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Actuarial & Investment Overview

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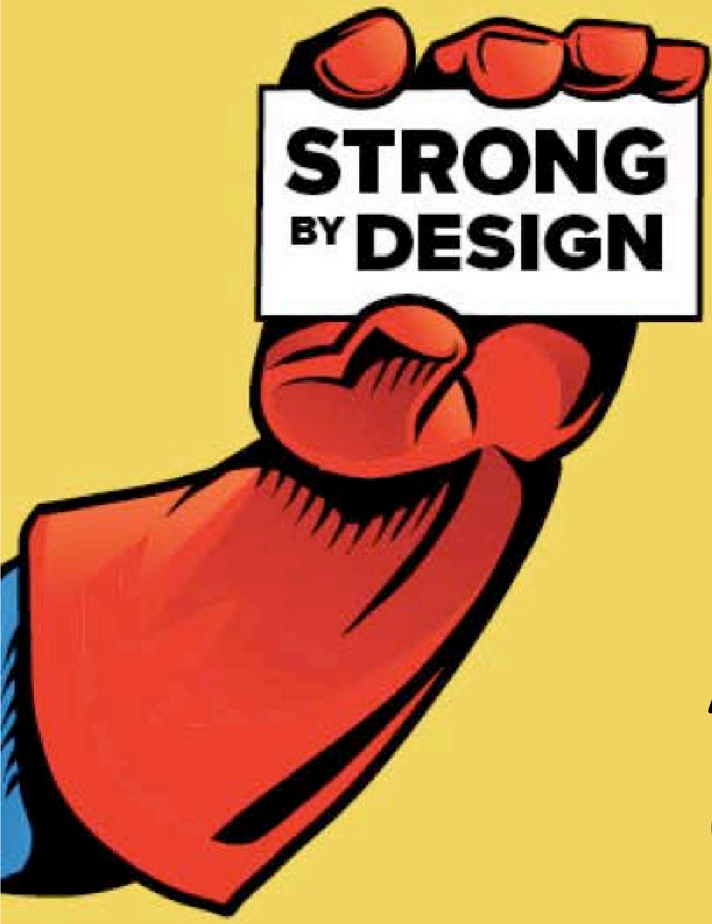
Chief Investment Officer, TMRS

Moderator, **Sean Thompson,** Regional Manager



ACTUARIAL CONSIDERATIONS

Leslee Hardy
TMRS Director of Actuarial Services

Presentations available at www.tmrs.com/ats.php and on the mobile app (Sessions)

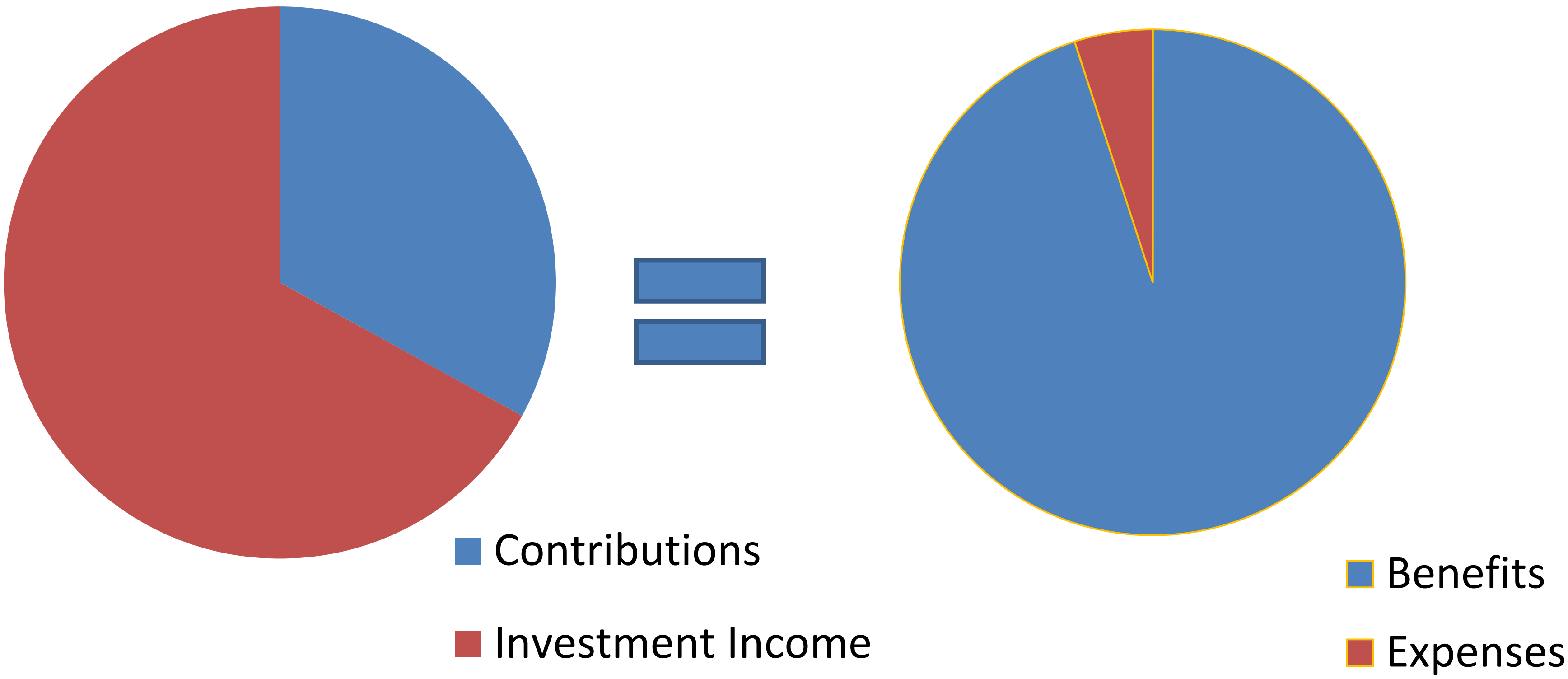
Fundamental Equation

Contri-
butions + Income = Benefits + Expenses

What Is a Cash Balance Plan?

- TMRS’ “hybrid” cash balance plan is a type of defined benefit plan
- TMRS’ lifetime benefit is determined by the cash balance at retirement (employee account balance with interest plus city matching dollars plus any additional credits, such as updated service credit)

TMRS' Plan Is Pre-Funded



TMRS Actuarial Valuations

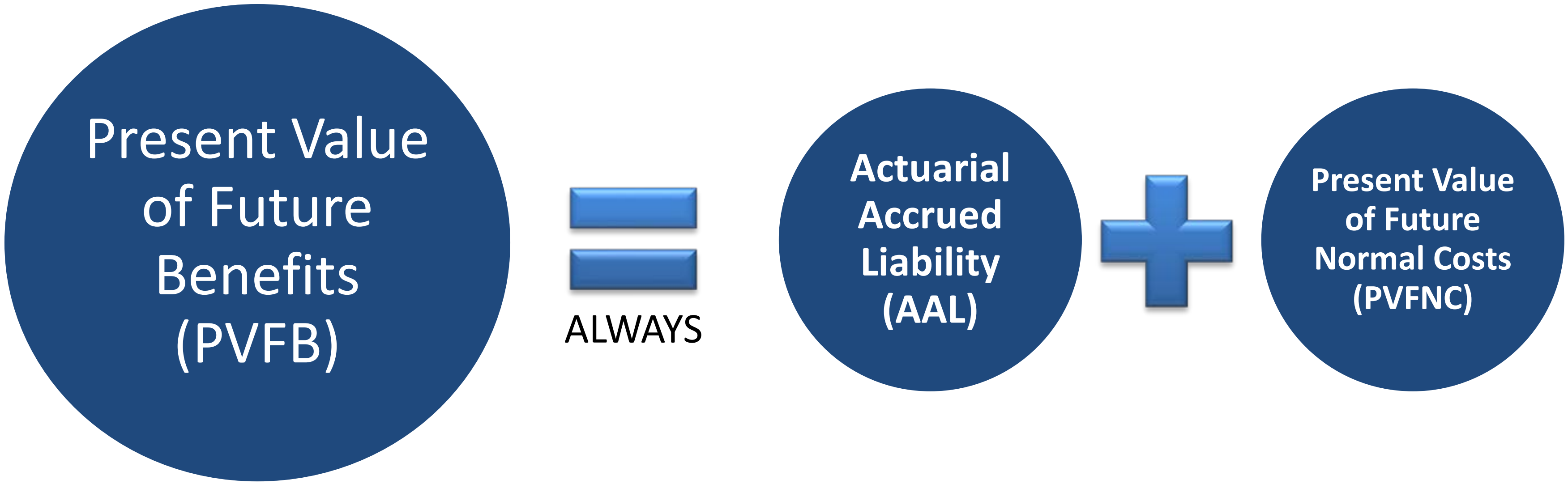
An Actuarial Valuation is taken as a snapshot at a specific time (TMRS uses 12/31), and it includes:

- Employer and employee contributions
- Return on investment
- Assumptions (demographic and economic)
- Project future benefit payments and use the discount rate to determine the present value of future benefits (PVFB)
- Assets and liabilities are determined for the system and for individual cities

