MEKETA

INVESTMENT GROUP

City of Marlborough
Contributory Retirement System

Meeting Materials
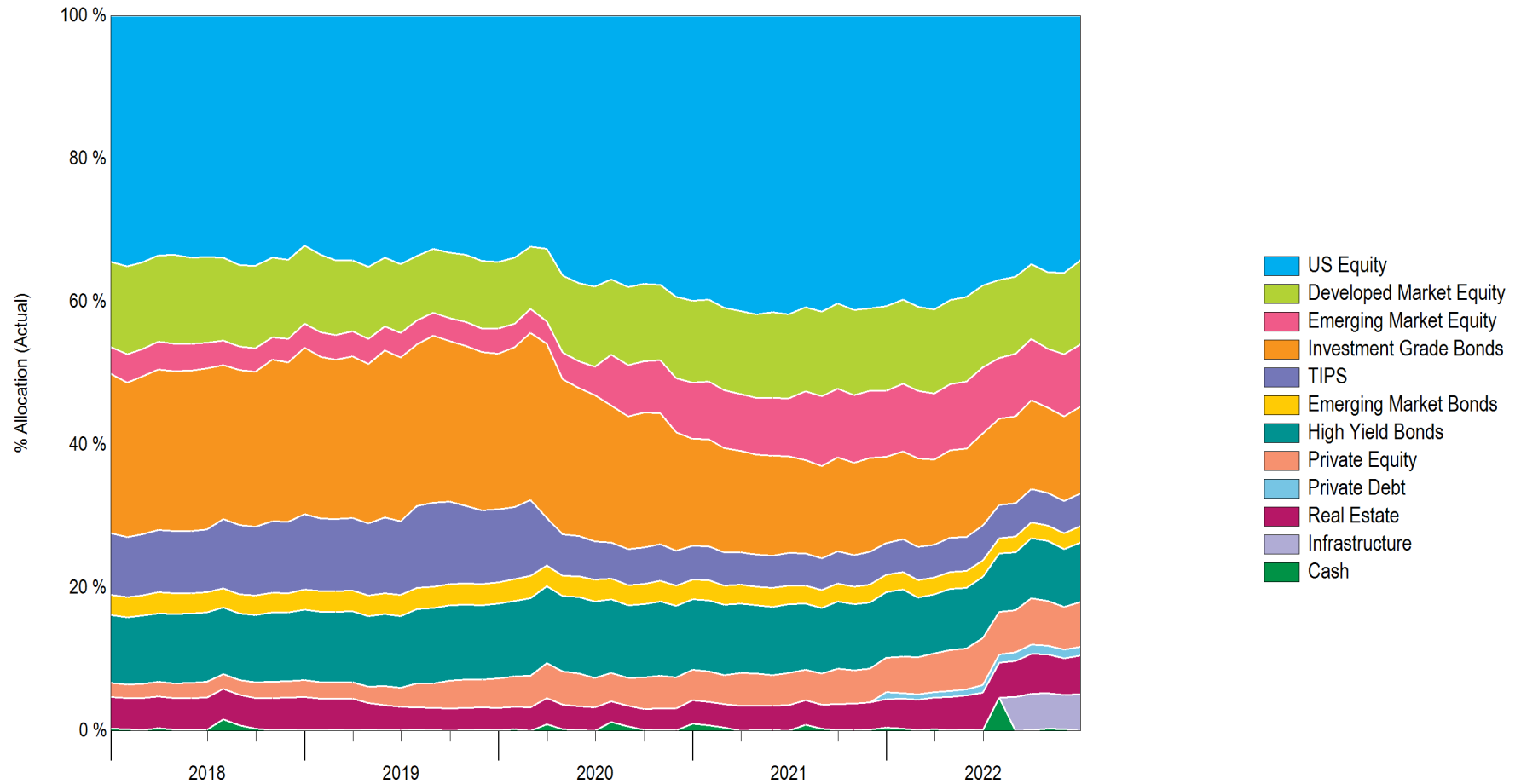### February 28, 2023

Fund Evaluation Report

Agenda

1. Performance Update as of January 31, 2022

2. Asset Allocation Discussion

3. Manager Due Diligence Presentations

4. Appendix

Performance Update
as of January 31, 2022

MEKETA

City of Marlborough Contributory Retirement System

Total Retirement System | As of December 31, 2022

Allocation vs. Targets and Policy	Current Balance	Current Allocation	Policy	Policy Range
US Equity	$69,885,440	34%	17%	11% - 23%
Developed Market Equity	$24,044,037	12%	14%	6% - 18%
Emerging Market Equity	$17,816,994	9%	14%	3% - 16%
Investment Grade Bonds	$24,762,569	12%	5%	3% - 10%
TIPS	$9,311,205	5%	5%	3% - 10%
Emerging Market Bonds	$4,781,153	2%	2%	1% - 5%
High Yield Bonds	$16,948,759	8%	5%	2% - 8%
Private Equity	$12,768,474	6%	10%	5% - 15%
Private Debt	$2,509,202	1%	8%	0% - 12%
Real Estate	$11,160,085	5%	10%	3% - 13%
Infrastructure	$10,427,904	5%	10%	0% - 13%
Cash	$179	0%	0%	0% - 5%
Total	**$204,416,002**	**100%**	**100%**	

Asset Allocation History
5 Years Ending December 31, 2022

Legend:
- US Equity
- Developed Market Equity
- Emerging Market Equity
- Investment Grade Bonds
- TIPS
- Emerging Market Bonds
- High Yield Bonds
- Private Equity
- Private Debt
- Real Estate
- Infrastructure
- Cash

Asset Class Performance Summary											
	Market Value ($)	% of Portfolio	QTD (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	20 Yrs (%)	Inception (%)	Inception Date
Total Retirement System (net)	204,416,002	100.0	6.3	-12.5	-12.5	4.4	5.0	6.6	7.1	7.4	Jul-88
55% MSCI World & 45% Barclays Aggregate			6.3	-15.6	-15.6	1.9	3.7	5.5	6.2	6.6	*Jul-88*
60% MSCI World & 40% Barclays Aggregate			6.7	-15.9	-15.9	2.2	4.0	5.9	6.4	6.7	*Jul-88*
InvMetrics Public DB $50mm-$250mm Net Median			5.7	-13.4	-13.4	3.8	5.1	6.9	6.7	8.2	*Jul-88*
Domestic Equity Assets (net)	69,885,440	34.2	8.9	-16.9	-16.9	5.5	6.9	11.0	9.0	8.0	Oct-06
Russell 3000			7.2	-19.2	-19.2	7.1	8.8	12.1	9.9	8.8	*Oct-06*
International Developed Markets Equity Assets (net)	24,044,037	11.8	17.2	-14.2	-14.2	1.1	1.8	4.3	--	2.7	Oct-06
MSCI EAFE			17.3	-14.5	-14.5	0.9	1.5	4.7	6.4	3.0	*Oct-06*
International Emerging Markets Equity Assets (net)	17,816,994	8.7	7.2	-19.3	-19.3	0.0	0.4	--	--	3.9	Jan-15
MSCI Emerging Markets			9.7	-20.1	-20.1	-2.7	-1.4	1.4	8.7	2.4	*Jan-15*
Investment Grade Bonds Assets (net)	24,762,569	12.1	1.7	-13.2	-13.2	-2.8	-0.1	1.0	3.1	5.3	Jul-88
Bloomberg US Aggregate TR			1.9	-13.0	-13.0	-2.7	0.0	1.1	3.1	5.4	*Jul-88*
PRIT Core Fixed Income			0.7	-18.3	-18.3	-2.9	0.2	1.9	3.6	6.0	*Jul-88*
High Yield Bond Assets (net)	16,948,759	8.3	3.6	-8.9	-8.9	0.2	2.4	3.8	--	5.8	Sep-03
Bloomberg US High Yield TR			4.2	-11.2	-11.2	0.0	2.3	4.0	7.3	6.6	*Sep-03*
PRIT Public Value-Added Fixed Income			4.4	-7.6	-7.6	-0.1	1.5	1.8	6.0	5.3	*Sep-03*
TIPS Assets (net)	9,311,205	4.6	1.8	-12.1	-12.1	1.0	2.0	1.1	--	3.3	Oct-05
Bloomberg US TIPS TR			2.0	-11.8	-11.8	1.2	2.1	1.1	3.8	3.3	*Oct-05*
Emerging Market Debt Assets (net)	4,781,153	2.3	10.3	-17.4	-17.4	-5.0	-1.5	--	--	1.8	Jan-15
JP Morgan EMBI Global Diversified			8.1	-17.8	-17.8	-5.3	-1.3	1.6	6.2	1.8	*Jan-15*
Open-Ended Real Estate (net)	7,215,131	3.5	-5.1	9.6	9.6	11.4	10.0	10.9	8.0	8.5	Oct-95
NCREIF ODCE			-5.0	7.5	7.5	9.9	8.7	10.1	8.4	9.1	*Oct-95*
Total Closed End Real Estate (net)	3,944,954	1.9	1.2	10.2	10.2	6.0	-6.3	4.3	--	4.3	Jan-13
Private Equity Assets (net)	12,768,474	6.2	-0.9	10.2	10.2	23.6	19.6	10.9	--	8.6	Oct-06
Private Debt Assets (net)	2,509,202	1.2	1.8	10.8	10.8	--	--	--	--	9.9	Dec-21
Infrastructure (net)	10,427,904	5.1	4.0	--	--	--	--	--	--	4.3	Aug-22
Cash (net)	179	0.0									

Trailing Performance	Market Value ($)	% of Portfolio	% of Sector	QTD (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	20 Yrs (%)	Inception (%)	Inception Date
Total Retirement System	**204,416,002**	**100.0**	**--**	**6.3**	**-12.5**	**-12.5**	**4.4**	**5.0**	**6.6**	**7.1**	**7.4**	**Jul-88**
55% MSCI World & 45% Barclays Aggregate				6.3	-15.6	-15.6	1.9	3.7	5.5	6.2	6.6	*Jul-88*
60% MSCI World & 40% Barclays Aggregate				6.7	-15.9	-15.9	2.2	4.0	5.9	6.4	6.7	*Jul-88*
InvMetrics Public DB $50mm-$250mm Net Median				5.7	-13.4	-13.4	3.8	5.1	6.9	6.7	8.2	*Jul-88*
Domestic Equity Assets	**69,885,440**	**34.2**	**34.2**	**8.9**	**-16.9**	**-16.9**	**5.5**	**6.9**	**11.0**	**9.0**	**8.0**	**Oct-06**
Russell 3000				7.2	-19.2	-19.2	7.1	8.8	12.1	9.9	8.8	*Oct-06*
RhumbLine S&P 500 Index	20,770,217	10.2	29.7	7.6	-18.1	-18.1	7.6	9.4	12.5	9.8	6.9	Mar-99
S&P 500				7.6	-18.1	-18.1	7.7	9.4	12.6	9.8	6.9	*Mar-99*
eV US Passive S&P 500 Equity Net Median				7.5	-18.2	-18.2	7.6	9.3	12.4	9.7	6.8	*Mar-99*
Frontier Capital Appreciation	21,701,887	10.6	31.1	11.0	-18.0	-18.0	4.6	4.9	--	--	9.8	Feb-13
Russell 2500 Growth				4.7	-26.2	-26.2	2.9	6.0	10.6	10.6	10.0	*Feb-13*
eV US Small-Mid Cap Growth Equity Net Median				4.7	-28.1	-28.1	5.5	7.9	10.9	10.8	10.3	*Feb-13*
RhumbLine HEDI	27,413,336	13.4	39.2	8.4	-15.2	-15.2	--	--	--	--	8.9	Nov-20
Russell 1000 HEDI Moderate GR USD				8.6	-15.1	-15.1	8.1	10.7	13.7	11.0	9.1	*Nov-20*
eV US Large Cap Core Equity Gross Median				8.7	-16.1	-16.1	7.9	9.4	12.5	10.3	10.1	*Nov-20*

	Market Value ($)	% of Portfolio	% of Sector	QTD (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	20 Yrs (%)	Inception (%)	Inception Date
International Developed Markets Equity Assets	**24,044,037**	**11.8**	**11.8**	**17.2**	**-14.2**	**-14.2**	**1.1**	**1.8**	**4.3**	**--**	**2.7**	**Oct-06**
MSCI EAFE				*17.3*	*-14.5*	*-14.5*	*0.9*	*1.5*	*4.7*	*6.4*	*3.0*	*Oct-06*
RhumbLine MSCI EAFE Index	24,044,037	11.8	100.0	17.2	-14.2	-14.2	1.1	1.8	--	--	2.9	Aug-14
MSCI EAFE				*17.3*	*-14.5*	*-14.5*	*0.9*	*1.5*	*4.7*	*6.4*	*2.7*	*Aug-14*
eV EAFE All Cap Equity Net Median				*15.9*	*-15.7*	*-15.7*	*0.8*	*1.3*	*5.0*	*7.1*	*3.2*	*Aug-14*
International Emerging Markets Equity Assets	**17,816,994**	**8.7**	**8.7**	**7.2**	**-19.3**	**-19.3**	**0.0**	**0.4**	**--**	**--**	**3.9**	**Jan-15**
MSCI Emerging Markets				*9.7*	*-20.1*	*-20.1*	*-2.7*	*-1.4*	*1.4*	*8.7*	*2.4*	*Jan-15*
DFA Emerging Markets	9,391,333	4.6	52.7	10.5	-16.4	-16.4	0.2	-0.2	--	--	3.3	Jan-15
MSCI Emerging Markets				*9.7*	*-20.1*	*-20.1*	*-2.7*	*-1.4*	*1.4*	*8.7*	*2.4*	*Jan-15*
eV Emg Mkts All Cap Equity Net Median				*10.3*	*-21.0*	*-21.0*	*-2.4*	*-0.8*	*2.0*	*9.2*	*2.8*	*Jan-15*
Driehaus Emerging Market Equity	8,425,662	4.1	47.3	3.7	-22.4	-22.4	-0.7	0.7	--	--	4.4	Jan-15
MSCI Emerging Markets				*9.7*	*-20.1*	*-20.1*	*-2.7*	*-1.4*	*1.4*	*8.7*	*2.4*	*Jan-15*
eV Emg Mkts All Cap Equity Net Median				*10.3*	*-21.0*	*-21.0*	*-2.4*	*-0.8*	*2.0*	*9.2*	*2.8*	*Jan-15*
Investment Grade Bonds Assets	**24,762,569**	**12.1**	**12.1**	**1.7**	**-13.2**	**-13.2**	**-2.8**	**-0.1**	**1.0**	**3.1**	**5.3**	**Jul-88**
Bloomberg US Aggregate TR				*1.9*	*-13.0*	*-13.0*	*-2.7*	*0.0*	*1.1*	*3.1*	*5.4*	*Jul-88*
PRIT Core Fixed Income				*0.7*	*-18.3*	*-18.3*	*-2.9*	*0.2*	*1.9*	*3.6*	*6.0*	*Jul-88*
SSgA U.S. Aggregate Bond Index	24,762,569	12.1	100.0	1.7	-13.2	-13.2	-2.8	-0.1	1.0	3.1	3.6	May-01
Bloomberg US Aggregate TR				*1.9*	*-13.0*	*-13.0*	*-2.7*	*0.0*	*1.1*	*3.1*	*3.6*	*May-01*
eV US Core Fixed Inc Net Median				*1.8*	*-13.1*	*-13.1*	*-2.4*	*0.2*	*1.2*	*3.3*	*3.8*	*May-01*

	Market Value ($)	% of Portfolio	% of Sector	QTD (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	20 Yrs (%)	Inception (%)	Inception Date
High Yield Bond Assets	**16,948,759**	**8.3**	**8.3**	**3.6**	**-8.9**	**-8.9**	**0.2**	**2.4**	**3.8**	**--**	**5.8**	**Sep-03**
Bloomberg US High Yield TR				*4.2*	*-11.2*	*-11.2*	*0.0*	*2.3*	*4.0*	*7.3*	*6.6*	*Sep-03*
PRIT Public Value-Added Fixed Income				*4.4*	*-7.6*	*-7.6*	*-0.1*	*1.5*	*1.8*	*6.0*	*5.3*	*Sep-03*
Shenkman Capital	16,948,759	8.3	100.0	3.6	-8.8	-8.8	0.3	2.4	3.8	--	5.6	Apr-06
Bloomberg US High Yield TR				*4.2*	*-11.2*	*-11.2*	*0.0*	*2.3*	*4.0*	*7.3*	*6.1*	*Apr-06*
eV US High Yield Fixed Inc Net Median				*3.9*	*-10.0*	*-10.0*	*0.3*	*2.3*	*3.7*	*6.6*	*5.6*	*Apr-06*
TIPS Assets	**9,311,205**	**4.6**	**4.6**	**1.8**	**-12.1**	**-12.1**	**1.0**	**2.0**	**1.1**	**--**	**3.3**	**Oct-05**
Bloomberg US TIPS TR				*2.0*	*-11.8*	*-11.8*	*1.2*	*2.1*	*1.1*	*3.8*	*3.3*	*Oct-05*
SSgA TIPS Index-NL	9,311,205	4.6	100.0	1.8	-12.1	-12.1	1.0	2.0	1.1	--	3.3	Oct-05
Bloomberg US TIPS TR				*2.0*	*-11.8*	*-11.8*	*1.2*	*2.1*	*1.1*	*3.8*	*3.3*	*Oct-05*
eV US TIPS / Inflation Fixed Inc Net Median				*2.0*	*-11.6*	*-11.6*	*1.2*	*2.1*	*1.1*	*3.9*	*3.3*	*Oct-05*
Emerging Market Debt Assets	**4,781,153**	**2.3**	**2.3**	**10.3**	**-17.4**	**-17.4**	**-5.0**	**-1.5**	**--**	**--**	**1.8**	**Jan-15**
JP Morgan EMBI Global Diversified				*8.1*	*-17.8*	*-17.8*	*-5.3*	*-1.3*	*1.6*	*6.2*	*1.8*	*Jan-15*
Payden Emerging Market Bond	4,781,153	2.3	100.0	10.3	-17.4	-17.4	-5.0	-1.5	--	--	1.8	Jan-15
JP Morgan EMBI Global Diversified				*8.1*	*-17.8*	*-17.8*	*-5.3*	*-1.3*	*1.6*	*6.2*	*1.8*	*Jan-15*
Open-Ended Real Estate	**7,215,131**	**3.5**	**3.5**	**-5.1**	**9.6**	**9.6**	**11.4**	**10.0**	**10.9**	**8.0**	**8.5**	**Oct-95**
NCREIF ODCE				*-5.0*	*7.5*	*7.5*	*9.9*	*8.7*	*10.1*	*8.4*	*9.1*	*Oct-95*
Clarion Partners	7,215,131	3.5	100.0	-5.1	9.6	9.6	11.4	10.0	10.9	8.0	8.0	Oct-02
NCREIF ODCE				*-5.0*	*7.5*	*7.5*	*9.9*	*8.7*	*10.1*	*8.4*	*8.4*	*Oct-02*

	Market Value ($)	% of Portfolio	% of Sector	QTD (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	20 Yrs (%)	Inception (%)	Inception Date
Total Closed End Real Estate	**3,944,954**	**1.9**	**1.9**	**1.2**	**10.2**	**10.2**	**6.0**	**-6.3**	**4.3**	**--**	**4.3**	**Jan-13**
Rockwood Capital Real Estate Partners Fund XI, L.P.	3,944,954	1.9	100.0	1.2	10.2	10.2	8.0	--	--	--	7.8	Dec-19
NCREIF-ODCE				*-5.0*	*7.5*	*7.5*	*9.9*	*8.7*	*10.1*	*8.4*	*10.2*	*Dec-19*
Private Equity Assets	**12,768,474**	**6.2**	**6.2**	**-0.9**	**10.2**	**10.2**	**23.6**	**19.6**	**10.9**	**--**	**8.6**	**Oct-06**
North American Strategic Partners 2006	18,450	0.0	0.1									
Ironsides Partnership Fund IV	2,405,983	1.2	18.8									
Ironsides Direct Investment Fund IV	2,131,251	1.0	16.7									
Ironsides Partnership Fund V, L.P.	1,809,405	0.9	14.2									
Ironsides Direct Investment Fund V, L.P.	3,055,003	1.5	23.9									
HarbourVest 2019 Global Fund	3,348,383	1.6	26.2									
Private Debt Assets	**2,509,202**	**1.2**	**1.2**	**1.8**	**10.8**	**10.8**	**--**	**--**	**--**	**--**	**9.9**	**Dec-21**
NB Private Debt Fund IV	2,509,202	1.2	100.0									
Infrastructure	**10,427,904**	**5.1**	**5.1**	**4.0**	**--**	**--**	**--**	**--**	**--**	**--**	**4.3**	**Aug-22**
IFM Global Infrastructure	10,427,904	5.1	100.0	4.0	--	--	--	--	--	--	4.3	Aug-22
CPI + 3%				*0.7*	*9.6*	*9.6*	*8.1*	*6.9*	*5.7*	*5.6*	*1.4*	*Aug-22*
Cash	**179**	**0.0**	**0.0**									

Closed End Real Estate, Private Equity, and Private Debt market values are as of September 30, 2022 and adjusted for subsequent flows.

