Real Estate</b>	<b>10.00</b>	<b>9.73</b>	<b>238,156,310</b>	<b>2.28</b>		<b>7.10</b>		<b>9.18</b>		<b>9.33</b>		<b>10.18</b>		<b>10.88</b>	
<i>NFI-ODCE Eq Wtd Net Non Lag</i>				1.18		3.83		5.27		6.69		8.68		9.89	
<b>Cash Composite</b>	<b>--</b>	<b>1.09</b>	<b>26,587,954</b>	<b>0.55</b>		<b>1.71</b>		<b>2.30</b>		<b>1.41</b>		<b>0.89</b>		<b>0.46</b>	
<i>91 Day T-Bills</i>				0.50		1.68		2.26		1.54		0.97		0.52	

Total Composite is ranked in the IFx Public DB (peer) Net+ Universe  
Global Equity Composite is ranked in the eV Global All Cap Equity Net Universe  
Fixed Income Composite is ranked in the eV All Global Fixed Inc Net Universe  
Opportunistic Debt Composite is ranked in the eV US High Yield Fixed Inc Net Universe



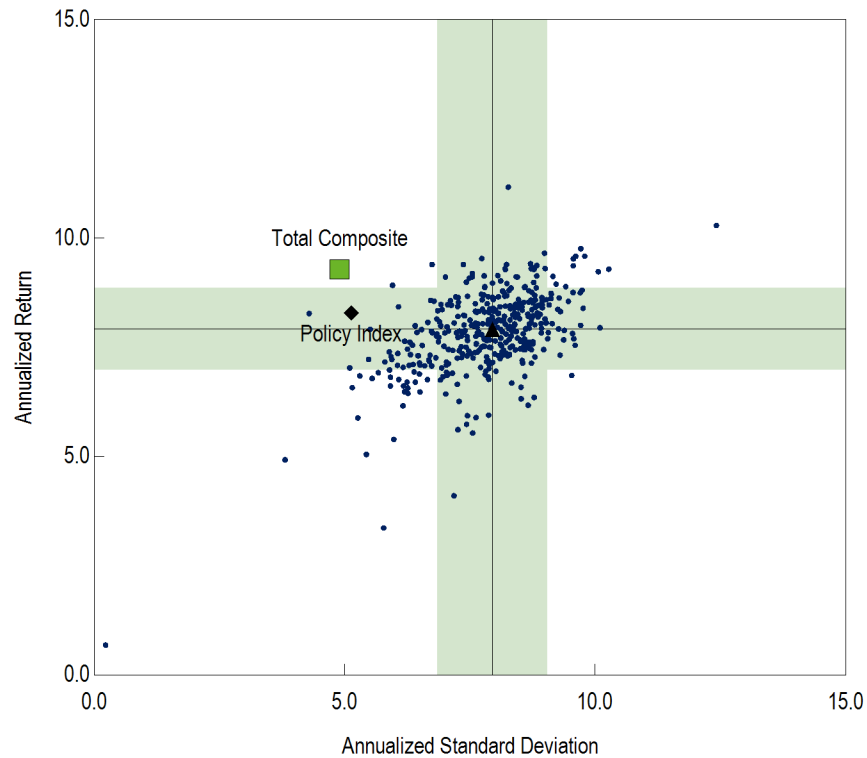
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## TOTAL FUND RETURN SUMMARY



# TOTAL FUND RISK/RETURN - 10 YEARS

10 Years Ending September 30, 2019



- Total Composite
- ◆ Policy Index
- ▲ Universe Median
- 68% Confidence Interval
- InvMetrics Public DB Net

415 Portfolios

## Statistics Summary 10 Years Ending September 30, 2019

	Anlzd Ret	Rank	Anlzd Std Dev	Rank
Total Composite	9.28%	5	4.90%	1
Policy Index	8.29%	31	5.13%	1