Assumptions

- Economic assumptions: investment return, inflation, payroll growth, individual salary increases
- Demographic assumptions: termination rates, forfeiture rates, pre-retirement mortality, disability rates, service retirement rates, post-retirement mortality rates, and disabled annuitant mortality rates.
- TMRS reviews assumptions once every 4 years in an experience study

Benefits



- AAL is the value of the benefits accrued from past years of service
- Normal cost is the value of the benefits accruing during the current year
- PVFNC is the value of the benefits accruing during the current and all future years of service (includes the normal cost)

Asset Smoothing

- Asset smoothing phases-in asset gains and losses to reduce contribution rate volatility which allows for more manageable budgeting of plan contributions
- Actuarial Value of Assets (AVA) is the value of assets used by the actuary for purposes of an actuarial valuation
- In TMRS, AVA is calculated based on Market Value of Assets (MVA) with 10-year smoothing
- The AVA is used to calculate the Unfunded Actuarial Accrued Liability (UAAL) and funded ratio

Unfunded Actuarial Accrued Liability & Funded Ratio

Unfunded Actuarial Accrued Liability (UAAL) = Actuarial Accrued Liability (AAL) − Actuarial Value of Assets (AVA)

Actuarial Value of Assets (AVA) ÷ Actuarial Accrued Liability (AAL) = Funded Ratio

Contributions

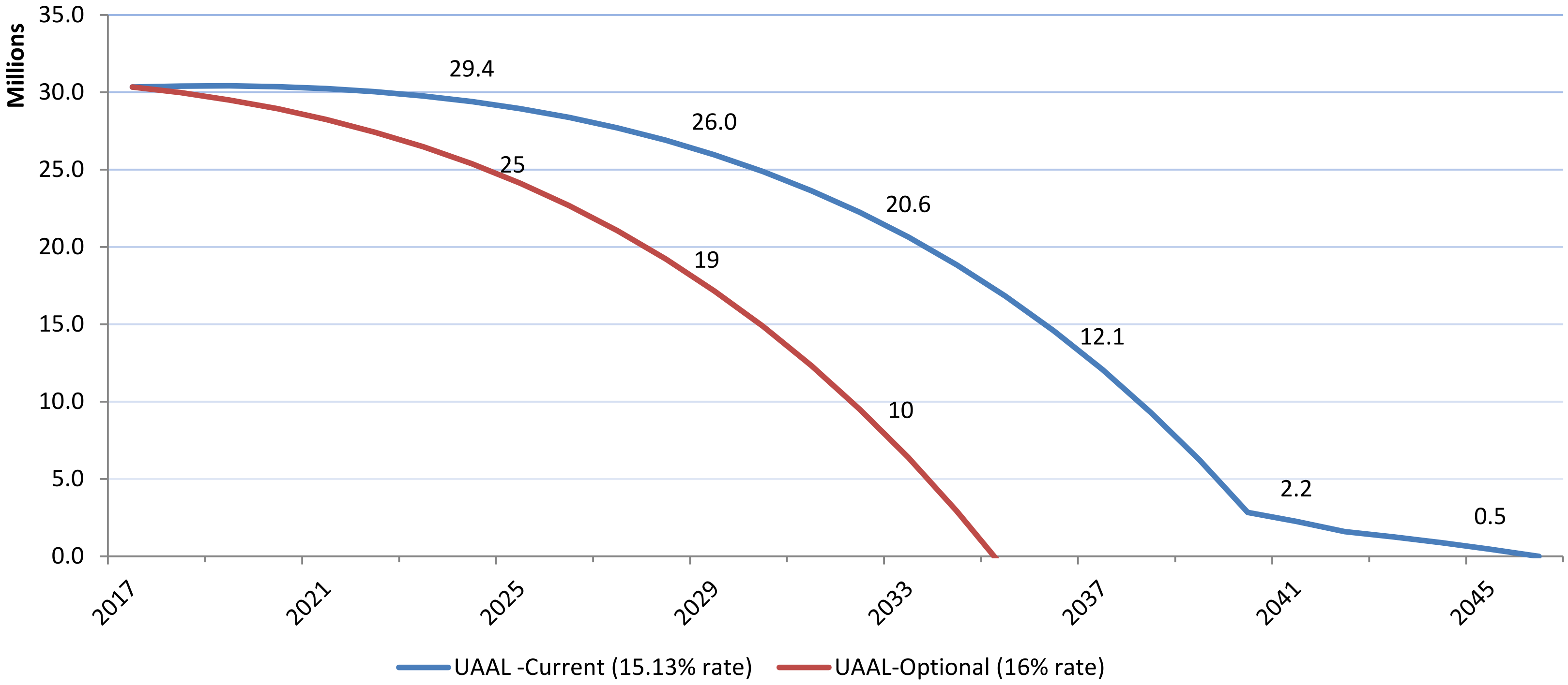
Total Retirement Rate = **Employer Normal Cost** + **Prior Service Cost**

- Normal cost contribution rate is the value of benefits accruing during the current year expressed as a percentage of payroll
- Prior service contribution rate is the level percentage of payroll required to amortize the unfunded actuarial liability over the specified amortization period

TMRS Amortization Policy

- For cities with 20 or more employees, the amortization is a level percentage of payroll over a 25-year closed period using the process of laddering
- Ad hoc benefits are amortized over a 15-year closed period using level-dollar amortization
- For a city that reaches an overfunded status, all non ad hoc bases are erased and the surplus is amortized over a 25-year open period
- For underfunded cities with less than 20 employees, shorter amortization periods apply

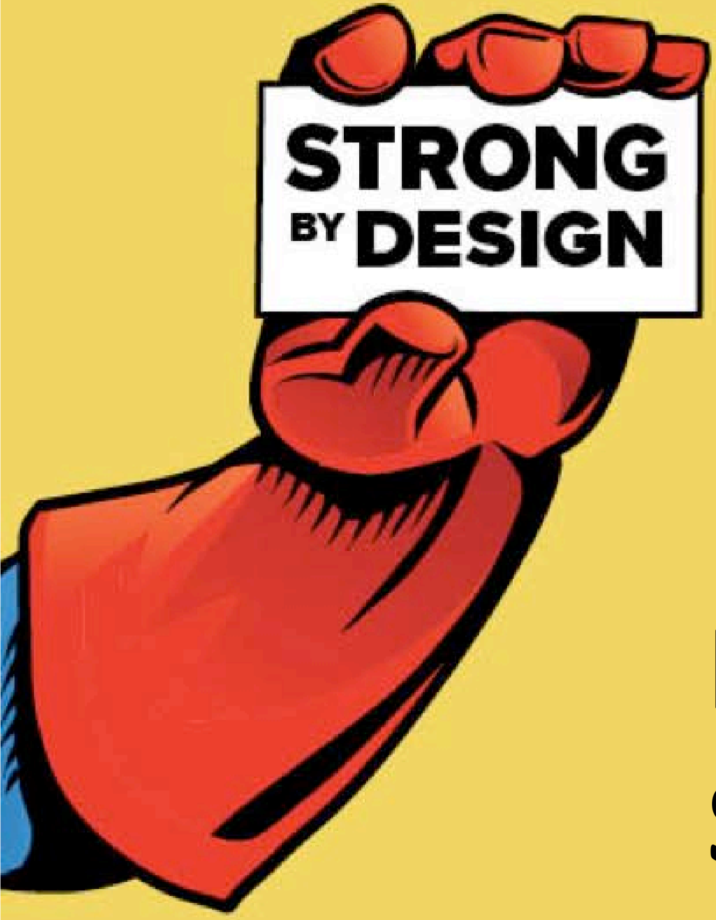
Impact of Additional Contributions on UAAL



Assumes all actuarial assumptions are exactly met each year

In the 2016 valuation, the City has a valuation payroll of $48M and a UAAL $30M. The City's calculated contribution rate is 15.13%.

By paying an additional 0.87% (16%), the City can pay off the UAAL 11 years sooner and save approximately $11M. This also allows the City a stable contribution rate for budgeting and builds a cushion for future adverse experience.