North American Strategic Partners market value is cash adjusted as of December 31, 2021. The fund is currently in the liquidation process and will only be reported on annually (as of December 31).

	Calendar Year Performance									
	2022 (%)	2021 (%)	2020 (%)	2019 (%)	2018 (%)	2017 (%)	2016 (%)	2015 (%)	2014 (%)	2013 (%)
Total Retirement System	**-12.5**	**13.8**	**14.2**	**17.5**	**-4.5**	**13.0**	**8.7**	**-0.2**	**6.3**	**14.0**
55% MSCI World & 45% Barclays Aggregate	*-15.6*	*10.9*	*12.9*	*19.1*	*-4.6*	*13.6*	*5.5*	*0.0*	*5.5*	*13.0*
60% MSCI World & 40% Barclays Aggregate	*-15.9*	*12.0*	*13.3*	*20.0*	*-5.1*	*14.5*	*5.7*	*-0.1*	*5.4*	*14.5*
Domestic Equity Assets	**-16.9**	**24.8**	**13.4**	**27.6**	**-6.9**	**20.1**	**14.6**	**-1.6**	**13.1**	**33.1**
Russell 3000	*-19.2*	*25.7*	*20.9*	*31.0*	*-5.2*	*21.1*	*12.7*	*0.5*	*12.6*	*33.6*
RhumbLine S&P 500 Index	-18.1	28.6	18.3	31.4	-4.4	21.8	11.9	1.4	13.6	32.2
S&P 500	*-18.1*	*28.7*	*18.4*	*31.5*	*-4.4*	*21.8*	*12.0*	*1.4*	*13.7*	*32.4*
Frontier Capital Appreciation	-18.0	18.2	18.1	28.9	-13.9	19.1	20.5	-6.5	12.4	--
Russell 2500 Growth	*-26.2*	*5.0*	*40.5*	*32.7*	*-7.5*	*24.5*	*9.7*	*-0.2*	*7.1*	*40.6*
RhumbLine HEDI	-15.2	25.5	--	--	--	--	--	--	--	--
Russell 1000 HEDI Moderate GR USD	*-15.1*	*25.5*	*18.5*	*32.7*	*-0.9*	*23.4*	*11.4*	*4.8*	*15.4*	*30.9*
International Developed Markets Equity Assets	**-14.2**	**11.5**	**7.9**	**22.3**	**-13.5**	**24.9**	**1.4**	**-0.8**	**-8.7**	**21.2**
MSCI EAFE	*-14.5*	*11.3*	*7.8*	*22.0*	*-13.8*	*25.0*	*1.0*	*-0.8*	*-4.9*	*22.8*
RhumbLine MSCI EAFE Index	-14.2	11.5	7.9	22.3	-13.5	24.9	1.4	-0.8	--	--
MSCI EAFE	*-14.5*	*11.3*	*7.8*	*22.0*	*-13.8*	*25.0*	*1.0*	*-0.8*	*-4.9*	*22.8*
International Emerging Markets Equity Assets	**-19.3**	**2.3**	**21.1**	**20.7**	**-15.4**	**39.7**	**9.4**	**-12.7**	**--**	**--**
MSCI Emerging Markets	*-20.1*	*-2.5*	*18.3*	*18.4*	*-14.6*	*37.3*	*11.2*	*-14.9*	*-2.2*	*-2.6*
DFA Emerging Markets	-16.4	5.8	13.9	16.0	-15.2	36.6	12.4	-14.9	--	--
MSCI Emerging Markets	*-20.1*	*-2.5*	*18.3*	*18.4*	*-14.6*	*37.3*	*11.2*	*-14.9*	*-2.2*	*-2.6*
Driehaus Emerging Market Equity	-22.4	-1.5	28.0	25.3	-15.6	43.0	6.5	-10.6	--	--
MSCI Emerging Markets	*-20.1*	*-2.5*	*18.3*	*18.4*	*-14.6*	*37.3*	*11.2*	*-14.9*	*-2.2*	*-2.6*

	2022 (%)	2021 (%)	2020 (%)	2019 (%)	2018 (%)	2017 (%)	2016 (%)	2015 (%)	2014 (%)	2013 (%)
Investment Grade Bonds Assets	**-13.2**	**-1.6**	**7.5**	**8.7**	**0.0**	**3.6**	**2.6**	**0.6**	**6.0**	**-2.0**
Bloomberg US Aggregate TR	*-13.0*	*-1.5*	*7.5*	*8.7*	*0.0*	*3.5*	*2.6*	*0.5*	*6.0*	*-2.0*
PRIT Core Fixed Income	*-18.3*	*0.1*	*12.0*	*11.2*	*-0.9*	*5.3*	*3.9*	*-2.0*	*15.1*	*-2.9*
SSgA U.S. Aggregate Bond Index	-13.2	-1.6	7.5	8.7	0.0	3.6	2.6	0.6	6.0	-2.0
Bloomberg US Aggregate TR	*-13.0*	*-1.5*	*7.5*	*8.7*	*0.0*	*3.5*	*2.6*	*0.5*	*6.0*	*-2.0*
High Yield Bond Assets	**-8.9**	**4.0**	**6.3**	**14.0**	**-1.8**	**6.5**	**12.6**	**-2.3**	**2.9**	**6.4**
Bloomberg US High Yield TR	*-11.2*	*5.3*	*7.1*	*14.3*	*-2.1*	*7.5*	*17.1*	*-4.5*	*2.5*	*7.4*
PRIT Public Value-Added Fixed Income	*-7.6*	*3.5*	*4.3*	*10.7*	*-2.5*	*8.5*	*11.2*	*-5.2*	*-0.7*	*-2.0*
Shenkman Capital	-8.8	4.0	6.3	14.0	-1.8	6.5	12.6	-2.3	2.9	6.4
Bloomberg US High Yield TR	*-11.2*	*5.3*	*7.1*	*14.3*	*-2.1*	*7.5*	*17.1*	*-4.5*	*2.5*	*7.4*
TIPS Assets	**-12.1**	**5.8**	**10.9**	**8.4**	**-1.4**	**3.0**	**4.7**	**-1.4**	**3.6**	**-8.6**
Bloomberg US TIPS TR	*-11.8*	*6.0*	*11.0*	*8.4*	*-1.3*	*3.0*	*4.7*	*-1.4*	*3.6*	*-8.6*
SSgA TIPS Index-NL	-12.1	5.8	10.9	8.4	-1.4	3.0	4.7	-1.4	3.6	-8.6
Bloomberg US TIPS TR	*-11.8*	*6.0*	*11.0*	*8.4*	*-1.3*	*3.0*	*4.7*	*-1.4*	*3.6*	*-8.6*
Emerging Market Debt Assets	**-17.4**	**-2.4**	**6.2**	**16.5**	**-7.0**	**12.0**	**11.5**	**-0.8**	**--**	**--**
JP Morgan EMBI Global Diversified	*-17.8*	*-1.8*	*5.3*	*15.0*	*-4.3*	*10.3*	*10.2*	*1.2*	*7.4*	*-5.3*
Payden Emerging Market Bond	-17.4	-2.4	6.2	16.5	-7.0	12.0	11.5	-0.8	--	--
JP Morgan EMBI Global Diversified	*-17.8*	*-1.8*	*5.3*	*15.0*	*-4.3*	*10.3*	*10.2*	*1.2*	*7.4*	*-5.3*
Open-Ended Real Estate	**9.6**	**23.4**	**2.2**	**7.3**	**8.6**	**7.9**	**9.1**	**15.7**	**13.2**	**12.8**
NCREIF ODCE	*7.5*	*22.2*	*1.2*	*5.3*	*8.3*	*7.6*	*8.8*	*15.1*	*12.5*	*13.9*
Clarion Partners	9.6	23.4	2.2	7.3	8.6	7.9	9.1	15.7	13.2	12.8
NCREIF ODCE	*7.5*	*22.2*	*1.2*	*5.3*	*8.3*	*7.6*	*8.8*	*15.1*	*12.5*	*13.9*

	2022 (%)	2021 (%)	2020 (%)	2019 (%)	2018 (%)	2017 (%)	2016 (%)	2015 (%)	2014 (%)	2013 (%)
Total Closed End Real Estate	**10.2**	**14.3**	**-5.3**	**-38.2**	**-1.8**	**15.1**	**9.5**	**23.8**	**13.3**	**18.8**
Rockwood Capital Real Estate Partners Fund XI, L.P.	10.2	14.3	0.0	--	--	--	--	--	--	--
NCREIF-ODCE	*7.5*	*22.2*	*1.2*	*5.3*	*8.3*	*7.6*	*8.8*	*15.0*	*12.5*	*13.9*
Private Equity Assets	**10.2**	**39.5**	**22.9**	**17.7**	**10.2**	**-5.3**	**-2.8**	**8.6**	**5.5**	**9.1**
North American Strategic Partners 2006										
Ironsides Partnership Fund IV										
Ironsides Direct Investment Fund IV										
Ironsides Partnership Fund V, L.P.										
Ironsides Direct Investment Fund V, L.P.										
HarbourVest 2019 Global Fund										
Private Debt Assets	**10.8**	--	--	--	--	--	--	--	--	--
NB Private Debt Fund IV										
Infrastructure	--	--	--	--	--	--	--	--	--	--
IFM Global Infrastructure	--	--	--	--	--	--	--	--	--	--
CPI + 3%	*9.6*	*10.2*	*4.4*	*5.3*	*5.0*	*5.2*	*5.1*	*3.7*	*3.8*	*4.5*
Cash										

Infrastructure Aggregate returns will be shown after the first full year of performance.
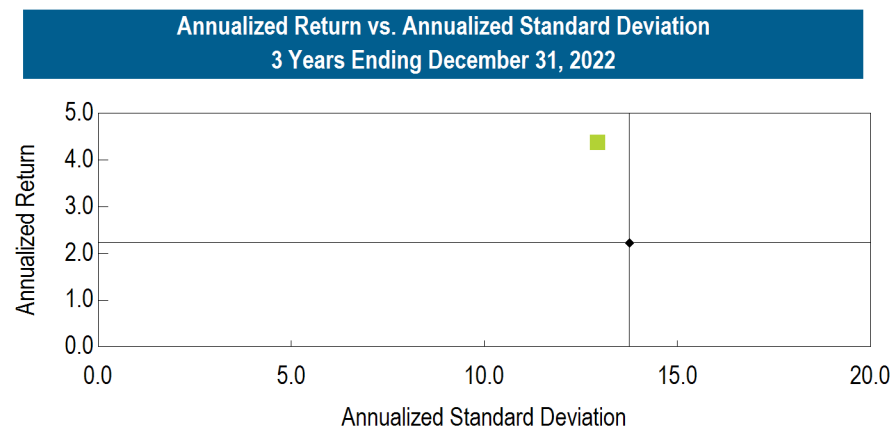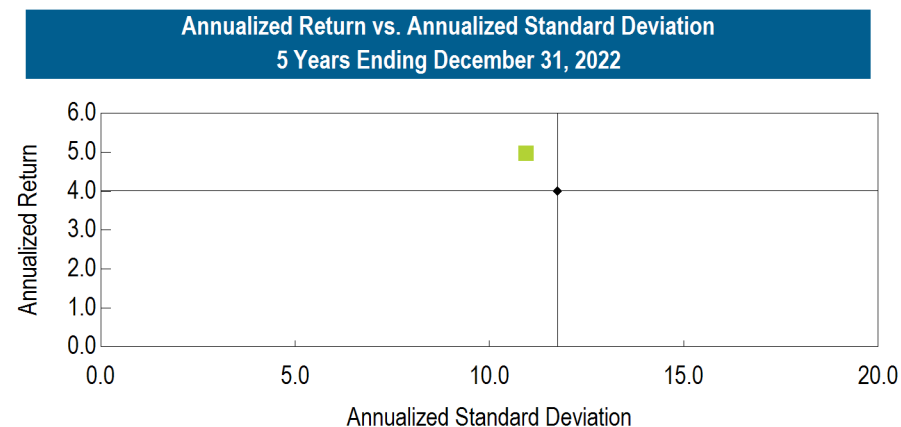
**Annualized Return vs. Annualized Standard Deviation
3 Years Ending December 31, 2022**

- Total Retirement System
- 60% MSCI World & 40% Barclays Aggregate

**Annualized Return vs. Annualized Standard Deviation
5 Years Ending December 31, 2022**

- Total Retirement System
- 60% MSCI World & 40% Barclays Aggregate

**Annualized Return vs. Annualized Standard Deviation
10 Years Ending December 31, 2022**

- Total Retirement System
- 60% MSCI World & 40% Barclays Aggregate

**Annualized Return vs. Annualized Standard Deviation
Since Inception**
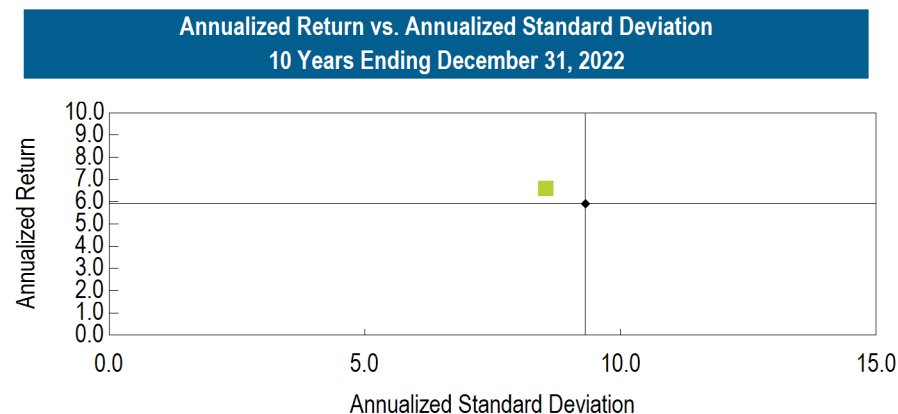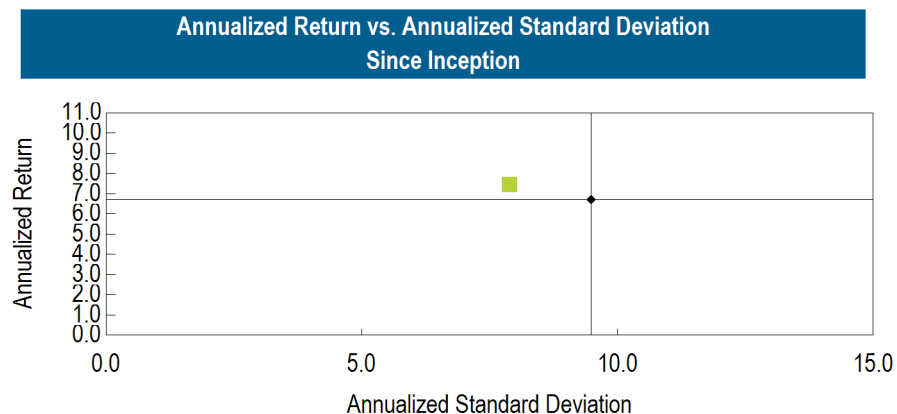
- Total Retirement System
- 60% MSCI World & 40% Barclays Aggregate

InvMetrics Public DB $50mm-$250mm Net Return Comparison
Ending December 31, 2022
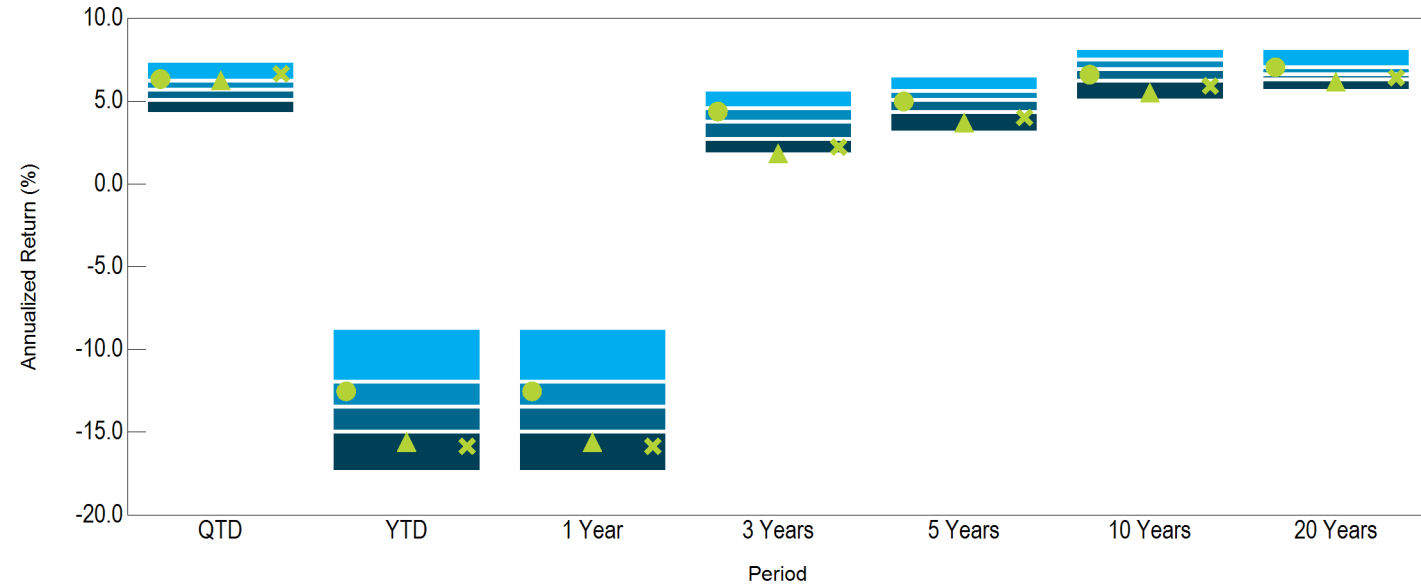
Return (Rank)														
	QTD		YTD		1 Year		3 Years		5 Years		10 Years		20 Years	
5th Percentile	7.4		-8.7		-8.7		5.7		6.5		8.2		8.2	
25th Percentile	6.2		-11.9		-11.9		4.6		5.6		7.5		7.1	
Median	5.7		-13.4		-13.4		3.8		5.1		6.9		6.7	
75th Percentile	5.1		-15.0		-15.0		2.7		4.4		6.2		6.3	
95th Percentile	4.2		-17.4		-17.4		1.8		3.1		5.0		5.6	
# of Portfolios	158		157		157		152		148		120		60	
● Total Retirement System	6.3	(22)	-12.5	(33)	-12.5	(33)	4.4	(30)	5.0	(57)	6.6	(65)	7.1	(26)
▲ 55% MSCI World & 45% Barclays Aggregate	6.3	(25)	-15.6	(84)	-15.6	(84)	1.9	(94)	3.7	(90)	5.5	(92)	6.2	(81)
✕ 60% MSCI World & 40% Barclays Aggregate	6.7	(17)	-15.9	(89)	-15.9	(89)	2.2	(89)	4.0	(85)	5.9	(87)	6.4	(68)

Statistics Summary 5 Years Ending December 31, 2022	Anlzd Return	Anlzd Standard Deviation	Information Ratio	Beta	Sharpe Ratio	Tracking Error
Total Retirement System	5.0%	10.9%	0.7	1.0	0.3	1.9%
55% MSCI World & 45% Barclays Aggregate	3.7%	11.0%	--	1.0	0.2	0.0%
Equity Assets	5.0%	18.3%	-1.0	0.9	0.2	3.8%
Russell 3000	8.8%	19.2%	--	1.0	0.4	0.0%
Domestic Equity Assets	6.9%	19.6%	-0.7	1.0	0.3	2.7%
Russell 3000	8.8%	19.2%	--	1.0	0.4	0.0%
RhumbLine S&P 500 Index	9.4%	18.7%	-1.2	1.0	0.4	0.0%
S&P 500	9.4%	18.7%	--	1.0	0.4	0.0%
Frontier Capital Appreciation	4.9%	25.9%	-0.1	1.0	0.1	9.1%
Russell 2500 Growth	6.0%	23.1%	--	1.0	0.2	0.0%
RhumbLine HEDI	--	--	--	--	--	--
Russell 1000 HEDI Moderate GR USD	10.7%	17.3%	--	1.0	0.5	0.0%
International Developed Markets Equity Assets	1.8%	17.4%	0.8	1.0	0.0	0.3%
MSCI EAFE	1.5%	17.5%	--	1.0	0.0	0.0%
RhumbLine MSCI EAFE Index	1.8%	17.4%	0.8	1.0	0.0	0.3%
MSCI EAFE	1.5%	17.5%	--	1.0	0.0	0.0%
International Emerging Markets Equity Assets	0.4%	17.9%	0.5	0.9	0.0	3.3%
MSCI Emerging Markets	-1.4%	18.8%	--	1.0	-0.1	0.0%

RhumbLine HEDI funded on 10/5/2020. Statistics will be reflected after first full five calendar years.