## Statistics Summary 10 Years Ending September 30, 2019

	Sharpe Ratio	Rank
Total Composite	1.79	1
Policy Index	1.51	1



# TOTAL FUND PERFORMANCE

NEPC, LLC

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**MPERS**

**TOTAL FUND PERFORMANCE DETAIL**

	Market Value (\$)	% of Portfolio	Policy %	3 Mo (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)
<b>Total Composite</b>	<b>2,447,489,206</b>	<b>100.00</b>	<b>100.00</b>	<b>1.49</b>	<b>8.73</b>	<b>5.68</b>	<b>8.66</b>	<b>7.16</b>	<b>9.28</b>
<i>Policy Index</i>				1.49	11.21	7.83	8.62	7.03	8.29
<i>Allocation Index</i>				1.50	9.75	6.09	8.04	6.82	--
<b>Equity Beta</b>	<b>1,225,651,010</b>	<b>50.08</b>	<b>50.00</b>	<b>0.42</b>	<b>11.04</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>
<i>Equity Beta Blended Benchmark</i>				1.02	14.28	--	--	--	--
<b>Public Equities</b>	<b>841,852,937</b>	<b>34.40</b>	<b>40.00</b>	<b>-0.59</b>	<b>12.76</b>	<b>-1.02</b>	<b>7.38</b>	<b>5.42</b>	<b>8.85</b>
<i>MSCI ACWI</i>				-0.03	16.20	1.38	9.71	6.65	8.35
<b>Global Public Equities w/ MLPs</b>	<b>705,448,679</b>	<b>28.82</b>	<b>--</b>	<b>-0.83</b>	<b>13.53</b>	<b>-1.92</b>	<b>7.82</b>	<b>5.82</b>	<b>--</b>
<b>MLPS</b>	<b>65,866,475</b>	<b>2.69</b>	<b>--</b>	<b>-6.22</b>	<b>9.96</b>	<b>-8.06</b>	<b>-1.84</b>	<b>-6.82</b>	<b>--</b>
<i>Alerian MLP Index</i>				-5.02	11.08	-8.13	-2.46	-8.65	6.25
<i>Tortoise</i>	65,866,475	2.69		-6.22	9.96	-8.06	-1.84	-6.82	--
<b>Global Public Equities</b>	<b>639,582,204</b>	<b>26.13</b>	<b>--</b>	<b>-0.25</b>	<b>13.92</b>	<b>-1.22</b>	<b>8.99</b>	<b>7.23</b>	<b>--</b>
<b>International Public Equities</b>	<b>229,683,933</b>	<b>9.38</b>	<b>--</b>	<b>-1.41</b>	<b>8.71</b>	<b>-4.58</b>	<b>6.27</b>	<b>4.27</b>	<b>5.88</b>
<i>MSCI ACWI ex USA</i>				-1.80	11.56	-1.23	6.33	2.90	4.46
<i>Acadian Int'l Small Cap</i>	40,358,836	1.65		-1.58	10.66	-8.71	6.16	6.49	--
<i>MSCI ACWI ex US Small Cap</i>				-1.19	10.28	-5.63	4.64	3.98	6.13
<i>Acadian Non-US Microcap</i>	29,803,170	1.22		-0.55	11.35	-5.92	--	--	--
<i>GMO EM</i>	23,344,417	0.95		-2.30	9.49	3.54	3.67	2.82	--
<i>MSCI Emerging Markets</i>				-4.25	5.90	-2.02	5.97	2.33	3.37
<i>Silchester</i>	134,916,551	5.51		-1.39	7.53	-4.24	6.30	4.26	7.84
<i>MSCI EAFE</i>				-1.07	12.80	-1.34	6.48	3.27	4.90
<i>Transition Account</i>	1,260,959	0.05							
<b>Domestic Public Equities</b>	<b>409,898,271</b>	<b>16.75</b>	<b>--</b>	<b>0.42</b>	<b>17.03</b>	<b>0.74</b>	<b>10.72</b>	<b>9.27</b>	<b>13.03</b>
<i>Russell 3000</i>				1.16	20.09	2.92	12.83	10.44	13.08
<b>Large Cap US Public Equities</b>	<b>349,412,736</b>	<b>14.28</b>	<b>--</b>	<b>0.56</b>	<b>17.78</b>	<b>2.19</b>	<b>11.26</b>	<b>9.82</b>	<b>12.91</b>
<i>Cash/S&amp;P Futures</i>	349,412,736	14.28		0.56	17.78	2.19	11.26	9.53	--
<i>S&amp;P 500</i>				1.70	20.55	4.25	13.39	10.84	13.24
<b>Small Cap US Public Equities</b>	<b>60,485,535</b>	<b>2.47</b>	<b>--</b>	<b>-0.38</b>	<b>12.88</b>	<b>-6.85</b>	<b>7.90</b>	<b>7.30</b>	<b>12.21</b>
<i>Russell 2000</i>				-2.40	14.18	-8.89	8.23	8.19	11.19
<i>Kennedy Capital</i>	31,542,585	1.29		-1.85	9.96	-7.20	9.06	9.78	--
<i>Russell Microcap</i>				-5.45	7.92	-15.98	5.32	6.15	9.81
<i>Kennedy Small-Cap Banking</i>	28,942,950	1.18		1.27	16.23	-6.47	--	--	--
<i>Russell 2000 Value</i>				-0.57	12.82	-8.24	6.54	7.17	10.06



**MPERS**

**TOTAL FUND PERFORMANCE DETAIL**

	Market Value (\$)	% of Portfolio	Policy %	3 Mo (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)
<b>Hedge Equity</b>	<b>136,404,258</b>	<b>5.57</b>	<b>0.00</b>	<b>0.70</b>	<b>8.93</b>	<b>2.97</b>	<b>5.70</b>	<b>3.12</b>	<b>--</b>
<i>HFRI Fund of Funds Composite Index</i>				-0.82	5.29	0.08	3.18	1.96	2.68
<b>Beta Overlay</b>	<b>13,427,346</b>	<b>0.55</b>	<b>--</b>	<b>4.45</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>
<i>HFRI Fund of Funds Composite Index</i>				-0.82	5.29	0.08	3.18	1.96	2.68
Equity Oriented Hedge Funds	13,427,346	0.55		4.45	--	--	--	--	--
<b>Equity Hedge Funds</b>	<b>122,976,912</b>	<b>5.02</b>	<b>--</b>	<b>0.31</b>	<b>6.42</b>	<b>0.60</b>	<b>4.91</b>	<b>2.66</b>	<b>4.67</b>
<i>HFRI Fund of Funds Composite Index</i>				-0.82	5.29	0.08	3.18	1.96	2.68
Alpstone Capital	12,840,173	0.52		4.07	11.91	15.76	--	--	--
Bridgewater Pure Alpha	20,295,822	0.83		0.73	-4.15	7.15	8.40	3.85	9.35
Cevian	14,140,785	0.58		-2.55	7.65	-10.88	3.70	3.57	--
Indus Pacific Opp. Fund	11,534,554	0.47		-6.37	0.00	-18.43	-0.84	2.99	--
Metacapital	13,030,539	0.53		4.76	10.28	6.92	4.84	3.75	--
Millenium USA LP	21,111,310	0.86		2.72	7.35	3.42	7.24	--	--
Pentwater	14,382,225	0.59		-2.88	7.78	6.58	12.77	--	--
ValueAct	15,641,504	0.64		1.05	22.07	-2.54	10.03	5.83	--
<b>Private Equity</b>	<b>383,798,073</b>	<b>15.68</b>	<b>10.00</b>	<b>2.71</b>	<b>7.83</b>	<b>11.50</b>	<b>14.93</b>	<b>12.60</b>	<b>13.21</b>
<i>MO Hwy Priv. Equ. Index - Lagged</i>				5.07	4.81	13.71	17.58	14.01	18.19
<b>PE Fund of Funds</b>	<b>256,609,471</b>	<b>10.48</b>	<b>--</b>	<b>2.56</b>	<b>7.53</b>	<b>11.39</b>	<b>14.31</b>	<b>12.19</b>	<b>--</b>
Grove Street - MP Ventures	70,562,037	2.88		4.70	10.09	18.75	11.67	9.86	11.55
Grove Street - MP Ventures II	177,375,148	7.25		1.04	5.54	7.30	15.57	13.49	10.56
Vectis H & L II	8,672,286	0.35		19.20	32.62	42.38	30.88	25.60	15.63
<b>PE Direct Funds</b>	<b>127,188,602</b>	<b>5.20</b>	<b>--</b>	<b>3.14</b>	<b>8.99</b>	<b>11.93</b>	<b>19.86</b>	<b>18.19</b>	<b>--</b>
Abry Partners VI	191,927	0.01		6.16	8.44	4.87	41.48	40.25	30.57
Abry Partners VII	1,753,694	0.07		-1.75	-2.38	-9.54	8.41	11.64	--
Aisling	9,772,623	0.40		17.56	18.45	20.86	22.41	--	--
Arrowroot Capital III	16,853,125	0.69		-0.60	2.30	1.99	--	--	--
Arrowroot Capital IV	5,951,228	0.24		-1.85	-7.34	--	--	--	--
Blackstone Asia	6,011,406	0.25		1.35	46.85	37.43	--	--	--
Capital Partners II	13,878,194	0.57		-1.34	-1.75	3.21	18.33	14.43	--
Capital Partners III	5,389,553	0.22		1.27	2.10	3.87	--	--	--
DC Capital Partners	2,153,100	0.09		0.16	31.38	29.77	6.18	--	--
Drive Overdrive I	2,612,626	0.11		-4.82	--	--	--	--	--

