Dallas Police and Fire Pension System

Asset Allocation Recommendation

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Recap of Process and Assignment

September Board Meeting

1.	Described the Meketa Investment Group asset modeling process.
2.	Discussed the challenges of achieving 7.25% going forward.
3.	Provided an analysis of the current starting point for DPFP.
4.	Presented a variety of asset allocation mixes that are expected to earn a long-term return of 7.25% per year, on average, with varying degrees of private market exposure. Each had roughly a 50% probability of earning 7.25%.

Assignment

1.	We were requested to prepare three asset mixes that are expected to earn 7.25% over the long-term with allocations to private markets ranging between 10% and 20%, and maximize the probability of earning 7.25% (to the extent possible).
2.	For comparison purposes, we were asked to: • Calculate the probability of hitting lower return targets (e.g. 7.0% or 6.75% rather than 7.25%) with the asset mixes presented. • Determine if there is an investable asset mix that has a 60% probability of earning 7.25%.
3.	We were asked to jointly (with DPFP staff) recommend one long-term target policy for the Board to adopt.
4.	Finally, we were asked to present an implementation plan bridging the gap between today's mix and the long-term policy. We discuss today a few alternative plans and their implications.

Reviews of Objectives

Long-Term return objectives

- All of the following return objectives are important in our view:
  - Improve funded status and solvency.
  - Meet or exceed actuarial assumed rate of return.
  - Control costs and expenses.

Long-Term risk tolerance objectives

- Common risk minimization objectives include:
  - Minimize the risk of permanent capital impairment.
  - Minimize volatility in asset values.
  - Given the net cash flow position, limit the extent of short-term losses.

Managing Investment Constraints

What is the overall time horizon for DPFP?

- On-going concern, with long-term time horizon for majority of assets.

What are the liquidity needs of the DPFP?

- Net cash outflows of approximately $130 million per year (approximately 6% of assets).

What is the Funded Status of DPFP?

- Approximately 47% funded.

What are the legal and regulatory constraints under which DPFP operates?

- Texas state laws.

Are there any other considerations that must be evaluated?

- Significant illiquidity in current portfolio. Staff/Trustees would prefer a more liquid portfolio.
- Approximately 25% of the Fund comprised of legacy[1] assets.
- Lower than projected contributions entering DPFP.
- Roughly equal ratio of active to retired participants.
- Pension reform passed in 2017.
- Due to funding status and cash flow position, path of returns matters to DPFP. Therefore, avoiding early losses is important.

[1] Assets defined as "legacy" were identified by DPFP staff as those assets with limited/no liquidity and expectations for low returns and high volatility.

Recommended Long-Term Allocation

Recommended Long-Term Allocation[1]

	Mix 15% Private (%)
Equities	**55**
Global Equity	40
Emerging Market Equity	10
Private Equity	5
Safety Reserve and Fixed Income	**35**
Cash Equivalents	3
Short-term Investment Grade Bonds	12
Investment Grade Bonds	4
High Yield Bonds	4
Bank Loans	4
Global Bonds	4
Emerging Market Bonds (50/50)	4
Real Assets	**10**
Private Real Estate	5
Private Natural Resources	5
Expected Return (20 years)	*7.3*
Standard Deviation	*13.4*
Sharpe Ratio	*0.33*
Probability of Achieving 7.25% over 20 Years	*50%*

- We recommend the Board adopt the above asset mix as DPFP's long-term asset allocation policy.

[1] Expected return and standard deviation are based upon Meketa Investment Group's 2018 Annual Asset Study. Throughout this document, returns for periods longer than one year are annualized. "Private" is defined by all asset classes not traded on public exchange or broker to broker. Specifically: private equity, private debt, private real estate, private natural resources and private infrastructure.

Highlights of Recommended Mix

- 15% allocation to private market assets.
- 50% probability of achieving a 7.25% return over a twenty-year horizon.
- 15% Safety Reserve®.
- Approximately 70% chance of producing a positive return in any given year.
- Trustees should expect the mix to produce an investment loss once every 3-4 years.
- With a standard deviation of 13.4%, the range of outcomes (one standard deviation) in any given year goes from -6.1% to 20.7%.
- The long-term recommended mix does not factor in any near term tactical considerations. It is based on long-term projections.

Other Policies for Illustration[1]

	Mix 10% Private (%)	Mix 15% Private (%)	Mix 20% Private (%)	60% Prob. of 7.25% (%)
Equities	**54**	**55**	**41**	**80**
Global Equity	42	40	28	50
Emerging Market Equity	7	10	8	20
Private Equity	5	5	5	10
Safety Reserve and Fixed Income	**34**	**35**	**42**	**15**
Cash Equivalents	3	3	3	3
Short-term Investment Grade Bonds	12	12	12	12
Investment Grade Bonds	0	4	0	0
TIPS	0	0	5	0
High Yield Bonds	5	4	7	0
Bank Loans	7	4	7	0
Global Bonds	3	4	0	0
Emerging Market Bonds (50/50)	4	4	8	0
Real Assets	**12**	**10**	**17**	**5**
REITs	4	0	2	0
Private Real Estate	3	5	5	0
Private Natural Resources	2	5	5	5
Infrastructure (Public)	3	0	0	0
Private Infrastructure	0	0	5	0
Legacy Assets	**0**	**0**	**0**	**0**
Expected Return (20 years)	*7.25*	*7.30*	*7.25*	*8.30*
Standard Deviation	*13.87*	*13.38*	*12.67*	*17.18*
Sharpe Ratio	*0.31*	*0.33*	*0.34*	*0.31*
Probability of Achieving 7.25% over 20 Years	*49%*	*50%*	*49%*	*60%*

[1] Expected return and standard deviation are based upon Meketa Investment Group's 2018 Annual Asset Study. Throughout this document, returns for periods longer than one year are annualized. "Private" is defined by all asset classes not traded on public exchange or broker to broker. Specifically: private equity, private debt, private real estate, private natural resources and private infrastructure. The mixes with 10% and 20% allocation to private markets are the same mixes developed by Meketa Investment Group and presented at the September 2018 Board meeting. Numbers rounded where appropriate.

Probability of Returns Matrix[1]

	Mix 10% Private (%)	Mix 15% Private (%)	Mix 20% Private (%)	60% Prob. of 7.25% (%)
At least: 7.25%	49	50	49	60
At least: 7.00%	52	53	53	63
At least: 6.75%	56	57	56	65
At least: 6.50%	59	60	60	68
At least: 6.00%	65	66	67	72

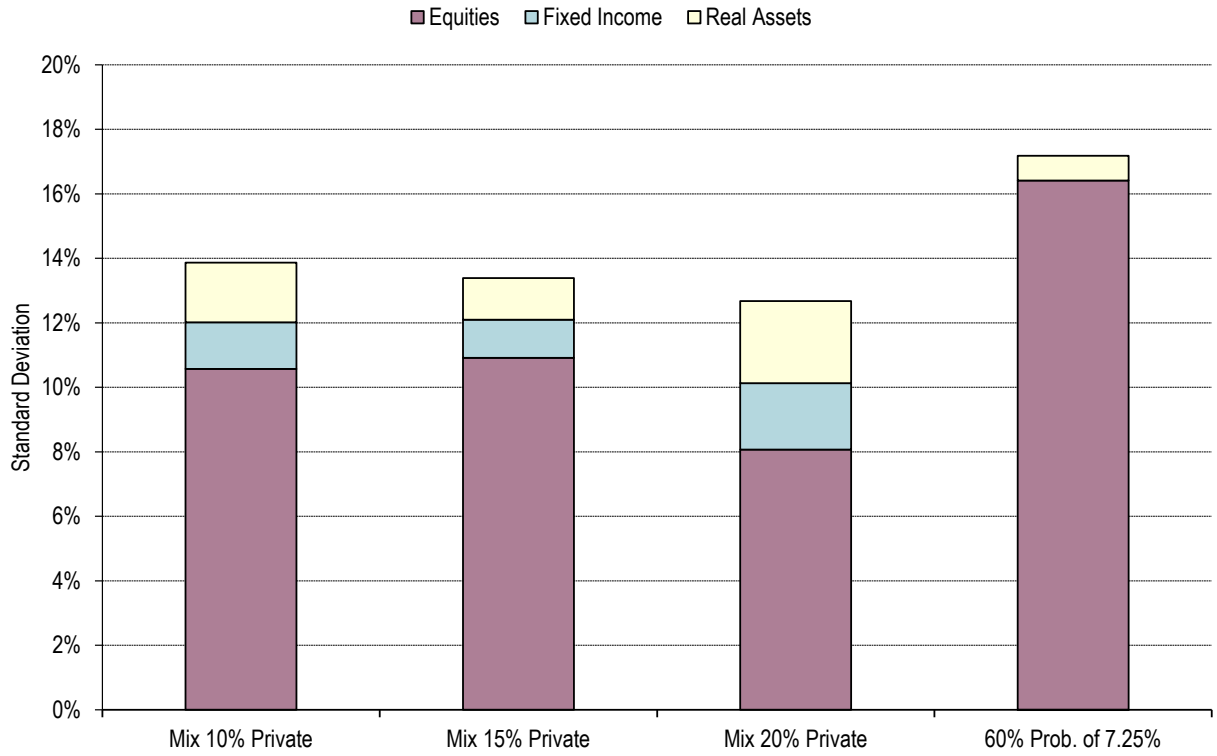
Probability of Negative Return in a Given Year[2]

	Mix 10% Private (%)	Mix 15% Private (%)	Mix 20% Private (%)	60% Prob. of 7.25% (%)
Less than 0%	29	29	28	31

- The first three mixes each have roughly 50% probability of earning 7.25% over the next twenty years.
- While the *60% Probability of 7.25%* mix has the highest probability of earning 7.25% over the long-term, we do not think it is investable for DPFP given the Plan's funded status and predicted negative cash flows (more discussion contained in the next section).

[1] Based on twenty year horizon.
[2] Based on one year horizon.

