State of Wisconsin Investment Board
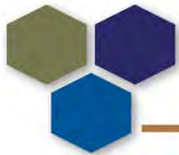
Wisconsin Retirement System
Actuarial Overview and Projections
Executive Summary

October 2015

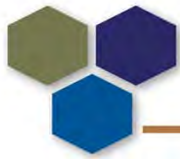**GRS**

Gabriel Roeder Smith & Company
Consultants & Actuaries
www.gabrielroeder.com

Today's Topics

- Wisconsin Retirement System Operation
- Wisconsin Retirement System Overview (assets, contributions, dividends)
- Actuarial Projection Summary

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Questions

- How much retiree purchasing power loss is tolerable?
- How much variation in employer and employee contribution rates is tolerable?
- What happens if another 2008 depletes the dividend reserve?
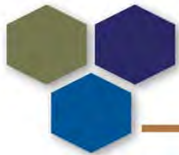
GRS
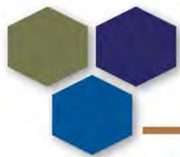
WRS Operation

- Benefits
- Plan Governance
  - ▶ ETF Board Role
  - ▶ SWIB Role
- WRS Accounts and Reserves
- Actuarial Valuation of WRS
  - ▶ Sharing Asset Experience
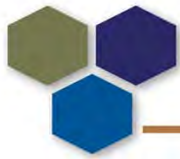 - ▶ Dividend Reserve Depletion

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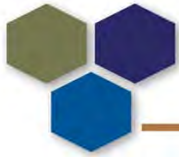
WRS OVERVIEW

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Covered Population at 12/31/2014

|	Number	Total $ Millions	Average	Type
		Financial Information		
	Number	**Total $ Millions**	**Average**	**Type**
Retirees	185,605	$ 4,489	$ 24,185	Annual Benefit
Active Members	256,100	13,037	50,907	Annual Pay
Inactive Members	154,286	2,093	13,564	Money Purchase Balance
Total	**595,991**			

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WRS Investment Funds

- Core Fund
  - ▶ Diversified Portfolio
  - ▶ 5 Year Smoothing through Market Recognition Account
- Variable Fund
  - ▶ Equity Portfolio
  - ▶ Marked to Market each year

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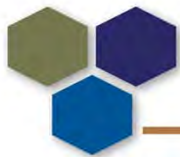
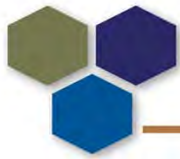# WRS Benefits

- Hybrid Plan
  - ▶ Defined Benefit: 1.6% x FAC x Service (Most participants)
  - ▶ Not less than twice value of member account (A form of employer match)
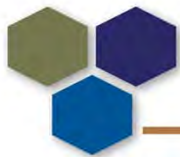- Adjustments are made to the above for members participating in Variable.

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WRS Contributions

- Four rate Groups: General, Executive, Protective with and without Social Security.
- Actuarial Valuation determines contributions by rate group.
- General and Executive participants split cost equally with employers.
- Protective participants pay the same rate as General participants and employers pay the difference.

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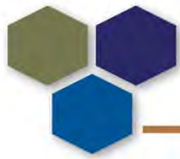# WRS Accounts and Reserves

- **Retired Reserve:** Intended to hold exactly the right amount of money so that **IF**
  - ▶ each person **lives** exactly the right number of years,
  - ▶ **and** gets exactly the same benefit each year
  - ▶ **and** the reserve earns exactly 5% each year,
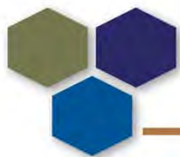- **Then** the reserve will be exhausted the day the last person dies.

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Dividend Reserve

- Retirees share in investment gains, but also share in investment losses. Prior dividends can be reduced if less than 5% is credited to the Core Annuity Division.

- Only dividends can be reduced. The original core benefit is protected.

- The present value of the excess of total core benefits over original benefits is called the "Dividend Reserve", although there is no formal definition of such a reserve.

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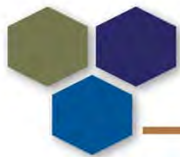
Dividend Reserve

- A positive dividend reserve means that retirees are getting some inflation protection, but also provides a means by which the effect of investment losses on employer rates can be dampened.

- A $0 dividend reserve means that retirees have lost all inflation protection and one of the shock absorbers on employer rates is gone.

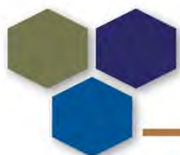12

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Dividend Reserve Depletion

- The probability of such an event is low. Even 2008 did not produce depletion.

- But low is not zero, and there are people who believe the stock market is currently in a bubble.

- The following slides explore in general terms what a deficit in the retiree reserve means for the System.
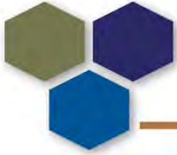
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Dividend Reserve Depletion:
Liability Attributable to Dividends

Valuation	Liability for Dividend Remaining (billions)	Liability for Dividend Adjustment (billions)
12/31/2009	$8.1	$(0.4)
12/31/2010	7.2	(0.3)
12/31/2011	6.4	(1.7)
12/31/2012	4.5	(1.3)
12/31/2013	3.0	2.0
12/31/2014	4.6	1.3
12/31/2015(est)	5.7	

- Liability for Dividend Remaining represents the value of all previously granted dividends
- If another market event similar to 2008 were to occur again, the complete depletion of the dividend would become a real possibility
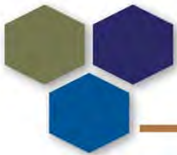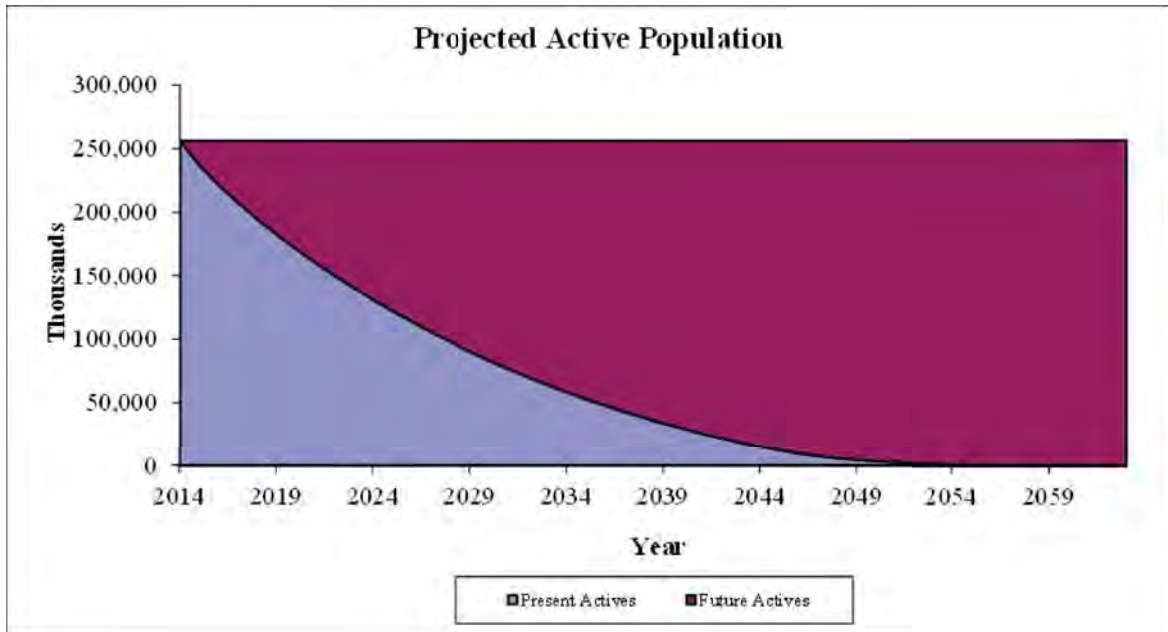
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WRS PROJECTIONS