	Anlzd Return	Anlzd Standard Deviation	Information Ratio	Beta	Sharpe Ratio	Tracking Error
DFA Emerging Markets	-0.2%	19.4%	0.3	1.0	-0.1	4.0%
MSCI Emerging Markets	-1.4%	18.8%	--	1.0	-0.1	0.0%
Driehaus Emerging Market Equity	0.7%	17.1%	0.4	0.9	0.0	5.5%
MSCI Emerging Markets	-1.4%	18.8%	--	1.0	-0.1	0.0%
Investment Grade Bonds Assets	-0.1%	5.1%	-0.8	1.0	-0.2	0.1%
Bloomberg US Aggregate TR	0.0%	5.1%	--	1.0	-0.2	0.0%
SSgA U.S. Aggregate Bond Index	-0.1%	5.1%	-0.8	1.0	-0.2	0.1%
Bloomberg US Aggregate TR	0.0%	5.1%	--	1.0	-0.2	0.0%
High Yield Bond Assets	2.4%	8.1%	0.1	0.9	0.2	1.2%
Bloomberg US High Yield TR	2.3%	9.1%	--	1.0	0.1	0.0%
Shenkman Capital	2.4%	8.1%	0.1	0.9	0.2	1.2%
Bloomberg US High Yield TR	2.3%	9.1%	--	1.0	0.1	0.0%
TIPS Assets	2.0%	5.8%	-1.3	1.0	0.1	0.1%
Bloomberg US TIPS TR	2.1%	5.8%	--	1.0	0.2	0.0%
SSgA TIPS Index-NL	2.0%	5.8%	-1.3	1.0	0.1	0.1%
Bloomberg US TIPS TR	2.1%	5.8%	--	1.0	0.2	0.0%
Emerging Market Debt Assets	-1.5%	12.7%	-0.1	1.1	-0.2	2.5%
JP Morgan EMBI Global Diversified	-1.3%	11.1%	--	1.0	-0.2	0.0%
Payden Emerging Market Bond	-1.5%	12.7%	-0.1	1.1	-0.2	2.5%
JP Morgan EMBI Global Diversified	-1.3%	11.1%	--	1.0	-0.2	0.0%

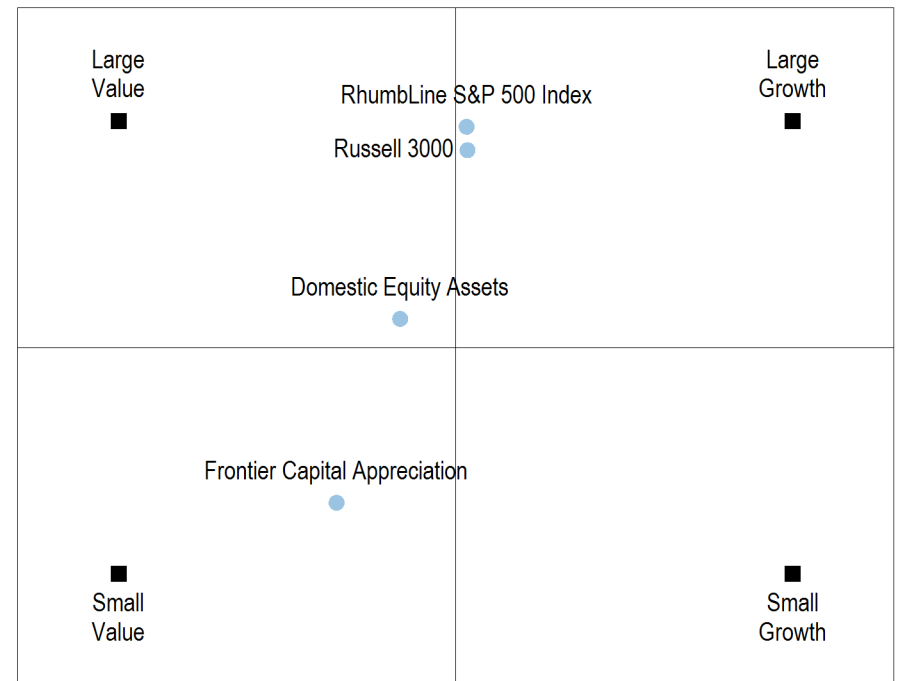|	Anlzd Return	Anlzd Standard Deviation	Information Ratio	Beta	Sharpe Ratio	Tracking Error
Open-Ended Real Estate	10.0%	7.3%	0.9	1.1	1.2	1.5%
NCREIF ODCE	8.7%	6.8%	--	1.0	1.1	0.0%
Clarion Partners	10.0%	7.3%	0.9	1.1	1.2	1.5%
NCREIF ODCE	8.7%	6.8%	--	1.0	1.1	0.0%
Total Closed End Real Estate	-6.3%	22.1%	-0.7	0.6	-0.3	21.9%
NCREIF ODCE	8.7%	6.8%	--	1.0	1.1	0.0%
Rockwood Capital Real Estate Partners Fund XI, L.P.	--	--	--	--	--	--
NCREIF-ODCE	8.7%	6.8%	--	1.0	1.1	0.0%
IFM Global Infrastructure	--	--	--	--	--	--
CPI + 3%	6.9%	1.4%	--	1.0	4.1	0.0%
EB Temporary Investment Fund	0.6%	0.5%	-1.2	0.4	-1.3	0.5%
91 Day T-Bills	1.2%	0.3%	--	1.0	0.0	0.0%

Rockwood Capital XI and IFM Global Infrastructure statistics will be reflected after first full five calendar years.

Retirement System Detail

Asset Allocation on December 31, 2022

	Actual	Actual
Frontier Capital Appreciation	$21,701,887	31.1%
RhumbLine HEDI	$27,413,336	39.2%
RhumbLine S&P 500 Index	$20,770,217	29.7%
Total	**$69,885,440**	**100.0%**

Domestic Equity Assets Style Map
3 Years Ending December 31, 2022

Domestic Equity Assets Characteristics	Portfolio Q4-22	Index Q4-22	Portfolio Q3-22
Market Value			
Market Value ($M)	69.9	--	67.8
Number Of Holdings	652	2960	665
Characteristics			
Weighted Avg. Market Cap. ($B)	279.9	360.3	315.5
Median Market Cap ($B)	24.3	2.5	22.9
P/E Ratio	19.2	18.5	18.0
Yield	1.4	1.7	1.5
EPS Growth - 5 Yrs.	16.8	17.2	16.8
Price to Book	3.6	3.6	3.4

Sector Allocation (%) vs Russell 3000

Sector	Domestic Equity Assets	Russell 3000
Energy	3.0	4.7
Materials	4.6	3.0
Industrials	16.5	9.8
Cons. Disc.	10.3	9.9
Cons. Staples	6.9	6.6
Health Care	13.7	15.7
Financials	11.9	12.4
Info. Tech.	23.0	24.6
Comm. Svc.	5.6	6.8
Utilities	1.0	3.1
Real Estate	1.8	3.3
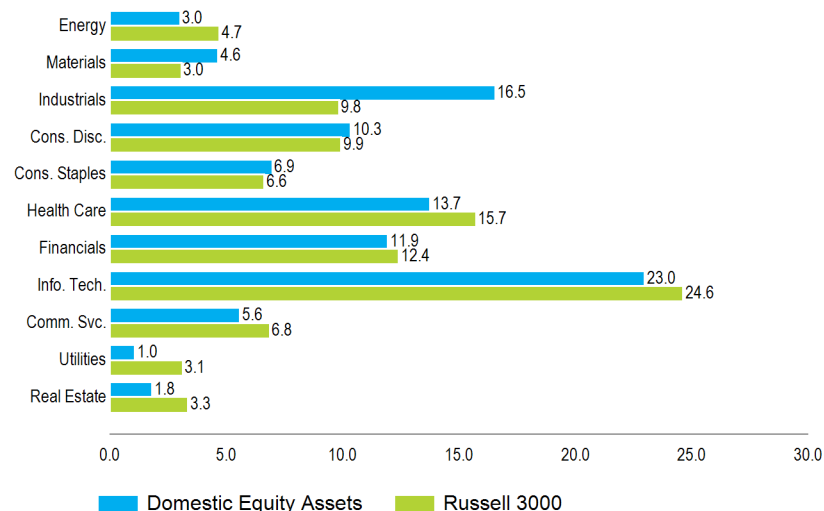
Top 10 Holdings

Holding	%
APPLE INC	3.9%
MICROSOFT CORP	3.8%
AMAZON.COM INC	1.2%
BERKSHIRE HATHAWAY INC	1.2%
ALPHABET INC	1.2%
ALPHABET INC	1.1%
UNITEDHEALTH GROUP INC	1.1%
JOHNSON & JOHNSON	1.1%
CASH - USD	1.0%
PROCTER & GAMBLE CO (THE)	0.8%
Total	**16.5%**

Asset Allocation on December 31, 2022
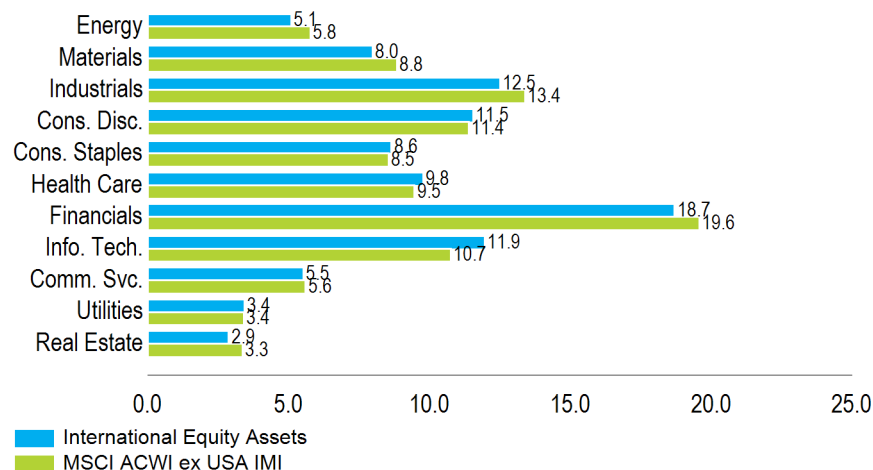
	Actual	Actual
DFA Emerging Markets	$9,391,333	22.4%
Driehaus Emerging Market Equity	$8,425,662	20.1%
RhumbLine MSCI EAFE Index	$24,044,037	57.4%
Total	**$41,861,031**	**100.0%**

International Equity Assets Style Map
3 Years Ending December 31, 2022
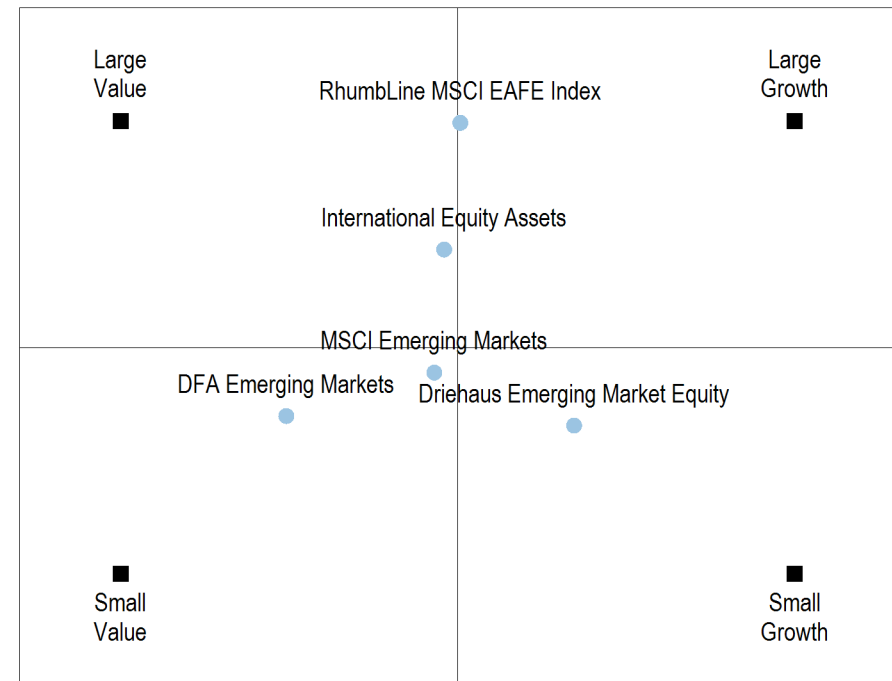
International Equity Characteristics			
	Portfolio Q4-22	Index Q4-22	Portfolio Q3-22
Market Value			
Market Value ($M)	41.9	--	37.1
Number Of Holdings	7252	6585	7388
Characteristics			
Weighted Avg. Market Cap. ($B)	84.0	69.8	75.5
Median Market Cap ($B)	0.7	1.6	0.6
P/E Ratio	12.3	12.6	11.3
Yield	3.4	3.4	3.6
EPS Growth - 5 Yrs.	11.7	11.5	13.7
Price to Book	2.5	2.4	2.5

Sector Allocation (%) vs MSCI ACWI ex USA IMI

Sector	International Equity Assets	MSCI ACWI ex USA IMI
Energy	5.1	5.8
Materials	8.0	8.8
Industrials	12.5	13.4
Cons. Disc.	11.5	11.4
Cons. Staples	8.6	8.5
Health Care	9.8	9.5
Financials	18.7	19.6
Info. Tech.	11.9	10.7
Comm. Svc.	5.5	5.6
Utilities	3.4	3.4
Real Estate	2.9	3.3

Top 10 Holdings	
SAMSUNG ELECTRONICS CO LTD	1.6%
TAIWAN SEMICONDUCTOR MANUFACTURING CO LTD	1.3%
NESTLE SA, CHAM UND VEVEY	1.3%
TENCENT HOLDINGS LTD	1.2%
AIA GROUP LTD	1.0%
NOVO NORDISK 'B'	0.9%
ROCHE HOLDING AG	0.9%
ASML HOLDING NV	0.9%
NORTHERN INSTITUTIONAL U.S. GOVERNMENT SELECT PORTFOLIO	0.8%
ASTRAZENECA PLC	0.8%
Total	**10.7%**

MEKETA

| Country Allocation Report | | | |
| As of 12/31/2022 | | | |
Region	% of Total	% of Bench	% Diff
North America ex U.S.	0.1%	7.7%	-7.6%
United States	1.5%	0.0%	1.5%
Europe Ex U.K.	30.5%	30.5%	0.1%
United Kingdom	7.1%	9.8%	-2.7%
Pacific Basin Ex Japan	9.7%	8.4%	1.2%
Japan	12.6%	15.0%	-2.4%
Emerging Markets	37.3%	27.7%	9.6%
Other	1.1%	0.9%	0.2%
Total	**100.0%**	**100.0%**	**0.0%**

International Equity Country Allocation vs MSCI ACWI ex USA IMI			
Country	% of Total	% of Bench	% Diff
ARGENTINA	0.2%	0.0%	0.2%
AUSTRALIA	4.4%	5.3%	-1.0%
AUSTRIA	0.1%	0.2%	-0.1%
BAHRAIN	0.0%	0.0%	0.0%
BANGLADESH	0.0%	0.0%	0.0%
BELGIUM	0.5%	0.7%	-0.2%
BRAZIL	2.3%	1.5%	0.8%
CANADA	0.1%	7.7%	-7.6%
CHILE	0.1%	0.2%	0.0%
CHINA	9.2%	8.2%	0.9%
COLOMBIA	0.0%	0.0%	0.0%
CROATIA	0.0%	0.0%	0.0%
CZECH REPUBLIC	0.0%	0.0%	0.0%
DENMARK	1.7%	1.8%	-0.1%
EGYPT	0.0%	0.0%	0.0%
ESTONIA	0.0%	0.0%	0.0%
FINLAND	0.7%	0.7%	0.0%
FRANCE	6.4%	6.9%	-0.5%
GERMANY	4.6%	4.9%	-0.3%
GREECE	0.2%	0.1%	0.1%
HONG KONG	4.2%	1.9%	2.3%
HUNGARY	0.0%	0.0%	0.0%
INDIA	7.2%	4.4%	2.8%
INDONESIA	1.1%	0.6%	0.5%

Country	% of Total	% of Bench	% Diff
IRELAND	0.6%	0.4%	0.2%
ISRAEL	0.5%	0.7%	-0.1%
ITALY	1.1%	1.6%	-0.5%
JAPAN	12.6%	15.0%	-2.4%
JORDAN	0.0%	0.0%	0.0%
KAZAKHSTAN	0.0%	0.0%	0.0%
KENYA	0.0%	0.0%	0.0%
KOREA	4.7%	3.3%	1.5%
KUWAIT	0.0%	0.3%	-0.3%
LEBANON	0.0%	0.0%	0.0%
LITHUANIA	0.0%	0.0%	0.0%
LUXEMBOURG	0.4%	0.0%	0.4%
MALAYSIA	0.4%	0.5%	-0.1%
MAURITIUS	0.0%	0.0%	0.0%
MEXICO	1.3%	0.6%	0.6%
MOROCCO	0.0%	0.0%	0.0%
NETHERLANDS	4.5%	2.5%	1.9%
NEW ZEALAND	0.1%	0.2%	-0.1%
NIGERIA	0.0%	0.0%	0.0%
NORWAY	0.5%	0.6%	-0.2%
OMAN	0.0%	0.0%	0.0%
OTHER	0.4%	0.0%	0.4%
PAKISTAN	0.0%	0.0%	0.0%
PERU	0.2%	0.1%	0.2%
PHILIPPINES	0.2%	0.2%	0.0%
POLAND	0.2%	0.2%	0.0%
PORTUGAL	0.1%	0.2%	0.0%