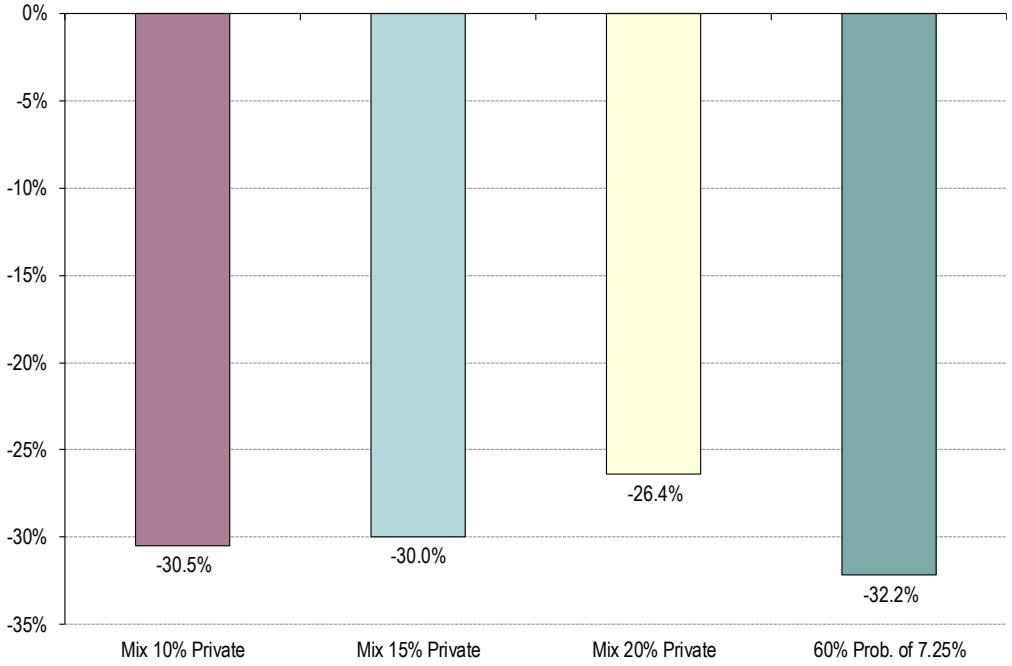
Risk Budgeting Analysis[1] (Standard Deviation Decomposition)



- Equity risk dominates the risk profile of all portfolios shown.
- The *60% Probability of 7.25%* mix is expected to have significantly more volatility (standard deviation).

[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.

Global Financial Crisis Repeat[1] (Oct 2007 - Mar 2009)



- In an extended down market environment (e.g., the GFC), all portfolio mixes experience significant losses.
- The mix with a 20% allocation to private markets produces the best relative return because it has the least amount of public equity exposure.

[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.

Relative Change: Recommended vs. Current Allocation

	Current Exposure (%)	Mix 15% Private (%)	Increase/Decrease (%)
Equities	**23**	**55**	**+32**
Global Equity	21	40	+19
Emerging Market Equity	2	10	+8
Private Equity	0	5	+5
Safety Reserve and Fixed Income	**29**	**35**	**+6**
Cash Equivalents	3	3	0
Short-term Investment Grade Bonds	12	12	0
Investment Grade Bonds	0	4	+4
High Yield Bonds	4	4	0
Bank Loans	5	4	-1
Private Debt Composite	1	0	-1
Global Bonds	3	4	+1
Emerging Market Bonds (50/50)	1	4	+3
Real Assets	**22**	**10**	**-12**
Private Real Estate	11	5	-6
Private Natural Resources	9	5	-4
Private Infrastructure	2	0	-2
Legacy Assets[1]	**26**	**0**	**-26**

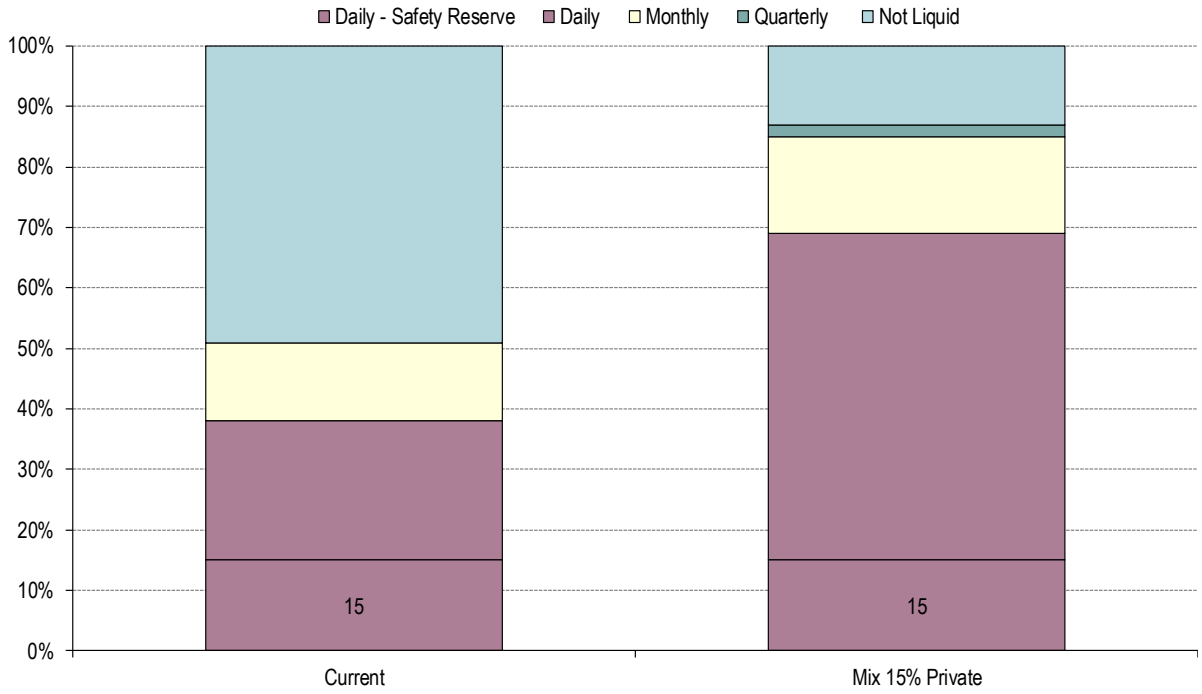
[1] Assets defined as "legacy" were identified by DPFP staff as those assets with limited/no liquidity and expectations for low returns and high volatility. Legacy assets we modeled an expected return of 0% but a standard deviation of 25% (our same standard deviation assumption for opportunistic real estate/private equity).

Implementation – Impact on Manager Roster

	Increase/Decrease (%)	Mix 15% Private (%)	Expected Timeframe
Legacy Assets[1]	**-26**	Full liquidation	Uncertain
Equities	**+32**		
Global Equity	+19	Manager Search(es)	Dependent on legacy unwind
Emerging Market Equity	+8	Manager Search(es)	Dependent on legacy unwind
Private Equity	+5	$100+ mm in commitments	~5 years
Safety Reserve and Fixed Income	**+6**		
Cash Equivalents	0	-	
ST Investment Grade Bonds	0	-	
Investment Grade Bonds	+4	Manager Search(es)	Less than 1 year
High Yield Bonds	0	-	
Bank Loans	-1	Rebalancing	Less than 1 year
Private Debt Composite	-1	Full liquidation	~5+ years
Global Bonds	+1	Rebalancing	Less than 1 year
Emerging Market Bonds (50/50)	+3	Rebalancing	Less than 1 year
Real Assets	**-12**		
Private Real Estate	-6	Manager Search (Core)	~3-5 years
Private Natural Resources	-4	Partial Liquidation	~1-2 years
Private Infrastructure	-2	Full liquidation	~3-5 years

[1] Assets defined as "legacy" were identified by DPFP staff as those assets with limited/no liquidity and expectations for low returns and high volatility.

Liquidity Profile[1]



- With the proposed mix, we expect 85% of DPFP's assets would be invested in strategies with monthly or better liquidity.
- Note that this mix maintains the current 15% target to Safety Reserve assets.

[1] For this analysis, we assume that emerging market debt, global bonds, high yield bonds and bank loans provide monthly liquidity. We assume core real estate and core infrastructure provide quarterly liquidity. We assume closed-end private real estate, private natural resources, private equity and private debt are non-liquid.

Short-Term Implementation Considerations

Overview

- Based on current funded status and expected net cash outflows (approximately 6% per year for benefit payments and expenses, net of contributions) DPFP is in a precarious situation.
- Any near term market correction or significant loss from the legacy assets could theoretically put DPFP on a path to insolvency.
- There are a variety of potential paths DPFP can take as it works towards the long-term asset allocation. We highlight two below:
    1. **Maintain a conservative allocation for the next few (3 to 5) years** until more certainty exists surrounding the exit of the legacy assets and the expected future contributions into the Fund.
        a. The risk of this approach may be locking in an actuarial loss, thereby worsening the funded status of the Pension Plan. Without a substantial increase in contributions or a reduction in benefits/expenses, a permanent conservative allocation would lead to insolvency.
    2. **Move towards the long-term asset mix gradually** as illiquid assets are redeemed/exited**.**
        a. This would increase the probability of achieving 7.25% in a normal/strong market environment, but would require accepting more market risk. If there is a significant equity market correction in the next few years or significant write-downs in the legacy assets, DPFP may not be able to repair its long-term expected funded status without a future cash infusion or a reduction in its cash outflows.