INVESTMENTS SUMMARY

T.J. Carlson
TMRS Chief Investment Officer

INVESTMENT TOPICS

I. Team and Process

II. Asset Allocation and Performance

III. Asset Classes, Compliance and Risk Management

- Public Equities
- Core Fixed Income
- Non Core Fixed Income
- Real Estate
- Real Return
- Absolute Return
- Private Equity
- Compliance
- Risk Management

I. Team and Process

Accountability in Action

Expansion of Staff Resources

Experience

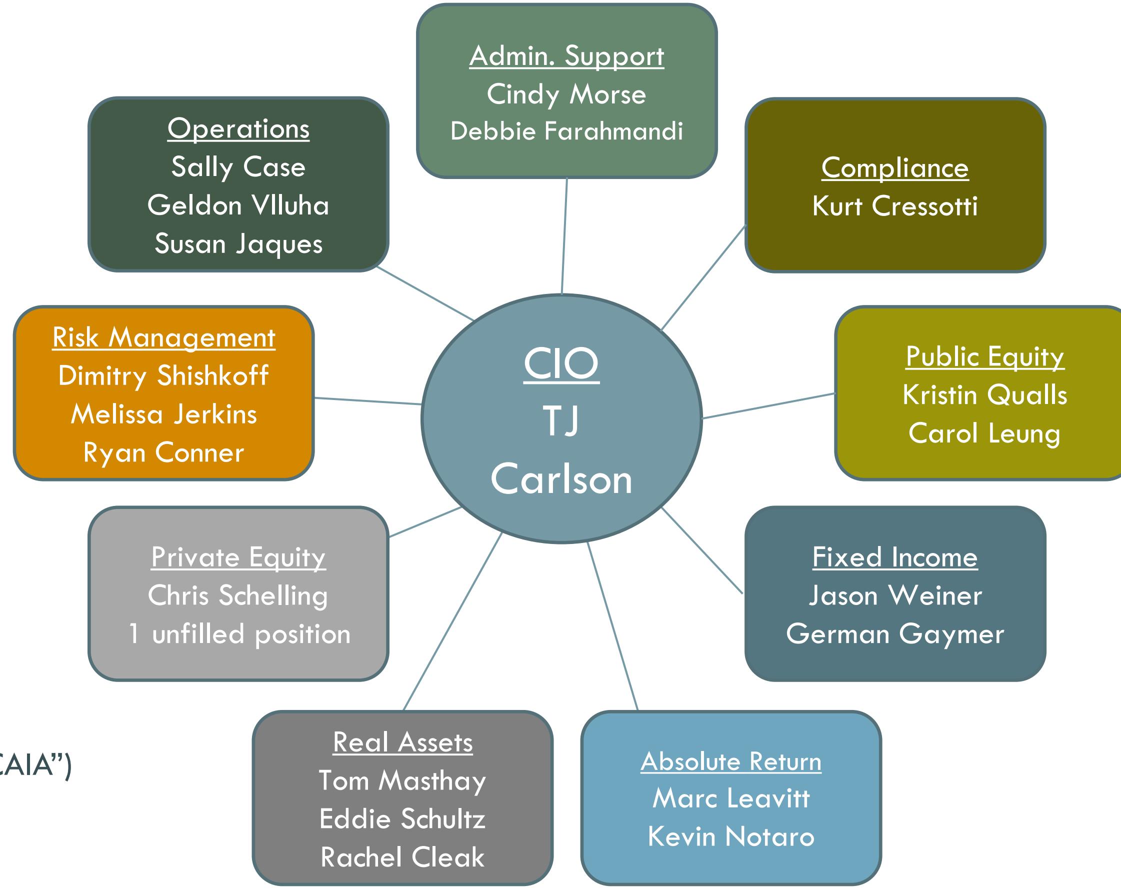
Cumulative Yrs. Experience: 235yrs.
Avg. Years Experience: 15yrs.
Cumulative $ Managed: $139B
Cumulative $ Invested: $60B
Nationalities Represented: 5

Higher Education:

7 Masters in Business Administration
2 Juris Doctorates ("JD")
2 Masters of Science ("MS")
1 PhD, Physics

Professional Designations

3 Chartered Financial Analysts ("CFA")
4 Chartered Alternative Investment Analysts ("CAIA")
1 Financial Risk Manager ("FRM")
6 other professional designations



Board approval to hire an Investment Operations Department, in addition to previous resource expansion in both Risk Management and Compliance, has enhanced Asset Class teams' abilities to introspectively improve investment, execution & monitoring processes.

Recent Investment Awards/Nominations

- 2017 “Turnaround of the Year” Finalist
  - Institutional Investor
- 2017 “Innovator of the Year” Finalist
  - Chief Investment Officer
- 2017 CIO 40 under 40
  - Tom Masthay - Institutional Investor
- 2016 Large Public Plan of the Year Finalist
  - Marc Leavitt - Institutional Investor, Hedge Funds
- 2016 Investor Intelligence Alpha Award
  - Chris Schelling - Institutional Investor

Accountability in Action

Investment Process Improvements / Investment Committee

Investment Committee was chartered under the direction of TJ Carlson on June 7, 2016.

The IC's objective is to "To establish and maintain an internal oversight committee for certain investment and operational related decisions and recommendations within the investment department."

The Committee was designed in conjunction with best practices drawn from both the public fund universe and private industry, creating a forum for the sharing of experience and knowledge, drawing clear lines of accountability and accommodation of dissenting opinions. It is through these mechanisms that TMRS Investment Staff helps ensure the fiduciary duties of Care, Loyalty, and Good Faith are all unquestionably achieved and documented.

The Investment Committee has enhanced the Real Asset manager selection process by providing diverse and informed opinions from other highly qualified investment professionals.

TMRS Investment Committee

TJ Carlson, CIO
Experience: 25 years
Qualifications: MBA, CAIA, CTP

Kristin Qualls, Dir. Equities
Experience: 25 years
Qualifications: Longest Tenure of TMRS Inv. Staff

Dimitry Shishkoff, Dir. Risk Management
Experience: 35 yrs.
Qualifications: Emerging Markets, Higher Mathematics

Marc Leavitt, Dir. Absolute Return
Experience: 22 years
Qualifications: MBA, CAIA

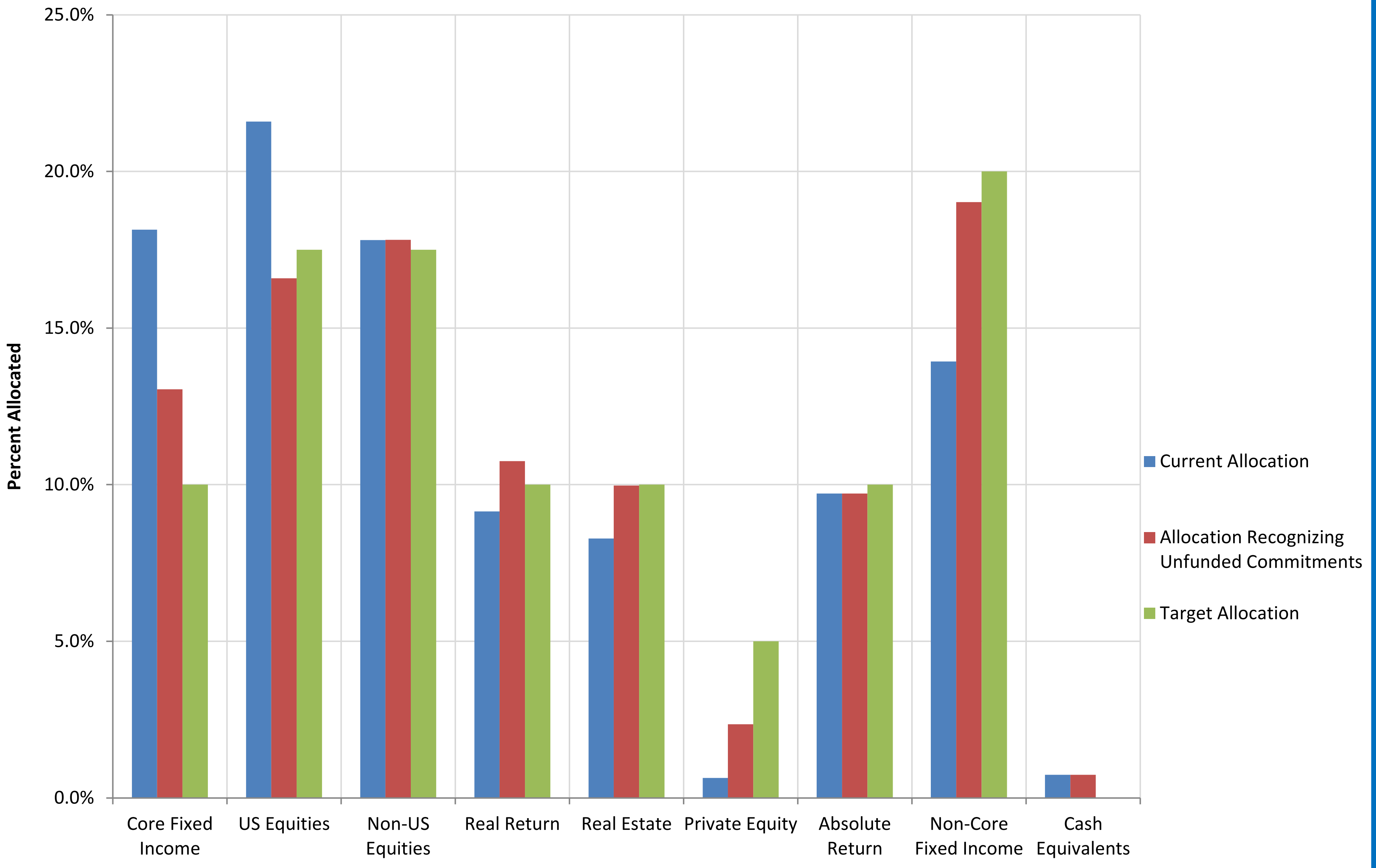
Chris Schelling, Dir. Private Equity
Experience: 17 years
Qualifications: MS Finance, MBA, CAIA