Country	% of Total	% of Bench	% Diff
QATAR	0.4%	0.3%	0.1%
ROMANIA	0.0%	0.0%	0.0%
SAUDI ARABIA	1.3%	1.1%	0.2%
SERBIA	0.0%	0.0%	0.0%
SINGAPORE	1.0%	1.0%	0.0%
SLOVENIA	0.0%	0.0%	0.0%
SOUTH AFRICA	1.0%	1.0%	0.0%
SPAIN	1.4%	1.5%	-0.1%
SRI LANKA	0.0%	0.0%	0.0%
SWEDEN	1.8%	2.4%	-0.6%
SWITZERLAND	6.1%	6.0%	0.1%
TAIWAN	5.5%	4.1%	1.4%
THAILAND	1.2%	0.7%	0.5%
TUNISIA	0.0%	0.0%	0.0%
TURKEY	0.2%	0.2%	0.0%
UNITED ARAB EMIRATES	0.6%	0.4%	0.3%
UNITED KINGDOM	7.1%	9.8%	-2.7%
UNITED STATES	1.5%	0.0%	1.5%
VIETNAM	0.1%	0.0%	0.1%
Total	**100.0%**	**100.0%**	**0.0%**

Asset Allocation on December 31, 2022	Actual	Actual
Payden Emerging Market Bond	$4,781,153	8.6%
Shenkman Capital	$16,948,759	30.4%
SSgA TIPS Index-NL	$9,311,205	16.7%
SSgA U.S. Aggregate Bond Index	$24,762,569	44.4%
Total	$55,803,687	100.0%

Fixed Income Characteristics vs. Bloomberg US Universal TR	Portfolio	Index	Portfolio
	Q4-22	Q4-22	Q3-22
Fixed Income Characteristics			
Yield to Maturity	6.1	5.1	6.3
Average Duration	5.3	6.0	5.4
Average Quality	A	AA	A
Weighted Average Maturity	7.5	8.3	7.6

Sector Allocation
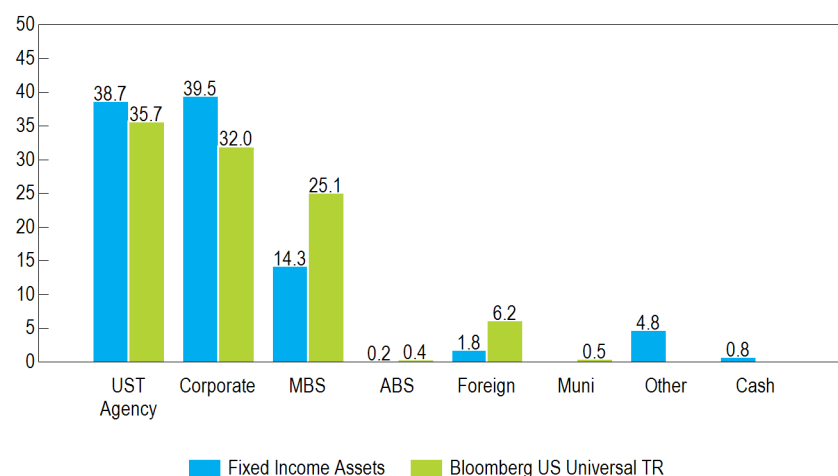
Credit Quality Allocation
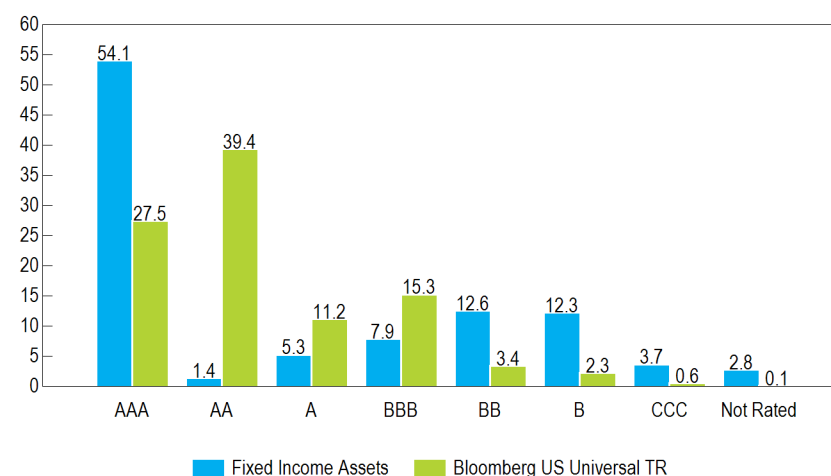
Portfolio Reviews

Account Information

Account Name	RhumbLine S&P 500 Index
Account Structure	Commingled Fund
Investment Style	Passive
Inception Date	3/01/99
Account Type	US Equity
Benchmark	S&P 500
Universe	eV US Passive S&P 500 Equity Net

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
RhumbLine S&P 500 Index	7.6	-18.1	7.6	9.4	12.5	6.9	Mar-99
S&P 500	7.6	-18.1	7.7	9.4	12.6	6.9	Mar-99

Top 10 Holdings

APPLE INC	6.2%
MICROSOFT CORP	5.7%
AMAZON.COM INC	2.4%
BERKSHIRE HATHAWAY INC	1.8%
ALPHABET INC	1.7%
UNITEDHEALTH GROUP INC	1.6%
ALPHABET INC	1.5%
JOHNSON & JOHNSON	1.5%
EXXON MOBIL CORP	1.4%
JPMORGAN CHASE & CO	1.3%
Total	**24.9%**

RhumbLine S&P 500 Index Equity Characteristics vs S&P 500

	Portfolio Q4-22	Index Q4-22	Portfolio Q3-22
Market Value			
Market Value ($M)	20.8	--	21.3
Number Of Holdings	485	503	507
Characteristics			
Weighted Avg. Market Cap. ($B)	424.5	415.6	463.5
Median Market Cap ($B)	29.6	29.6	27.1
P/E Ratio	19.3	19.5	18.4
Yield	1.8	1.7	1.8
EPS Growth - 5 Yrs.	17.0	16.8	17.1
Price to Book	3.9	3.9	3.8
Sector Distribution			
Energy	5.3	5.1	4.6
Materials	2.7	2.7	2.5
Industrials	7.9	8.6	7.8
Consumer Discretionary	9.6	10.0	11.6
Consumer Staples	7.3	7.8	6.8
Health Care	15.7	15.4	15.0
Financials	12.1	12.0	11.4
Information Technology	25.6	25.3	26.2
Communication Services	7.3	7.5	8.0
Utilities	3.2	3.0	3.0
Real Estate	2.7	2.6	2.8

Account Information

Account Name	**RhumbLine HEDI**
Account Structure	**Separate Account**
Investment Style	**Passive**
Inception Date	**11/01/20**
Account Type	**US Equity**
Benchmark	**Russell 1000 HEDI Moderate GR USD**
Universe	**eV US Large Cap Core Equity Gross**

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
RhumbLine HEDI	8.4	-15.2	--	--	--	8.9	Nov-20
Russell 1000 HEDI Moderate GR USD	*8.6*	*-15.1*	*8.1*	*10.7*	*13.7*	*9.1*	*Nov-20*

Top 10 Holdings

MICROSOFT CORP	5.3%
APPLE INC	5.3%
BERKSHIRE HATHAWAY INC	1.8%
ALPHABET INC	1.8%
ALPHABET INC	1.7%
JOHNSON & JOHNSON	1.7%
UNITEDHEALTH GROUP INC	1.6%
AMAZON.COM INC	1.4%
PROCTER & GAMBLE CO (THE)	1.3%
VISA INC	1.2%
Total	**23.2%**

Rhumbline HEDI Characteristics

	Portfolio Q4-22	Portfolio Q3-22
Market Value		
Market Value ($M)	27.4	27.0
Number Of Holdings	231	229
Characteristics		
Weighted Avg. Market Cap. ($B)	367.2	402.6
Median Market Cap ($B)	34.4	32.1
P/E Ratio	22.1	21.0
Yield	1.6	1.7
EPS Growth - 5 Yrs.	15.3	16.1
Price to Book	4.8	4.5
Sector Distribution		
Energy	0.9	0.8
Materials	2.7	2.6
Industrials	16.8	16.3
Consumer Discretionary	9.2	9.9
Consumer Staples	12.2	11.7
Health Care	13.2	12.7
Financials	12.0	11.6
Information Technology	24.7	25.1
Communication Services	6.6	7.4
Utilities	0.3	0.3
Real Estate	1.3	1.5

Russell 1000 HEDI benchmark characteristic data is unavailable.

MEKETA

Account Information

Account Name	**Frontier Capital Appreciation**
Account Structure	**Commingled Fund**
Investment Style	**Active**
Inception Date	**2/01/13**
Account Type	**US Equity**
Benchmark	**Russell 2500 Growth**
Universe	**eV US Small-Mid Cap Growth Equity Net**

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
Frontier Capital Appreciation	11.0	-18.0	4.6	4.9	--	9.8	Feb-13
Russell 2500 Growth	*4.7*	*-26.2*	*2.9*	*6.0*	*10.6*	*10.0*	*Feb-13*

Top 10 Holdings

CASH - USD	3.1%
BUILDERS FIRSTSOURCE INC	2.2%
MRC GLOBAL INC	1.9%
ARRAY TECHNOLOGIES INC	1.8%
MACOM TECHNOLOGY SOLUTIONS HOLDINGS INC	1.8%
INSULET CORPORATION	1.7%
KBR INC	1.7%
ATI INC	1.6%
BANCORP INC (THE)	1.5%
JABIL INC	1.5%
Total	**18.6%**

Frontier Capital Appreciation Characteristics

	Portfolio Q4-22	Index Q4-22	Portfolio Q3-22
Market Value			
Market Value ($M)	21.7	--	19.5
Number Of Holdings	142	1340	136
Characteristics			
Weighted Avg. Market Cap. ($B)	7.4	6.0	7.1
Median Market Cap ($B)	4.1	1.8	3.7
P/E Ratio	14.7	16.7	13.9
Yield	0.8	0.9	0.8
EPS Growth - 5 Yrs.	20.5	22.0	18.4
Price to Book	2.5	4.1	2.4
Sector Distribution			
Energy	3.5	6.2	3.7
Materials	8.8	5.2	9.3
Industrials	24.1	18.5	22.8
Consumer Discretionary	12.3	12.2	12.3
Consumer Staples	0.0	4.0	0.0
Health Care	12.6	19.4	13.3
Financials	11.7	6.9	14.9
Information Technology	18.3	22.0	17.3
Communication Services	2.5	1.8	2.0
Utilities	0.0	1.3	0.0
Real Estate	1.5	2.6	1.4

Account Information

Account Name	RhumbLine MSCI EAFE Index
Account Structure	Commingled Fund
Investment Style	Passive
Inception Date	8/01/14
Account Type	Non-US Stock Developed
Benchmark	MSCI EAFE
Universe	eV EAFE All Cap Equity Net

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
RhumbLine MSCI EAFE Index	17.2	-14.2	1.1	1.8	--	2.9	Aug-14
MSCI EAFE	17.3	-14.5	0.9	1.5	4.7	2.7	Aug-14

Top 10 Holdings

NESTLE SA, CHAM UND VEVEY	2.2%
NOVO NORDISK 'B'	1.5%
ROCHE HOLDING AG	1.5%
ASML HOLDING NV	1.5%
ASTRAZENECA PLC	1.5%
SHELL PLC	1.4%
LVMH MOET HENNESSY LOUIS VUITTON SE	1.4%
NOVARTIS AG	1.4%
BHP GROUP LTD	1.1%
TOTALENERGIES SE	1.1%
Total	**14.6%**

Rhumbline MSCI EAFE Index Characteristics

	Portfolio Q4-22	Index Q4-22	Portfolio Q3-22
Market Value			
Market Value ($M)	24.0	--	20.5
Number Of Holdings	787	796	802
Characteristics			
Weighted Avg. Market Cap. ($B)	78.9	78.1	68.1
Median Market Cap ($B)	11.7	11.8	10.4
P/E Ratio	13.8	13.7	12.2
Yield	3.4	3.4	3.7
EPS Growth - 5 Yrs.	9.9	9.9	11.6
Price to Book	2.5	2.4	2.4
Sector Distribution			
Energy	4.9	5.0	4.9
Materials	7.7	7.8	7.3
Industrials	14.8	15.1	14.5
Consumer Discretionary	10.9	11.1	10.7
Consumer Staples	10.2	10.5	10.9
Health Care	13.4	13.6	13.5
Financials	18.4	18.7	17.3
Information Technology	7.7	7.8	7.7
Communication Services	4.4	4.5	4.6
Utilities	3.4	3.5	3.3
Real Estate	2.6	2.6	2.7

Account Information

Account Name	DFA Emerging Markets
Account Structure	Mutual Fund
Investment Style	Active
Inception Date	1/01/15
Account Type	Non-US Stock Emerging
Benchmark	MSCI Emerging Markets
Universe	eV Emg Mkts All Cap Equity Net

DFA Emerging Markets Characteristics

	Portfolio Q4-22	Index Q4-22	Portfolio Q3-22
Market Value			
Market Value ($M)	9.4	--	8.5
Number Of Holdings	6441	1375	6568
Characteristics			
Weighted Avg. Market Cap. ($B)	59.8	95.7	52.5
Median Market Cap ($B)	0.5	6.5	0.4
P/E Ratio	9.5	11.4	8.6
Yield	4.2	3.4	4.7
EPS Growth - 5 Yrs.	14.8	14.6	15.0
Price to Book	2.3	2.6	2.2
Sector Distribution			
Energy	5.1	4.9	5.5
Materials	12.9	8.9	12.8
Industrials	9.3	6.1	9.3
Consumer Discretionary	11.0	14.1	11.0
Consumer Staples	6.5	6.4	6.7
Health Care	4.6	4.1	4.5
Financials	17.2	22.1	16.9
Information Technology	18.8	18.6	18.6
Communication Services	7.4	9.9	7.3
Utilities	3.3	3.0	3.5
Real Estate	3.3	1.9	3.4

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
DFA Emerging Markets	10.5	-16.4	0.2	-0.2	--	3.3	Jan-15
MSCI Emerging Markets	*9.7*	*-20.1*	*-2.7*	*-1.4*	*1.4*	*2.4*	*Jan-15*

Top 10 Holdings

TENCENT HOLDINGS LTD	2.9%
SAMSUNG ELECTRONICS CO LTD	2.9%
TAIWAN SEMICONDUCTOR MANUFACTURING CO LTD	2.6%
TAIWAN SEMICONDUCTOR MANUFACTURING CO LTD	1.1%
CHINA CONSTRUCTION BANK CORP	1.0%
VALE SA	0.9%
ALIBABA GROUP HOLDING LTD	0.8%
PING AN INSURANCE GROUP	0.8%
RELIANCE INDUSTRIES LTD	0.7%
INFOSYS LTD	0.6%
Total	**14.5%**

Account Information

Account Name	**Driehaus Emerging Market Equity**
Account Structure	**Commingled Fund**
Investment Style	**Active**
Inception Date	**1/01/15**
Account Type	**Non-US Stock Emerging**
Benchmark	**MSCI Emerging Markets**
Universe	**eV Emg Mkts All Cap Equity Net**

Driehaus Emerging Market Equity Characteristics

	Portfolio Q4-22	Index Q4-22	Portfolio Q3-22
Market Value			
Market Value ($M)	8.4	--	8.1
Number Of Holdings	113	1375	99
Characteristics			
Weighted Avg. Market Cap. ($B)	130.0	95.7	120.2
Median Market Cap ($B)	18.4	6.5	20.0
P/E Ratio	13.7	11.4	14.3
Yield	2.3	3.4	2.3
EPS Growth - 5 Yrs.	13.3	14.6	16.7
Price to Book	2.8	2.6	2.8
Sector Distribution			
Energy	5.6	4.9	7.9
Materials	3.2	8.9	2.9
Industrials	9.4	6.1	9.2
Consumer Discretionary	13.9	14.1	16.0
Consumer Staples	6.6	6.4	8.9
Health Care	5.1	4.1	3.6
Financials	21.2	22.1	18.2
Information Technology	16.3	18.6	14.6
Communication Services	6.5	9.9	5.2
Utilities	3.4	3.0	2.6
Real Estate	3.1	1.9	3.1

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
Driehaus Emerging Market Equity	3.7	-22.4	-0.7	0.7	--	4.4	Jan-15
MSCI Emerging Markets	*9.7*	*-20.1*	*-2.7*	*-1.4*	*1.4*	*2.4*	*Jan-15*

Top 10 Holdings

TAIWAN SEMICONDUCTOR MANUFACTURING CO LTD	5.4%
SAMSUNG ELECTRONICS CO LTD	4.7%
NORTHERN INSTITUTIONAL U.S. GOVERNMENT SELECT PORTFOLIO	4.2%
ALIBABA GROUP HOLDING LTD	2.7%
TENCENT HOLDINGS LTD	2.6%
ICICI BANK LTD	2.2%
AIA GROUP LTD	2.2%
RELIANCE INDUSTRIES LTD	2.1%
MEITUAN DIANPING USD0.00001 A B CLASS ISIN KYG596691041	2.1%
GPO FINANCE BANORTE	1.9%
Total	**30.1%**

Account Information

Account Name	SSgA U.S. Aggregate Bond Index
Account Structure	Commingled Fund
Investment Style	Passive
Inception Date	5/01/01
Account Type	US Fixed Income Investment Grade
Benchmark	Bloomberg US Aggregate TR
Universe	eV US Core Fixed Inc Net

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
SSgA U.S. Aggregate Bond Index	1.7	-13.2	-2.8	-0.1	1.0	3.6	May-01
Bloomberg US Aggregate TR	*1.9*	*-13.0*	*-2.7*	*0.0*	*1.1*	*3.6*	*May-01*

SSgA U.S. Aggregate Bond Index Characteristics
vs. Bloomberg US Aggregate TR

	Portfolio Q4-22	Index Q4-22	Portfolio Q3-22
Fixed Income Characteristics			
Yield to Maturity	4.7	4.6	4.8
Average Duration	6.2	6.2	6.2
Average Quality	AA	AA	AA
Weighted Average Maturity	8.6	8.4	8.6

Credit Quality Allocation

	SSgA U.S. Aggregate Bond Index	Bloomberg US Aggregate TR
AAA	72.2	31.8
AA	3.0	44.6
A	10.9	9.9
BBB	12.8	13.6
BB		0.1
Not Rated	1.2	

Sector Allocation

	SSgA U.S. Aggregate Bond Index	Bloomberg US Aggregate TR
UST Agency	42.1	42.0
Corporate	24.3	24.3
MBS	29.4	29.4
ABS	0.5	0.5
Foreign	3.6	3.2
Muni		0.6
Cash	0.1	

Account Information

Account Name	**Shenkman Capital**
Account Structure	**Commingled Fund**
Investment Style	**Active**
Inception Date	**4/01/06**
Account Type	**US Fixed Income High Yield**
Benchmark	**Bloomberg US High Yield TR**
Universe	**eV US High Yield Fixed Inc Net**

Credit Quality Allocation

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
Shenkman Capital	3.6	-8.8	0.3	2.4	3.8	5.6	Apr-06
Bloomberg US High Yield TR	*4.2*	*-11.2*	*0.0*	*2.3*	*4.0*	*6.1*	*Apr-06*

Shenkman Capital Characteristics
vs. Bloomberg US High Yield TR

	Portfolio Q4-22	Index Q4-22	Portfolio Q3-22
Fixed Income Characteristics			
Yield to Maturity	8.7	8.9	9.0
Average Duration	3.4	4.3	3.7
Average Quality	BB	B	BB
Weighted Average Maturity	5.0	5.5	5.1
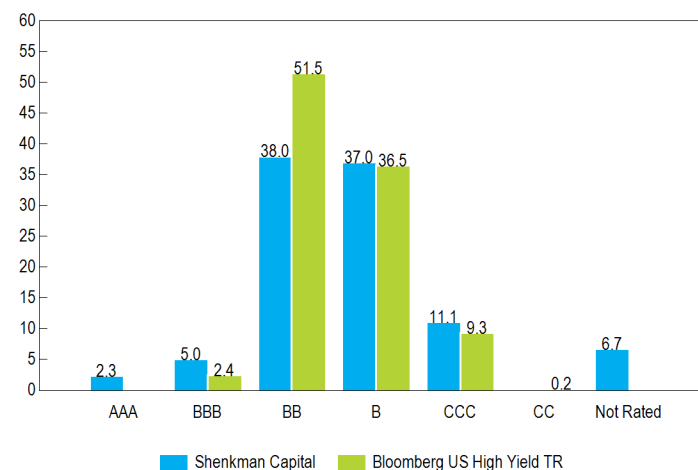
Sector Allocation