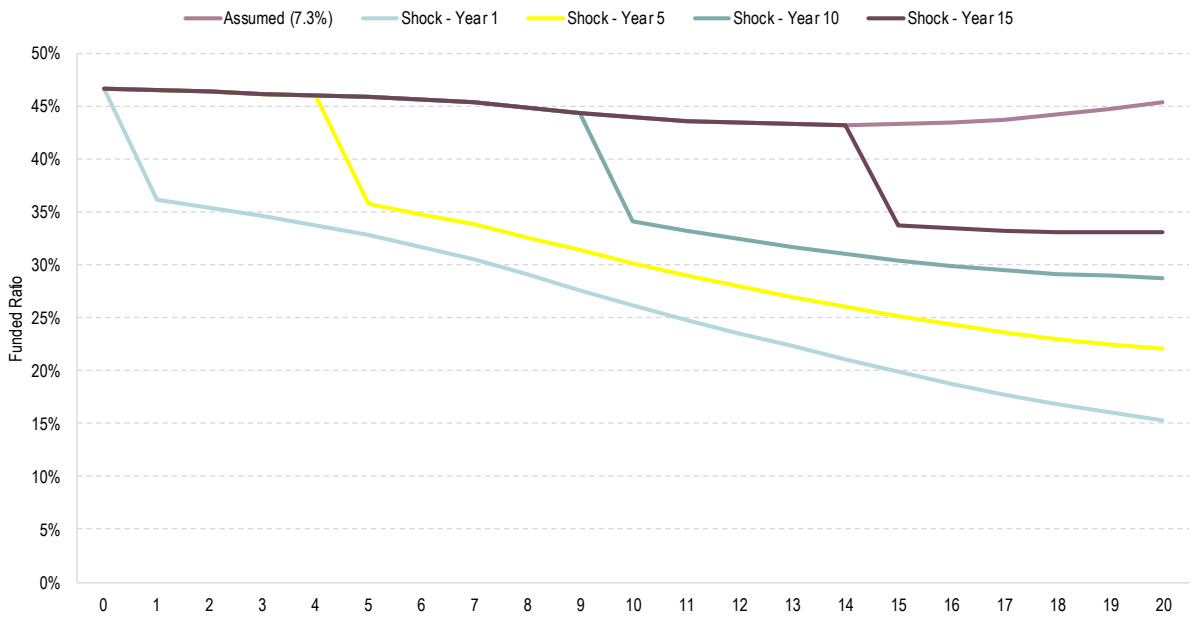
Risks and Considerations

- Over the next few pages we highlight the potential impact to DPFP's funded status under a variety of (primarily negative) scenarios. We note there is no optimal solution or answer towards devising an implementation plan to bridge the gap from the current asset mix to the long-term asset mix approved by the Board. Each approach presents risks. As such, it is critical the Trustees understand the various trade-offs in these alternative routes.
- We can summarize the risk into three major categories:
    1. **Volatility / Path of Returns**: There are an infinite number of potential paths of returns that the Fund can follow, yet only one will materialize in the future. This future path is unknown today. The greater this volatility of the asset mix, the more risk there is of generating a loss in the early years. The greater this early loss, the greater the risk of insolvency. Therefore, controlling for volatility and mitigating large drawdowns would be important for the Fund's solvency. The cost of doing so is typically accepting a lower long-term return, so this is a challenging trade-off.
    2. **Payroll / Contribution**: Contributions into the Fund by the City are a very important variable. The risk to the Fund is a payroll that is lower than projected in the City's Hiring Plan. The greater this shortfall, the larger the risk to the Fund's solvency. As this shortfall extends, the Fund's investment returns matter less (e.g., the Fund can achieve excellent returns, but on a small asset base, and as such it would not have a chance to catch up to the growing liabilities).
    3. **Legacy Assets**: Presently, 26% of the Fund's assets have been deemed by DPFP to be "Legacy Assets". Current assumption by DPFP is that these assets would be exited at par (e.g., generate a 0% return until they are liquidated). A risk to the Fund exists if the value of that exit is lower than accounted for, or if the time to exit takes longer than planned. As an illustration, a 40% write-off would translate to close to a 10% loss at the total Fund level, without accounting for the performance of the rest of the Fund. Since the actual exit price and timing are unknown, this is a risk to the Fund.

Equity Market Correction Today is Much More Meaningful than a Correction in the Future

- A 25% decline in large cap stocks is expected to result in a -15.8% return for the recommended long-term mix (in the year shown).
- The timing of a potential equity shock is impactful. A shock now is much worse than a shock in the future.
- All the "shock" lines below have the exact same total annualized return[1].

Funded Status[2] Under Different "Shock" Time Points



[1] Returns modeled as 7.3% in 19 of 20 years, but one year of -15.8%, the total twenty-year return decreases to 6.0%.
[2] Model assumes the average contribution rate of the city payroll forecast and the actual payroll contributions net of expected benefit payments.

Equity Market Correction Today is Much More Meaningful than a Correction in the Future (continued)

- Below is the corresponding data for the chart on the prior page.

Funded Status and Predicted Cash Flows[1]

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Assumed (7.3%)	47%	47%	46%	46%	46%	46%	46%	45%	45%	44%	44%	44%	43%	43%	43%	43%	44%	44%	44%	45%	45%
Shock – Year 1	47%	36%	35%	35%	34%	33%	32%	31%	29%	28%	26%	25%	24%	22%	21%	20%	19%	18%	17%	16%	15%
Shock – Year 5	47%	47%	46%	46%	46%	36%	35%	34%	33%	31%	30%	29%	28%	27%	26%	25%	24%	24%	23%	23%	22%
Shock – Year 10	47%	47%	46%	46%	46%	46%	46%	45%	45%	44%	34%	33%	32%	32%	31%	30%	30%	29%	29%	29%	29%
Shock – Year 15	47%	47%	46%	46%	46%	46%	46%	45%	45%	44%	44%	44%	43%	43%	43%	34%	33%	33%	33%	33%	33%
Net Cash Flow[1] ($mm)	$0	-$133	-$131	-$137	-$139	-$139	-$148	-$143	-$160	-$154	-$148	-$142	-$136	-$130	-$125	-$120	-$115	-$108	-$99	-$95	-$90

Returns

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Shock – Year 1	0.0%	-15.8%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%
Shock – Year 5	0.0%	7.3%	7.3%	7.3%	7.3%	-15.8%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%
Shock – Year 10	0.0%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	-15.8%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%
Shock – Year 15	0.0%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3	7.3%	7.3%	7.3%	7.3%	-15.8%	7.3%	7.3%	7.3%	7.3%	7.3%

[1] Model assumes average contribution rate of the city payroll forecast and the actual payroll contributions net of expected benefit payments.

Scenario Analysis - Part One

- In the following slides, Meketa analyzed several scenarios for DPFP over the next 20 years.
- In each case we modeled different return paths in years 1-5.
- In each case[1] we assume that DPFP earns the expected return rate for the recommended long-term mix (7.3%) in years 6-20.
- The most optimistic scenario evaluated is the baseline actuarial return assumption.
- The most dire (worst case) scenario is a full write-off all the legacy assets over the five years with the rest of the Fund generating a zero percent return.
- Each scenario is detailed below.

"Grade"	Scenario Description	2018 DPFP Return	2019 DPFP Return	2020 DPFP Return	2021 DPFP Return	2022 DPFP Return	*Years 6-20*
A	Actuarial Base Line	5.0%	5.25%	6.25%	7.25%	7.25%	*7.25%*
B	Bond-like performance for 5 years	4.0%	4.0%	4.0%	4.0%	4.0%	*7.30%*
C	Legacy assets negate performance of rest of portfolio for 5 years	0.0%	0.0%	0.0%	0.0%	0.0%	*7.30%*
D	1/2 of legacy assets is written off over next 5 years	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	*7.30%*
F	All legacy assets are written off over next five years	-5.0%	-5.0%	-5.0%	-5.0%	-5.0%	*7.30%*

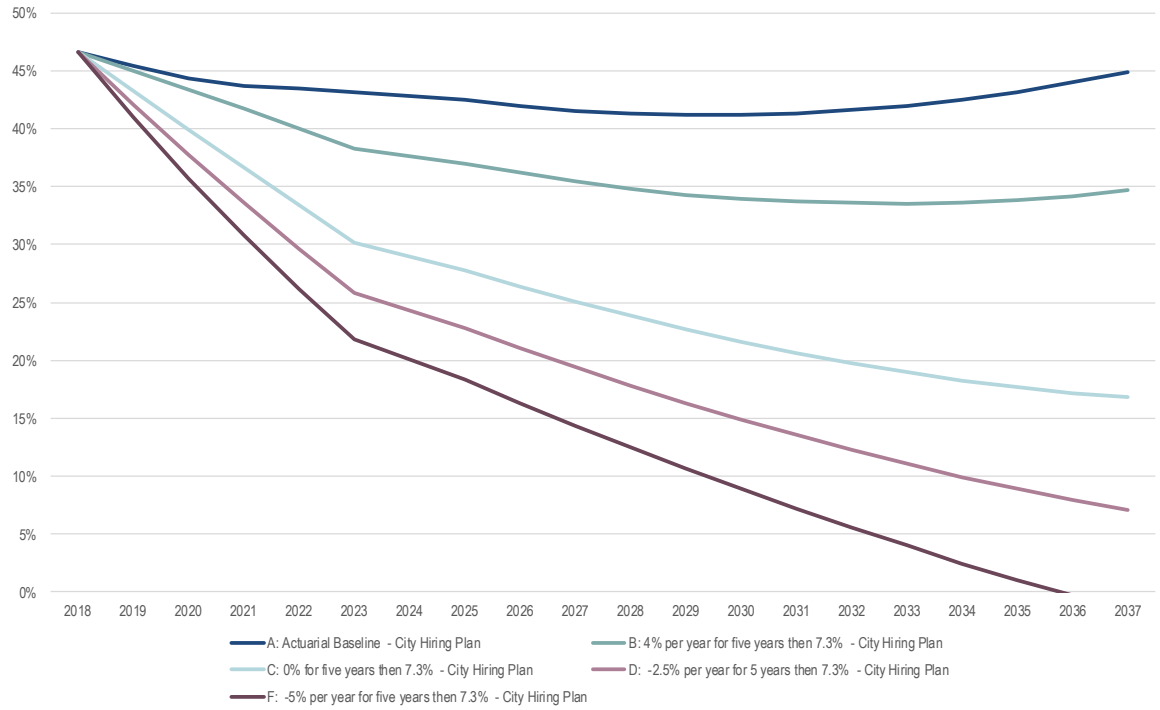
- We ran the model on two different contribution rates, highlighting the importance of receiving increased contributions into the plan. The first chart shows the potential funded status under the City Hiring Payroll Plan and the second chart shows the potential funded status under the Actual 2018 Payroll Projections.

[1] For Path A "Actuarial Base Line" we used 7.25% instead of the recommended long-term mix 7.3% assumed return for years 6-20.