Fixed Income Custom Benchmark was BBgBarc US Universal TR preceding 01/01/2017. As of 01/01/2017 the benchmark is BBgBarc US Agg Govt/Credit.



**MPERS**

**TOTAL FUND PERFORMANCE DETAIL**

	Market Value (\$)	% of Portfolio	Policy %	3 Mo (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)
DYAL IV	409,973	0.02		21.88	13.83	11.10	--	--	--
KPS IV	7,177,199	0.29		4.41	8.51	16.35	--	--	--
Long Ridge II	11,280,636	0.46		16.54	27.74	36.31	20.36	--	--
Monomoy Capital Partners III	1,384,408	0.06		-8.75	6.77	-18.13	--	--	--
Newquest Fund	6,564,348	0.27		1.78	5.78	32.45	-14.83	--	--
Nexus	3,004,247	0.12		-4.13	-10.41	-34.09	--	--	--
Opengate Capital II	1,865,771	0.08		-4.61	--	--	--	--	--
Opengate Capital Partners	11,193,475	0.46		2.21	11.28	20.53	28.01	--	--
Pfingsten Fund V	5,924,161	0.24		5.01	23.43	17.40	1.88	--	--
Shore Capital Partners GP I LP	10,395,344	0.42		2.94	20.30	20.19	40.79	2.18	--
Shoreline China Valu III	3,421,564	0.14		0.16	1.21	0.36	7.11	--	--
<i>MO Hwy Priv. Equ. Index - Lagged</i>				5.07	4.81	13.71	17.58	14.01	18.19
<b>Rates and Credit Beta</b>	<b>661,486,095</b>	<b>27.03</b>	<b>30.00</b>	<b>3.25</b>	<b>9.10</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>
<b>Traditional Fixed Income</b>	<b>399,245,123</b>	<b>16.31</b>	<b>22.50</b>	<b>3.66</b>	<b>11.09</b>	<b>13.61</b>	<b>5.59</b>	<b>6.03</b>	<b>7.46</b>
<i>Fixed Income Custom Benchmark</i>				2.64	9.72	11.32	3.44	3.74	4.20
<b>Core Fixed Income</b>	<b>158,279,496</b>	<b>6.47</b>	<b>10.00</b>	<b>1.14</b>	<b>5.81</b>	<b>7.05</b>	<b>3.67</b>	<b>3.70</b>	<b>5.14</b>
<i>BBgBarc US Govt/Credit TR</i>				2.64	9.72	11.32	3.16	3.61	3.94
Aberdeen	11,001,530	0.45		1.31	6.26	5.84	7.10	5.98	7.22
<i>BBgBarc US Aggregate TR</i>				2.27	8.52	10.30	2.92	3.38	3.75
Internal Fixed - Core	109,040,101	4.46		1.09	5.58	8.16	2.95	3.02	--
<i>BBgBarc US Govt/Credit TR</i>				2.64	9.72	11.32	3.16	3.61	3.94
Octagon Senior Debt	28,956,503	1.18		1.05	5.80	2.84	3.30	--	--
<i>BBgBarc US Aggregate TR</i>				2.27	8.52	10.30	2.92	3.38	3.75
Principal CMBS Fixed	9,281,362	0.38		1.72	7.94	9.84	5.45	4.83	--
<i>BBgBarc US CMBS Investment Grade</i>				1.89	8.60	10.40	3.31	3.79	6.12
<b>Long Duration</b>	<b>202,972,896</b>	<b>8.29</b>	<b>7.50</b>	<b>6.01</b>	<b>15.88</b>	<b>20.34</b>	<b>5.16</b>	<b>6.84</b>	<b>--</b>
Internal Fixed - Long Duration	202,972,896	8.29		6.01	15.88	20.34	5.16	6.84	7.01
<i>BBgBarc US Aggregate TR</i>				2.27	8.52	10.30	2.92	3.38	3.75
<b>US TIPS</b>	<b>37,992,731</b>	<b>1.55</b>	<b>5.00</b>	<b>1.93</b>	<b>8.66</b>	<b>7.54</b>	<b>2.92</b>	<b>2.95</b>	<b>--</b>
Internal US TIPS	37,992,731	1.55		1.93	8.66	7.54	2.92	2.95	--
<i>BBgBarc US TIPS TR</i>				1.34	7.58	7.13	2.21	2.45	3.46