Jason Weiner, Dir. Fixed Income
Experience: 24 years
Qualifications: CFA

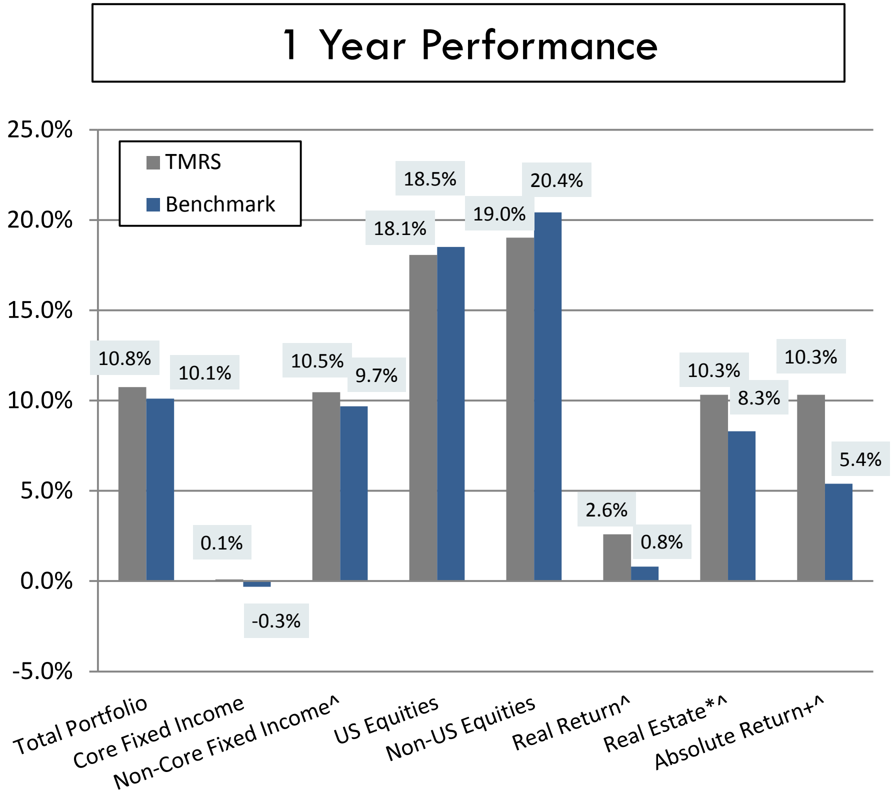
Tom Masthay, Dir. Real Assets
Experience: 10 years
Qualifications: MBA, CFA, CAIA, FRM

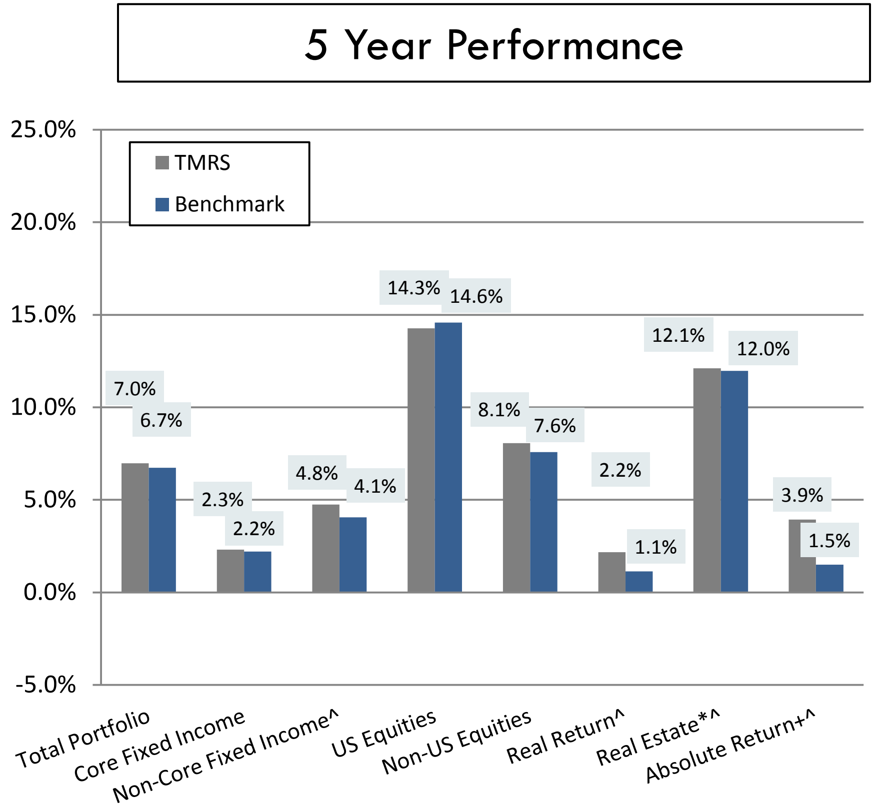
II. Asset Allocation and Performance

TMRS Investment Portfolio Asset Allocation as of 6/30/2017



TMRS INVESTMENT PORTFOLIO
Net Performance By Asset Class
June 2017





*Real Estate return as of prior quarter end (real estate returns are available on a quarterly basis only)

^Non-Core Fixed Income and Absolute Return performance are the annualized return since inception, given their performance history are less than 5 years

Source: State Street Investment Analytics

III. Asset Classes, Compliance and Risk Management

*Public Equities — Asset Class Overview

US Equity

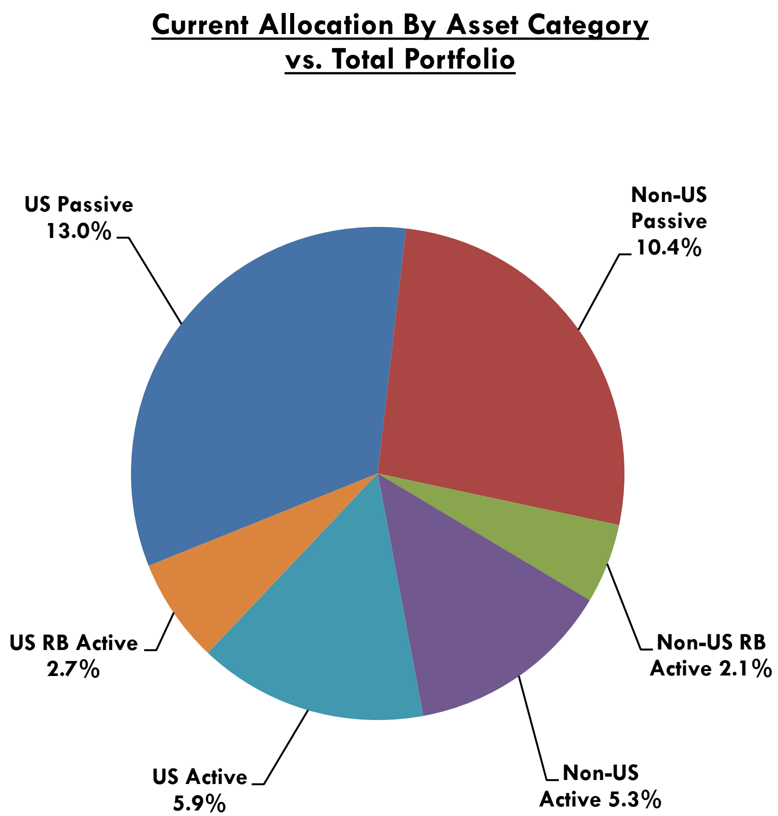
- Objective
  - Intended to provide capital appreciation and is structured using a Core-Satellite Approach with the overall objective of exceeding its benchmark performance net of fees over rolling five year periods.
  - Satellite strategies (Active and Rules-Based strategies with an active component) are expected to add excess return within established tracking error limits and will meet quality, diversification, and liquidity guidelines as specified in the Managers' contracts.