Possible Funded Status under Various Near Term Return Scenarios

- If DPFP earns the actuarial baseline return for the next five years or 4% annualized for the next five years, the funded status takes a moderate hit but begins to eventually rebound.
- Flat or negative returns in years 1-5 could put DPFP into a severe unfunded situation (paths C, D, F below).

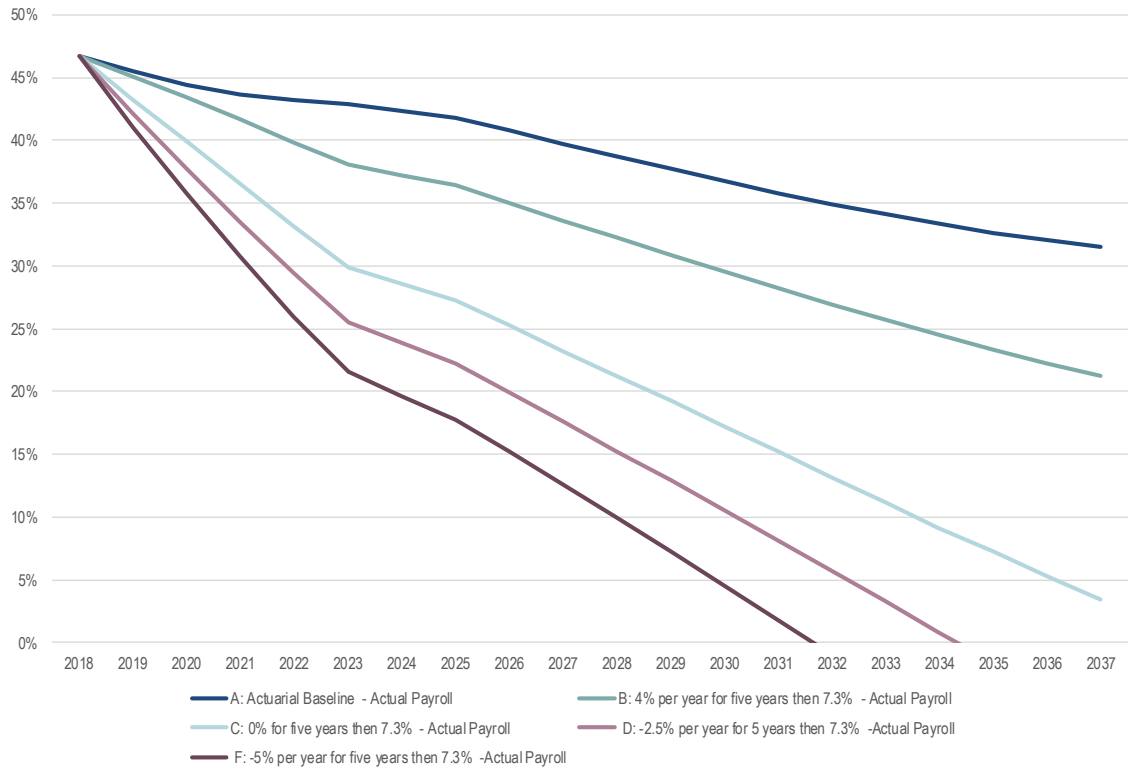
Funded Status with City Hiring Plan Contributions



Funded Status Could Decline More Precipitously Under Lower Projected Contribution Rates

- The only variable changed in the model below is the contribution rate (i.e. lower) – modeled with the actual 2018 payroll projected contribution rates.

Funded Status with Actual 2018 Payroll Projections



Resulting Funded Status under Both Contribution Rates

- Under both contribution rates, DPFP can likely remain solvent with moderate returns over the next few years if followed by the expected return (7.3%) in the long term.
- Under the Actual 2018 Payroll Projection rates (assuming no changes in the future) early losses have a drastic impact to the funded status, leading to insolvency.

Funded Status with City Hiring Plan Contributions

"Grade"	Scenario Description	Projected Fund Status in Year 20	Projected Fund Status in Year 40	Projected Fund Status in Year 45
A	Actuarial Base Line	45%	88%	100%
B	Bond-like performance for 5 years	35%	67%	77%
C	Legacy assets negate performance of rest of portfolio for 5 years	17%	28%	33%
D	1/2 of legacy assets is written off over next 5 years	7%	7%	10%
F	All legacy assets are written off over next five years	0%	0%	0%

Funded Status with Actual 2018 Payroll Projections

"Grade"	Scenario Description	Projected Fund Status in Year 20	Projected Fund Status in Year 40	Projected Fund Status in Year 45
A	Actuarial Base Line	32%	35%	38%
B	Bond-like performance for 5 years	21%	13%	13%
C	Legacy assets negate performance of rest of portfolio for 5 years	3%	0%	0%
D	1/2 of legacy assets is written off over next 5 years	0%	0%	0%
F	All legacy assets are written off over next five years	0%	0%	0%

Scenario Analysis - Part Two

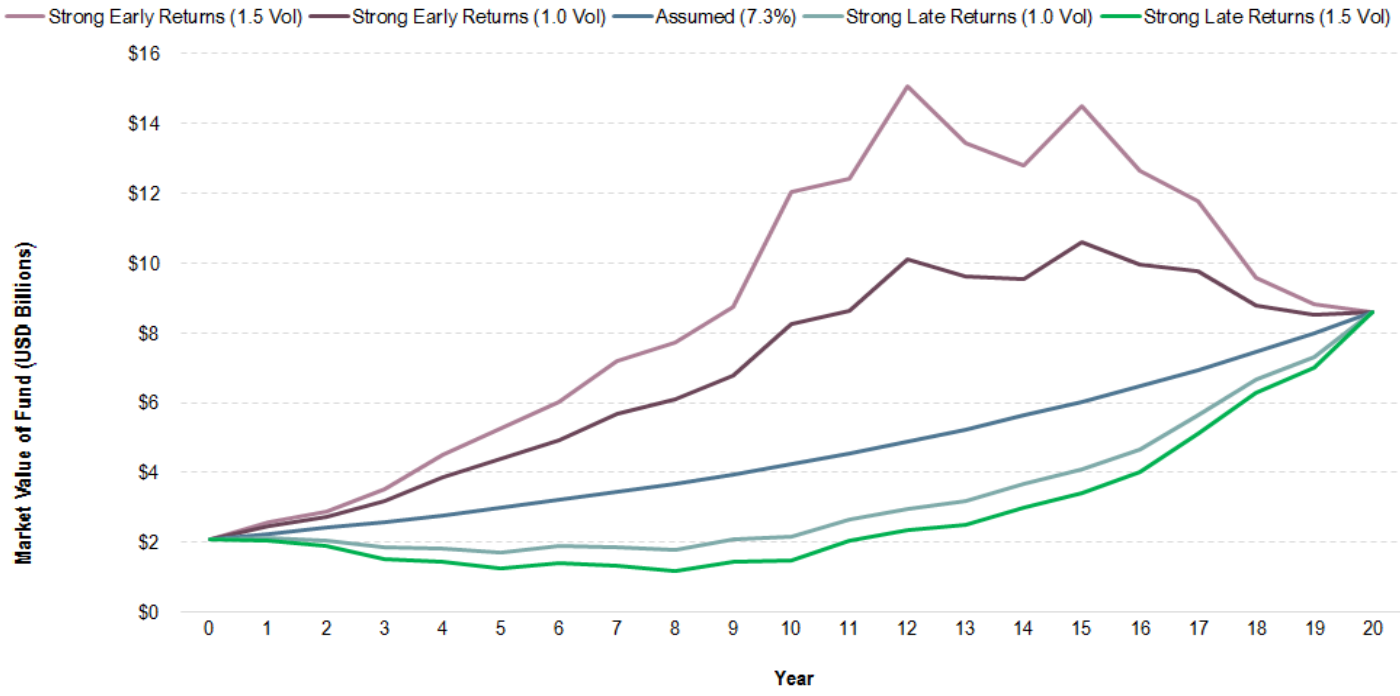
- The prior slides focused on the first five years followed by a simplified assumption of linear returns thereafter.
- In the following slides, we seek to model more realistic variety of returns, (i.e. getting 7.3% over 20 years but according to paths that are more varied and possibly more reflective of the real world).
- Each of the following charts show strong early returns or strong late returns based on the expected volatility (standard deviation) of the asset allocation policy.
  - They also show constant returns at the expected return rate for the recommended long-term mix (7.3%).
  - The policy standard deviation of 13.4% was used for both scenarios.
    - "1 Vol" uses the expected return + or – the standard deviation of 13.4%
    - "1.5 Vol" uses the return + or – the standard deviation multiplied by 1.5 (i.e. 20.1%).
- The scenarios analyze different return streams to the portfolio over the 20-year forecast period and how they impact the financial position of DPFP. They include:
  - Market value growth under a hypothetical no cash flow scenario: assumes net CF = 0.
  - Market value growth under the predicted cash out flows under the City Hiring Plan.
  - Market value growth under the predicted cash out flows under the 2018 Actual Payroll Projections.
  - Resulting funded status under the City Hiring Plan.

Hypothetical Return Stream Used in the Models

Year	Strong Early Returns (1 Vol) (%)	Strong Late Returns (1 Vol) (%)	Strong Early Returns (1.5 Vol) (%)	Strong Late Returns (1.5 Vol) (%)
1	17	1	22	-3
2	10	-3	11	-8
3	18	-10	23	-19
4	21	-2	27	-7
5	14	-6	17	-13
6	12	11	14	13
7	15	-1	19	-5
8	7	-5	7	-11
9	11	17	13	21
10	22	5	37	3
11	5	22	3	37
12	17	11	21	13
13	-5	7	-11	7
14	-1	15	-5	19
15	11	12	13	14
16	-6	14	-13	17
17	-2	21	-7	27
18	-10	18	-19	23
19	-3	10	-8	11
20	1	17	-3	22
First 10 yrs.	***14.7%***	***0.4%***	***19.0%***	***-3.3%***
Last 10 yrs.	***0.4%***	***14.7%***	***-3.3%***	***19.0%***
Total Period	***7.3%***	***7.3%***	***7.3%***	***7.3%***

The Order of Returns Does Not Matter When There Are No Cash Flows[1]

- If DPFP was cash flow neutral, the order of the returns would not matter.
- The chart shows various return paths over 20 years that all result in the same long-term return: 7.3% annualized.
- The ending market value after 20 years is the same regardless of the path of returns.