Account Information

Account Name	**SSgA TIPS Index-NL**
Account Structure	**Commingled Fund**
Investment Style	**Passive**
Inception Date	**10/01/05**
Account Type	**US Inflation Protected Fixed**
Benchmark	**Bloomberg US TIPS TR**
Universe	**eV US TIPS / Inflation Fixed Inc Net**

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
SSgA TIPS Index-NL	1.8	-12.1	1.0	2.0	1.1	3.3	Oct-05
Bloomberg US TIPS TR	*2.0*	*-11.8*	*1.2*	*2.1*	*1.1*	*3.3*	*Oct-05*

SSgA TIPS Index-NL Characteristics
vs. Bloomberg US TIPS TR

	Portfolio Q4-22	Index Q4-22	Portfolio Q3-22
Fixed Income Characteristics			
Yield to Maturity	4.3	4.1	4.2
Average Duration	5.4	6.6	5.9
Average Quality	AAA	AA	AAA
Weighted Average Maturity	7.1	7.1	7.3

Credit Quality Allocation

Sector Allocation

MEKETA
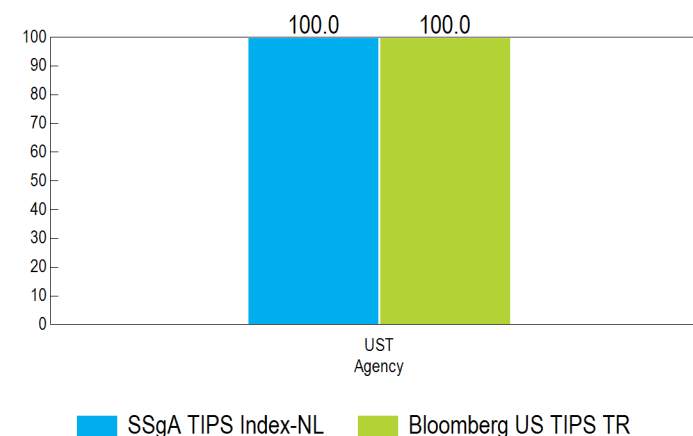
Account Information

Account Name	Payden Emerging Market Bond
Account Structure	Mutual Fund
Investment Style	Active
Inception Date	1/01/15
Account Type	International Emerging Market Debt
Benchmark	JP Morgan EMBI Global Diversified
Universe	

Payden Emerging Market Bond Characteristics
vs. JP Morgan EMBI Global Diversified

	Portfolio Q4-22	Index Q4-22	Portfolio Q3-22
Fixed Income Characteristics			
Yield to Maturity	8.2	7.8	8.5
Average Duration	7.6	6.8	6.7
Average Quality	BB	BB	BB
Weighted Average Maturity	12.0	11.7	12.3

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
Payden Emerging Market Bond	10.3	-17.4	-5.0	-1.5	--	1.8	Jan-15
JP Morgan EMBI Global Diversified	*8.1*	*-17.8*	*-5.3*	*-1.3*	*1.6*	*1.8*	*Jan-15*

Fixed Income Sectors as of September 30, 2022

GOVERNMENT	66.1%
MUNICIPAL	0.0%
CORPORATE	11.2%
SECURITIZED	0.0%
CASH & EQUIVALENTS	6.0%
DERIVATIVE	16.7%

Fund Characteristics as of September 30, 2022
Versus JP Morgan EMBI Global Diversified

Sharpe Ratio (3 Year)	-0.5
Average Duration	6.7
Average Coupon	5.8%
Average Effective Maturity	12.1
R-Squared (3 Year)	1.0
Alpha (3 Year)	0.1%
Beta (3 Year)	1.1

Credit Quality as of September 30, 2022

AAA	4.0%
AA	3.0%
A	5.0%
BBB	28.0%
BB	25.0%
B	24.0%
Below B	8.0%
Not Rated	3.0%

Account Information

Account Name	Clarion Partners
Account Structure	Commingled Fund
Investment Style	Active
Inception Date	10/01/02
Account Type	Real Estate
Benchmark	NCREIF ODCE
Universe	

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
Clarion Partners	-5.1	9.6	11.4	10.0	10.9	8.0	Oct-02
NCREIF ODCE	*-5.0*	*7.5*	*9.9*	*8.7*	*10.1*	*8.4*	*Oct-02*

Geographic Diversification

West 50.4 %
South 17.8 %
North 2.1 %
East 29.7 %

Property Type Allocation

Residential 28.3 %
Retail 5.8 %
Specialty 12.0 %
Industrial 34.4 %
Office 19.5 %
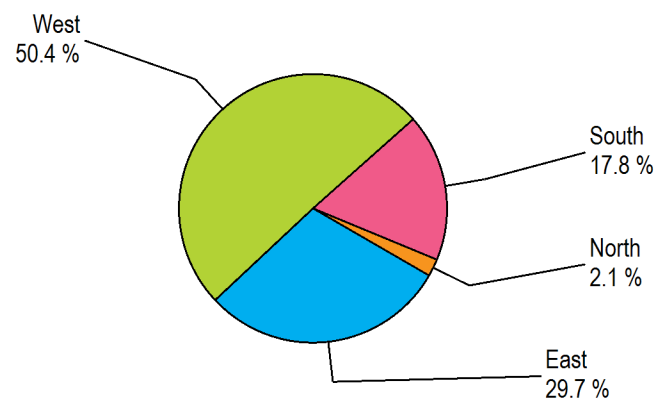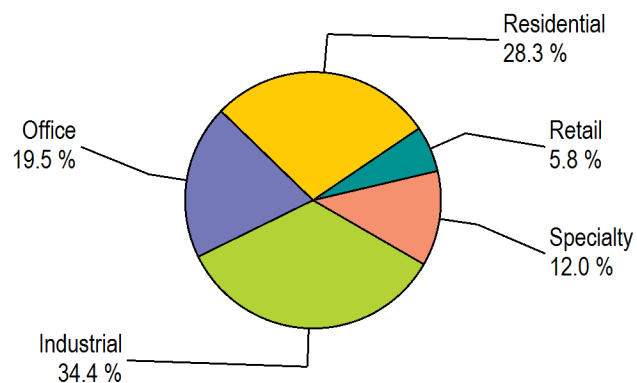
Clarion Partners characteristics are as of 12/31/2022.

Account Information

Account Name	Rockwood Capital Real Estate Partners Fund XI, L.P.
Account Structure	Other
Investment Style	Passive
Inception Date	12/01/19
Account Type	Real Estate
Benchmark	NCREIF-ODCE
Universe	

Geographic Diversification

West 73.6 %
South 3.3 %
East 23.1 %

Portfolio Performance Summary

	QTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Inception (%)	Inception Date
Rockwood Capital Real Estate Partners Fund XI, L.P.	1.2	10.2	8.0	--	--	7.8	Dec-19
NCREIF-ODCE	*-5.0*	*7.5*	*9.9*	*8.7*	*10.1*	*10.2*	*Dec-19*

Property Type Allocation

Residential 62.5 %
Office 37.5 %
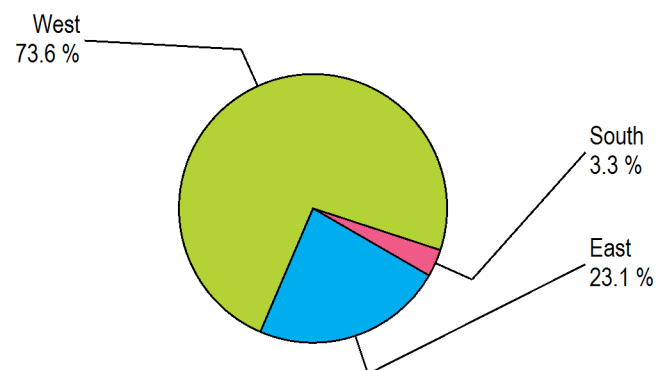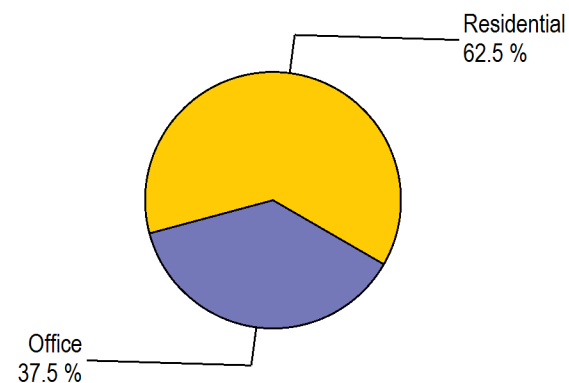
Rockwood Real Estate characteristics are as of 9/30/2022.

Non-Marketable Securities Overview As of December 31, 2022						
Account	Vintage Year	Commitment	Cumulative Takedown	Cumulative Distributions	Value (RV)	IRR (%)
North American Strategic Partners 2006	2006	$4,539,998	$4,411,659	$2,094,251	$18,450	6.4
Ironsides Partnership Fund IV	2015	$2,500,000	$1,424,191	$1,609,619	$2,405,983	30.2
Ironsides Direct Investment Fund IV	2015	$2,500,000	$2,419,534	$2,669,241	$2,131,251	21.6
Ironsides Partnership Fund V, L.P.	2019	$2,000,000	$1,301,601	$0	$1,809,405	26.7
Ironsides Direct Investment Fund V, L.P.	2019	$2,000,000	$2,538,377	$436,888	$3,055,003	24.4
HarbourVest 2019 Global Fund	2019	$4,000,000	$2,548,386	$533,243	$3,348,383	34.3
Total Account		**$17,539,998**	**$14,643,749**	**$3,154,739**	**$12,768,474**	

IRRs are as of 9/30/2022. Exceptions include North American Strategic Partners 2006 which is as of 12/31/2021.

Non-Marketable Securities Overview							
As of December 31, 2022							
Account Type	Account	Vintage Year	Commitment	Cumulative Takedown	Cumulative Distributions	Value (RV)	IRR (%)
Private Debt	NB Private Debt Fund IV	2021	$5,000,000	$3,250,000	$955,707	$2,509,202	--
	Total Account		**$5,000,000**	**$3,250,000**	**$955,707**	**$2,509,202**	

IRRs for investments less than 2 years are not shown.

Annual Investment Expense Analysis As Of December 31, 2022				
Name	**Fee Schedule**	**Market Value**	**Estimated Fee Value**	**Estimated Fee**
Equity Assets		**$111,746,471**		
Domestic Equity Assets		**$69,885,440**		
RhumbLine S&P 500 Index	0.07% of First 25.0 Mil, 0.05% of Next 25.0 Mil, 0.04% Thereafter	$20,770,217	$14,539	0.07%
Frontier Capital Appreciation	0.79% of Assets	$21,701,887	$171,445	0.79%
RhumbLine HEDI	0.05% of Assets	$27,413,336	$13,707	0.05%
International Equity Assets		**$41,861,031**		
International Developed Markets Equity Assets		**$24,044,037**		
RhumbLine MSCI EAFE Index	0.08% of First 25.0 Mil, 0.07% of Next 25.0 Mil, 0.05% Thereafter	$24,044,037	$19,235	0.08%
International Emerging Markets Equity Assets		**$17,816,994**		
DFA Emerging Markets	0.39% of Assets	$9,391,333	$36,626	0.39%
Driehaus Emerging Market Equity	0.90% of Assets	$8,425,662	$75,831	0.90%
Fixed Income Assets		**$55,803,687**		
Investment Grade Bonds Assets		**$24,762,569**		
SSgA U.S. Aggregate Bond Index	0.04% of Assets	$24,762,569	$9,905	0.04%
High Yield Bond Assets		**$16,948,759**		
Shenkman Capital	0.45% of Assets	$16,948,759	$76,269	0.45%
TIPS Assets		**$9,311,205**		
SSgA TIPS Index-NL	0.04% of Assets	$9,311,205	$3,724	0.04%
Emerging Market Debt Assets		**$4,781,153**		
Payden Emerging Market Bond	0.69% of Assets	$4,781,153	$32,990	0.69%
Real Estate Assets		**$11,160,085**		
Open-Ended Real Estate		**$7,215,131**		
Clarion Partners	1.10% of Assets	$7,215,131	$79,366	1.10%

Name	Fee Schedule	Market Value	Estimated Fee Value	Estimated Fee
Total Closed End Real Estate		**$3,944,954**		
Rockwood Capital Real Estate Partners Fund XI, L.P.	1.4% of committed capital during investment period; 1.4% on invested equity thereafter	$3,944,954		
Private Equity Assets		**$12,768,474**		
North American Strategic Partners 2006	0.8% on drawn and undrawn capital less investments sold or written off | 5% carried interest, 8% preferred return	$18,450		
Ironsides Partnership Fund IV	0% Management fee, 8% Preferred Return, 5% Carried Interest	$2,405,983		
Ironsides Direct Investment Fund IV	0.5% Management fee, 8% Preferred Return, 15% Carried Interest	$2,131,251		
Ironsides Partnership Fund V, L.P.		$1,809,405		
Ironsides Direct Investment Fund V, L.P.	0.5% Management fee, 8% preferred return, 15% carried interest	$3,055,003		
HarbourVest 2019 Global Fund	0.69% average annual management fee; 8.0% preferred return on secondary and direct investments and with corresponding carried interest of 12.5% on secondary and direct investments	$3,348,383		
Private Debt Assets		**$2,509,202**		
NB Private Debt Fund IV	1.0% on invested capital	$2,509,202		
Infrastructure		**$10,427,904**		
IFM Global Infrastructure	0.77% Management fee, 8% Preferred Return, 10% Carried Interest	$10,427,904		
Cash		**$179**		
EB Temporary Investment Fund		$179		
Total		**$204,416,002**	**$533,638**	**0.26%**

Meketa has negotiated a 50% discount on fees for NB Private Debt Fund IV through June 2022. After June 2022, depending on Meketa's aggregate investment, the fee will become 0.7% or return to 1%.

Asset Allocation Discussion

Introduction

Introduction

→ This document evaluates the current asset allocation policy and presents alternative asset allocation options for the System.

→ We provide various approaches to assessing risk in order to provide a "mosaic" of the risks faced by the System.

→ The goal of this review is not to declare one portfolio the "right" choice or the only prudent choice, but to highlight the risk and return tradeoffs of different policy portfolios.

→ This year's asset allocation review differs from other recent years' reviews due to the vast change in market-circumstances, primarily the large increase in interest rates during 2022.

- The abrupt increase of investment grade yields alongside relatively consistent credit spreads has meaningfully increased long-term expected returns across fixed income instruments.

- As a result, pension investors seeking mid-to-high single digit levels of nominal return are able to realistically consider lower equity asset allocations for the first time in over a decade.

Asset Allocation Overview

Mean Variance Optimization

→ MVO is the traditional starting point for determining asset allocation.

→ MVO mathematically determines an "efficient frontier" of policy portfolios with the highest risk-adjusted returns.

→ All asset classes exhibit only three characteristics, which serve as inputs to the model:

→ Expected return

→ Expected volatility

→ Expected covariance with all other assets

→ The model assumes:

→ Normal return distribution

→ Stable volatility and covariances over time

→ Returns are not serially correlated

→ The MVO model tends to underestimate the risks of large negative events.

Proposed Policy Options

Asset Allocation Policy Options[1]

	Current Policy (%)	Actual Allocation (%)	Option A (%)	Option B (%)	Option C (%)
Growth/Equity	55	62	48	42	35
US Equity	17	35	20	18	15
Developed Market Equity (non-US)	14	12	10	10	12
Emerging Market Equity	14	9	8	6	3
Private Equity	10	6	10	8	5
Credit	15	11	17	15	15
High Yield Bonds	5	8	7	5	5
Private Debt	8	1	5	5	5
Emerging Market Bonds	2	2	5	5	5
Rate Sensitive	10	17	22	33	40
Cash Equivalents	0	0	0	0	0
Investment Grade Bonds	5	12	17	23	30
TIPS	5	5	5	10	10
Real Assets	20	10	13	10	10
Real Estate	10	5	5	5	5
Infrastructure	10	5	8	5	5
Expected Return (20 years)	9.09	8.58	8.44	7.96	7.55
Standard Deviation	14.3	13.6	12.4	10.9	9.6
Probability of Achieving 7.5% over 20 Years	68.9	63.6	62.9	57.1	50.6

---

[1] Expected return and standard deviation are based upon Meketa Investment Group's 2023 Annual Asset Study. Throughout this document, returns for periods longer than one year are annualized.

Review of Proposed Asset Allocation Policies

→ The System's expected portfolio return has increased drastically due primarily to an increase in returns for fixed income instruments.

→ We prepared portfolios with the following aims in mind:

→ Keeping expected return within 1% of the actuarial target while still achieving that target.

→ Reducing volatility while maintaining adequate diversification.

→ Maintaining protection against othe risks to the portfolio, primarily but not limited to, inflation.

→ Reducing implementation lag for private market asset classes.

→ The asset allocation policies outlined incorporate various changes.

→ Moving toward global equity weight in public equity (contrast with emerging overweight)

→ Increasing public fixed income exposure.

→ Increasing liquidity.

- Decreasing targets to private asset classes with significant implementation lag.

→ Ultimately, the three alternative policy portfolios on the previous page were selected for presentation to the Board.

Diversification and Risk Analysis

Diversification

→ The primary motive for diversifying a portfolio is to reduce risk.

→ Diversification is the sole "free lunch" available to investors. That is, it represents the only way to reduce risk without reducing expected returns.

→ Therefore, investments should be allocated across multiple classes of assets, based in part on the expected correlation of their returns.

→ Within each asset type, investments should be distributed across strategies and risk factors to further reduce volatility.

Types of Risk Analysis Addressed

→ Risk budgeting[1]

- Attributes overall portfolio risks to specific asset classes

- Highlights the source and scale of portfolio-level risk

→ MVO-based risk analytics

- Includes worst-case return expectations and Value at Risk (VaR)[2]

- Relies on assumptions underlying MVO

→ Scenario analysis

- Stress tests policy portfolios using actual historical examples

- Stress tests policy portfolios under specific hypothetical scenarios.

---

[1] Risk budgeting seeks to decompose the aggregate risk of a portfolio into different sources (in this case, by asset class), with risk defined as standard deviation.

[2] VaR is a risk measure that estimates the maximum loss on a portfolio over a given time horizon and a given confidence level (usually 95% or 99%).