**MPERS**

**TOTAL FUND PERFORMANCE DETAIL**

	Market Value (\$)	% of Portfolio	Policy %	3 Mo (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)
<b>Opportunistic Debt</b>	<b>262,240,972</b>	<b>10.71</b>	<b>7.50</b>	<b>2.68</b>	<b>6.30</b>	<b>6.86</b>	--	--	--
<i>BBgBarc US High Yield TR</i>				1.33	11.41	6.36	6.07	5.37	7.94
<b>Direct Lending</b>	<b>181,097,823</b>	<b>7.40</b>	--	<b>3.83</b>	<b>8.29</b>	--	--	--	--
<b>Core Direct Lending</b>	<b>87,467,742</b>	<b>3.57</b>	--	<b>6.48</b>	<b>11.05</b>	--	--	--	--
GOLUB Capital	29,398,991	1.20		11.99	14.99	17.87	12.66	10.51	--
Internal Fixed - Nonrated	12,737,179	0.52		3.04	9.95	13.20	7.12	--	--
M&G III	3,068,973	0.13		-1.90	1.65	1.01	5.95	1.37	--
MGG	12,663,111	0.52		2.31	7.28	8.52	--	--	--
Owl Rock	29,599,488	1.21		5.78	10.86	12.42	--	--	--
<b>Opportunistic Direct Lending</b>	<b>93,630,081</b>	<b>3.83</b>	--	<b>1.47</b>	<b>5.84</b>	--	--	--	--
Audax Mezzanine II	2,459	0.00							
GSO Energy II	527,941	0.02		5.53	--	--	--	--	--
GSO Energy Select Opps	5,811,405	0.24		1.12	3.71	9.07	11.22	--	--
GSO I	222,375	0.01		-10.76	-28.74	-38.62	-22.97	-12.82	3.06
GSO II	3,369,241	0.14		1.87	4.46	-0.84	9.65	8.40	--
GSO III	9,844,376	0.40		2.64	8.14	11.22	9.20	--	--
Northern Shipping II	8,310,249	0.34		0.23	4.32	4.55	7.04	8.29	--
Northern Shipping III	13,317,255	0.54		2.02	5.36	7.50	7.11	--	--
OCP Asia	27,250,276	1.11		0.09	6.21	7.97	13.27	13.81	--
Riverstone Credit Partners	14,347,146	0.59		2.43	5.28	9.13	12.49	--	--
Riverstone Credit Partners II	10,627,358	0.43		2.90	8.04	17.46	--	--	--
<b>Distressed /Special Sits</b>	<b>45,620,074</b>	<b>1.86</b>	--	<b>3.39</b>	<b>2.92</b>	--	--	--	--
Anchorage Capital III	1,101,218	0.04		-3.05	-8.87	-13.00	3.94	6.72	--
Anchorage Illiquid Opps V	14,961,365	0.61		5.31	7.41	5.92	8.50	--	--
CVI Credit Value	813,744	0.03		36.93	17.99	19.92	13.95	13.54	--
CVI Credit Value Fund III	9,164,064	0.37		-0.56	4.69	2.16	8.31	--	--
CVI Global Value	659,398	0.03		8.85	6.81	10.90	5.36	4.31	10.32
Longford II	5,345,682	0.22		3.53	19.72	--	--	--	--
Miravast ILS Credit Opp	10,867,911	0.44		3.84	8.10	--	--	--	--
Siguler Guff Sec Opps	67,613	0.00							
Silver Point Distressed	605,758	0.02		--	--	--	--	--	--
Varde Asia Credit Fund	2,033,321	0.08		-3.29	-0.53	-6.45	--	--	--





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**TOTAL FUND PERFORMANCE DETAIL**

	Market Value (\$)	% of Portfolio	Policy %	3 Mo (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)
<b>Liquid Credit</b>	<b>35,523,075</b>	<b>1.45</b>	<b>--</b>	<b>-3.67</b>	<b>1.79</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>
ABRY ASF	146,730	0.01		-1.98	8.41	-17.80	-4.92	1.91	13.41
Anchorage Structured Credit	2,945,580	0.12		-0.18	--	--	--	--	--
GSO Credit Alpha Fund	10,708,543	0.44		0.34	0.54	-0.16	7.27	--	--
Och-Ziff Struct Products II	1,743,343	0.07		1.09	4.30	-0.48	24.13	16.31	--
Octagon Opportunistic	19,978,879	0.82		-6.68	1.98	-5.58	5.98	--	--
<i>BBgBarc US High Yield TR</i>				1.33	11.41	6.36	6.07	5.37	7.94
<b>Real Assets Beta</b>	<b>533,764,147</b>	<b>21.81</b>	<b>20.00</b>	<b>1.79</b>	<b>3.43</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>
<b>Real Assets</b>	<b>295,607,837</b>	<b>12.08</b>	<b>10.00</b>	<b>1.39</b>	<b>0.72</b>	<b>4.57</b>	<b>8.19</b>	<b>2.69</b>	<b>--</b>
<i>CPI + 4% (Unadjusted)</i>				1.23	5.24	5.77	6.15	5.58	5.81
<b>Natural Resources</b>	<b>177,984,295</b>	<b>7.27</b>	<b>--</b>	<b>1.18</b>	<b>0.42</b>	<b>6.35</b>	<b>10.93</b>	<b>2.82</b>	<b>--</b>
Ares Energy	12,631,960	0.52		5.92	11.05	--	--	--	--
Blue Road	9,375,888	0.38		-2.46	-3.03	5.91	4.65	--	--
EMG I	4,062,858	0.17		-2.29	-6.03	-5.53	-2.98	-11.13	--
EMG II	9,471,108	0.39		3.94	5.15	10.70	11.25	6.02	--
EMG III	20,426,418	0.83		-4.33	-6.56	4.08	2.02	-0.92	--
EMG IV	21,783,726	0.89		4.25	2.27	18.44	24.04	--	--
EMG V	5,411,565	0.22		7.91	--	--	--	--	--
Grey Rock Energy Fund II	11,314,775	0.46		5.34	10.96	19.48	6.50	--	--
Grey Rock Energy Fund III	6,609,119	0.27		2.78	-0.22	-1.94	--	--	--
NGP IX	304,507	0.01		19.80	25.50	48.21	57.11	15.59	--
NGP X	3,940,310	0.16		-13.81	-30.48	-33.03	-1.18	-4.10	--
NGP XI	13,567,402	0.55		-3.57	-8.28	-6.00	15.41	--	--
Orion II	13,377,443	0.55		3.32	16.66	16.65	--	--	--
Orion III	1,645,429	0.07		--	--	--	--	--	--
Orion Mine Finance Fund I	7,620,670	0.31		-5.24	-6.40	-9.94	8.89	6.11	--
Orion Mineral Royalty	27,787	0.00							
Quantum VII	7,575,680	0.31		0.11	3.75	5.52	--	--	--
Ridgewood Energy	11,593,289	0.47		5.16	-1.09	8.87	17.19	10.44	--
Ridgewood III	4,319,126	0.18		-1.31	-1.74	-2.47	19.11	--	--
Turnbridge Capital Partners I	12,925,235	0.53		7.61	11.86	--	--	--	--