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Study Objectives

- Review emerging demographic trends
- Perform stochastic projections
- Perform various deterministic projections
- Evaluate worst case scenarios
- Investigate probability of depleting the dividend reserve
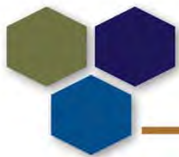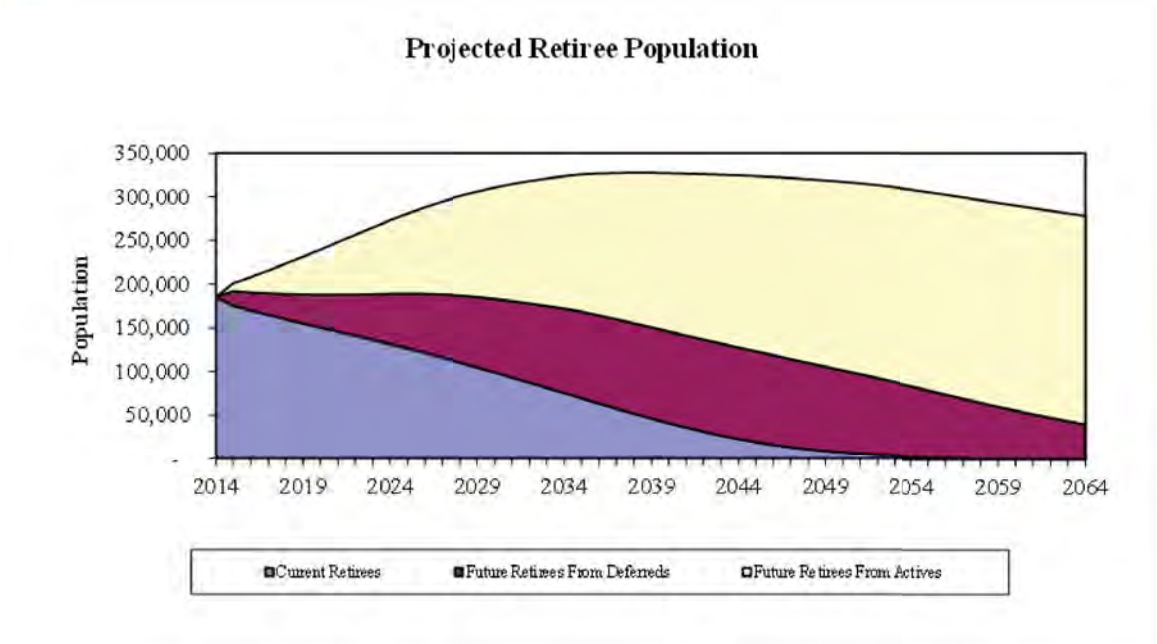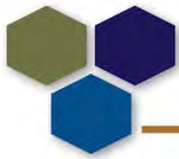- Investigate probable range of contribution rates

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Present & Future Actives

Projected Active Population

The present population has a "half life" of about 10 years.
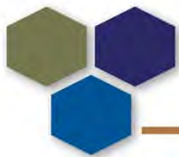
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Retiree Population
Present and Future

Projected Retiree Population

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Projected Core Trust Fund Assets ($Billions)

Chart legend:
- ■ 2014 Dollars
- ■ Portion Due to Inflation

Year	2014 Dollars	Portion Due to Inflation
2014	83	-
2019	88	15
2024	88	33
2029	87	53
2034	85	75
2039	83	99
2044	82	128
2049	81	164
2054	81	205
2059	81	253
2064	81	309

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Projected Net External Cash Flow*
Valuation Assumptions

Year	$ (Millions)	% of Assets	% of Payroll
2015	$ (2,557)	(3.1)%	(18.9)%
2025	(4,828)	(4.0)%	(25.6)%
2035	(7,015)	(4.4)%	(26.6)%
2045	(8,460)	(4.0)%	(23.0)%
2055	(11,185)	(3.9)%	(22.2)%
2065	(15,195)	(3.9)%	(22.0)%

Contribution income minus benefit payout.

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Projected Contributions and Benefits as a % of Active Payroll

Expected Benefit Payments as a % of Active Payroll

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Monte Carlo Simulations

- Based on 10,000 random trials
- Valuation Assumptions held constant
- Assumes seven sets of expected return/standard deviations

Scenario 1 - 5.0%/9.3%
Scenario 2 - 6.0%/11.9%
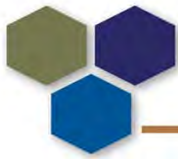Scenario 3 - 7.0%/15.9%   ← Current Allocation
Scenario 4 - 7.2%/16.8%
Scenario 5 - 8.0%/20.6%
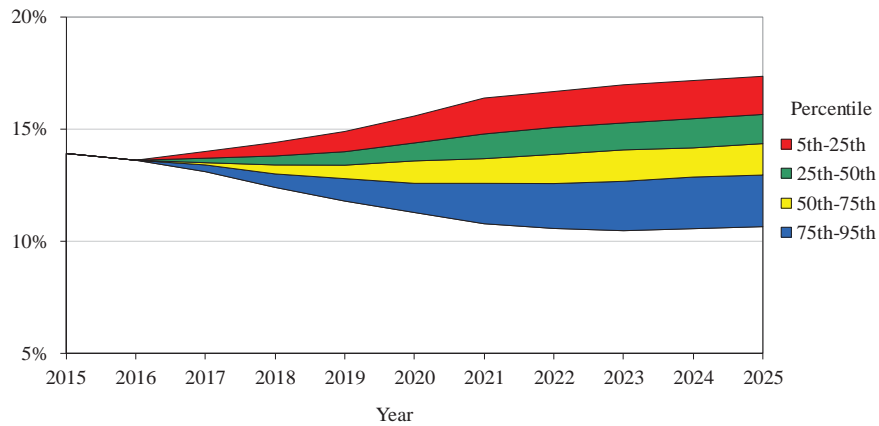Scenario 6 - 9.0%/25.9%
Scenario 7 - 10.0%/32.3%

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Contribution as a % of Payroll
Scenario 2 – 6.0%ER,11.9%SD

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	13.9%	13.6%	14.0%	14.4%	14.9%	15.6%	16.4%	16.7%	17.0%	17.2%	17.3%
25th Percentile	13.9%	13.6%	13.7%	13.8%	14.0%	14.4%	14.8%	15.1%	15.3%	15.5%	15.6%
Median	13.9%	13.6%	13.5%	13.4%	13.4%	13.6%	13.7%	13.9%	14.1%	14.2%	14.3%
75th Percentile	13.9%	13.6%	13.4%	13.0%	12.8%	12.6%	12.6%	12.6%	12.7%	12.9%	12.9%
95th Percentile	13.9%	13.6%	13.1%	12.4%	11.8%	11.3%	10.8%	10.6%	10.5%	10.6%	10.6%

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Dividend Rates
Scenario 2 – 6.0%ER,11.9%SD

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	-1.3%	-1.3%	-3.0%	-4.7%	-5.2%	-3.8%	-3.3%	-2.9%	-2.5%	-2.4%	-2.2%
25th Percentile	1.0%	1.4%	0.0%	-1.4%	-1.5%	-1.0%	-0.9%	-0.7%	-0.6%	-0.5%	-0.4%
Median	2.6%	3.3%	2.1%	0.8%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
75th Percentile	4.1%	5.2%	4.2%	3.1%	3.1%	2.6%	2.4%	2.2%	2.1%	2.0%	1.9%
95th Percentile	6.5%	8.1%	7.3%	6.3%	6.4%	5.3%	4.6%	4.4%	4.1%	3.8%	3.6%