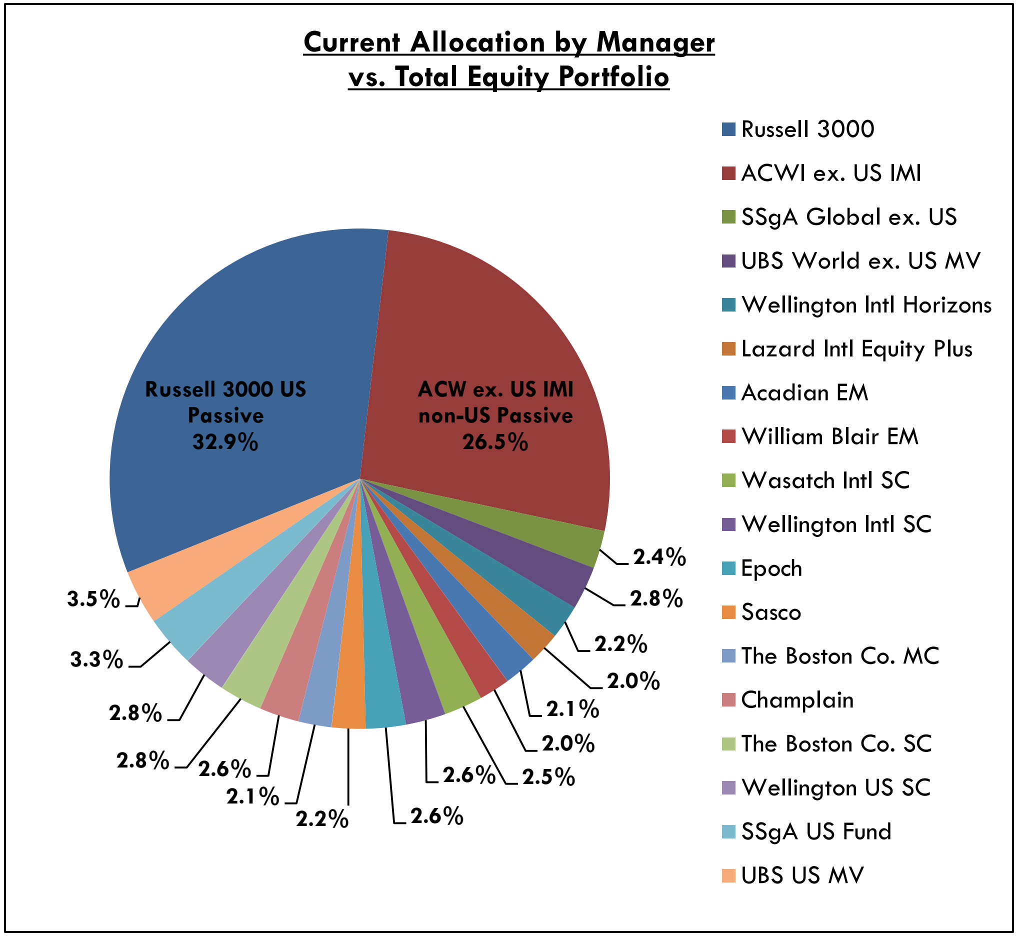
International Equity

- Objective
  - Intended to provide capital appreciation and diversification, and is structured using a Core-Satellite Approach with the overall objective of exceeding its benchmark performance net of fees over rolling five year periods.
  - Satellite strategies (Active and Rules-Based strategies with an active component) are expected to add excess return within established tracking error limits and will meet quality, diversification, and liquidity guidelines as specified in the Managers' contracts or otherwise agreed to in writing between TMRS and the Investment Manager.

Current Passive/Active Allocation

as of 6/30/2017





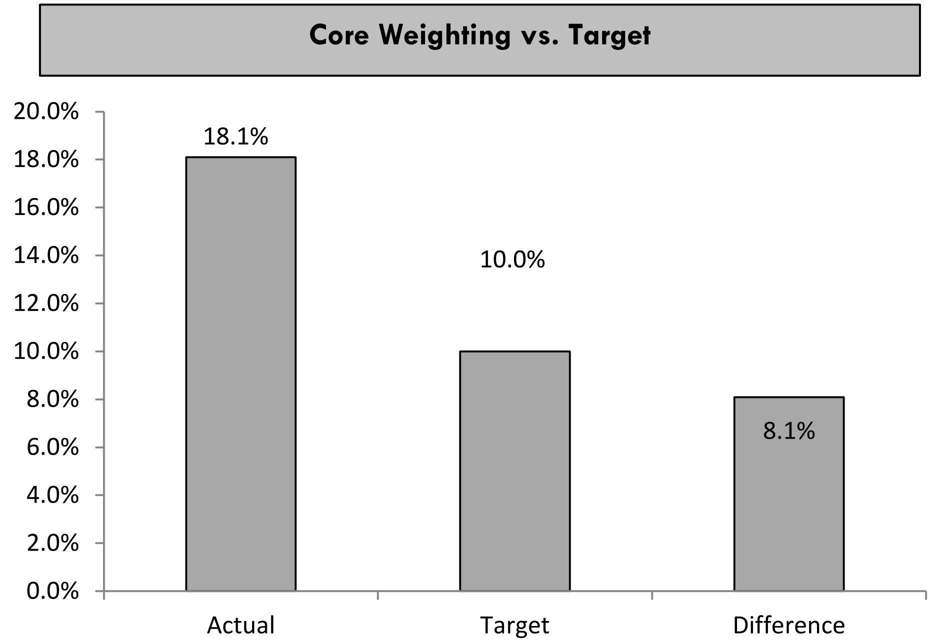
Core Fixed Income
Asset Class Overview

- US Core Fixed Income
  - Objective
    - Purpose is to diversify the risk of the overall investment portfolio with a secondary goal of capital preservation.
    - Performance objective is to exceed the Barclay's US Aggregate Bond Index net of fees over rolling five-year periods and within tracking errors as specified in the Manager contracts, determined according to the specific strategies employed.
  - Investment Philosophy- BlackRock
    - Top down determination of investment themes are based on bottom-up inputs. Investment themes establish parameters for sector, sub-sector and security selection. Macro overlays for duration and volatility are viewed as a separate sector and used opportunistically.
  - Investment Philosophy- PIMCO
    - PIMCO's investment philosophy is driven by diversifying strategies and focuses on longer term secular (3-5 year) trends.
    - Seek to add value through top down strategies including interest rate exposures, duration, volatility, yield curve positioning and sector rotation.
    - Employ "bottom-up" strategies through in depth credit analysis and specific security selection.

Core Fixed Income Allocation

As of 6/30/2017

Mandate	Market Value	% of Total Fund
CORE FIXED INCOME		
BlackRock	$3,117,497,395	11.65%
PIMCO	$1,723,463,259	6.44%
TOTAL	$4,840,960,654	18.10%



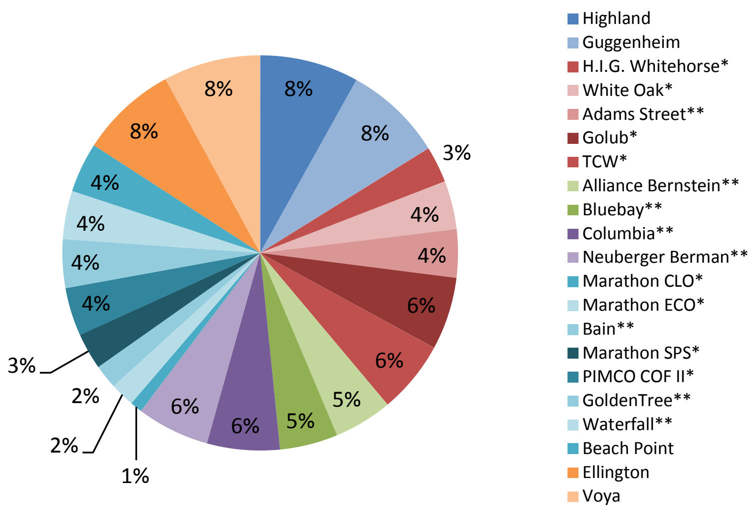
NOTE: Percentages may not be exact due to rounding

Non-Core Fixed Income
Asset Class Overview

- Objective
  - The purpose is to enhance total return through income and capital appreciation and provide diversification to the total investment portfolio. This allocation may be managed actively and/or passively through multiple managers in consideration of manager concentration risk.
  - The Performance Objectives is to exceed the returns of a blended benchmark comprised of the Barclays US Corporate High Yield Index 50%, the JPM GBI-EM Global Diversified Index (USD Unhedged) 25%, and JPM CEMBI Broad Diversified Index 25%, net of fees over rolling five-year periods and within tracking errors as specified in the manager contracts or otherwise agreed to in writing, determined according to the specific strategies employed.

Non-Core Fixed Income Portfolio Construction

Non-Core Fixed Portfolio



Total non-core fixed income portfolio allocation will reach approximately $5 billion upon funding.

Capital Preservation — Income — Capital Appreciation

RMBS/CMBS (16%)
- Ellington
- Voya

BL/CLO (16%)
- Guggenheim
- Highland

Direct Lending (23%)
- Adams Street**
- Golub*
- H.I.G. Whitehorse*
- TCW*
- White Oak*

HY (12%)
- Columbia**
- Neuberger Berman**

EMD (10%)
- Alliance Bernstein**
- Bluebay**

Opportunistic Credit (23%)
- Bain**
- BeachPoint
- GoldenTree**
- Marathon SPS*
- Marathon ECO*
- Marathon CLO*
- PIMCO COF II*
- Waterfall**