[1] Model assumes no cash flows and the recommended long-term mix returns and volatility.

The Order of Returns Does Not Matter When There Are No Cash Flows[1] (Continued)

Market Value ($ bb) Under Different Return Streams w/ No Cash Flows

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strong Early Returns (1.5 Vol)	$2.1	$2.6	$2.9	$3.5	$4.5	$5.3	$6.0	$7.2	$7.7	$8.7	$12.0	$12.4	$15.1	$13.4	$12.8	$14.5	$12.6	$11.8	$9.6	$8.8	$8.6
Strong Early Returns (1.0 Vol)	$2.1	$2.5	$2.7	$3.2	$3.9	$4.4	$4.9	$5.7	$6.1	$6.8	$8.3	$8.6	$10.1	$9.6	$9.5	$10.6	$40.0	$9.8	$8.8	$8.5	$8.6
Assumed (7.3%)	$2.1	$2.3	$2.4	$2.6	$2.8	$3.0	$3.2	$3.4	$3.7	$4.0	$4.2	$4.6	$4.9	$5.2	$5.6	$6.0	$6.5	$6.9	$7.5	$8.0	$8.6
Strong Late Returns (1.0 Vol)	$2.1	$2.1	$2.1	$1.8	$1.8	$1.7	$1.9	$1.9	$1.8	$2.1	$2.2	$2.7	$3.0	$3.2	$3.7	$4.1	$4.7	$5.6	$6.6	$7.3	$8.6
Strong Late Returns (1.5 Vol) (%)	$2.1	$2.0	$1.9	$1.5	$1.4	$1.2	$1.4	$1.3	$1.2	$1.5	$1.5	$2.0	$2.3	$2.5	$3.0	$3.4	$4.0	$5.5	$6.3	$7.0	$8.6
Net Cash Flow	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

Returns

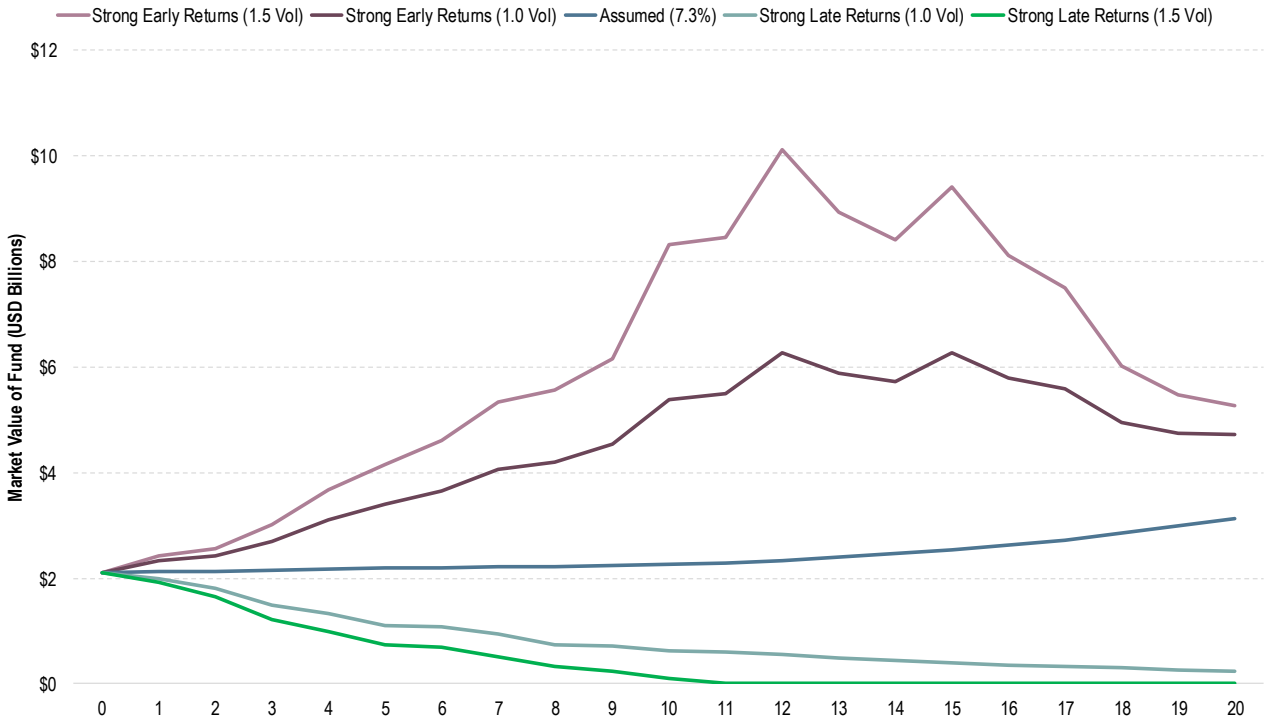
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strong Early Returns (1.5 Vol) (%)	0%	22%	11%	23%	27%	17%	14%	19%	7%	13%	37%	3%	21%	-11%	-5%	13%	-13%	-7%	-19%	-8%	-3%
Strong Early Returns (1.0 Vol) (%)	0%	17%	10%	18%	21%	14%	12%	15%	7%	11%	22%	5%	17%	-5%	-1%	11%	-6%	-2%	-10%	-3%	1%
Strong Late Returns (1.0 Vol) (%)	0%	1%	-3%	-10%	-2%	-6%	11%	-1%	-5%	17%	5%	22%	11%	7%	15%	12%	14%	21%	18%	10%	17%
Strong Late Returns (1.5 Vol) (%)	0%	-3%	-8%	-19%	-7%	-13%	13%	-5%	-11%	21%	3%	37%	13%	7%	19%	14%	17%	27%	23%	11%	22%

[1] Model assumes no cash flows and the recommended long-term mix returns and volatility.

The Order of Returns is Very Meaningful When There are Significant Cash Flows[1]

- The chart below shows various return paths that all result in the same long term return: 7.3% annualized.
- Unlike the prior chart, DPFP's asset growth is permanently impaired if negative/low returns occur in the near term. The path of returns is very significant because of the negative cash outflows.

Market value under the predicted cash out flows under the City Hiring Plan



[1] Model assumes city payroll forecast net of expected benefit payments and the recommended long-term mix returns and volatility.

The Order of Returns is Very Meaningful When There are Significant Cash Flows[1] (Continued)

Market value ($ bb) under the predicted cash out flows under the City Hiring Plan

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strong Early Returns (1.5 Vol)	$2.1	$2.4	$2.6	$3.0	$3.7	$4.2	$4.6	$5.3	$5.6	$6.2	$8.3	$8.4	$10.1	$8.9	$8.4	$9.4	$8.1	$7.5	$6.0	$5.5	$5.3
Strong Early Returns (1.0 Vol)	$2.1	$2.3	$2.4	$2.7	$3.1	$3.4	$3.7	$4.1	$4.2	$4.5	$5.4	$5.5	$6.3	$5.9	$5.7	$6.3	$5.8	$5.6	$5.0	$4.7	$4.7
Assumed (7.3%)	$2.1	$2.1	$2.1	$2.2	$2.2	$2.2	$2.2	$2.2	$2.2	$2.2	$2.3	$2.3	$2.3	$2.4	$2.5	$2.5	$2.6	$2.7	$2.8	$3.0	$3.1
Strong Late Returns (1.0 Vol)	$2.1	$2.0	$1.8	$1.5	$1.3	$1.1	$1.1	$0.9	$0.7	$0.7	$0.6	$0.6	$0.6	$0.5	$0.4	$0.4	$0.3	$0.3	$0.3	$0.3	$0.2
Strong Late Returns (1.5 Vol)	$2.1	$1.9	$1.6	$1.2	$1.0	$0.7	$0.7	$0.5	$0.3	$0.2	$0.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Net Cash Flow ($ mm)	$0	-$133	-$131	-$135	-$137	-$137	-$145	-$140	-$147	-$140	-$133	-$125	-$117	-$109	-$104	-$98	-$92	-$84	-$75	-$70	-$65

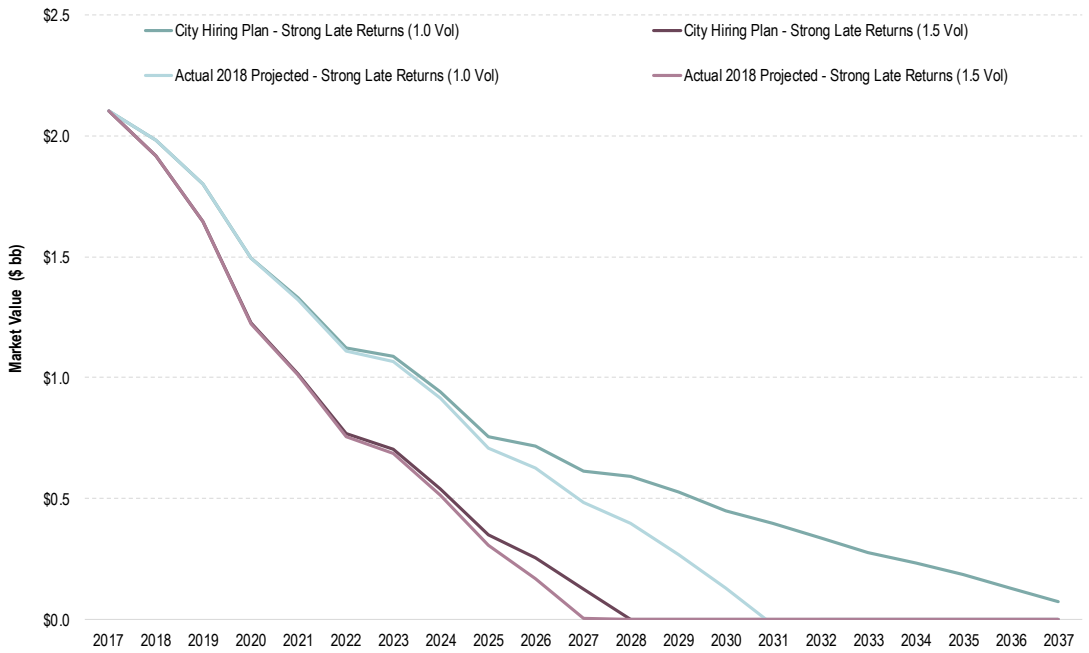
Returns

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strong Early Returns (1.5 Vol) (%)	0%	22%	11%	23%	27%	17%	14%	19%	7%	13%	37%	3%	21%	-11%	-5%	13%	-13%	-7%	-19%	-8%	-3%
Strong Early Returns (1.0 Vol) (%)	0%	17%	10%	18%	21%	14%	12%	15%	7%	11%	22%	5%	17%	-5%	-1%	11%	-6%	-2%	-10%	-3%	1%
Strong Late Returns (1.0 Vol) (%)	0%	1%	-3%	-10%	-2%	-6%	11%	-1%	-5%	17%	5%	22%	11%	7%	15%	12%	14%	21%	18%	10%	17%
Strong Late Returns (1.5 Vol) (%)	0%	-3%	-8%	-19%	-7%	-13%	13%	-5%	-11%	21%	3%	37%	13%	7%	19%	14%	17%	27%	23%	11%	22%

[1] Model assumes city payroll forecast net of expected benefit payments and the recommended long-term mix returns and volatility.