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Contribution rate summary under alternate scenarios - median

Comparison of contribution rates under alternate scenarios

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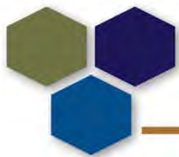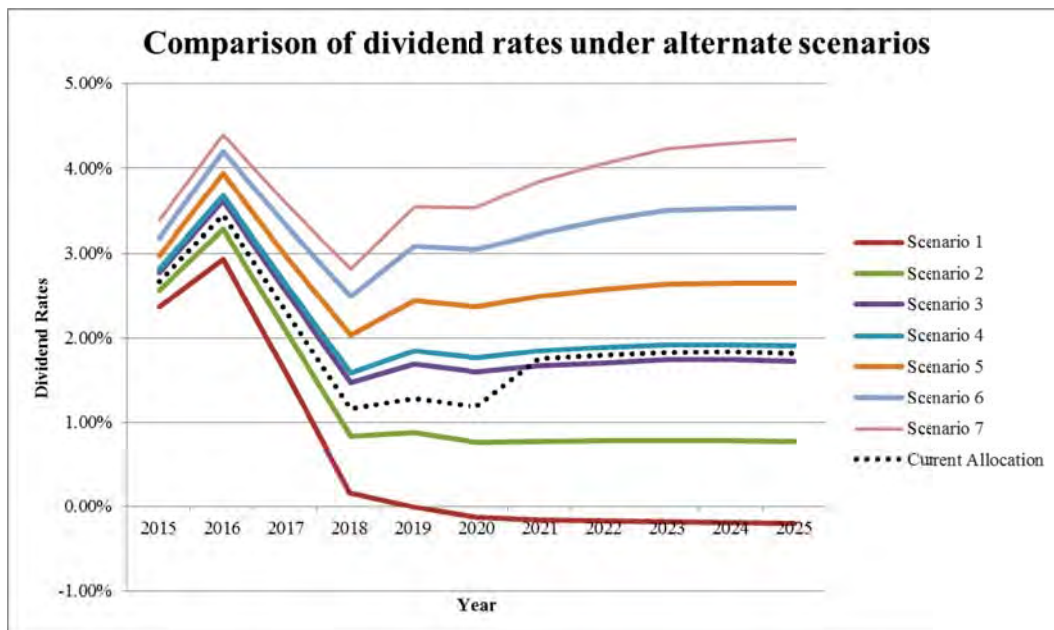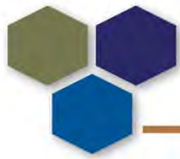# Dividend rate summary under alternate scenarios - median

Comparison of dividend rates under alternate scenarios
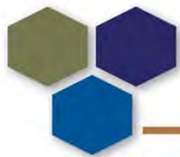
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Discussion of Dividend

Probability that Dividend will be Depleted by Year

	Expected ROR	Standard Deviation	Year				
			1	5	10	20	50
1	5.0%	9.3%	0.0%	4.3%	11.4%	18.3%	30.5%
2	6.0%	11.9%	0.0%	7.9%	11.1%	8.3%	3.2%
3	7.0%	15.9%	0.0%	12.0%	12.2%	6.1%	0.8%
4	7.2%	16.8%	0.0%	12.8%	12.6%	6.0%	0.7%
5	8.0%	20.6%	0.1%	15.9%	14.0%	5.9%	0.5%
6	9.0%	25.9%	0.4%	19.7%	16.4%	6.8%	0.5%
7	10.0%	32.3%	1.4%	23.2%	19.7%	8.7%	0.8%

Current Allocation → (row 2)

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Discussion of Dividend

Probability of Negative Dividend by Year

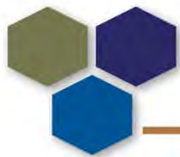|	Expected ROR	Standard Deviation	Year				
			1	5	10	20	50
1	5.0%	9.3%	7.9%	50.2%	56.0%	54.9%	54.4%
2	6.0%	11.9%	13.8%	40.6%	34.0%	30.1%	30.1%
3	7.0%	15.9%	18.9%	36.6%	24.6%	19.8%	20.5%
4	7.2%	16.8%	19.8%	36.1%	23.4%	18.9%	19.5%
5	8.0%	20.6%	23.5%	35.2%	20.9%	16.1%	16.8%
6	9.0%	25.9%	26.7%	35.4%	19.5%	14.8%	15.5%
7	10.0%	32.3%	29.6%	36.6%	20.0%	15.0%	16.0%

Current Allocation → (row 2)

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Discussion of Dividend

**Worst Case Scenario of Cumulative Dividend Percent
(% of Floor Benefit that is funded)**

	Expected	Standard	Year				
	ROR	Deviation	1	5	10	20	50
1	5.0%	9.3%	109%	93%	85%	80%	68%
2	6.0%	11.9%	109%	86%	79%	81%	86%
3	7.0%	15.9%	107%	77%	72%	78%	105%
4	7.2%	16.8%	106%	75%	70%	77%	108%
5	8.0%	20.6%	105%	66%	61%	72%	118%
6	9.0%	25.9%	102%	54%	49%	62%	124%
7	10.0%	32.3%	99%	40%	34%	46%	115%

Current Allocation → (row 3)

Worst Case Scenario based on 1st Percentile (i.e. 1% probability)

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Dividend Observations

- The low risk scenarios are actually risky in the sense that, for example, 5% expected return has much higher chance of dividend depletion in later years than higher risk scenarios
- Must balance short and long term volatility
- Consider probability of dividend depletion
- Consider level of worst case scenario that is acceptable

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Combination of all Scenarios

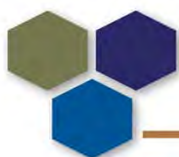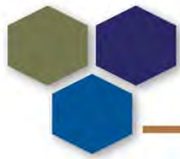|		ROR	StdDev	Sharpe Ratio	Leverage Ratio	2025 Results						Worst Case Retiree FS
						Contribution Rates			Dividend Rates			
						Better	Median	Worse	Better	Median	Worse	
	1	5.0%	9.3%	0.48	1.00	12.6%	15.0%	17.1%	1.8%	-0.2%	-2.3%	68% in year 50
Current Allocation	2	6.0%	11.9%	0.46	1.03	10.6%	14.3%	17.3%	3.6%	0.8%	-2.2%	79% in year 10
	3	7.0%	15.9%	0.40	1.38	8.3%	13.6%	17.6%	5.5%	1.7%	-2.2%	72% in year 10
	4	7.2%	16.8%	0.40	1.46	7.7%	13.5%	17.7%	5.9%	1.9%	-2.2%	70% in year 10
	5	8.0%	20.6%	0.36	1.78	5.5%	12.9%	18.2%	7.6%	2.6%	-2.5%	61% in year 10
	6	9.0%	25.9%	0.33	2.25	2.1%	12.3%	19.0%	9.8%	3.5%	-2.9%	49% in year 10
	7	10.0%	32.3%	0.29	2.80	0.0%	11.8%	20.8%	12.2%	4.3%	-3.7%	34% in year 10

At least with respect to the 2025 outcome, there is a much narrower range on the worse results than on the better results, indicating a potential justification for risk above the minimum illustrated. After scenario 4, the worse results degrade at a high rate. Also the worst case scenario for the retiree dividend pool fall below 70% for scenarios 1, 5, 6 and 7. So do 2, 3, and 4 comprise a "Goldilocks Zone?"