**MPERS**

**TOTAL FUND PERFORMANCE DETAIL**

	Market Value (\$)	% of Portfolio	Policy %	3 Mo (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)
<b>Infrastructure &amp; Transport</b>	<b>40,693,913</b>	<b>1.66</b>	<b>--</b>	<b>4.85</b>	<b>2.31</b>	<b>5.21</b>	<b>7.83</b>	<b>4.22</b>	<b>--</b>
American Infrastructure I MLP	7,456,586	0.30		0.52	-6.45	-5.30	3.91	4.71	--
American Infrastructure II MLP	8,889,166	0.36		4.51	3.22	7.52	7.26	7.09	--
Apollo Aviation III	2,994,070	0.12		21.18	38.71	47.73	29.30	--	--
CIM INFRA FUND II	3,228,312	0.13		-0.55	-3.07	1.52	--	--	--
Corrum Capital Aviation	11,855,722	0.48		9.75	15.24	17.12	--	--	--
EIF - US Power III	2,557,433	0.10		-4.90	-19.97	-19.07	-7.95	1.61	--
Sciens Marine Investments	3,712,624	0.15		1.34	-15.62	-12.28	17.97	-15.16	--
<i>CPI + 4% (Unadjusted)</i>				1.23	5.24	5.77	6.15	5.58	5.81
<b>Timber</b>	<b>76,929,629</b>	<b>3.14</b>	<b>--</b>	<b>0.15</b>	<b>0.48</b>	<b>1.53</b>	<b>3.46</b>	<b>-0.43</b>	<b>--</b>
MP Timber	37,064,002	1.51		1.37	3.05	5.51	5.12	--	--
MPATC	29,374,729	1.20		-1.08	-3.02	-3.02	--	--	--
MPCTT	1,114,267	0.05		-1.02	4.84	4.66	--	--	--
MPMCB	8,488,280	0.35		0.02	-0.67	-0.90	--	--	--
Russellville Land Timber	888,351	0.04		0.00	-0.43	-0.43	--	--	--
<i>NCREIF Timberland 1 Qtr. Lag</i>				1.04	1.91	2.95	3.29	4.64	3.99
<b>Real Estate</b>	<b>238,156,310</b>	<b>9.73</b>	<b>10.00</b>	<b>2.28</b>	<b>7.10</b>	<b>9.18</b>	<b>9.33</b>	<b>10.18</b>	<b>10.88</b>
<i>NFI-ODCE Eq Wtd Net Non Lag</i>				1.18	3.83	5.27	6.69	8.68	9.89
<b>REITS</b>	<b>18,861,827</b>	<b>0.77</b>	<b>--</b>	<b>4.55</b>	<b>22.32</b>	<b>14.82</b>	<b>5.07</b>	<b>5.09</b>	<b>6.24</b>
CBRE Investors	18,861,827	0.77		4.55	22.32	14.82	5.07	5.08	6.24
<i>FTSE NAREIT Developed</i>				4.63	19.82	13.00	5.61	6.81	8.63
<b>Core</b>	<b>111,886,639</b>	<b>4.57</b>	<b>--</b>	<b>0.78</b>	<b>3.87</b>	<b>6.93</b>	<b>8.06</b>	<b>10.09</b>	<b>12.07</b>
Clarion Partners Lion Prop Fd	25,755,643	1.05		1.39	4.34	6.18	8.16	9.74	10.80
Principal CMBS	2,527,049	0.10		1.46	19.22	53.87	15.85	13.84	22.08
Principal Enhanced Property	54,046,212	2.21		0.00	2.26	3.84	8.31	11.83	10.35
<i>NCREIF Property Index</i>				1.41	4.79	6.23	6.76	8.57	9.77
Principal U.S. Property Fund	29,557,735	1.21		1.63	4.65	5.96	7.83	9.55	10.69
<i>NCREIF ODCE</i>				1.31	3.77	5.59	7.30	9.34	10.86