Risk Budgeting Analysis[1]
(Capital Allocation vs. Risk Allocation)

■ Growth/Equity   ■ Credit   ■ Rate Sensitive   ■ Real Assets   ■ Other
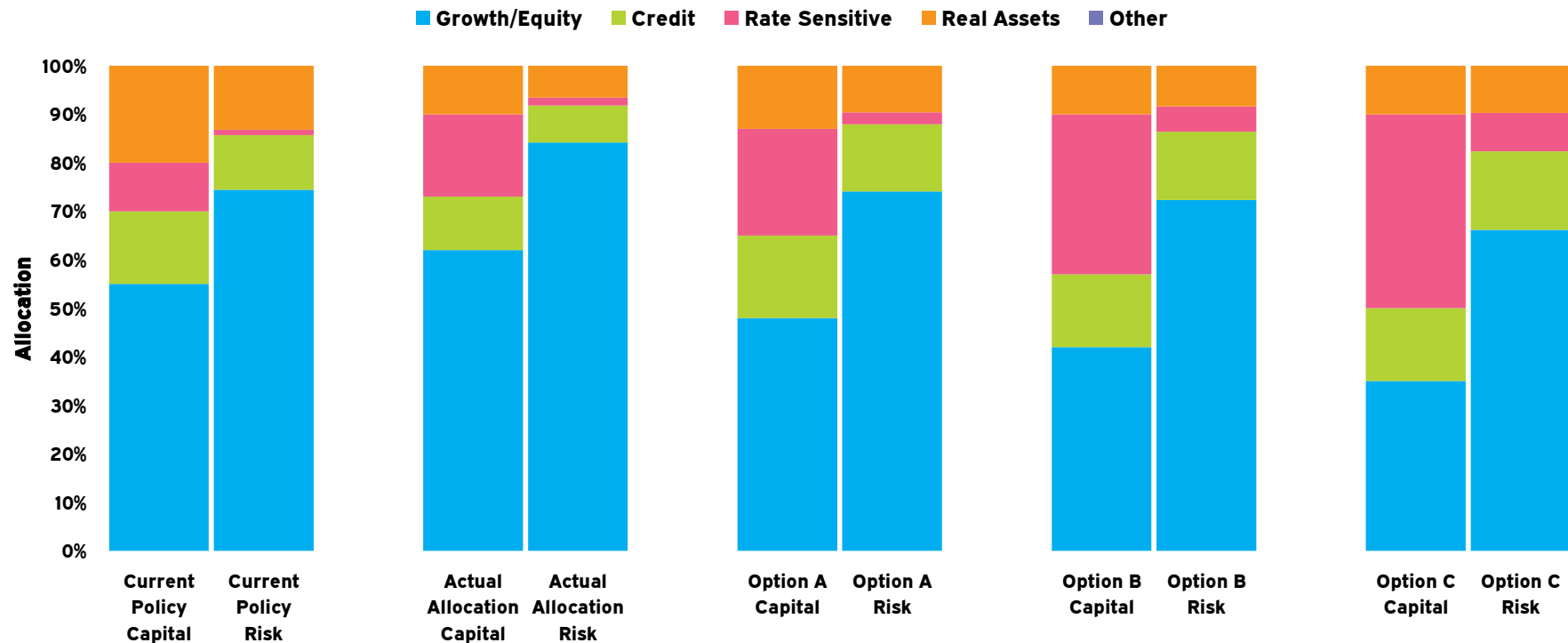
→ Assets with low relative volatility, such as rate sensitive fixed income, contribute less to risk than their asset weighting implies.

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[1] Risk allocation is calculated by multiplying the weight of the asset class by its standard deviation and its correlation with the total portfolio and then dividing this by the standard deviation of the total portfolio.

Risk Budgeting Analysis[1]
(Absolute Contribution to Risk)
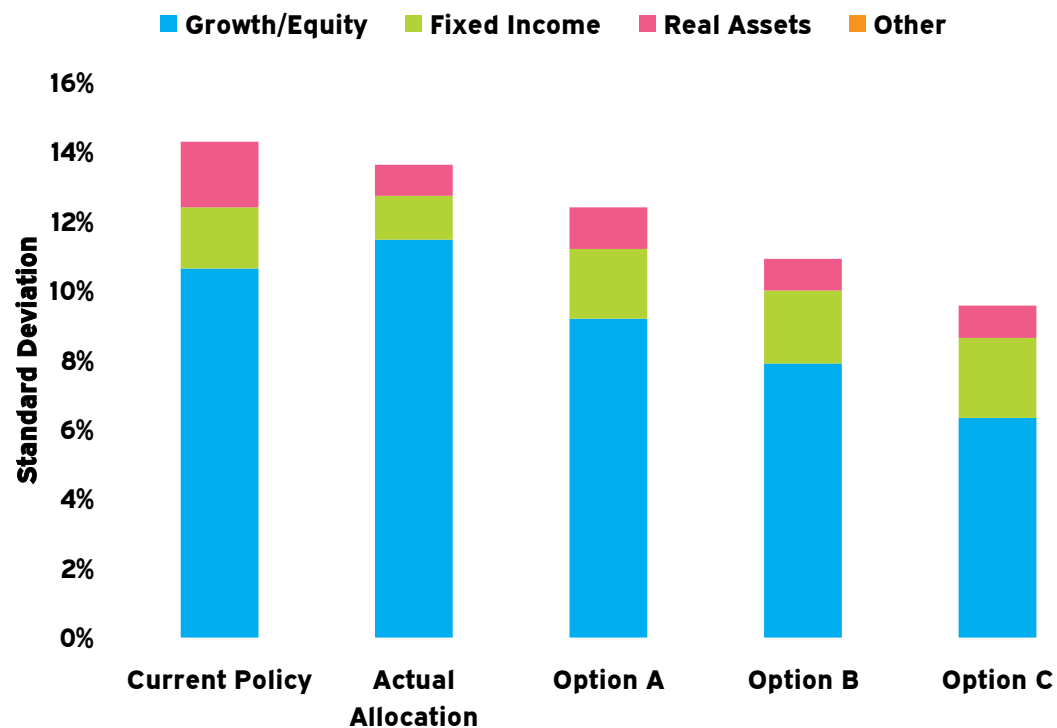
→ In each policy option, equity risk dominates the risk profile of the portfolio.

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[1] Contribution to risk is calculated by multiplying the weight of the asset class by its standard deviation and its correlation with the total portfolio.

MVO-Based Risk Analysis

Scenario	Current Policy (%)	Actual Allocation (%)	Option A (%)	Option B (%)	Option C (%)
Worst Case Returns (1)					
OneYear (annualized)	-19.3	-18.7	-16.7	-14.5	-12.5
ThreeYears (annualized)	-8.3	-8.1	-6.9	-5.7	-4.5
FiveYears (annualized)	-4.7	-4.6	-3.6	-2.8	-1.9
TenYears (annualized)	-0.9	-0.9	-0.3	0.3	0.8
TwentyYears (annualized)	1.9	1.8	2.2	2.4	2.7
Probability of Experiencing Negative Returns					
OneYear	25.2	25.4	23.8	22.3	20.6
ThreeYears	12.3	12.6	10.9	9.4	7.8
FiveYears	6.7	7.0	5.6	4.4	3.3
TenYears	1.7	1.8	1.2	0.8	0.5
TwentyYears	0.1	0.2	0.1	0.0	0.0
Probability of Achieving at least a 7.5% Return					
OneYear	54.4	53.1	52.9	51.6	50.1
ThreeYears	57.6	55.3	55.1	52.8	50.2
FiveYears	59.7	56.9	56.6	53.6	50.3
TenYears	63.6	59.7	59.2	55.1	50.4
TwentyYears	68.9	63.6	62.9	57.1	50.6

Conditional Value at Risk[1]

Scenario	Current Policy	Actual Allocation	Option A	Option B	Option C
CVaR (%):					
1 month	-10.2	-9.7	-8.8	-7.7	-6.7
3 months	-16.5	-15.8	-14.2	-12.4	-10.8
6 months	-21.9	-21.0	-18.8	-16.3	-14.1

$\rightarrow$ According to the cVaR model, the Fund could lose roughly 10% in a single month and 22% in 6 months with the current policy.

$\rightarrow$ cVar drops significantly in the alternative portfolios due to their lower forecast standard deviation.

Historical Negative Scenario Analysis[1]
(*Cumulative* Return)

Scenario	Current Policy (%)	Actual Allocation (%)	Option A (%)	Option B (%)	Option C (%)
COVID-19 Market Shock (Feb 2020-Mar 2020)	-17.9	-21.6	-16.5	-14.6	-13.1
Taper Tantrum (May - Aug 2013)	-0.7	-0.7	-1.0	-1.7	-2.0
Global Financial Crisis (Oct 2007 - Mar 2009)	-30.2	-30.8	-23.9	-20.0	-16.7
Popping of the TMT Bubble (Apr 2000 - Sep 2002)	-14.4	-18.9	-9.6	-4.4	0.1
LTCM (Jul - Aug 1998)	-9.3	-10.2	-8.3	-7.1	-5.9
Asian Financial Crisis (Aug 97 - Jan 98)	0.1	0.8	2.0	2.3	2.9
Rate spike (1994 Calendar Year)	0.8	0.2	-0.3	-0.6	-0.9
Early 1990s Recession (Jun - Oct 1990)	-6.7	-8.4	-5.8	-4.6	-3.7
Crash of 1987 (Sep - Nov 1987)	-11.0	-14.5	-9.8	-8.3	-6.8
Strong dollar (Jan 1981 - Sep 1982)	0.3	1.9	4.0	6.8	9.1
Volcker Recession (Jan - Mar 1980)	-3.5	-4.5	-4.3	-4.9	-5.2
Stagflation (Jan 1973 - Sep 1974)	-22.8	-25.6	-19.2	-16.0	-13.0

[1] See the Appendix for our scenario inputs. In periods where the ideal benchmark was not yet available we used the next closest benchmark(s) as a proxy.

Stress Testing: Impact of Market Movements
(Expected Return under Stressed Conditions)[1]

Scenario	Current Policy (%)	Actual Allocation (%)	Option A (%)	Option B (%)	Option C (%)
10-year Treasury Bond rates rise 100 bps	4.8	4.5	3.4	2.3	1.5
10-year Treasury Bond rates rise 200 bps	-1.1	-2.0	-2.6	-3.4	-4.1
10-year Treasury Bond rates rise 300 bps	-2.8	-2.5	-4.1	-5.2	-6.1
Baa Spreads widen by 50 bps, High Yield by 200 bps	0.1	0.1	0.5	0.9	1.3
Baa Spreads widen by 300 bps, High Yield by 1000 bps	-23.2	-24.1	-19.9	-17.8	-15.6
Trade Weighted Dollar gains 10%	-5.2	-4.7	-4.0	-3.5	-3.0
Trade Weighted Dollar gains 20%	-2.7	-1.3	-1.4	-0.9	-0.1
US Equities decline 10%	-6.2	-6.7	-5.4	-4.5	-3.6
US Equities decline 25%	-18.5	-18.9	-15.9	-13.9	-11.9
US Equities decline 40%	-28.3	-29.8	-24.3	-21.9	-19.3

→ Each policy portfolio has a different sensitivity to four major risk factors: interest rates, credit spreads, currency fluctuations, and equity values.

→ The Fund's primary risk factors would continue to be an equity market decline and a widening of credit spreads, no matter the policy.

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[1] Assumes that assets not directly exposed to the factor are affected nonetheless. See the Appendix for further details.

MEKETA

Liquidity Analysis

Recommendations

→ Liquidity risk is a meaningful risk that is generally not captured in traditional asset allocation processes.

→ The System must maintain adequate liquidity to satisfy benefit payments and to avoid having to sell illiquid assets at distressed prices if possible.

Liquidity Profile[1]
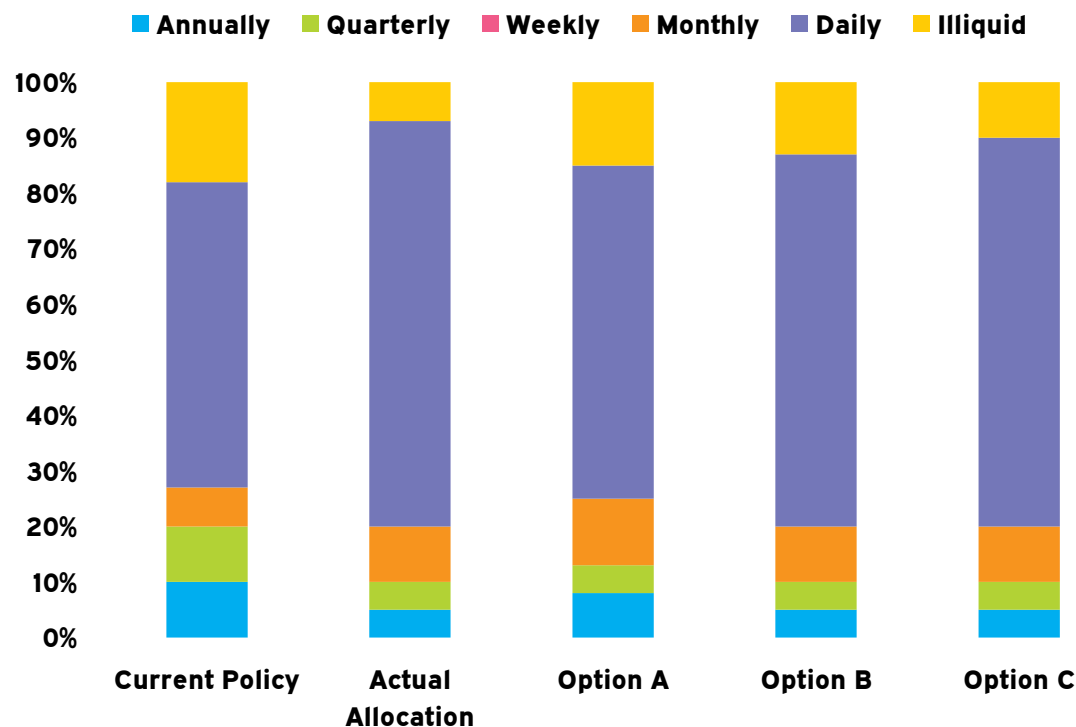
→ The alternative portfolios generally decrease illiquid investments and boost daily liquidity.

[1] For this analysis, we assume that emerging market debt provides monthly liquidity; core real estate and core infrastructure provide quarterly liquidity; and private equity, opportunistic debt, non-core real estate, and non-core infrastructure are illiquid.

Liquidity Stress Test Introduction

→ We conducted an extreme stress test to analyze the System's liquidity. Specifically, we evaluated whether the System could:

→ Only receive contributions sufficient to meet outflows (ie, no net external funding),

→ While staying within its target allocation ranges,

→ And at what cost (i.e., to what extent would it be forced to sell stressed or distressed assets)?

→ The scenario is designed to be extreme.

→ In Years 1 – 3, we use the returns produced by each asset class in 4Q07, 2008, and 1Q09, respectively. In Years 4 – 5, we assume flat (0%) returns for each asset class (i.e., no rebound).

→ We assume closed-end funds offer no liquidity in years 1 – 4, and very limited liquidity in year 5.

→ We assume open-end and hedge funds offer no liquidity in years 1 – 3, and limited liquidity in years 4 - 5.

→ We assume the System would rebalance toward its policy targets each year.

→ We show the results for Policy B on the following pages, as it is the middle case among the alternative options..

Liquidity Stress Test: Liquidity Profile
(for Policy B)
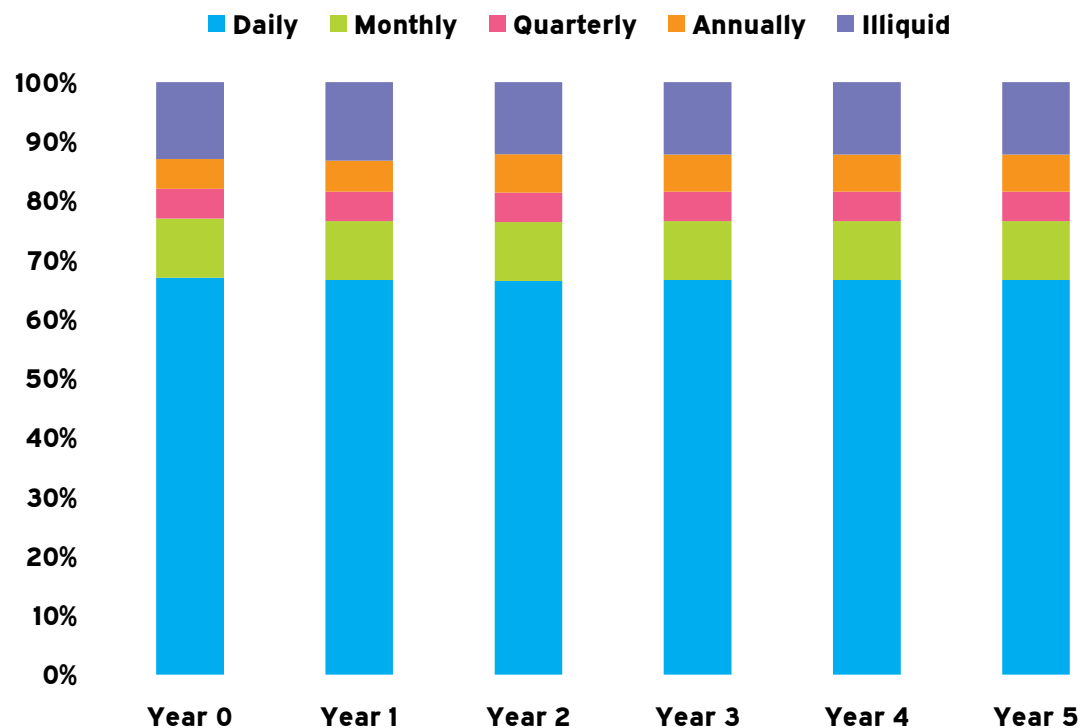
→ At the trough, the policy portfolio would have roughly two-thirds of its assets in daily liquid vehicles.

Liquidity Stress Test: Impact on Asset Allocation
(for Policy C)
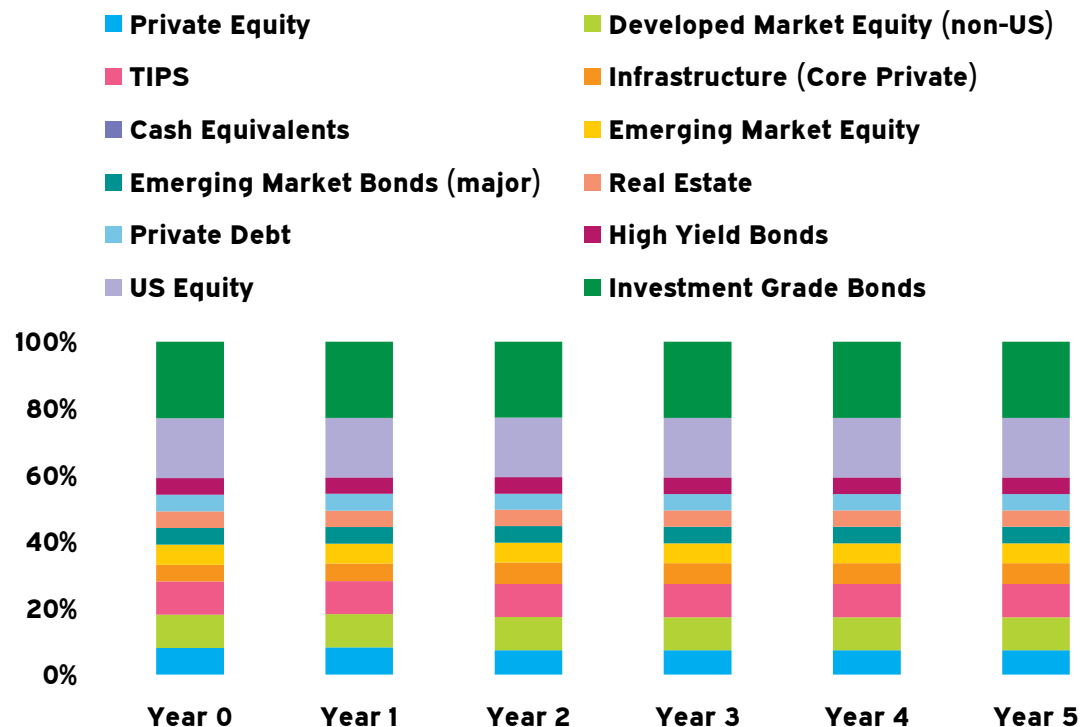
→ A stressful market environment would alter the asset allocation. However, rebalancing of the liquid assets would bring most asset classes back to their targets.

Liquidity Stress Test: Summary
(for Policy B)

Metric	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Ending Market Value	204.0	207.1	167.3	161.1	161.1	161.1
Net flows	0.0	0.0	0.0	0.0	0.0	0.0
Flows as percentage of Market Value	0%	0%	0%	0%	0%	0%
Assets Sold in Duress	0.0	0.0	0.0	0.0	0.0	0.0
Percentage of Outflows sold in duress	0%	0%	0%	0%	0%	0%
Percentage of Assets sold in duress	0%	0%	0%	0%	0%	0%
Remaining liquid Market Value	177.5	179.7	146.9	141.4	141.4	141.4
Total Illiquid Assets	26.5	27.4	20.4	19.6	19.6	19.6
Percentage of Illiquid Assets	13%	13%	12%	12%	12%	12%
Portfolio Return	0.0%	1.5%	-19.2%	-3.7%	0.0%	0.0%

$\rightarrow$ Even under this extreme scenario, Policy B (and all of the policy portfolios) would maintain sufficient liquidity to pay benefits and other expenses.