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2015 Observations

- 2013 and 2014 results helped rebuild the dividend base somewhat
- 2015 investment results might reduce some of that cushion depending on measured return at December 31
- High expected return/volatility scenarios appear to result in nearer term dividend risk
- Low expected return/volatility scenarios appear to result in longer term dividend risk
- Target 'Goldilocks zone' that provides for positive return with appropriate downside protection

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Disclaimers

- This presentation shall not be construed to provide tax advice, legal advice or investment advice.
- Readers are cautioned to examine original source materials and to consult with subject matter experts before making decisions related to the subject matter of this presentation.
- This presentation expresses the views of the authors and does not necessarily express the views of Gabriel, Roeder, Smith & Company.

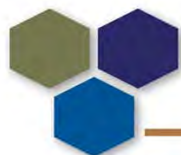**GRS**

State of Wisconsin Investment Board

Wisconsin Retirement System
50-Year Actuarial Projection

October 2015

GRS
Gabriel Roeder Smith & Company
Consultants & Actuaries
www.gabrielroeder.com

Introduction

August SWIB meeting

- Actuarial overview of WRS
  - ▶ Focus: role of investment return in System operation (contribution rates, dividends)

October SWIB meeting

- Focus: Use stochastic projections to
  - ▶ Evaluate worst case scenarios
  - ▶ Investigate probability of depleting the dividend reserve
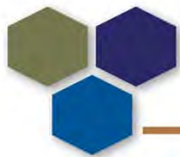 - ▶ Investigate probable range of contribution rates

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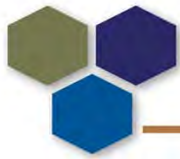
Introduction

October SWIB meeting

- Observations from this study
  - ▶ Pursuing lower risk/return alternatives may lead to undesirable WRS results
  - ▶ Pursuing higher risk/return alternatives may lead to undesirable WRS results
  - ▶ Target 'Goldilocks zone' that provides for positive return with appropriate downside protection
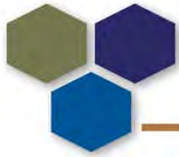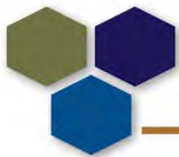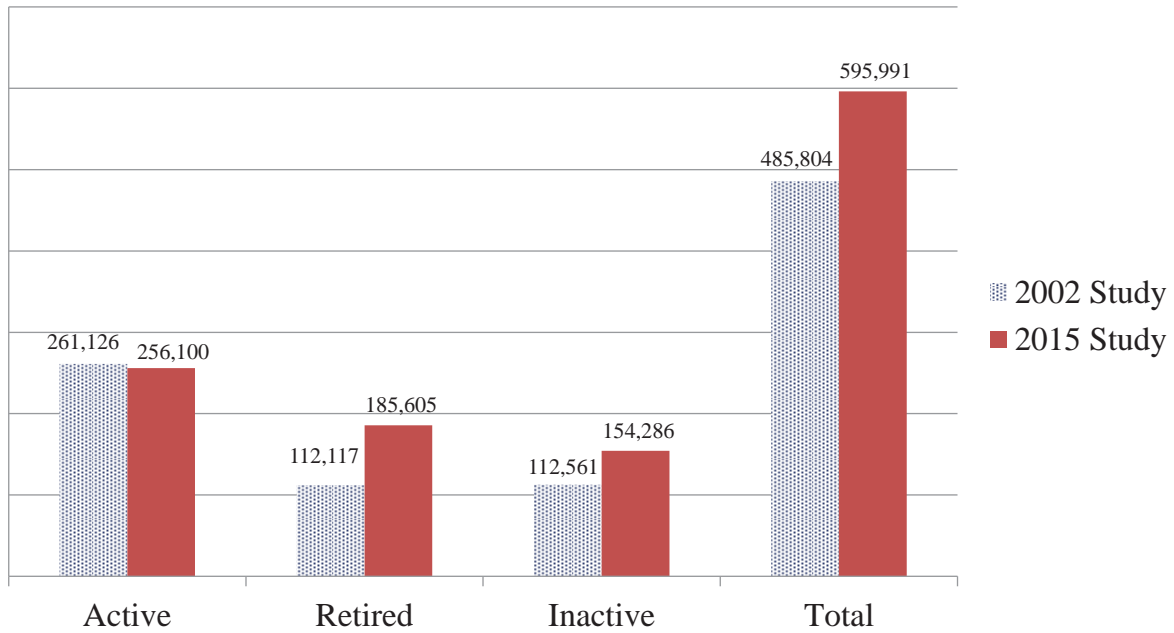
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Study Objectives

- Review emerging demographic trends
- Perform stochastic projections
- Perform various deterministic projections
- Evaluate worst case scenarios
- Investigate probability of depleting the dividend reserve
- Investigate probable range of contribution rates

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WRS Population

Legend:
- 2002 Study
- 2015 Study

	Active	Retired	Inactive	Total
2002 Study	261,126	112,117	112,561	485,804
2015 Study	256,100	185,605	154,286	595,991

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Ratio of Active Members to Retirees

Legend:
- 2002 Study
- 2015 Study

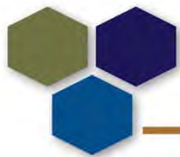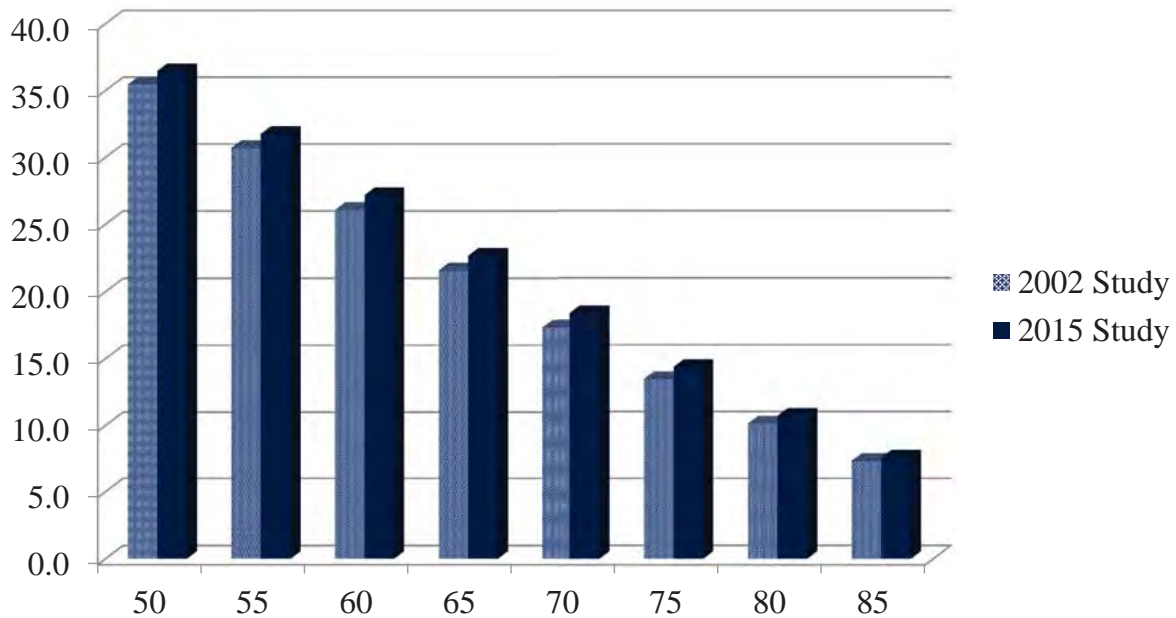(Years: 2014, 2019, 2024, 2029, 2034, 2039, 2044, 2049, 2054, 2059)