Lower Contributions Could Accelerate a Decline in Market Value/Funded Status[1]

- Below we focus only on the bad outcomes (low returns in first ten years followed by strong late returns). We compare the impact of the Actual 2018 Payroll Projections vs. the City Hiring Forecast
- The more severe the early negative years are (1.5 vol scenarios), the less the contributions matter. But if DPFP experiences negative returns within one standard deviation in the first ten years, the contribution rate could be the deciding factor on DPFP's solvency.



[1] Model assumes both contribution rates and the recommended long-term mix returns and volatility.

Lower Contributions Could Accelerate a Decline in Market Value/Funded Status [1] (Continued)

Market value ($ bb) under different return paths and contribution rates

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
City Hiring Plan - Strong Late Returns (1.0 Vol)	$2.1	$2.0	$1.8	$1.5	$1.3	$1.1	$1.1	$0.9	$0.8	$0.7	$0.6	$0.6	$0.5	$0.4	$0.4	$0.3	$0.3	$0.2	$0.2	$0.1	$0.1
Actual 2018 Projected - Strong Late Returns (1.0 Vol)	$2.1	$2.0	$1.8	$1.5	$1.3	$1.1	$1.1	$0.9	$0.7	$0.6	$0.5	$0.4	$0.3	$0.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
City Hiring Plan - Strong Late Returns (1.5 Vol)	$2.1	$1.9	$1.6	$1.2	$1.0	$0.8	$0.7	$0.5	$0.3	$0.3	$0.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Actual 2018 Projected - Strong Late Returns (1.5 Vol)	$2.1	$1.9	$1.6	$1.2	$1.0	$0.8	$0.7	$0.5	$0.3	$0.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

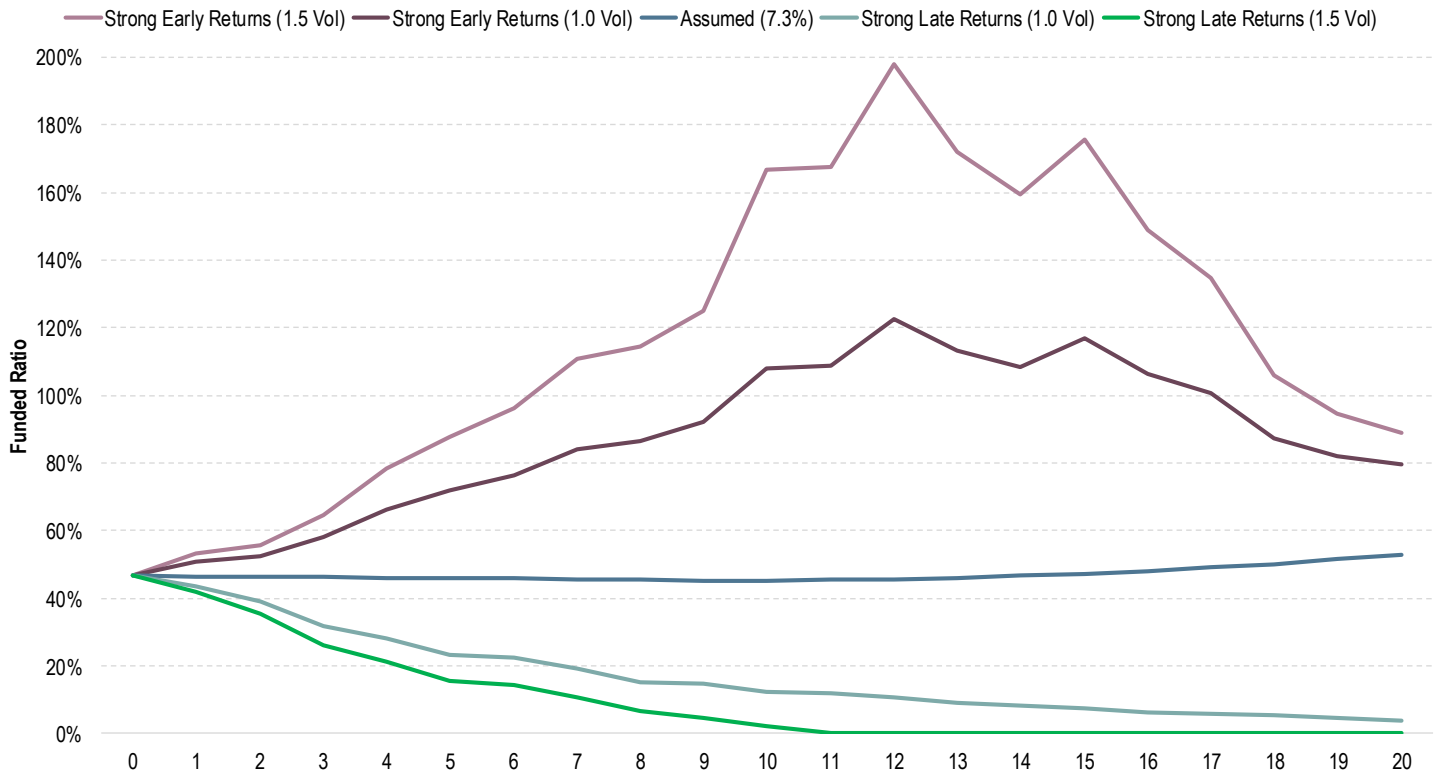
Returns

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strong Late Returns (1.0 Vol) (%)	0%	1%	-3%	-10%	-2%	-6%	11%	-1%	-5%	17%	5%	22%	11%	7%	15%	12%	14%	21%	18%	10%	17%
Strong Late Returns (1.5 Vol) (%)	0%	-3%	-8%	-19%	-7%	-13%	13%	-5%	-11%	21%	3%	37%	13%	7%	19%	14%	17%	27%	23%	11%	22%

[1] Model assumes both contribution rates and the recommended long-term mix returns and volatility.

Funded Status may Never Fully Recover if Low Returns Occur in the Near Term[1]

- Every line below has the exact same long-term return (7.3%) but the ending funded status ranges from 0% to 89% after 20 years.



[1] Model assumes city payroll forecast net of expected benefit payments and the recommended long-term mix returns and volatility. Model does not factor in any emergency funding provisions from city.

Funded Status may Never Fully Recover if Low Returns Occur in the Near Term (Continued)

Funded Status under Different Return Streams w/ City Hiring Plan Contributions[1]

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strong Early Returns (1.5 Vol)	47%	53%	56%	65%	78%	88%	96%	111%	114%	125%	167%	168%	198%	172%	159%	176%	149%	135%	106%	95%	89%
Strong Early Returns (1.0 Vol)	47%	51%	52%	58%	66%	72%	76%	84%	86%	92%	108%	109%	123%	113%	109%	117%	106%	101%	87%	82%	80%
Assumed (7.3%)	47%	47%	46%	46%	46%	46%	46%	46%	45%	45%	45%	45%	46%	46%	47%	47%	48%	49%	50%	51%	53%
Strong Late Returns (1.0 Vol)	47%	44%	39%	32%	28%	23%	23%	19%	15%	15%	12%	12%	11%	9%	8%	7%	6%	6%	5%	4%	4%
Strong Late Returns (1.5 Vol)	47%	42%	36%	26%	21%	16%	14%	11%	7%	5%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Net Cash Flow ($ mm)	$0	-$133	-$131	-$135	-$137	-$137	-$145	-$140	-$147	-$140	-$133	-$125	-$117	-$109	-$104	-$98	-$92	-$84	-$75	-$70	-$65

Returns

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strong Early Returns (1.5 Vol) (%)	0%	22%	11%	23%	27%	17%	14%	19%	7%	13%	37%	3%	21%	-11%	-5%	13%	-13%	-7%	-19%	-8%	-3%
Strong Early Returns (1.0 Vol) (%)	0%	17%	10%	18%	21%	14%	12%	15%	7%	11%	22%	5%	17%	-5%	-1%	11%	-6%	-2%	-10%	-3%	1%
Strong Late Returns (1.0 Vol) (%)	0%	1%	-3%	-10%	-2%	-6%	11%	-1%	-5%	17%	5%	22%	11%	7%	15%	12%	14%	21%	18%	10%	17%
Strong Late Returns (1.5 Vol) (%)	0%	-3%	-8%	-19%	-7%	-13%	13%	-5%	-11%	21%	3%	37%	13%	7%	19%	14%	17%	27%	23%	11%	22%

[1] Model assumes city payroll forecast net of expected benefit payments and the recommended long-term mix returns and volatility. Model does not factor in any emergency funding provisions from city.