Appendices

Setting Capital Market Expectations

Overview of Annual Asset Study Methodology

→ In order to construct an optimal portfolio from a risk-return standpoint, conventional financial wisdom dictates that one develop return, volatility, and correlation expectations over the relevant investing horizon.

→ Given the uncertainty surrounding financial and economic forecasts, expectations development is challenging, and any of several methodological approaches may meaningfully contribute to this complex task.

→ Meketa Investment Group's process relies on both quantitative and qualitative methodologies.

→ First, we employ a large set of quantitative models to arrive at a set of baseline expected ten-year annualized returns for major asset classes.

→ These models attempt to forecast a gross "beta" return for each public market asset class; that is, we specifically do not model "alpha," nor do we apply an estimate for management fees or other operational expenses.[1]

→ Our models are fundamentally based (based on some theoretically defined return relationship with current observable factors).

→ Some of these models are more predictive than others. For this reason, we next overlay a qualitative analysis, which takes the form of a data-driven deliberation among the research team and our Investment Policy Committee.

→ Return assumptions for hard-to-predict asset classes as well as those with limited data will be influenced more heavily by our qualitative analysis.

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[1] Our expectations are net of fees where passive management is not available (e.g., private markets and hedge funds).

Overview of Annual Asset Study Methodology (continued)

→ As a result of this process, we form our ten-year annualized return expectations, which serve as the primary foundation of our longer-term, twenty-year expectations.

→ We form our twenty-year annualized return expectations by systematically considering historical returns on an asset class by asset class level. Specifically, we construct a weighted average of our ten-year expectations and average historical returns in each asset class.

→ The weights are determined by a qualitative assessment of the value of the historical data. Generally, if we have little confidence that the historical average return is representative of what an investor can expect,[1] we will weight our ten-year forecast more heavily. Therefore, the weight on our ten-year forecasts ranges from 0.5 to 0.9.

→ We develop our twenty-year volatility and correlation expectations differently. We rely primarily on historical averages, with an emphasis given to the experience of the trailing fifteen years.

→ Qualitative adjustments, when applied, usually serve to increase the correlations and volatility over and above the historical estimates (e.g., using the higher correlations usually observed during a volatile market).

→ We also make adjustments to the volatility based on the historical skewness of each asset class (e.g., increasing the volatility for an asset class that has been negatively skewed).

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[1] For example, we have less confidence in historical data that do not capture many possible market scenarios or that are overly polluted by survivorship bias.

Overview of Annual Asset Study Methodology (continued)

→ In the case of private markets and other illiquid asset classes where historical volatility and correlations have been artificially dampened, we seek public market equivalents on which to base our estimates before applying any qualitative adjustments.

→ These volatility and correlation expectations are then combined with our twenty-year return expectations to assist us in subsequent asset allocation work, including mean-variance optimization and scenario analyses.

→ Capital Markets Expectations are the inputs needed to conduct MVO.

- MVO is the traditional starting point for determining asset allocation.

→ Consultants (including Meketa) generally set them once a year.

- Our results are published in January, based on December 31 data.

→ This involves setting long-term expectations for a variety of asset classes for the following.

- Returns.

- Standard Deviation.

- Correlations(i.e., covariance).

→ Our process relies on both quantitative and qualitative methodologies.

Asset Class Definitions

$\rightarrow$ We identify asset classes and strategies that are appropriate for long-term allocation of funds, and that also are investable.

$\rightarrow$ Several considerations influence this process.

- Unique return behavior.

- Observable historical track record.

- A robust market.

- Client requests.

$\rightarrow$ We then make forecasts for each asset class.

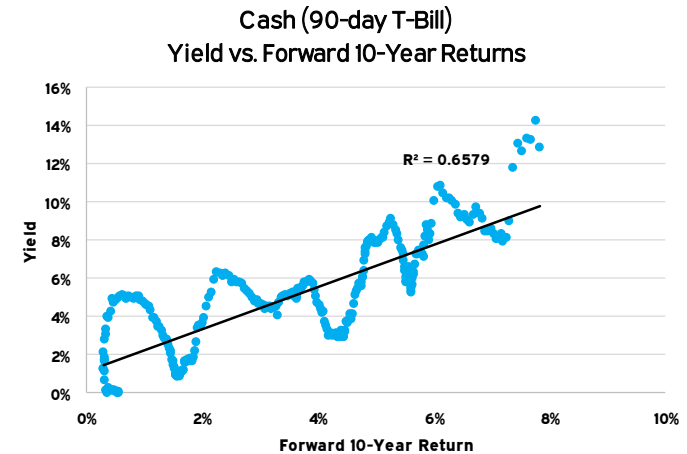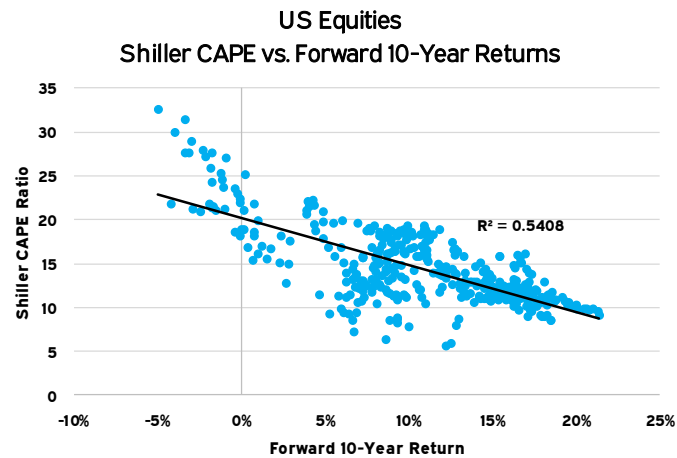- We created inputs for 97 "asset classes" in 2022.
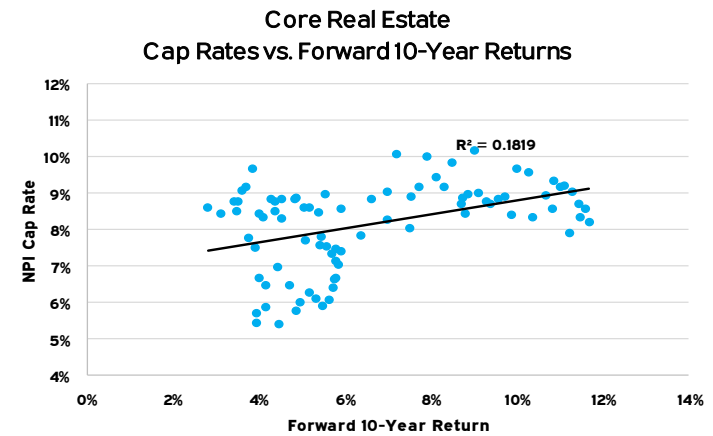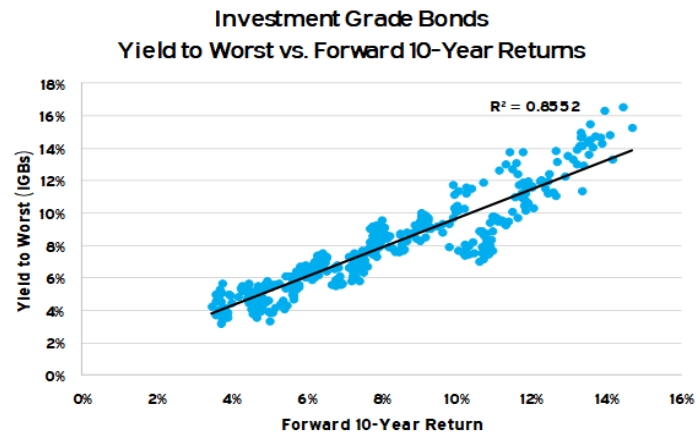
Building 10-Year Forecasts

→ The first step is to build our 10-year forecasts based on fundamental models.

- Each model is based on the most important factors that drive returns for that asset class.

Asset Class Category	Major Factors
Equities	Dividend Yield, GDP Growth, Valuation
Bonds	Yield to Worst, Default Rate, Recovery Rate
Commodities	Collateral Yield, Roll Yield, Inflation
Infrastructure	Public IS Valuation, Income, Growth
Natural Resources	Price per Acre, Income, Public Market Valuation
Real Estate	Cap Rate, Yield, Growth
Private Equity	EBITDA Multiple, Debt Multiple, Public VC Valuation
Hedge Funds and Other	Leverage, Alternative Betas

→ The common components are income, growth, and valuation.

Some factors are naturally more predictive than others.

Investment Grade Bonds
Yield to Worst vs. Forward 10-Year Returns — R² = 0.8552

Core Real Estate
Cap Rates vs. Forward 10-Year Returns — R² = 0.1819

US Equities
Shiller CAPE vs. Forward 10-Year Returns — R² = 0.5408

Cash (90-day T-Bill)
Yield vs. Forward 10-Year Returns — R² = 0.6579

Moving from 10-Year to 20-Year Forecasts

→ Our next step is to combine our 10-year forecasts with projections for years 11-20 for each asset class.

→ We use a risk premia approach to forecast 10-year returns in ten years (i.e., years 11-20).

- We start with an assumption (market informed, such as the 10-year forward rate) for what the risk free rate will be in ten years.

- We then add a risk premia for each asset class.

- We use historical risk premia as a guide, but many asset classes will differ from this, especially if they have a shorter history.

  – We seek consistency with finance theory (i.e., riskier assets will have a higher risk premia assumption).

- Essentially, we assume mean-reversion over the first ten years (where appropriate), and consistency with CAPM thereafter.

- The final step is to make any qualitative adjustments.

  – The Investment Policy Committee reviews the output and may make adjustments.

Capital Market Assumption Development Example

Equities

→ We use a fundamental model for equities that combines income and capital appreciation.

$$E(R) = Dividend\ Yield + Expected\ Earnings\ Growth + Multiple\ Effect + Currency\ Effect$$

→ Meketa Investment Group evaluates historical data statistically to develop expectations for dividend yield, earnings growth, the multiple effect, and currency effect.

→ Our models assume that there is a reversion to the mean over long time periods.

Bonds

→ The short version for investment grade bond models is:

$$E(R) = Current\ YTW\ (yield\ to\ worst)$$

→ Our models assume that there is a reversion to the mean for spreads (though not yields).

→ For TIPS, we add the real yield of the TIPS index to the breakeven inflation rate.

→ As with equities, we make currency adjustments when necessary for foreign bonds.

→ For bonds with credit risk, Meketa Investment Group estimates default rates and loss rates, in order to project an expected return:

$$E(R) = YTW - (Annual\ Default\ Rate * Loss\ Rate)$$

The Other Inputs: Standard Deviation and Correlation

→ Standard Deviation:

→ We review the trailing fifteen-year standard deviation, as well as skewness.

→ Historical standard deviation serves as the base for our assumptions.

→ If there is a negative skew, we increased the volatility assumption based on the size of the historical skewness.

Asset Class	Historical Standard Deviation (%)	Skewness	Assumption (%)
Bank Loans	7.7	-2.7	10.0
FI/L-S Credit	6.8	-2.5	9.0

→ We also adjust for private market asset classes with "smoothed" return streams.

→ Correlation:

→ We use trailing fifteen-year correlations as our guide.

→ Again, we make adjustments for "smoothed" return streams.

→ Most of our adjustments are conservative in nature (i.e., they increase the standard deviation and correlation).

Horizon Study

→ Annually, Horizon Actuarial Services, LLC publishes a survey of capital market assumptions that they collect from various investment advisors.

→ In the 2021[1] survey there were 39 respondents.

→ The Horizon survey is a useful tool for Board members to determine whether their consultant's expectations for returns (and risk) are reasonable.

Asset Class	10-Year Average (%)	Meketa 10-Year (%)	20-Year Average (%)	Meketa 20-Year (%)
Cash Equivalents	1.2	0.7	1.9	1.1
TIPS	1.6	1.2	2.4	1.8
US Core Bonds	2.1	1.2	3.2	1.8
US High Yield Bonds	3.8	3.3	5.0	4.2
Emerging Market Debt	4.2	3.9	5.3	3.8
Private Debt	6.5	6.6	6.9	6.8
US Equity (large cap)	5.8	5.2	6.7	6.8
Developed Non-US Equity	6.4	6.7	7.1	7.1
Emerging Non-US Equity	7.2	7.5	7.8	8.1
Private Equity	8.8	8.0	9.6	9.1
Real Estate	5.5	6.5	6.2	6.9
Infrastructure	6.2	7.1	6.8	7.0
Commodities	3.1	3.4	4.0	3.7
Hedge Funds	4.5	3.4	5.3	4.3
Inflation	2.1	2.3	2.2	2.1

[1] The 10-year horizon includes all 39 respondents and the 20-year horizon includes 24 respondents. Figures are based on Meketa's 2021 CMEs.

Notes and Disclaimers

[1] The returns shown in the Policy Options and Risk Analysis sections rely on estimates of expected return, standard deviation, and correlation developed by Meketa Investment Group. To the extent that actual return patterns to the asset classes differ from our expectations, the results in the table will be incorrect. However, our inputs represent our best unbiased estimates of these simple parameters.

[2] The returns shown in the Policy Options and Risk Analysis sections use a lognormal distribution, which may or may not be an accurate representation of each asset classes' future return distribution. To the extent that it is not accurate in whole or in part, the probabilities listed in the table will be incorrect. As an example, if some asset classes' actual distributions are even more right-skewed than the lognormal distribution (i.e., more frequent low returns and less frequent high returns), then the probability of the portfolio hitting a given annual return will be lower than that stated in the table.

[3] The standard deviation bars in the chart in the Risk Analysis section do not indicate the likelihood of a 1, 2, or 3 standard deviation event—they simply indicate the return we expect if such an event occurs. Since the likelihood of such an event is the same across allocations regardless of the underlying distribution, a relative comparison across policy choices remains valid.

Scenario Return Inputs

Asset Class	Benchmark Used
Investment Grade Bonds	Barclays Aggregate
TIPS	Barclays US TIPS
Intermediate-term Government Bonds	Barclays Treasury Intermediate
Long-term Government Bonds	Barclays Long US Treasury
EM Bonds (local)	JPM GBI-EM Global Diversified Composite
Bank Loans	CSFB Leveraged Loan
High Yield Bonds	Barclays High Yield
Direct Lending	Cliffwater Direct Lending Index
Mezzanine Debt	Preqin Associates Mezzanine
Distressed Debt	Preqin Distressed Debt Index
Core Real Estate	NCREIF Property
Value-Added RE	NCREIF Townsend Value Added
Opportunistic RE	NCREIF Townsend Opportunistic
REITs	NAREIT Equity
Infrastructure (private)	S&P Global Infrastructure
Natural Resources (private)	S&P Global Natural Resources
Timber	NCREIF Timberland
Commodities	Bloomberg Commodity Index
US Equity	Russell 3000
Public Foreign Equity (Developed)	MSCI EAFE
Public Foreign Equity (Emerging)	MSCI Emerging Markets
Private Equity	Preqin Private Equity Composite
Long-short Equity	HFRI Equity Hedge
Global Macro	HFRI Macro
Hedge Funds	HFRI Fund Weighted Composite
Private Debt	Weighted average of Distressed Debt, Mezzanine Debt and Direct Lending (2nd Lien)

Negative Historical Scenario Returns - Sample Inputs

	Covid-19 Market Shock (Feb 2020-Mar 2020)	Taper Tantrum (May - Aug 2013)	Global Financial Crisis (Oct 2007 - Mar 2009)	Popping of the TMT Bubble (Apr 2000 - Sep 2002)	LTCM (Jul - Aug 1998)
Cash Equivalents	0.4	0.0	2.6	9.9	0.8
Short-term Investment Grade Bonds	0.4	-0.1	7.9	21.9	1.6
Investment Grade Bonds	-0.9	-3.7	8.5	28.6	1.8
Long-term Corporate Bonds	-18.4	-9.3	-10.3	26.9	-0.6
Long-term Government Bonds	12.7	-11.6	24.2	35.5	4.1
TIPS	-0.4	-8.5	8.2	37.4	0.7
Global ILBs	-6.5	-7.4	-3.9	39.7	0.7
High Yield Bonds	-20.8	-2.0	-22.8	-6.3	-5.0
Bank Loans	-20.3	0.8	-23.7	6.3	0.7
Direct Lending	-4.8	2.6	-3.3	-2.6	-2.3
Foreign Bonds	-4.5	-3.2	2.1	8.5	3.5
Mezzanine Debt	-4.8	4.6	-26.4	-2.0	-2.6
Distressed Debt	-12.2	4.6	-26.4	-2.0	-2.6
Emerging Market Bonds (major)	-15.3	-11.5	-5.0	6.3	-28.2
Emerging Market Bonds (local)	-13.9	-14.3	-7.9	7.2	-34.1
US Equity	-35.0	3.0	-45.8	-43.8	-15.4
Developed Market Equity (non-US)	-32.7	-2.2	-52.1	-46.7	-11.5
Emerging Market Equity	-31.2	-9.4	-51.2	-43.9	-26.7
Global Equity	-33.6	-0.7	-49.3	-46.7	-14.0
Private Equity/Debt	-7.8	5.7	-27.7	-23.4	-3.2
Private Equity	-7.4	5.8	-28.2	-26.0	-3.3
Private Debt Composite	-10.1	4.6	-22.3	-1.7	-2.3
REITs	-41.0	-13.3	-63.0	45.4	-15.3
Core Private Real Estate	0.7	3.6	-10.6	23.6	2.3
Value-Added Real Estate	-3.5	3.8	-20.2	177.0	1.8
Opportunistic Real Estate	-8.6	4.0	-25.7	21.4	1.5
Natural Resources (Private)	-22.1	2.5	-31.2	-3.9	-16.9
Timberland	0.1	1.3	20.7	-1.5	0.5
Farmland	-0.1	3.3	26.7	11.4	0.8
Commodities (naïve)	-18.9	-2.4	-36.9	18.5	-12.0
Core Infrastructure	-1.3	3.7	-0.8	24.8	-0.3
Hedge Funds	-9.1	-0.4	-17.8	-2.1	-9.4
Long-Short	-10.9	1.0	-26.4	-8.8	-8.3
Hedge Fund of Funds	-7.6	-0.5	-19.5	-0.4	-7.7

Negative Historical Scenario Returns-Sample Inputs (Continued)

	Rate spike (1994 Calendar Year)	Crash of 1987 (Sep-Nov 1987)	Strong dollar (Jan 1981-Sep 1982)	Volcker Recession (Jan-Mar 1980)	Stagflation (Jan 1973-Sep 1974)
Cash Equivalents	3.9	1.4	24.4	2.9	13.5
Short-term Investment Grade Bonds	0.5	2.3	29.9	-2.6	4.3
Investment Grade Bonds	-2.9	2.2	29.9	-8.7	7.9
Long-term Corporate Bonds	-5.8	1.5	29.6	-14.1	-12.0
Long-term Government Bonds	-7.6	2.6	28.4	-13.6	-1.8
TIPS	-7.5	2.8	15.6	-7.8	4.3
Global ILBs	-7.9	2.9	16.5	-8.3	4.5
High Yield Bonds	-1.0	-3.6	6.9	-2.3	-15.5
Bank Loans	10.3	-1.7	3.3	-1.1	-7.5
Direct Lending	7.6	-2.3	3.2	-1.0	-7.2
Foreign Bonds	5.3	-0.3	34.8	-6.5	-1.4
Mezzanine Debt	7.6	-2.3	3.2	-1.0	-7.2
Distressed Debt	7.6	-2.3	3.2	-1.0	-7.2
Emerging Market Bonds (major)	-18.9	-9.2	-1.6	-2.6	-20.2
Emerging Market Bonds (local)	-22.8	-11.0	-2.0	-3.2	-23.9
US Equity	1.3	-29.5	-2.3	-4.1	-42.6
Developed Market Equity (non-US)	7.8	-14.5	-18.0	-7.0	-36.3
Emerging Market Equity	-7.3	-25.3	-12.1	-6.6	-44.2
Global Equity	5.0	-21.5	-11.2	-5.8	-39.3
Private Equity/Debt	13.2	-0.7	-2.7	-2.5	-18.2
Private Equity	14.2	-0.5	-3.9	-2.7	-20.1
Private Debt Composite	6.2	-1.8	3.0	-1.0	-6.9
REITs	-3.5	-19.5	2.5	-3.6	-33.9
Core Private Real Estate	6.4	2.5	23.9	5.5	-4.4
Value-Added Real Estate	11.2	4.3	44.2	9.6	-7.6
Opportunistic Real Estate	18.8	3.1	30.7	7.0	-5.6
Natural Resources (Private)	12.6	-9.9	-9.5	-9.1	19.3
Timberland	15.4	9.2	23.6	-7.4	5.5
Farmland	9.4	5.3	13.3	-4.2	3.1
Commodities (naïve)	16.6	1.8	-16.0	-9.6	139.5
Core Infrastructure	-11.5	-0.1	-0.2	-0.1	-0.5
Hedge Funds	4.1	-7.8	-3.8	-1.9	-15.7
Long-Short	2.6	-10.0	-4.9	-2.5	-19.8
Hedge Fund of Funds	-3.5	-5.7	-2.7	-1.4	-11.5