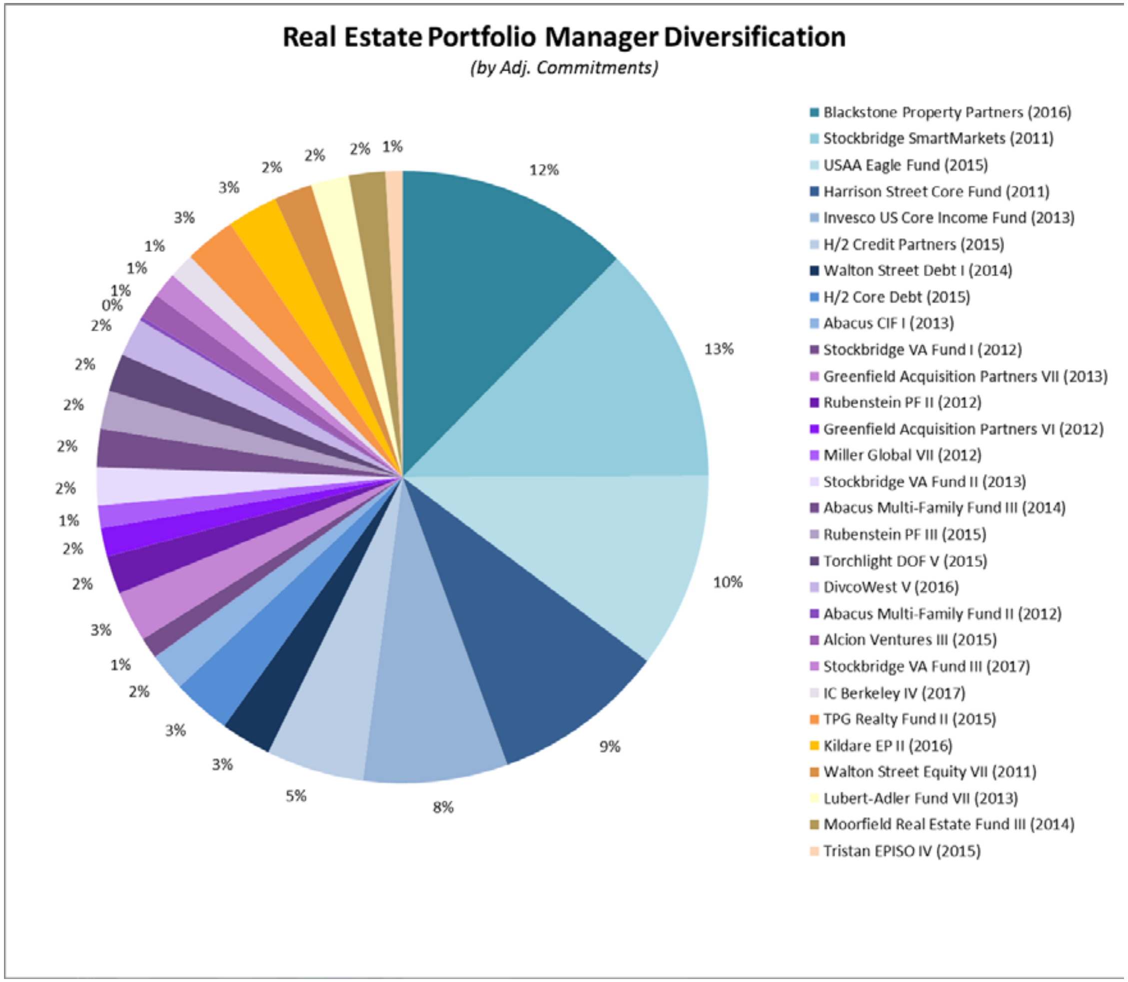
*Partially funded
**Committed, funding pending

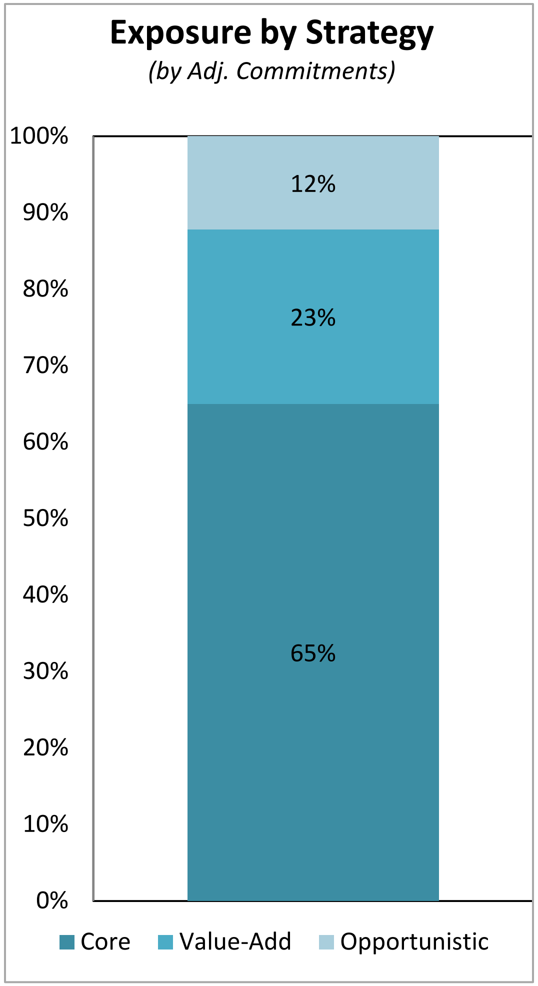
Real Estate
Asset Class Overview

- Objective
  - To enhance total return and provide diversification to the overall investment portfolio.
  - Due to the illiquid and cyclical nature of the real estate asset class, Staff and the Real Estate Investment Consultant recommend that the target allocation be invested over a multi-year period in order to avoid considerable vintage year risks.

- Performance Objective
  - Long term performance objective is a real rate of return (adjusted for inflation) of five percent (5%) net of investment management fees.
  - The real estate portfolio is expected to generate returns net of all fees and expenses, in excess of their respective indices, over rolling five year investment time horizons.

Real Estate Portfolio Statistics





The TMRS' portfolio is well diversified by manager & strategy type. Under both metrics, TMRS is in compliance with IPS limitations.

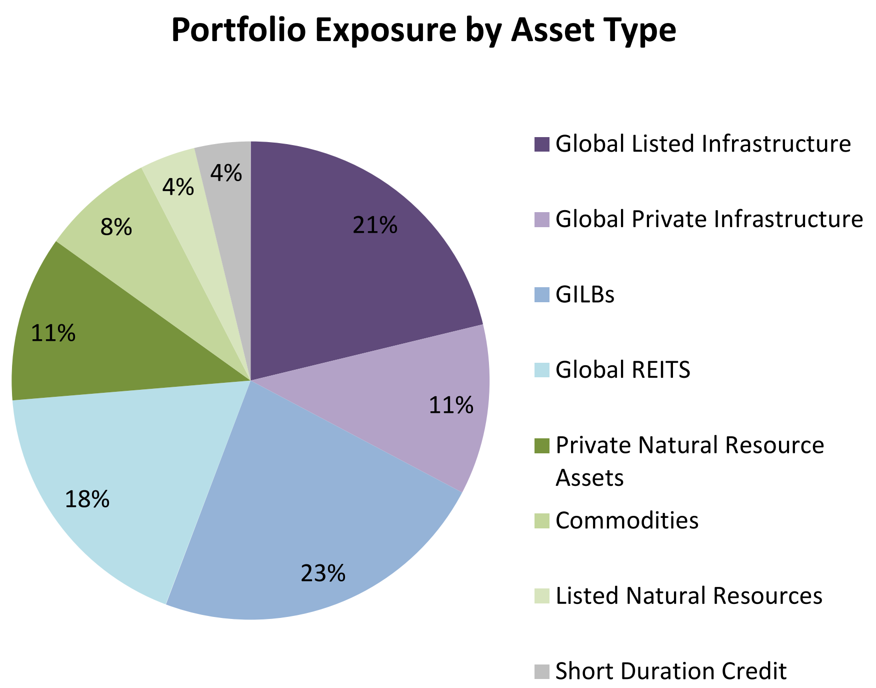
*TMRS may not be invested with greater than 20% exposure to any one manager, 15% to any one investment vehicle, or have less than 50% of real estate exposure dedicated to core holdings. On a market value basis, TMRS is 72% core real estate today.

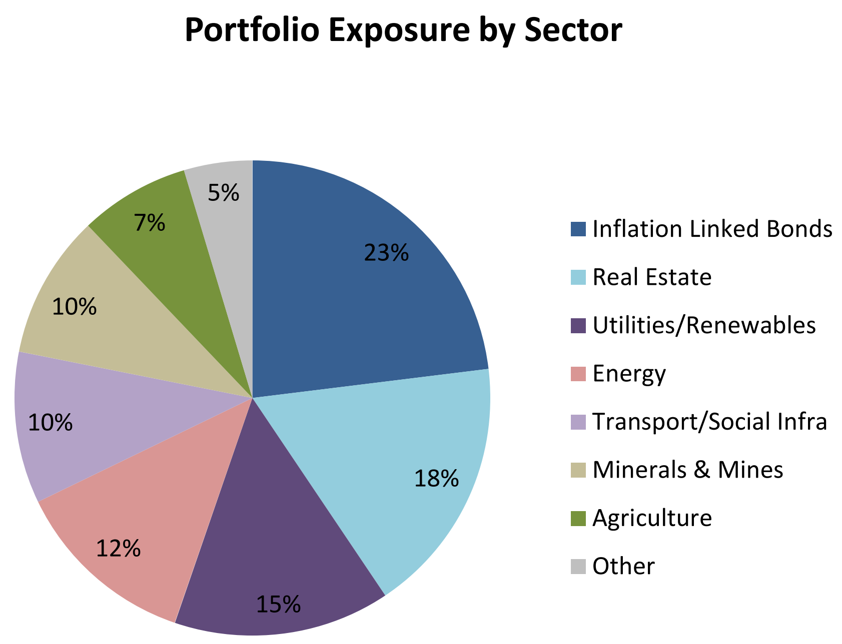
Real Return
Asset Class Overview

- Objective
  - Purpose is to enhance total return and provide diversification and hedge against inflation risks to the overall investment portfolio.
  - Due to the varied nature of the *Real Return* space the portfolio will include strategies across a variety of real asset types as well as a number of investment vehicle types in order to maintain a diversified approach.