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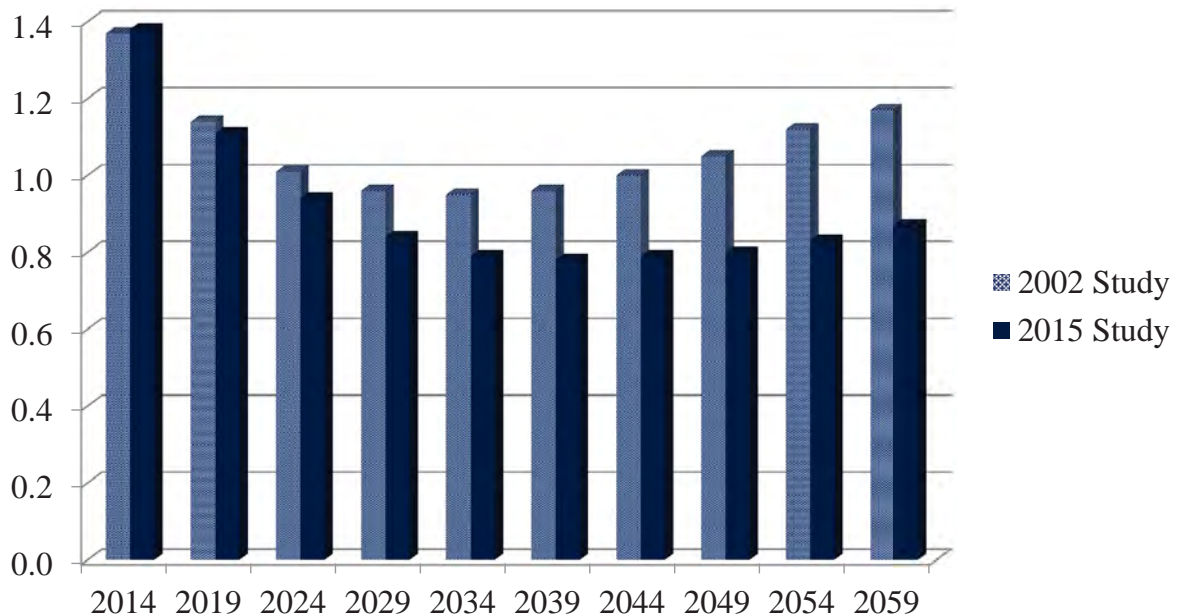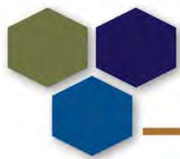
Male Life Expectancy
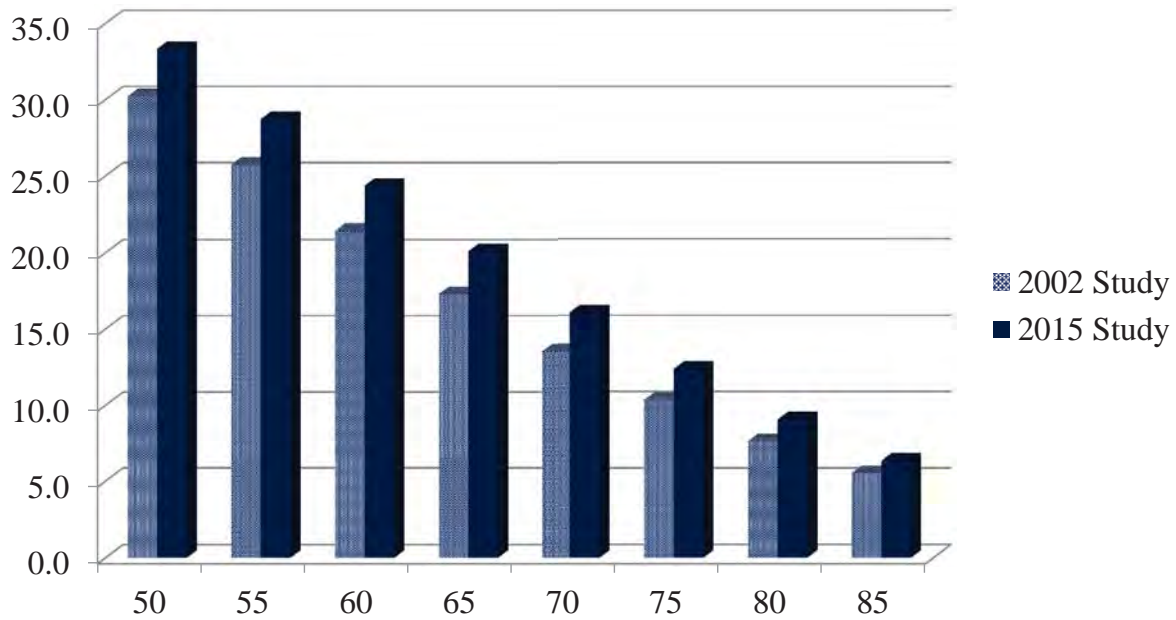
7

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Female Life Expectancy

8

GRS
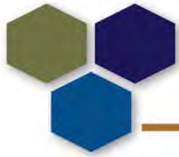
Present & Future Actives
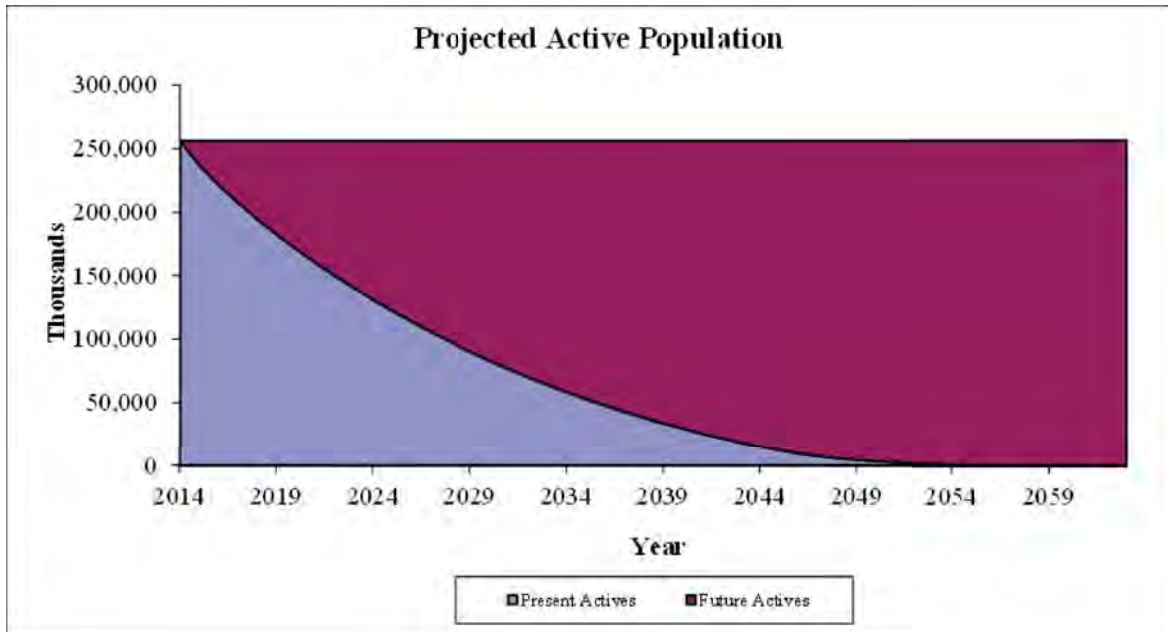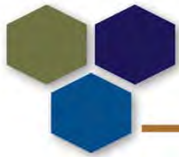
Projected Active Population

The present population has a "half life" of about 10 years.