Stress Test Return Assumptions-Sample Inputs[1]

	10-year Treasury Bond rates rise 100 bps	10-year Treasury Bond rates rise 200 bps	10-year Treasury Bond rates rise 300 bps	Baa Spreads widen by 50 bps, High Yield by 200 bps	Baa Spreads widen by 300 bps, High Yield by 1000 bps	Trade Weighted Dollar gains 10%	Trade Weighted Dollar gains 20%	US Equities decline 10%	US Equities decline 25%	US Equities decline 40%
Cash Equivalents	-0.2	-0.4	-0.5	2.8	1.1	4.0	1.3	3.1	2.3	0.4
Short-term Investment Grade Bonds	-1.2	-2.5	-3.7	2.2	1.5	1.2	1.4	1.3	0.7	0.8
Investment Grade Bonds	-4.3	-8.3	-11.9	3.9	-0.4	1.7	4.2	2.4	0.7	-1.0
Long-term Corporate Bonds	-8.9	-16.2	-20.9	2.6	-13.4	0.8	8.1	0.5	-8.3	-12.3
Long-term Government Bonds	-10.6	-18.8	-23.6	7.8	7.3	3.7	12.8	3.0	2.6	2.4
TIPS	-4.9	-9.8	-13.7	2.8	-6.1	-2.1	-0.2	2.6	-2.3	-8.7
Global ILBs	-1.6	-7.9	-11.9	2.4	-11.1	-3.1	-4.8	2.8	-5.4	-16.3
High Yield Bonds	2.7	-3.4	-3.6	-1.8	-23.0	-3.5	-0.6	-4.9	-15.5	-21.2
Bank Loans	1.4	-0.8	-5.1	-2.8	-20.8	-3.2	-0.6	-3.7	-13.2	-17.4
Direct Lending	0.0	-3.7	-6.3	-1.8	-9.1	-4.3	-0.6	-4.1	-7.6	-5.7
Foreign Bonds	-4.6	-9.8	-15.7	6.6	-2.9	-3.3	-8.8	1.8	-4.6	-9.2
Mezzanine Debt	3.8	-0.9	-6.1	-1.9	-19.4	-2.8	-6.4	-4.9	-15.6	-20.4
Distressed Debt	4.4	-1.1	-6.4	-2.2	-21.4	-3.5	-9.0	-5.4	-17.3	-21.8
Emerging Market Bonds (major)	1.0	-4.9	-3.6	-0.1	-14.7	-1.4	-4.2	-3.3	-12.5	-15.4
Emerging Market Bonds (local)	1.8	-5.1	-3.0	0.1	-12.8	-1.4	-12.2	-2.8	-13.3	-20.5
US Equity	7.2	0.9	2.8	-1.2	-32.0	-2.5	1.6	-10.6	-26.5	-42.4
Developed Market Equity (non-US)	9.2	3.1	-5.6	0.3	-35.1	-12.9	-9.0	-8.7	-23.4	-41.4
Emerging Market Equity	10.3	5.5	0.1	-1.1	-42.8	-15.1	-15.7	-11.9	-30.8	-46.9
Global Equity	7.8	2.1	-0.5	-0.7	-33.6	-8.3	-5.9	-9.8	-25.3	-41.5
Private Equity/Debt	6.4	0.9	-5.5	-0.2	-22.5	-4.3	-7.2	-10.1	-22.5	-25.3
Private Equity	6.8	1.0	-5.3	0.0	-22.8	-4.1	-6.4	-10.9	-23.3	-25.7
Private Debt Composite	2.5	-2.0	-6.2	-1.8	-15.8	-3.5	-4.3	-4.6	-12.8	-15.0
REITs	4.1	-3.5	1.2	-3.8	-37.3	-1.0	12.4	-6.5	-32.8	-55.7
Core Private Real Estate	2.4	2.7	5.0	2.0	-7.1	1.2	9.7	-0.2	-8.5	-14.0
Value-Added Real Estate	4.8	7.4	14.1	7.2	-13.5	13.8	6.4	1.3	-13.6	-23.1
Opportunistic Real Estate	4.1	6.5	9.9	1.1	-20.6	0.8	15.6	-1.5	-17.1	-26.3
Natural Resources (Private)	13.1	5.8	-3.5	-0.9	-27.5	-6.5	-21.5	-5.4	-20.9	-35.9
Timberland	1.4	1.6	-9.9	5.0	6.9	2.5	8.6	0.1	2.7	3.9
Farmland	2.4	-0.1	-9.2	3.9	10.1	0.8	8.0	0.6	4.9	10.3
Commodities (naïve)	9.6	5.3	-6.6	-4.3	-25.0	-5.6	-24.0	4.8	-11.1	-37.8
Core Infrastructure	0.3	-6.4	-6.1	1.2	0.1	-1.8	3.6	-1.1	-5.0	-7.8
Hedge Funds	3.0	-1.4	-5.1	-0.6	-14.5	-2.1	-1.7	-4.3	-12.2	-15.7
Long-Short	5.3	-0.7	-4.2	-0.1	-21.0	-3.0	-4.3	-7.3	-17.7	-23.5
Hedge Fund of Funds	2.2	-2.1	-5.7	-1.3	-14.8	-2.7	-2.4	-4.9	-12.5	-16.0

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[1] Assumptions are based on performance for each asset class during historical periods that resembled these situations.

Meketa Investment Group 2023 Annual Asset Study
Twenty-Year Annualized Return and Volatility Expectations for Major Asset Classes

Asset Class	10-year Expected Return (%)	20-year Expected Return (%)	Standard Deviation (%)	11-20 year Risk Premia[1] (%)
Cash Equivalents	3.1	2.9	1.0	-1.5
Investment Grade Bonds	4.8	4.7	4.0	0.4
Long-term Government Bonds	4.3	5.0	12.0	1.5
TIPS	4.3	4.5	7.0	0.5
High Yield Bonds	8.0	7.3	11.0	2.5
Bank Loans	7.6	7.0	10.0	2.2
Emerging Market Debt (local)	6.4	6.0	12.0	1.5
Private Debt	9.4	9.0	15.0	4.6
US Equity	7.8	8.7	18.0	5.5
Developed Non-US Equity	10.1	9.8	19.0	5.4
Emerging Non-US Equity	10.3	10.0	23.0	5.6
Global Equity	8.8	9.2	18.0	5.5
Private Equity	9.7	11.0	27.0	8.0
Real Estate	5.9	7.8	16.0	5.5
Infrastructure	6.9	8.3	15.0	5.6
Commodities	6.3	5.7	17.0	1.0
Hedge Funds	5.4	6.1	7.0	2.6
Inflation	2.5	2.6	3.0	-1.5

Meketa Investment Group 2023 Annual Asset Study: Correlation Expectations

	Inv. Grade Bonds	Long-term Gov't Bonds	TIPS	High Yield Bonds	US Equity	Dev. Non-US Equity	Em. Market Equity	Private Equity	Real Estate	Commod.	Infra.	Hedge Funds
Investment Grade Bonds	1.00											
Long-term Government Bonds	0.83	1.00										
TIPS	0.76	0.53	1.00									
High Yield Bonds	0.22	-0.22	0.41	1.00								
US Equity	0.02	-0.31	0.20	0.74	1.00							
Developed Non-US Equity	0.09	-0.28	0.26	0.76	0.89	1.00						
Emerging Market Equity	0.14	-0.23	0.34	0.76	0.77	0.87	1.00					
Private Equity	0.00	-0.10	0.05	0.70	0.85	0.80	0.75	1.00				
Real Estate	0.20	0.05	0.10	0.50	0.50	0.45	0.40	0.45	1.00			
Commodities	0.00	-0.29	0.31	0.55	0.53	0.61	0.65	0.30	0.15	1.00		
Infrastructure	0.29	0.09	0.31	0.64	0.63	0.65	0.58	0.50	0.57	0.41	1.00	
Hedge Funds	0.03	-0.34	0.26	0.77	0.86	0.87	0.85	0.60	0.45	0.69	0.65	1.00

MARLBOROUGH RETIREMENT SYSTEM

Manager Due Diligence Meetings
Tuesday, February 28, 2023

Dial: (646) 558-8656
Meeting ID: 942 2573 8770
Passcode: 941405

I. Manager Due Diligence Presentations   8:45 a.m.

Manager/Product	Asset Class	Time
Rhumbline	Passive Index	8:45
S&P 500 Index		
Russell 1000 HEDI Index		
MSCI EAFE Index		
SSGA	Passive Index	8:55
US Aggregate Bond Index		
US TIPS Index		
Payden & Rygel	Emerging Markets Debt	9:05
Emerging Market Bond		

Appendix

Disclaimer, Glossary, and Notes

WE HAVE PREPARED THIS REPORT (THIS "REPORT") FOR THE SOLE BENEFIT OF THE INTENDED RECIPIENT (THE "RECIPIENT").

SIGNIFICANT EVENTS MAY OCCUR (OR HAVE OCCURRED) AFTER THE DATE OF THIS REPORT AND THAT IT IS NOT OUR FUNCTION OR RESPONSIBILITY TO UPDATE THIS REPORT. ANY OPINIONS OR RECOMMENDATIONS PRESENTED HEREIN REPRESENT OUR GOOD FAITH VIEWS AS OF THE DATE OF THIS REPORT AND ARE SUBJECT TO CHANGE AT ANY TIME. ALL INVESTMENTS INVOLVE RISK. THERE CAN BE NO GUARANTEE THAT THE STRATEGIES, TACTICS, AND METHODS DISCUSSED HERE WILL BE SUCCESSFUL.

INFORMATION USED TO PREPARE THIS REPORT WAS OBTAINED FROM INVESTMENT MANAGERS, CUSTODIANS, AND OTHER EXTERNAL SOURCES. WHILE WE HAVE EXERCISED REASONABLE CARE IN PREPARING THIS REPORT, WE CANNOT GUARANTEE THE ACCURACY OF ALL SOURCE INFORMATION CONTAINED HEREIN.

CERTAIN INFORMATION CONTAINED IN THIS REPORT MAY CONSTITUTE "FORWARD - LOOKING STATEMENTS," WHICH CAN BE IDENTIFIED BY THE USE OF TERMINOLOGY SUCH AS "MAY," "WILL," "SHOULD," "EXPECT," "AIM", "ANTICIPATE," "TARGET," "PROJECT," "ESTIMATE," "INTEND," "CONTINUE" OR "BELIEVE," OR THE NEGATIVES THEREOF OR OTHER VARIATIONS THEREON OR COMPARABLE TERMINOLOGY. ANY FORWARD-LOOKING STATEMENTS, FORECASTS, PROJECTIONS, VALUATIONS, OR RESULTS IN THIS PRESENTATION ARE BASED UPON CURRENT ASSUMPTIONS. CHANGES TO ANY ASSUMPTIONS MAY HAVE A MATERIAL IMPACT ON FORWARD - LOOKING STATEMENTS, FORECASTS, PROJECTIONS, VALUATIONS, OR RESULTS. ACTUAL RESULTS MAY THEREFORE BE MATERIALLY DIFFERENT FROM ANY FORECASTS, PROJECTIONS, VALUATIONS, OR RESULTS IN THIS PRESENTATION.

PERFORMANCE DATA CONTAINED HEREIN REPRESENT PAST PERFORMANCE. PAST PERFORMANCE IS NO GUARANTEE OF FUTURE RESULTS.

Credit Risk: Refers to the risk that the issuer of a fixed income security may default (i.e., the issuer will be unable to make timely principal and/or interest payments on the security).

Duration: Measure of the sensitivity of the price of a bond to a change in its yield to maturity. Duration summarizes, in a single number, the characteristics that cause bond prices to change in response to a change in interest rates. For example, the price of a bond with a duration of three years will rise by approximately 3% for each 1% decrease in its yield to maturity. Conversely, the price will decrease 3% for each 1% increase in the bond's yield. Price changes for two different bonds can be compared using duration. A bond with a duration of six years will exhibit twice the percentage price change of a bond with a three-year duration. The actual calculation of a bond's duration is somewhat complicated, but the idea behind the calculation is straightforward. The first step is to measure the time interval until receipt for each cash flow (coupon and principal payments) from a bond. The second step is to compute a weighted average of these time intervals. Each time interval is measured by the present value of that cash flow. This weighted average is the duration of the bond measured in years.

Information Ratio: This statistic is a measure of the consistency of a portfolio's performance relative to a benchmark. It is calculated by subtracting the benchmark return from the portfolio return (excess return), and dividing the resulting excess return by the standard deviation (volatility) of this excess return. A positive information ratio indicates outperformance versus the benchmark, and the higher the information ratio, the more consistent the outperformance.

Jensen's Alpha: A measure of the average return of a portfolio or investment in excess of what is predicted by its beta or "market" risk. Portfolio Return- [Risk Free Rate+Beta*(market return-Risk Free Rate)].

Market Capitalization: For a firm, market capitalization is the total market value of outstanding common stock. For a portfolio, market capitalization is the sum of the capitalization of each company weighted by the ratio of holdings in that company to total portfolio holdings; thus it is a weighted-average capitalization. Meketa Investment Group considers the largest 65% of the broad domestic equity market as large capitalization, the next 25% of the market as medium capitalization, and the smallest 10% of stocks as small capitalization.

Market Weighted: Stocks in many indices are weighted based on the total market capitalization of the issue. Thus, the individual returns of higher market-capitalization issues will more heavily influence an index's return than the returns of the smaller market-capitalization issues in the index.

Maturity: The date on which a loan, bond, mortgage, or other debt/security becomes due and is to be paid off.

Prepayment Risk: The risk that prepayments will increase (homeowners will prepay all or part of their mortgage) when mortgage interest rates decline; hence, investors' monies will be returned to them in a lower interest rate environment. Also, the risk that prepayments will slow down when mortgage interest rates rise; hence, investors will not have as much money as previously anticipated in a higher interest rate environment. A prepayment is any payment in excess of the scheduled mortgage payment.

Price-Book Value (P/B) Ratio: The current market price of a stock divided by its book value per share. Meketa Investment Group calculates P/B as the current price divided by Compustat's quarterly common equity. Common equity includes common stock, capital surplus, retained earnings, and treasury stock adjusted for both common and nonredeemable preferred stock. Similar to high P/E stocks, stocks with high P/B's tend to be riskier investments.

Price-Earnings (P/E) Ratio: A stock's market price divided by its current or estimated future earnings. Lower P/E ratios often characterize stocks in low growth or mature industries, stocks in groups that have fallen out of favor, or stocks of established blue chip companies with long records of stable earnings and regular dividends. Sometimes a company that has good fundamentals may be viewed unfavorably by the market if it is an industry that is temporarily out of favor. Or a business may have experienced financial problems causing investors to be skeptical about is future. Either of these situations would result in lower relative P/E ratios. Some stocks exhibit above-average sales and earnings growth or expectations for above average growth. Consequently, investors are willing to pay more for these companies' earnings, which results in elevated P/E ratios. In other words, investors will pay more for shares of companies whose profits, in their opinion, are expected to increase faster than average. Because future events are in no way assured, high P/E stocks tend to be riskier and more volatile investments. Meketa Investment Group calculates P/E as the current price divided by the I/B/E/S consensus of twelve-month forecast earnings per share.

Quality Rating: The rank assigned a security by such rating services as Fitch, Moody's, and Standard & Poor's. The rating may be determined by such factors as (1) the likelihood of fulfillment of dividend, income, and principal payment of obligations; (2) the nature and provisions of the issue; and (3) the security's relative position in the event of liquidation of the company. Bonds assigned the top four grades (AAA, AA, A, BBB) are considered investment grade because they are eligible bank investments as determined by the controller of the currency.

Sharpe Ratio: A commonly used measure of risk-adjusted return. It is calculated by subtracting the risk free return (usually three-month Treasury bill) from the portfolio return and dividing the resulting excess return by the portfolio's total risk level (standard deviation). The result is a measure of return per unit of total risk taken. The higher the Sharpe ratio, the better the fund's historical risk adjusted performance.

STIF Account: Short-term investment fund at a custodian bank that invests in cash-equivalent instruments. It is generally used to safely invest the excess cash held by portfolio managers.

Standard Deviation: A measure of the total risk of an asset or a portfolio. Standard deviation measures the dispersion of a set of numbers around a central point (e.g., the average return). If the standard deviation is small, the distribution is concentrated within a narrow range of values. For a normal distribution, about two thirds of the observations will fall within one standard deviation of the mean, and 95% of the observations will fall within two standard deviations of the mean.

Style: The description of the type of approach and strategy utilized by an investment manager to manage funds. For example, the style for equities is determined by portfolio characteristics such as price-to-book value, price-to-earnings ratio, and dividend yield. Equity styles include growth, value, and core.

Tracking Error: A divergence between the price behavior of a position or a portfolio and the price behavior of a benchmark, as defined by the difference in standard deviation.

Yield to Maturity: The yield, or return, provided by a bond to its maturity date; determined by a mathematical process, usually requiring the use of a "basis book." For example, a 5% bond pays $5 a year interest on each $100 par value. To figure its current yield, divide $5 by $95—the market price of the bond—and you get 5.26%. Assume that the same bond is due to mature in five years. On the maturity date, the issuer is pledged to pay $100 for the bond that can be bought now for $95. In other words, the bond is selling at a discount of 5% below par value. To figure yield to maturity, a simple and approximate method is to divide 5% by the five years to maturity, which equals 1% pro rata yearly. Add that 1% to the 5.26% current yield, and the yield to maturity is roughly 6.26%.

$$\frac{5\% \text{ (discount)}}{5 \text{ (yrs. to maturity)}} = \begin{matrix}1\% \text{ pro rata, plus} \\ 5.26\% \text{ (current yield)}\end{matrix} = 6.26\% \text{ (yield to maturity)}$$

Yield to Worst: The lowest potential yield that can be received on a bond without the issuer actually defaulting. The yield to worst is calculated by making worst-case scenario assumptions on the issue by calculating the returns that would be received if provisions, including prepayment, call, or sinking fund, are used by the issuer.

NCREIF Property Index (NPI): Measures unleveraged investment performance of a very large pool of individual commercial real estate properties acquired in the private market by tax-exempt institutional investors for investment purposes only. The NPI index is capitalization-weighted for a quarterly time series composite total rate of return.

NCREIF Fund Index - Open End Diversified Core Equity (NFI-ODCE): Measures the investment performance of 28 open-end commingled funds pursuing a core investment strategy that reflects funds' leverage and cash positions. The NFI-ODCE index is equal-weighted and is reported gross and net of fees for a quarterly time series composite total rate of return.

Sources: Investment Terminology, International Foundation of Employee Benefit Plans, 1999.

The Handbook of Fixed Income Securities, Fabozzi, Frank J., 1991

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Throughout this report, numbers may not sum due to rounding.

Returns for periods greater than one year are annualized throughout this report.

Values shown are in millions of dollars, unless noted otherwise.