Implementation Options - Summary

- Moving towards the long-term asset mix will require a process as to how to reallocate capital as illiquid assets are exited over the coming years. Below we describe a variety of options, and highlight the pros and cons of each approach.
- **Conservative to Aggressive**:
  - Concept: Allocate distributions first to the least volatile asset class that is underweight. Once the long-term target is reached for that asset class, proceed to the underweight asset class with the second lowest volatility, and so forth.
  - Pros: Reduces drawdown; reduces likelihood of early heavy hit to funded status in event of large decline in markets; easy to implement and monitor.
  - Cons: May lead to lower total Fund returns; may lead to lower funded status; may lead to tracking error vs. peers if markets rise.
- **Dollar Cost Averaging**:
  - Concept: Since market returns are unknown in advance, allocate a set dollar amount of distributions to risk assets so as to diversify contributions over time. For example, allocate the first $10 mm in distributions per quarter to equities, and any excess to fixed income.
  - Pros: Methodical approach to build a larger public equity exposure; lowers risk of market decline after large contribution; easy to implement and monitor.
  - Cons: Allocating to volatile equities first may backfire in the event of a market correction; in a severe correction may lead to strong decline in funded status. If coupled with losses in legacy assets and/or lower payroll than budgeted, could put Fund's solvency into question.

Implementation Options – Summary (continued)

- **Pro-Rata**:
  - Concept: Since market returns are unknown in advance, allocate a set percentage amount to each underweight asset class.
  - Pros: Methodical approach; takes no position on markets.
  - Cons: Would result in large allocation to equities, which may backfire in the event of a market correction; in a severe correction may lead to strong decline in funded status. If coupled with losses in legacy assets and/or lower payroll than budgeted, could put Fund's solvency into question.
- **Dynamic Approach**:
  - Concept: Allocate distributions according to the financial health of the Fund. If the Fund is generating losses, seek to mitigate further drawdowns by investing in low-risk assets such as Safety Reserve® / Core Bonds. If the Fund is generating gains, distributions may be allocated to risk assets such as equities.
  - Pros: Conceptually appealing as it seeks to minimize severity of drawdown; controlling large drawdowns early on has been shown to be very important for DPFP.
  - Cons: Most difficult to implement as it requires frequent assessment of performance across each asset and at the total Fund level; is pro-cyclical, meaning it allocates to risky assets after a good environment, and to defensive assets after a loss.

Summary/Conclusion

- The biggest risk to DPFP is an environment of negative returns in the near term.
- As the charts here have shown, returns in years 1-5 set the outcome for funded status in years 6-20, and beyond.
- There are pros and cons to moving fast or slow to the long-term target asset allocation.
- It may be prudent to move conservatively toward the long-term allocation (i.e. remain underweight global equities and private equity) until there is more clarity on the exit valuations on the legacy assets and employee contribution rates. This is not a market timing call, but rather a reflection of the actual circumstances of the Fund.
- In other words, these two variables (legacy assets and contribution rates) appear to have wide dispersion of outcomes, and have material implications for DPFP.
  - As such, more conservative positioning in the balance of the portfolio (liquid assets) may be desirable in the short term (three to five years).
- However, the Trustees need to be comfortable with peer ranking tracking error and opportunity cost lost if markets continue to perform strongly for the near future. In addition, the Trustees would need to feel comfortable adopting a short-term asset allocation that has an expected return below that of the actuarially assumed rate of return.

Appendix

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.

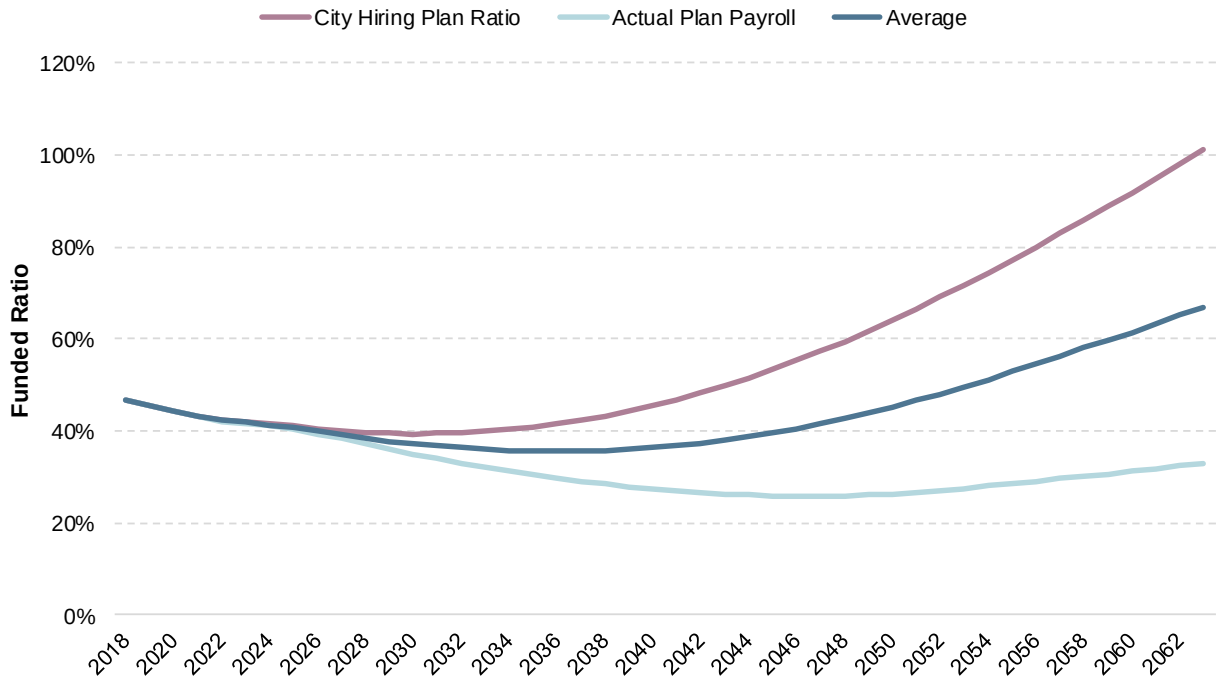
[2] The returns shown in the policy options and risk analysis sections use a lognormal distribution, which may or may not be an accurate representation of each asset classes' future return distribution. To the extent that it is not accurate in whole or in part, the probabilities listed in the table will 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.

Impact of Different Contribution Rates

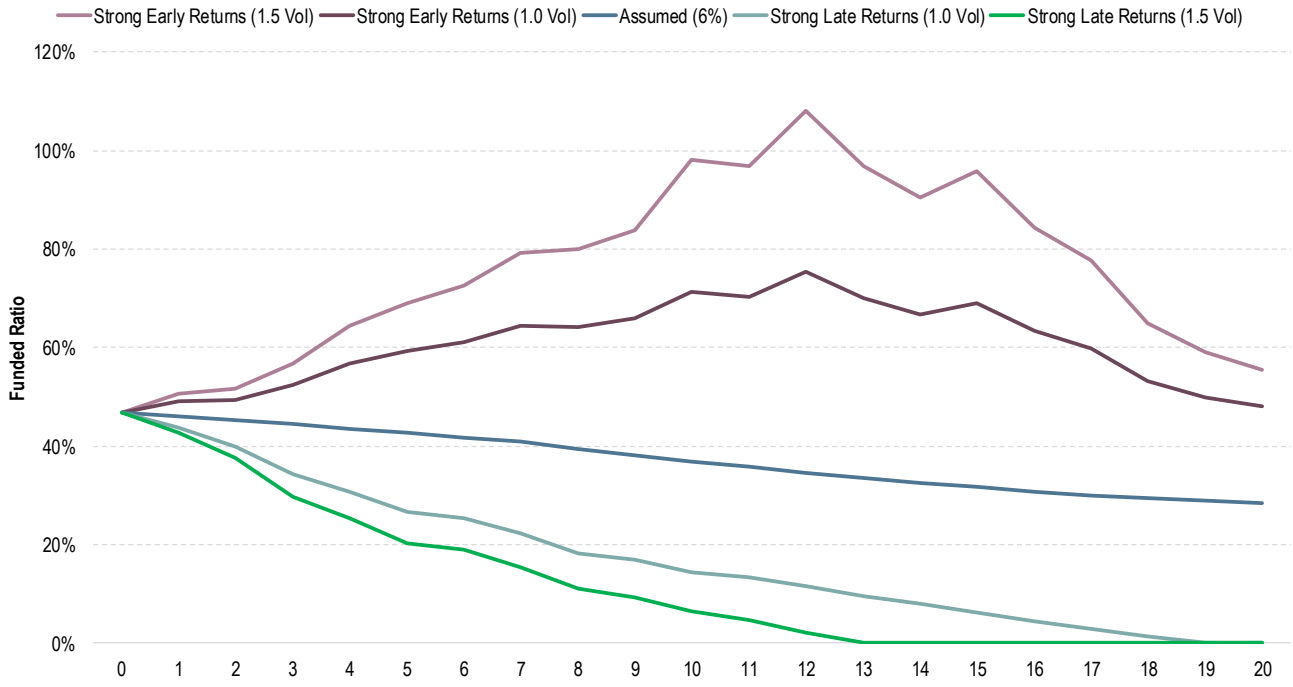
- The chart below projects the funded status (under different contribution rates) with the assumption DPFP earns the actuarial return every year.
- Under a more optimistic contribution rate the funded status improves faster.

Actuarial Return Projections



What if DPFP Adopted an Asset Allocation with a 6% Return Target[1]

- If DPFP adopted a lower return/lower standard deviation asset allocation (e.g. target of 6% return), the funded status path would still be exposed to the same issue (inability to overcome negative returns in the near term) but the path down would likely be slower/more gradual.
- Every line below has a twenty year 6% annualized return.



[1] Model assumes City Hiring Plan payroll contributions net of expected benefit payments and portfolio with 6% annualized return and corresponding standard deviation.