GRS

Retiree Population
Present and Future

Projected Retiree Population

GRS
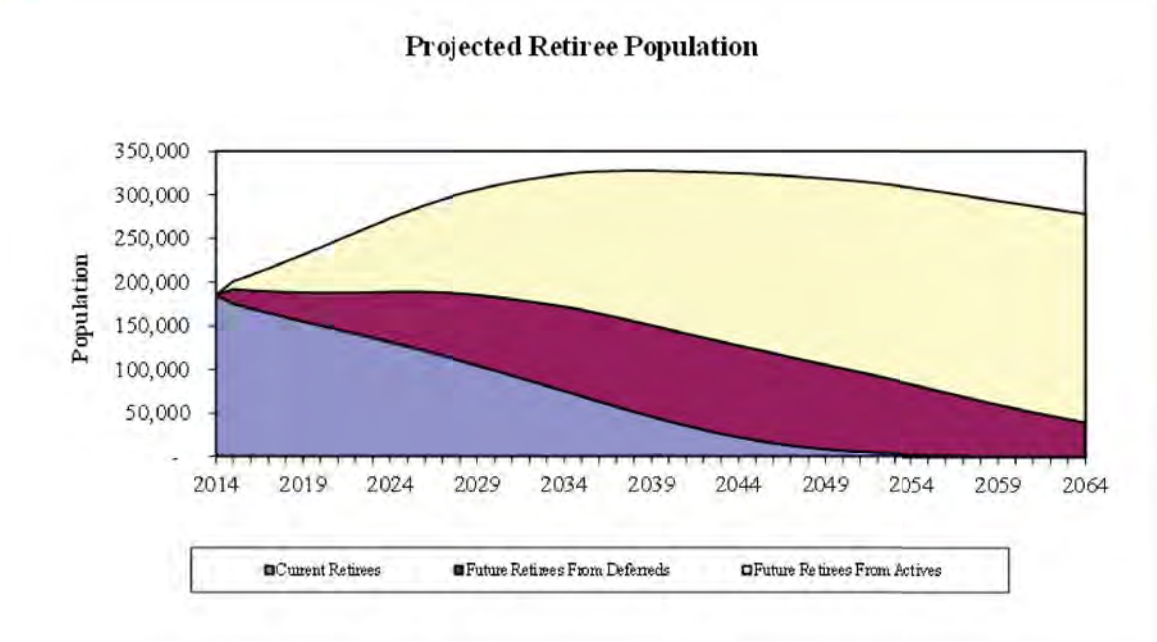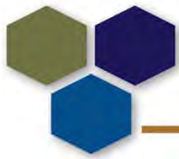
Projected Core Trust Fund Assets ($Billions)

GRS
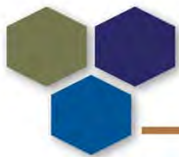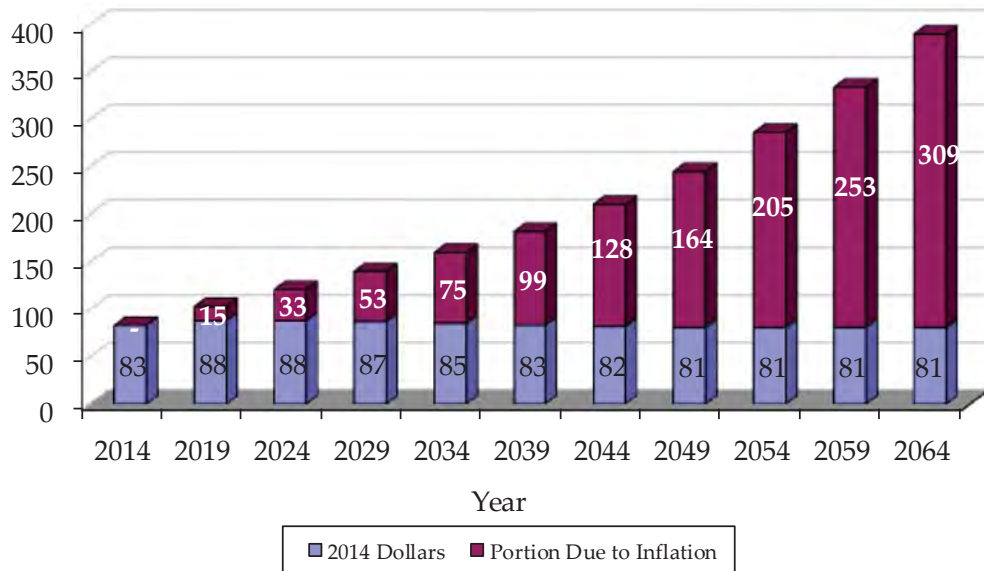
Observations

- In nominal terms, assets will increase by a factor of 4.7 during the projection period
- In real terms, assets need to grow a little to cover the peak of the baby boom retirements
- They *may* decline slightly after that

GRS
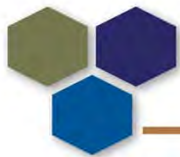
Observations

- A few present retirees will probably draw benefits for more than 50 years
- The number of retirees will increase by about 73% over the next 20 years
- Retiree liability will grow to about 60% of total liability
- Assets are about 6 times payroll

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GRS
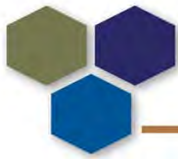
Observations

Maturing pension plans (like WRS) accumulate substantial assets relative to payroll

- Asset volatility increases dramatically for most plans
- Due to cost sharing nature of WRS, asset changes have been traditionally shared by:
  - ▶ Employees (through money purchase benefit)
  - ▶ Employers (through contributions)
  - ▶ Retirees (through dividends)
- WRS Market Recognition account serves to further filter asset experience

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Projected Net External Cash Flow*
Valuation Assumptions

Year	$ (Millions)	% of Assets	% of Payroll
2015	$ (2,557)	(3.1)%	(18.9)%
2025	(4,828)	(4.0)%	(25.6)%
2035	(7,015)	(4.4)%	(26.6)%
2045	(8,460)	(4.0)%	(23.0)%
2055	(11,185)	(3.9)%	(22.2)%
2065	(15,195)	(3.9)%	(22.0)%

Contribution income minus benefit payout.

GRS
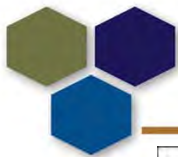
Projected Contributions and Benefits
as a % of Active Payroll
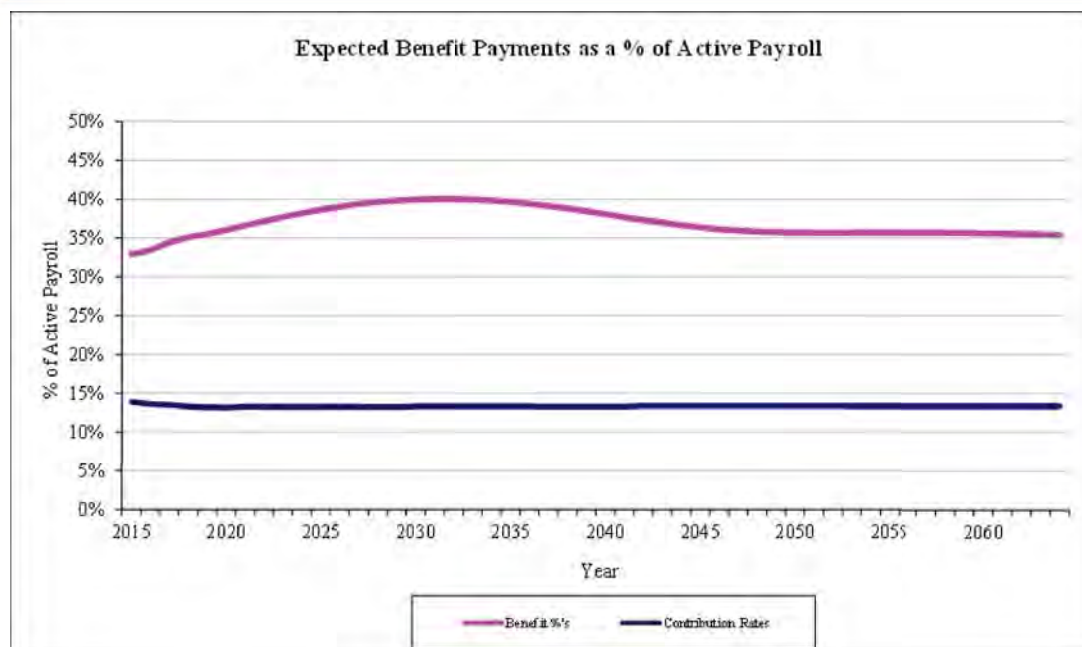
GRS