**MPERS**

**TOTAL FUND PERFORMANCE DETAIL**

	Market Value (\$)	% of Portfolio	Policy %	3 Mo (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)
<b>Non-Core</b>	<b>107,407,844</b>	<b>4.39</b>	<b>--</b>	<b>3.40</b>	<b>8.56</b>	<b>10.87</b>	<b>11.64</b>	<b>10.55</b>	<b>9.26</b>
<b>Value-Add</b>	<b>99,909,217</b>	<b>4.08</b>	<b>--</b>	<b>3.05</b>	<b>7.16</b>	<b>9.37</b>	<b>11.87</b>	<b>11.14</b>	<b>--</b>
Centersquare III	33,845,644	1.38		8.58	23.00	23.00	16.96	--	--
Centersquare IV	19,024,552	0.78		3.32	-4.45	-4.35	--	--	--
M&G II	3,467,989	0.14		-1.11	3.14	3.10	8.36	4.01	--
New Mountain	2,917,755	0.12		-4.18	14.94	17.46	--	--	--
Oak Street IV	7,133,011	0.29		1.29	4.07	6.86	--	--	--
Och Ziff RE Credit FD LP	4,351,851	0.18		3.01	5.46	6.46	8.22	--	--
Torchlight Debt Opp II	2,845	0.00		-25.64	-24.51	18.81	3.72	6.58	--
Torchlight Debt Opp III	36,983	0.00		0.00	-20.29	-21.02	-4.18	7.19	--
Torchlight Debt Opps V	7,982,115	0.33		2.41	2.59	6.98	13.45	--	--
Tristan EPISO	1,969,066	0.08		-5.94	-17.78	-29.47	-9.48	1.19	2.84
Tristan EPISO 3	4,562,612	0.19		-5.49	-13.24	-11.49	16.48	7.64	--
Tristan EPISO 4	14,260,413	0.58		-2.67	5.52	7.27	5.52	--	--
Tristan EPISO 5	354,381	0.01		-100.00	--	--	--	--	--
<i>NCREIF Property Index</i>				1.41	4.79	6.23	6.76	8.57	9.77
<b>Opportunistic</b>	<b>7,498,627</b>	<b>0.31</b>	<b>--</b>	<b>8.68</b>	<b>26.11</b>	<b>33.63</b>	<b>16.36</b>	<b>12.95</b>	<b>--</b>
AEW Partners V	35,291	0.00		-2.15	0.05	7.80	17.97	39.60	25.21
Apollo European III	190,026	0.01		12.74	-14.50	-47.53	-32.33	-23.05	-9.54
Apollo Real Estate	1,614,100	0.07		32.40	75.77	92.93	28.53	24.19	11.90
Clarion Part Lion Mexico Fund	1,057,307	0.04		-1.14	-19.05	-19.98	-20.14	-19.11	-11.07
Colony Capital VIII	202,000	0.01		-7.42	-15.90	-16.08	-1.17	-6.06	1.12
Och-Ziff	519,160	0.02		13.03	137.61	219.70	79.57	61.69	40.46
Och-Ziff RE III	3,880,743	0.16		4.16	10.73	13.71	22.23	1.00	--
<b>Cash Composite</b>	<b>26,587,954</b>	<b>1.09</b>	<b>0.00</b>	<b>0.55</b>	<b>1.71</b>	<b>2.30</b>	<b>1.41</b>	<b>0.89</b>	<b>0.46</b>
<i>91 Day T-Bills</i>				0.50	1.68	2.26	1.54	0.97	0.52



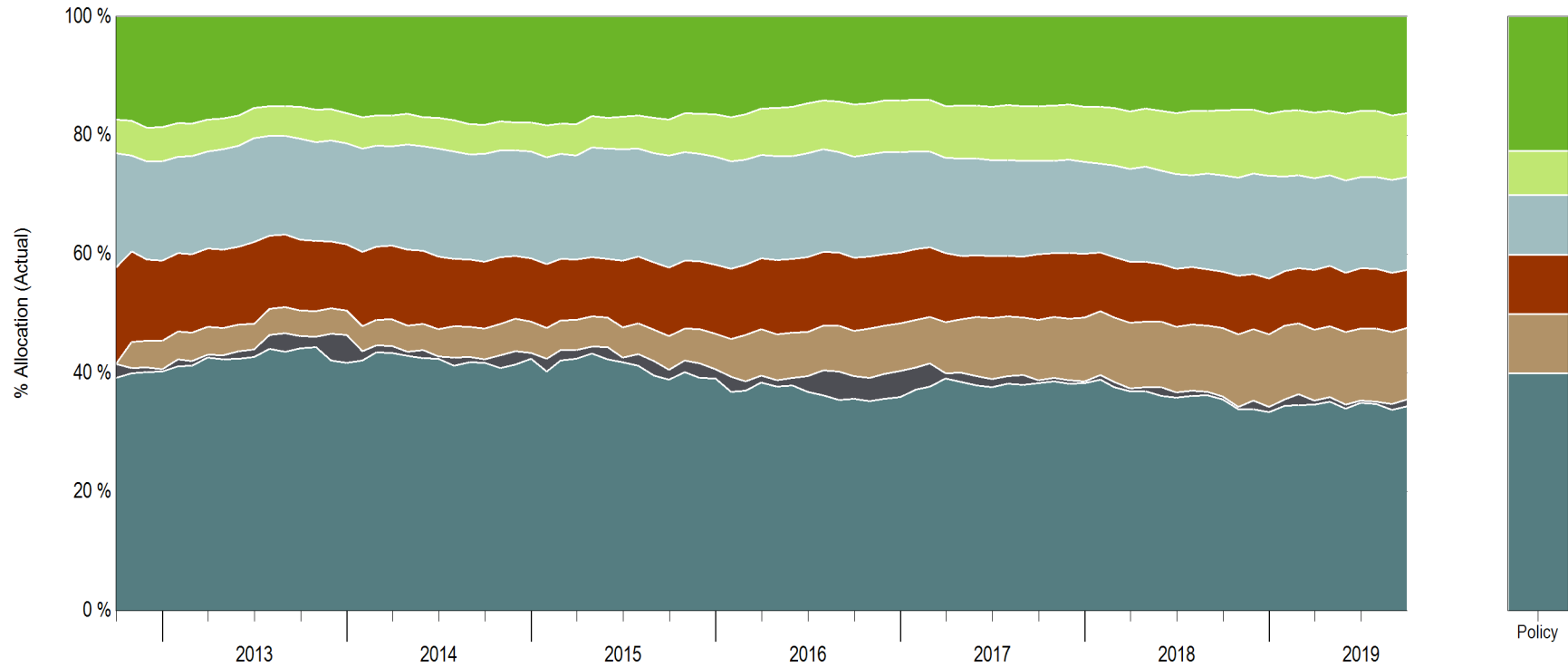
# APPENDIX

NEPC, LLC

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# TOTAL FUND ASSET ALLOCATION HISTORY