- Performance Objective
  - Long term performance objective over a period 5 years or a full market cycle is a real rate of return (adjusted for inflation) of CPI + 400 basis points.
  - On a short term basis the real return portfolio is expected to generate returns net of all fees and expenses, in excess of their respective indices individually and in excess of the Barclay's World Government Inflation Linked Bond Index for the portfolio as a whole.

Real Return Portfolio Statistics





Recent recommendations have enhanced TMRS' diversification within the infrastructure, mining and agricultural sectors.

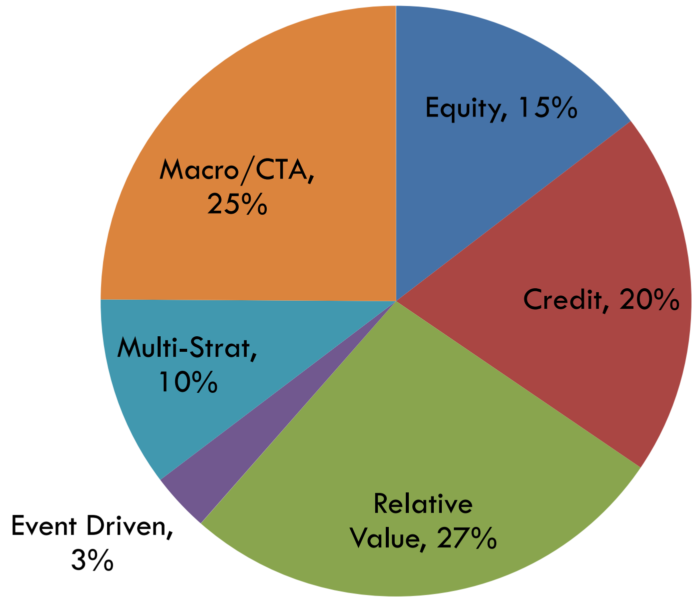
All charts presented on an adjusted committed basis. Slide originally presented in conjunction with June 2017 real return recommendations.

Absolute Return
Asset Class Overview

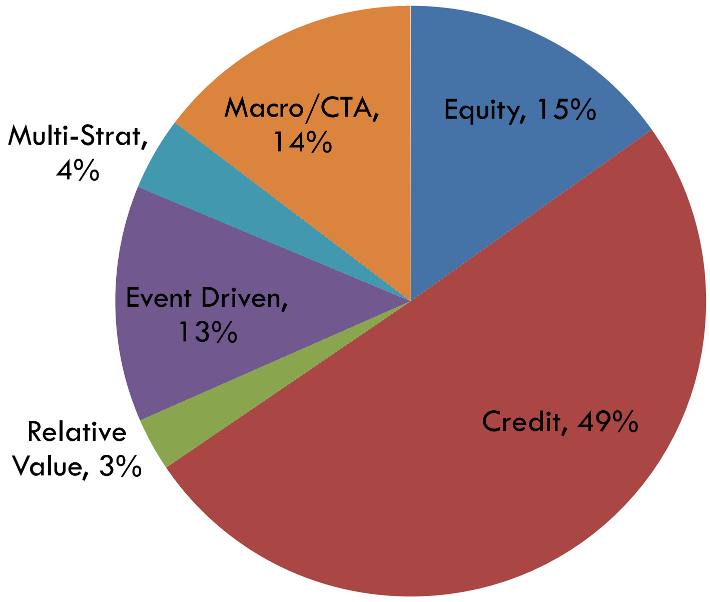
- Objective
  - Purpose is to diversify equity and credit market risk by targeting hedge fund return streams that are independent of the directionality of the broad stock and bond markets. The ARS portfolio will be invested in a wide variety of hedge fund strategies, with specific constraints on overall portfolio risk and individual manager exposure.
  - Performance objective is to exceed the benchmark, defined as the HFRI Fund of Funds Diversified Index, net of fees, and to earn in excess of the appropriate long-term benchmark (3-month LIBOR + 500 basis points) on an ongoing rolling 5-year period.
- Investment Philosophy
  - Predicated on manager skill in:
    - Rotating (long/short trading) market factors based on valuation
    - Navigating less liquid, non public and opaque markets
    - Navigating special situations
    - Predicting and capturing market trends
  - Accordingly, ARS is not an “asset class” (or market sector)

Current Allocation
(Strategy Exposures)

Direct Portfolio Aggregated Manager Exposures



BAAM Aggregated Manager Exposures



Source: BAAM; State Street

Private Equity
Asset Class Overview

- Objective
  - The primary objective is to enhance the total return of the overall investment portfolio, and secondarily to provide diversification. Private Equity investments are commingled funds structured as limited partnerships with capital commitments that are drawn down over time based on manager discretion. Potential distributions are made as a fund matures and investments are typically realized over an 8-12 year horizon.
  - The long term policy objective is to meet or exceed the Russell 3000 + 3.00% over periods of five years or greater.

- Investment Philosophy
  - Manager selection is critical, and managers add value through:
    - Reducing agency conflicts and aligning equity holder/executive incentives
    - Investment structuring and balance sheet management
    - Deep sector experience and creating operating efficiencies
    - Navigating non-public information and capturing illiquidity premia
  - *Note: Due to the illiquid nature of the Private Equity asset class, the target allocation will be invested over a multi-year period in order to avoid considerable vintage year risks.*

Private Equity Allocation

Figure 3: Private Equity Manager Diversification by Commitment

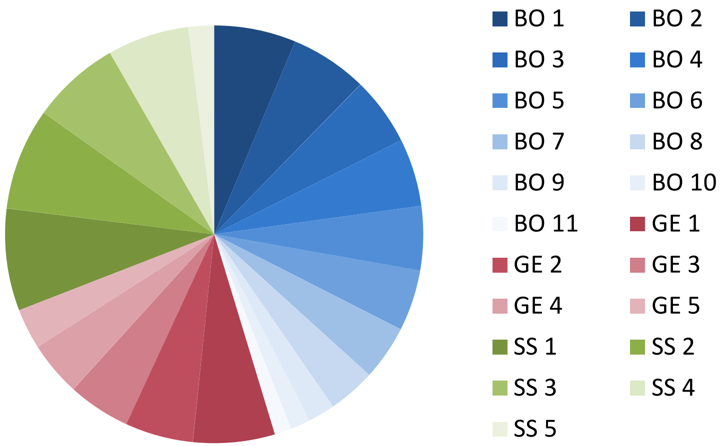
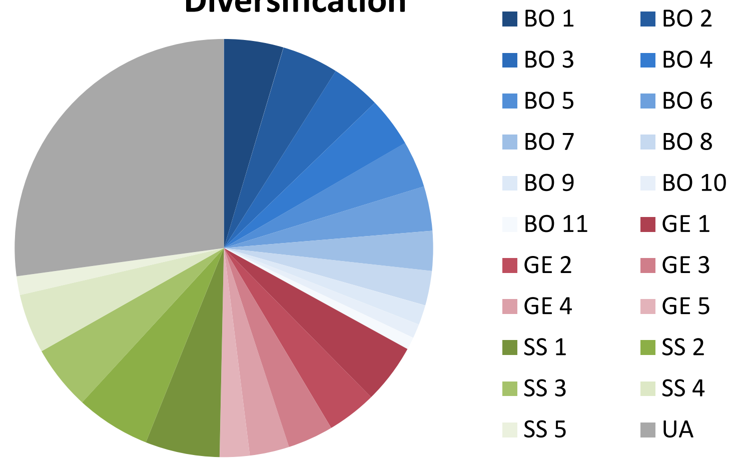


Figure 4: Private Equity Target Manager Diversification



Policy Guidelines

No more than 35% with any one investment manager
No more than 25% in any one investment vehicle

NOTE: Percentages may not be exact due to rounding

Compliance Overview

- IPS Objectives
  - The primary objective of Compliance is to implement a detailed compliance program which uses a combination of daily, weekly and monthly testing of all testable parameters of the Investment Policy Statement and all Manager guidelines at the Manager, asset class and total fund level, as appropriate.
  - Testing may be completed either through systematic resources (automated custodial compliance) or manually if necessary.
  - Compliance personnel shall create and present a quarterly report to the Board with the results of the testing performed during each period.