Comments

- Liquidity needs (i.e., contributions less benefits) increase to over 4% of fund assets

- Benefit payout peaks at about 40% of payroll – more than 3 times the level of contribution income

- Benefits as % of payroll have increased more than expected primarily due to declines in active headcount and low wage inflation

- More than 2/3^{rds} of benefit payout will come from investment return

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GRS
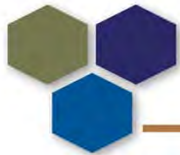
Stochastic Scenarios

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Monte Carlo Simulations

- Based on 10,000 random trials
- Valuation Assumptions held constant
- Assumes seven sets of expected return/standard deviations

  Scenario 1 - 5.0%/9.3%
  Scenario 2 - 6.0%/11.9%
  Scenario 3 - 7.0%/15.9% ← Current Allocation
  Scenario 4 - 7.2%/16.8%
  Scenario 5 - 8.0%/20.6%
  Scenario 6 - 9.0%/25.9%
  Scenario 7 - 10.0%/32.3%

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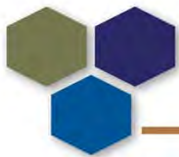
Contribution as a % of Payroll
Scenario 1 – 5.0%ER,9.3%SD
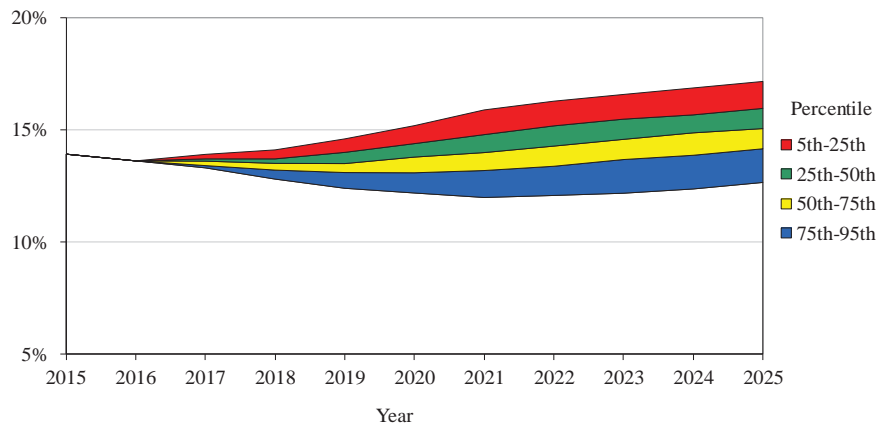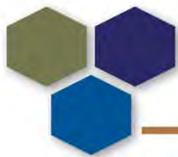
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	13.9%	13.6%	13.9%	14.1%	14.6%	15.2%	15.9%	16.3%	16.6%	16.9%	17.1%
25th Percentile	13.9%	13.6%	13.7%	13.7%	14.0%	14.4%	14.8%	15.2%	15.5%	15.7%	15.9%
Median	13.9%	13.6%	13.6%	13.5%	13.5%	13.8%	14.0%	14.3%	14.6%	14.9%	15.0%
75th Percentile	13.9%	13.6%	13.4%	13.2%	13.1%	13.1%	13.2%	13.4%	13.7%	13.9%	14.1%
95th Percentile	13.9%	13.6%	13.3%	12.8%	12.4%	12.2%	12.0%	12.1%	12.2%	12.4%	12.6%

GRS

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Contribution as a % of Payroll
Scenario 2 – 6.0%ER, 11.9%SD

Percentile
■ 5th-25th
■ 25th-50th
■ 50th-75th
■ 75th-95th

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	13.9%	13.6%	14.0%	14.4%	14.9%	15.6%	16.4%	16.7%	17.0%	17.2%	17.3%
25th Percentile	13.9%	13.6%	13.7%	13.8%	14.0%	14.4%	14.8%	15.1%	15.3%	15.5%	15.6%
Median	13.9%	13.6%	13.5%	13.4%	13.4%	13.6%	13.7%	13.9%	14.1%	14.2%	14.3%
75th Percentile	13.9%	13.6%	13.4%	13.0%	12.8%	12.6%	12.6%	12.6%	12.7%	12.9%	12.9%
95th Percentile	13.9%	13.6%	13.1%	12.4%	11.8%	11.3%	10.8%	10.6%	10.5%	10.6%	10.6%

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Contribution as a % of Payroll
Scenario 3 – 7.0%ER, 15.9%SD

Percentile
■ 5th-25th
■ 25th-50th
■ 50th-75th
■ 75th-95th

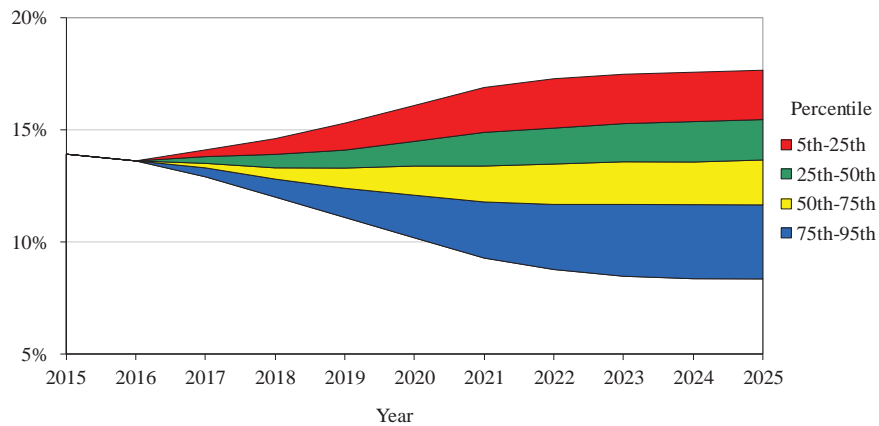|	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	13.9%	13.6%	14.1%	14.6%	15.3%	16.1%	16.9%	17.3%	17.5%	17.6%	17.6%
25th Percentile	13.9%	13.6%	13.8%	13.9%	14.1%	14.5%	14.9%	15.1%	15.3%	15.4%	15.4%
Median	13.9%	13.6%	13.5%	13.3%	13.3%	13.4%	13.4%	13.5%	13.6%	13.6%	13.6%
75th Percentile	13.9%	13.6%	13.3%	12.8%	12.4%	12.1%	11.8%	11.7%	11.7%	11.7%	11.6%
95th Percentile	13.9%	13.6%	12.9%	12.0%	11.1%	10.2%	9.3%	8.8%	8.5%	8.4%	8.3%