Asset Allocation History

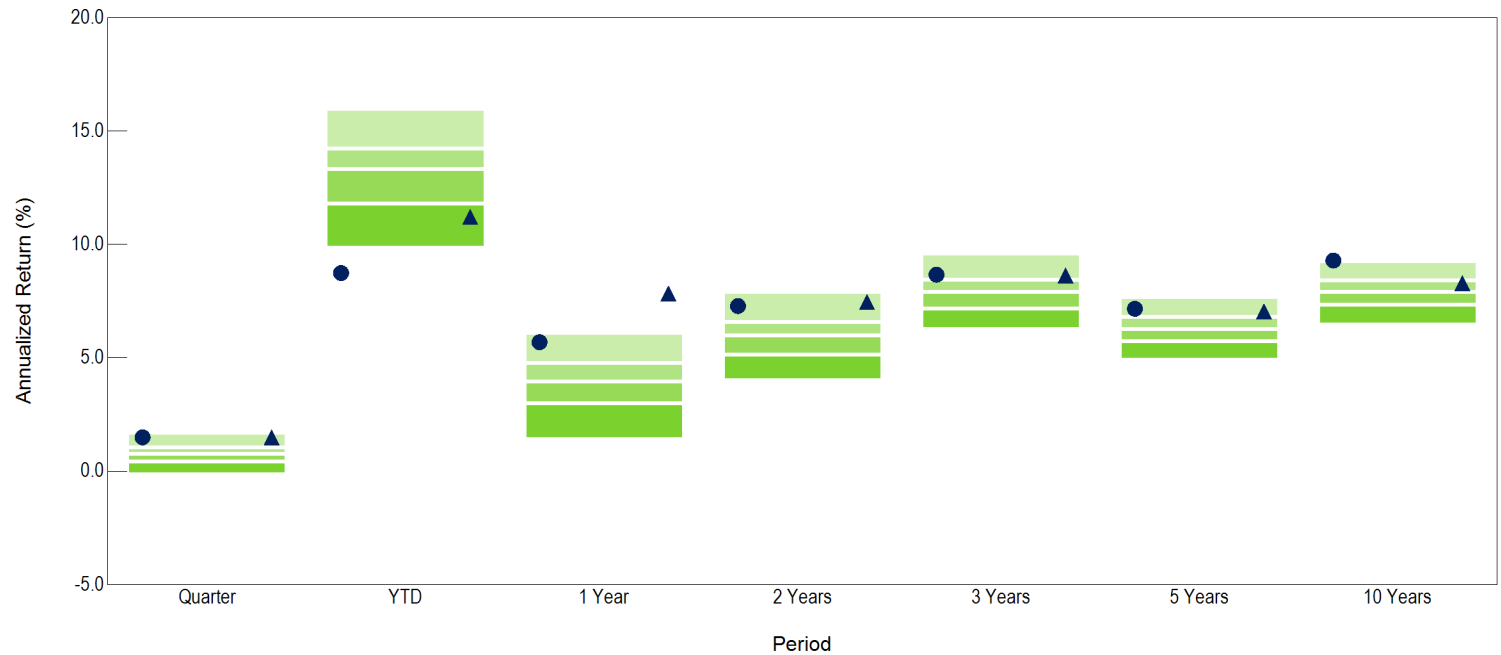


- Fixed Income
- Opportunistic Fixed Income
- Opportunistic
- Private Equity
- Real Estate
- Real Assets
- Cash
- Public Equity



# TOTAL FUND RETURN SUMMARY VS. PEER UNIVERSE

Total Composite vs. InvMetrics Public DB Net

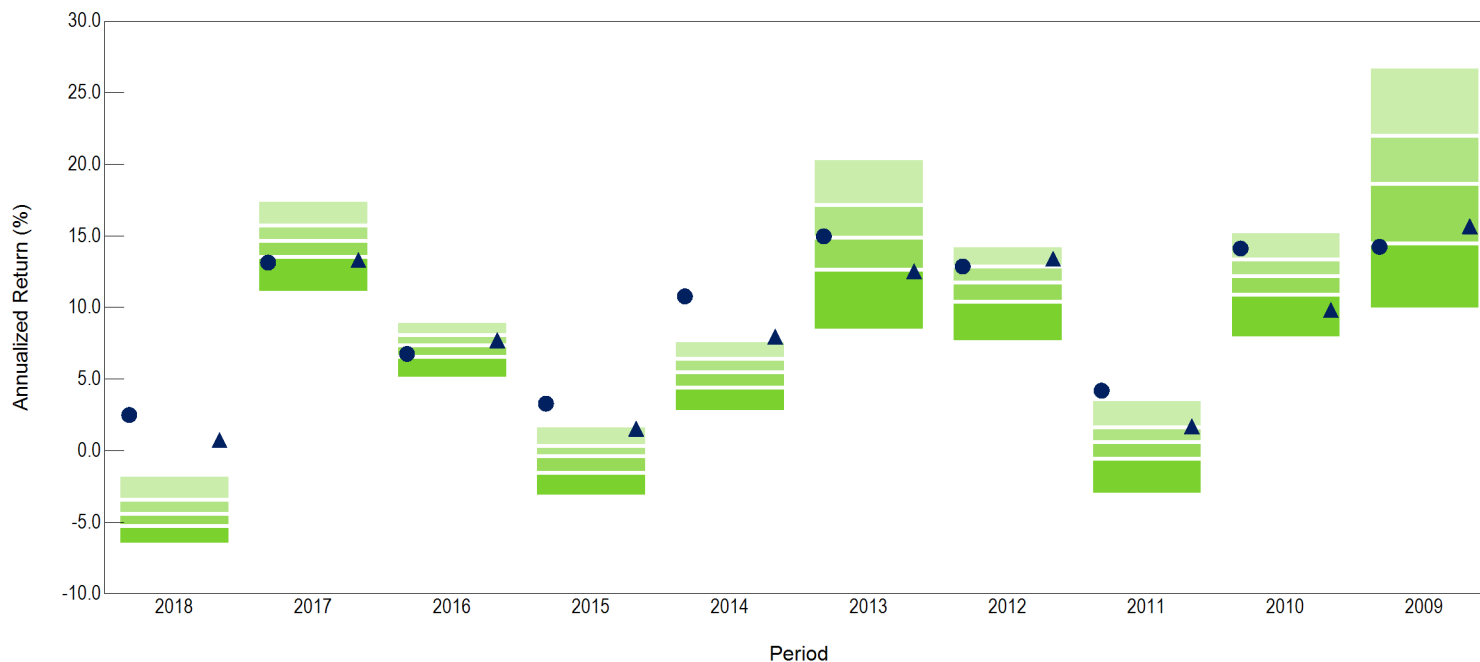


	Return (Rank)													
5th Percentile	1.7	15.9	6.1	7.9	9.6	7.7	9.2							
25th Percentile	1.1	14.2	4.8	6.6	8.4	6.8	8.4							
Median	0.8	13.3	4.0	6.0	7.9	6.3	7.9							
75th Percentile	0.4	11.8	3.0	5.2	7.2	5.7	7.4							
95th Percentile	-0.1	9.8	1.4	4.0	6.3	4.9	6.5							
# of Portfolios	562	558	554	552	542	495	415							
● Total Composite	1.5	(6)	8.7	(98)	5.7	(9)	7.3	(13)	8.7	(22)	7.2	(13)	9.3	(5)
▲ Policy Index	1.5	(6)	11.2	(82)	7.8	(1)	7.5	(9)	8.6	(22)	7.0	(17)	8.3	(31)