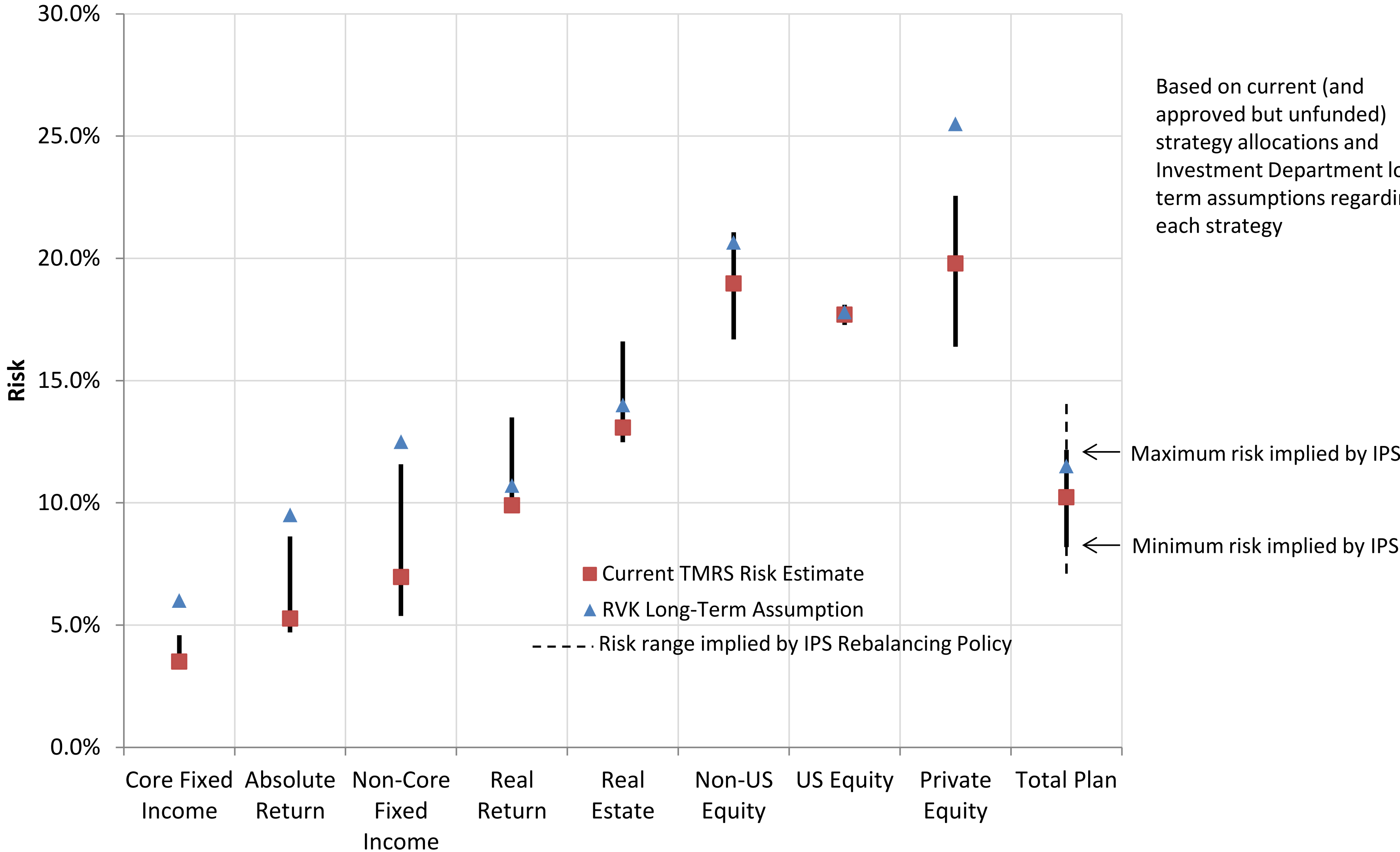
Investment Guideline Compliance
June 2017

Policy Guidelines	Core Fixed Income	Non-Core Fixed Income	Real Return	Domestic Equities	Global Equities
Credit Quality	✓	✓	✓	✓	✓
Liquidity/Cash Management	✓	✓	✓	✓	✓
Permissible/Prohibited Investments	✓	✓	✓	✓	✓
Concentration Risk	✓	✓	✓	✓	✓
Country/Region & Currency	✓	✓	✓	✓	✓
Issue/Issuer	✓	✓	✓	✓	✓
Sector & Asset Type	✓	✓	✓	✓	✓
Interest Rate Risk	✓	✓	✓	N/A	N/A
Spread Risk	✓	✓	✓	N/A	N/A

- 413 guideline compliance tests were run on TMRS's 19 separately managed account portfolios as of June 30, 2017. There were no material violations of TMRS guidelines.

Implementation Risk Ranges Implied by IPS Asset Class Guidelines

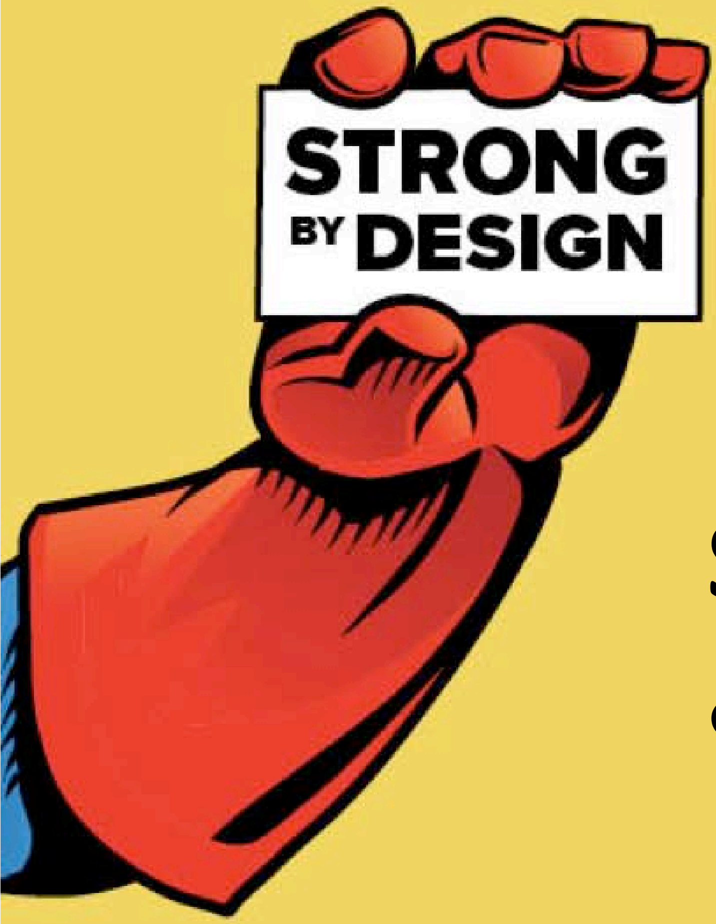
March 2017



Based on current (and approved but unfunded) strategy allocations and Investment Department long-term assumptions regarding each strategy

DISCLOSURES

TMRS periodically discloses public information that is not excepted from disclosure under Section 552.0225(b) of the Texas Public Information Act. Information provided by a manager, a Managing General Partner (GP), any of its Associates or other data provider to TMRS or a TMRS service provider, and contained in these materials (i) may have been independently produced or modified by TMRS or the TMRS service provider; (ii) has not been reviewed or approved by the manager, Managing GP or any of its Associates; and (iii) may not reflect the historical performance or asset value reflected in the manager's, Managing GP's or any of its Associates' records and, therefore, should not be used for comparative purposes.



SUSTAINABILITY & FUNDING STRENGTH

Mark Randall

Chief Executive Officer

Gabriel, Roeder, Smith & Co.

Sustainability Definition

Per Google, dictionary, etc., sustainability is:

- The capacity to endure; endurance of systems and processes
- When a system maintains its own viability by using techniques that allow for continual reuse
- Ability to be supported as with the basic necessities or sufficient funds
- Ability to be used without being completely used up or destroyed

Public employee retirement system sustainability, per the American Academy of Actuaries:

- Promotes intergenerational equity
- Allocates cost properly among stakeholders
- Withstands market shocks
- Maintains balance between sustainability and benefit adequacy

Sustainability Checklist

- The following is a list of metrics that can be used to assess the sustainability of a pension plan.
- This can be used to gain a larger picture of sources of risk on a pension plan.
- Please note the aggregate results are much more meaningful than the impact of any one item.
- Also, it is unnecessary to achieve a 5-star result on each item to be considered sustainable. In fact, that type of result may suggest too much conservatism.

Source: GRS, as presented to the TMRS Board of Trustees, May 2016.

Sustainability Checklist as of 12/31/16	Answer	Stars
Do you have a legally required contribution amount based on accepted actuarial practices?	Yes	*****
Does the contribution amount automatically adjust if certain minimums are not met?	Yes	*****
Have you met the required contribution each year over the past 10 years?	Yes	*****
What is the amortization period for the current UAAL based on the required contribution?	19.7 Years	*****
What is the amortization period for new losses?	25 Years	*****
What is the sum of your amortization period and asset smoothing period?	35 Years	****
What is your investment return assumption?	6.75%	*****
Does your current investment policy and target asset allocation support the current assumption?	Yes	****
What is your payroll (revenue) growth assumption?	3.00%	****
Are there any benefits, that are likely to be paid, not reflected in the liabilities and contributions?	Yes^	***
Are any of the liabilities contingent on future experience?	No#	***
What is your short — intermediate term negative cash flow as a % of assets?	0-1%	*****
What is your longer term negative cash flow as a % of assets?	2-3%	*****
What is your current active to retiree ratio?	1.8	****
What is your longer term active to retiree ratio?	1.0-1.3	**
What is your ratio of accrued liability to payroll?	4.9	****
What is your longer term ratio of accrued liability to payroll?	6.5-7.0	**

^ It is possible to get interest credits to member accounts higher than 5%. Also, ad hoc COLAs are possible, but have a strong funding policy.
 # COLAs are tied to actual CPI, which is usually correlated to economic growth. Annuity Purchase Rates adjust to reflect changes in mortality.

QUESTIONS

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TMRS
Texas Municipal Retirement System