What if DPFP Adopted an Asset Allocation with a 6% Return Target[1] (Continued)

Funded Status under Different Return Streams (6% annualized) w/ Average of Two Contribution Rates

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strong Early Returns (1.5 Vol)	47%	51%	52%	57%	64%	69%	73%	79%	80%	84%	98%	97%	108%	97%	90%	96%	84%	78%	65%	59%	56%
Strong Early Returns (1.0 Vol)	47%	49%	49%	52%	57%	59%	61%	64%	64%	66%	71%	70%	75%	70%	67%	69%	63%	60%	53%	50%	48%
Assumed (6%)	47%	46%	45%	44%	44%	43%	42%	41%	39%	38%	37%	36%	35%	34%	33%	32%	31%	30%	29%	29%	28%
Strong Late Returns (1.0 Vol)	47%	44%	40%	34%	31%	27%	25%	22%	18%	17%	14%	13%	12%	9%	8%	6%	4%	3%	1%	0%	0%
Strong Late Returns (1.5 Vol)	47%	43%	38%	30%	25%	20%	19%	15%	11%	9%	6%	5%	2%	0%	0%	0%	0%	0%	0%	0%	0%
Net Cash Flow ($ bb)	$0	-$133	-$131	-$137	-$139	-$139	-$148	-$143	-$160	-$154	-$148	-$142	-$136	-$130	-$125	-$120	-$115	-$108	-$99	-$95	-$90

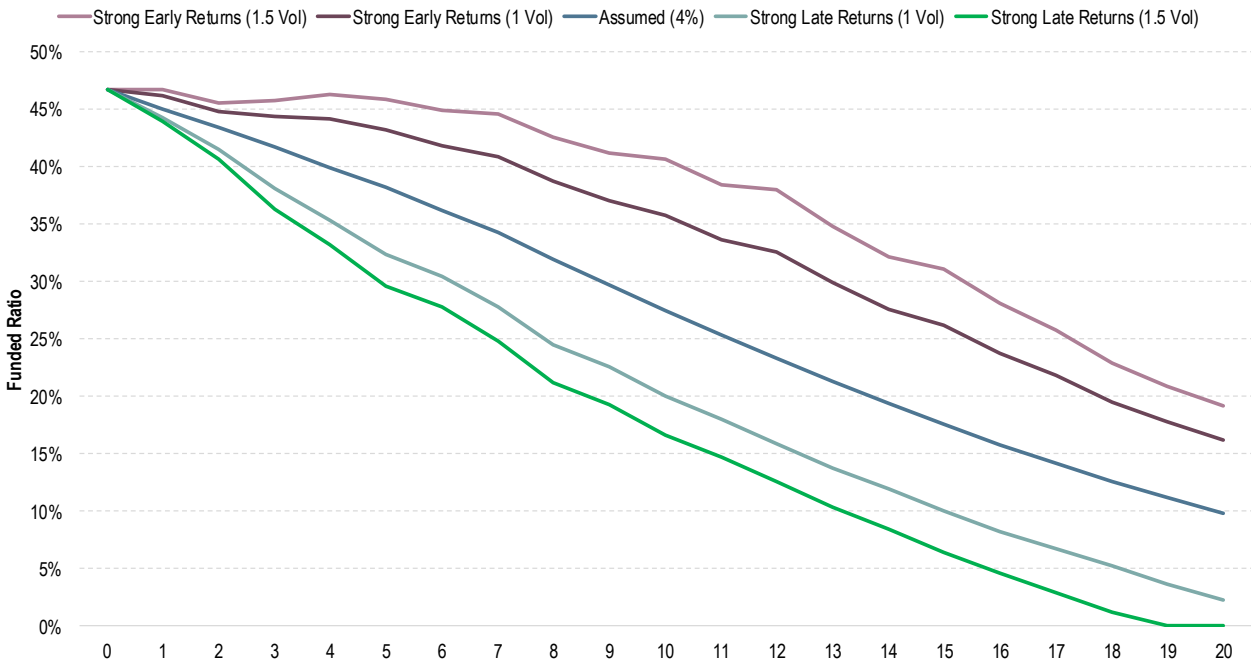
Returns

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strong Early Returns (1.5 Vol) (%)	0%	17%	9%	17%	20%	13%	11%	15%	6%	10%	22%	3%	16%	-7%	-3%	10%	-8%	-4%	-12%	-5%	-1%
Strong Early Returns (1.0 Vol) (%)	0%	13%	8%	14%	15%	11%	9%	12%	6%	9%	14%	4%	13%	-3%	0%	9%	-3%	-1%	-6%	-1%	1%
Strong Late Returns (1.0 Vol) (%)	0%	1%	-1%	-6%	-1%	-3%	9%	0%	-3%	13%	4%	14%	9%	6%	12%	9%	11%	15%	14%	8%	13%
Strong Late Returns (1.5 Vol) (%)	0%	-1%	-5%	-12%	-4%	-8%	10%	-3%	-7%	16%	3%	22%	10%	6%	15%	11%	13%	20%	17%	9%	17%

[1] Model assumes City Hiring Plan payroll contributions net of expected benefit payments and portfolio with 6% annualized return and corresponding standard deviation.

Asset Allocation Illustration with a 4% Return Target[1]

- For illustration purposes, the chart below shows the funded status if DPFP generated a 4% return.
- The funded status paths show a gradual decline because a 4% return portfolio cannot overcome the large negative cash flows.
- Every line below has a twenty year 4% annualized return.



[1] Model assumes City Hiring Plan payroll contributions net of expected benefit payments and portfolio with 6% annualized return and corresponding standard deviation.

Asset Allocation Illustration with a 4% Return Target[1] (Continued)

Funded Status Under Different Return Streams (4% annualized) w/ Average of Two Contribution Rates

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strong Early Returns (1.5 Vol)	47%	47%	46%	46%	46%	46%	45%	45%	43%	41%	41%	38%	38%	35%	32%	31%	28%	26%	23%	21%	19%
Strong Early Returns (1.0 Vol)	47%	46%	45%	44%	44%	43%	42%	41%	39%	37%	36%	34%	33%	30%	28%	26%	24%	22%	20%	18%	16%
Assumed (6%)	47%	45%	43%	42%	40%	38%	36%	34%	32%	30%	27%	25%	23%	21%	19%	18%	16%	14%	13%	11%	10%
Strong Late Returns (1.0 Vol)	47%	44%	42%	38%	35%	32%	30%	28%	24%	23%	20%	18%	16%	14%	12%	10%	8%	7%	5%	4%	2%
Strong Late Returns (1.5 Vol)	47%	44%	41%	36%	33%	30%	28%	25%	21%	19%	17%	15%	13%	10%	8%	6%	5%	3%	1%	0%	0%
Net Cash Flow ($ mm)	$0	-$133	-$131	-$137	-$139	-$139	-$148	-$143	-$160	-$154	-$148	-$142	-$136	-$130	-$125	-$120	-$115	-$108	-$99	-$95	-$90

Returns

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strong Early Returns (1.5 Vol) (%)	0%	8%	5%	8%	9%	7%	6%	7%	4%	6%	7%	3%	8%	-1%	1%	6%	-1%	0%	-3%	0%	1%
Strong Early Returns (1.0 Vol) (%)	0%	7%	5%	7%	7%	6%	5%	6%	4%	5%	6%	3%	6%	1%	2%	5%	1%	2%	0%	1%	2%
Strong Late Returns (1.0 Vol) (%)	0%	2%	1%	0%	2%	1%	5%	2%	1%	6%	3%	6%	5%	4%	6%	5%	6%	7%	7%	5%	7%
Strong Late Returns (1.5 Vol) (%)	0%	1%	0%	-3%	0%	-1%	6%	1%	-1%	8%	3%	7%	6%	4%	7%	6%	7%	9%	8%	5%	8%

[1] Model assumes City Hiring Plan payroll contributions net of expected benefit payments and portfolio with 4% annualized return and corresponding standard deviation.

Meketa Investment Group 2018 Annual Asset Study
Twenty-Year Annualized Return and Volatility Expectations for Major Asset Classes

Asset Class	Annualized Compounded Return (%)	Annualized Standard Deviation (%)
Rate Sensitive		
Cash Equivalents	2.9	1.0
Investment Grade Bonds	3.6	4.0
Long-term Government Bonds	3.5	13.0
TIPS	3.3	7.5
Credit		
High Yield Bonds	5.4	12.5
Bank Loans	5.0	10.0
Emerging Market Bonds (major; unhedged)	4.9	11.5
Emerging Market Bonds (local; unhedged)	5.4	14.5
Direct Lending - First Lien	5.7	11.0
Direct Lending - Second Lien	7.3	16.0
Mezzanine Debt	6.6	17.0
Distressed Debt	6.6	22.0
Equities		
Public U.S. Equity	7.3	18.0
Public Developed Market Equity	7.1	20.0
Public Emerging Market Equity	9.4	25.0
Private Equity Composite	9.3	27.0
Real Assets		
REITs	6.8	28.5
Core Private Real Estate	5.5	12.0
Value Added Real Estate	6.9	19.0
Opportunistic Real Estate	8.5	25.0
High Yield Real Estate Debt	6.4	23.0
Natural Resources (Private)	8.8	23.0
Commodities	4.6	18.0
Infrastructure (Core)	6.6	15.0
Infrastructure (Non-Core)	8.5	23.0
Other		
Hedge Funds	5.2	8.5

Meketa Investment Group 2018 Annual Asset Study: Correlation Expectations

	TIPS	Investment Grade Bonds	High Yield Bonds	U.S. Equity	Developed Market Equity	Emerging Market Equity	Private Equity	Real Estate	Natural Resources (private)	Commodities	Core Infrastructure (private)	Hedge Funds
TIPS	1.00											
Investment Grade Bonds	0.80	1.00										
High Yield Bonds	0.30	0.20	1.00									
U.S. Equity	0.00	0.05	0.70	1.00								
Developed Market Equity	0.15	0.05	0.70	0.90	1.00							
Emerging Market Equity	0.15	0.05	0.70	0.80	0.90	1.00						
Private Equity	0.05	0.05	0.65	0.85	0.80	0.75	1.00					
Real Estate	0.10	0.20	0.50	0.50	0.45	0.40	0.45	1.00				
Natural Resources (private)	0.10	0.10	0.45	0.65	0.60	0.60	0.55	0.45	1.00			
Commodities	0.35	0.05	0.40	0.35	0.55	0.60	0.30	0.15	0.65	1.00		
Core Infrastructure (private)	0.30	0.30	0.60	0.55	0.55	0.50	0.45	0.60	0.60	0.40	1.00	
Hedge Funds	0.20	0.05	0.70	0.80	0.85	0.85	0.65	0.45	0.65	0.35	0.60	1.00