# TOTAL FUND RETURN SUMMARY VS. PEER UNIVERSE

Total Composite vs. InvMetrics Public DB Net



	Return (Rank)																			
5th Percentile	-1.7	17.5	9.0	1.7	7.7	20.4	14.3	3.6	15.3	26.8										
25th Percentile	-3.4	15.8	8.1	0.4	6.4	17.2	12.9	1.6	13.4	22.0										
Median	-4.4	14.7	7.4	-0.4	5.5	14.9	11.8	0.6	12.2	18.6										
75th Percentile	-5.2	13.6	6.6	-1.5	4.4	12.7	10.4	-0.5	10.9	14.5										
95th Percentile	-6.5	11.1	5.0	-3.2	2.7	8.4	7.6	-3.1	7.9	9.9										
# of Portfolios	496	269	269	262	210	191	159	137	131	128										
● Total Composite	2.5	(1)	13.1	(83)	6.8	(70)	3.3	(1)	10.8	(1)	15.0	(49)	12.9	(26)	4.2	(3)	14.1	(14)	14.2	(77)
▲ Policy Index	0.7	(1)	13.3	(81)	7.7	(39)	1.5	(7)	8.0	(4)	12.5	(76)	13.4	(15)	1.7	(24)	9.8	(88)	15.7	(68)



# GLOSSARY OF INVESTMENT TERMINOLOGY

**Alpha** - Measures the relationship between the fund performance and the performance of another fund or benchmark index and equals the excess return while the other fund or benchmark index is zero.

**Alpha Jensen** - The average return on a portfolio over and above that predicted by the capital asset pricing model (CAPM), given the portfolio's beta and the average market return. Also known as the abnormal return or the risk adjusted excess return.

**Annualized Excess Return over Benchmark** - Annualized fund return minus the annualized benchmark return for the calculated return.

**Annualized Return** - A statistical technique whereby returns covering periods greater than one year are converted to cover a 12 month time span.

**Beta** - Measures the volatility or systematic risk and is equal to the change in the fund's performance in relation to the change in the assigned index's performance.

**Information Ratio** - A measure of the risk adjusted return of a financial security, asset, or portfolio.

*Formula:*  
 $(\text{Annualized Return of Portfolio} - \text{Annualized Return of Benchmark}) / \text{Annualized Standard Deviation}(\text{Period Portfolio Return} - \text{Period Benchmark Return})$ . To annualize standard deviation, multiply the deviation by the square root of the number of periods per year where monthly returns per year equals 12 and quarterly returns is four periods per year.

**R-Squared** - Represents the percentage of a fund's movements that can be explained by movements in an index. R-Squared values range from 0 to 100. An R-Squared of 100 denotes that all movements of a fund are completely explained by movements in the index.

**Sharpe Ratio** - A measure of the excess return or risk premium per unit of risk in an investment asset or trading strategy.

**Sortino Ratio** - A method to differentiate between good and bad volatility in the Sharpe Ratio. The differentiation of up and down volatility allows the calculation to provide a risk adjusted measure of a security or fund's performance without upward price change penalties.

*Formula:*  
 $\text{Calculation Average } (X-Y) / \text{Downside Deviation } (X-Y) * 2$   
Where X=Return Series Y = Return Series Y which is the risk free return (91 day T-bills)

**Standard Deviation** - The standard deviation is a statistical term that describes the distribution of results. It is a commonly used measure of volatility of returns of a portfolio, asset class, or security. The higher the standard deviation the more volatile the returns are.

*Formula:*  
 $(\text{Annualized Return of Portfolio} - \text{Annualized Return of Risk Free}) / \text{Annualized Standard Deviation (Portfolio Returns)}$

**Tracking Error** - Tracking error, also known as residual risk, is a measure of the degree to which a portfolio tracks its benchmark. It is also a measure of consistency of excess returns. Tracking error is computed as the annualized standard deviation of the difference between a portfolio's return and that of its benchmark.

*Formula:*  
 $\text{Tracking Error} = \text{Standard Deviation } (X-Y) * \sqrt{\text{\# of periods per year}}$   
Where X = periods portfolio return and Y = the period's benchmark return  
For monthly returns, the periods per year = 12  
For quarterly returns, the periods per year = 4

**Treynor Ratio** - A risk-adjusted measure of return based on systematic risk. Similar to the Sharpe ratio with the difference being the Treynor ratio uses beta as the measurement of volatility.

*Formula:*  
 $(\text{Portfolio Average Return} - \text{Average Return of Risk-Free Rate}) / \text{Portfolio Beta}$

**Up/Down Capture Ratio** - A measure of what percentage of a market's returns is "captured" by a portfolio. For example, if the market declines 10% over some period, and the manager declines only 9%, then his or her capture ratio is 90%. In down markets, it is advantageous for a manager to have as low a capture ratio as possible. For up markets, the higher the capture ratio the better. Looking at capture ratios can provide insight into how a manager achieves excess returns. A value manager might typically have a lower capture ratio in both up and down markets, achieving excess returns by protecting on the downside, whereas a growth manager might fall more than the overall market in down markets, but achieve above-market returns in a rising market.

$\text{Upside Capture} = \text{Total Return}(\text{Fund Returns}) / \text{Total Returns}(\text{BM Return})$  when Period Benchmark Return is  $> = 0$

$\text{Downside Capture} = \text{Total Return}(\text{Fund Returns}) / \text{Total Returns}(\text{BM Return})$  when Benchmark  $< 0$

Data Source: InvestorForce