GRS
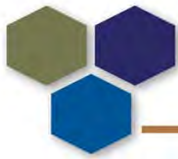
Contribution as a % of Payroll
Scenario 4 – 7.2%ER,16.8%SD
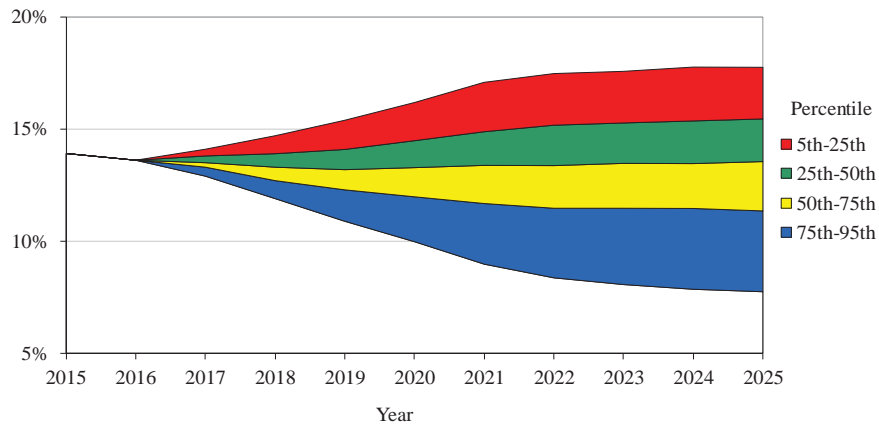
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	13.9%	13.6%	14.1%	14.7%	15.4%	16.2%	17.1%	17.5%	17.6%	17.8%	17.7%
25th Percentile	13.9%	13.6%	13.8%	13.9%	14.1%	14.5%	14.9%	15.2%	15.3%	15.4%	15.4%
Median	13.9%	13.6%	13.5%	13.3%	13.2%	13.3%	13.4%	13.4%	13.5%	13.5%	13.5%
75th Percentile	13.9%	13.6%	13.3%	12.7%	12.3%	12.0%	11.7%	11.5%	11.5%	11.5%	11.3%
95th Percentile	13.9%	13.6%	12.9%	11.9%	10.9%	10.0%	9.0%	8.4%	8.1%	7.9%	7.7%

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Contribution as a % of Payroll
Scenario 5 – 8.0%ER,20.6%SD

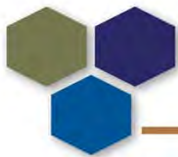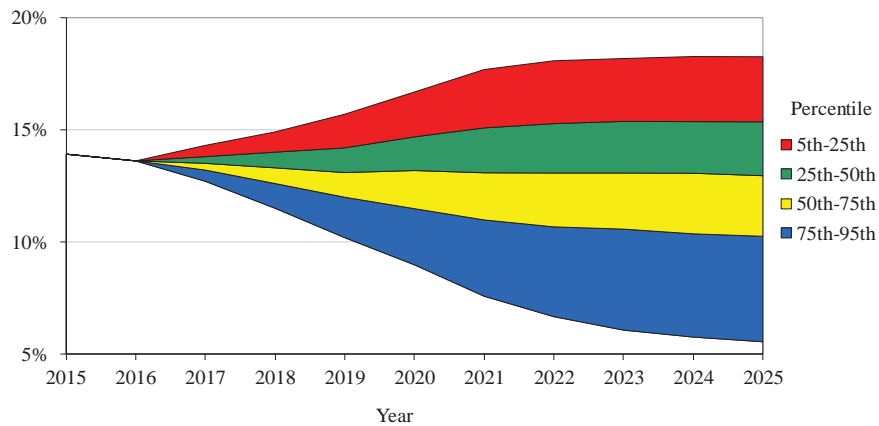|	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	13.9%	13.6%	14.3%	14.9%	15.7%	16.7%	17.7%	18.1%	18.2%	18.3%	18.2%
25th Percentile	13.9%	13.6%	13.8%	14.0%	14.2%	14.7%	15.1%	15.3%	15.4%	15.4%	15.3%
Median	13.9%	13.6%	13.5%	13.3%	13.1%	13.2%	13.1%	13.1%	13.1%	13.1%	12.9%
75th Percentile	13.9%	13.6%	13.2%	12.6%	12.0%	11.5%	11.0%	10.7%	10.6%	10.4%	10.2%
95th Percentile	13.9%	13.6%	12.7%	11.5%	10.2%	9.0%	7.6%	6.7%	6.1%	5.8%	5.5%

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GRS
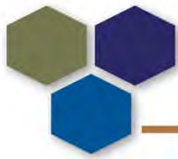
Contribution as a % of Payroll
Scenario 6 – 9.0%ER,25.9%SD
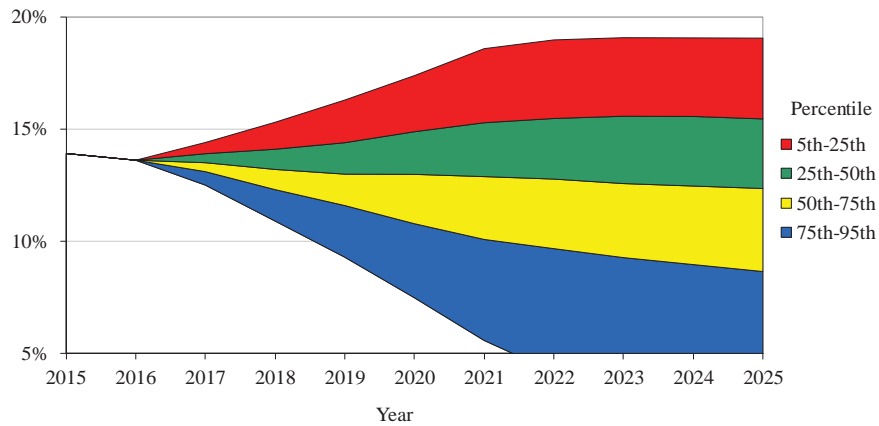
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	13.9%	13.6%	14.4%	15.3%	16.3%	17.4%	18.6%	19.0%	19.1%	19.1%	19.0%
25th Percentile	13.9%	13.6%	13.9%	14.1%	14.4%	14.9%	15.3%	15.5%	15.6%	15.6%	15.4%
Median	13.9%	13.6%	13.5%	13.2%	13.0%	13.0%	12.9%	12.8%	12.6%	12.5%	12.3%
75th Percentile	13.9%	13.6%	13.1%	12.3%	11.6%	10.8%	10.1%	9.7%	9.3%	9.0%	8.6%
95th Percentile	13.9%	13.6%	12.5%	10.9%	9.3%	7.5%	5.6%	4.2%	3.3%	2.7%	2.1%

GRS

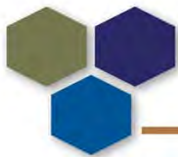# Contribution as a % of Payroll
Scenario 7 – 10.0%ER,32.3%SD
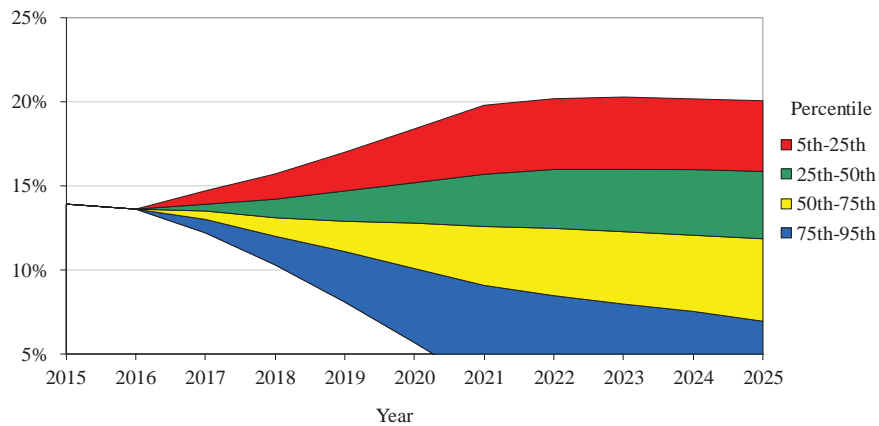
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	13.9%	13.6%	14.7%	15.7%	17.0%	18.4%	19.8%	20.2%	20.3%	20.2%	20.0%
25th Percentile	13.9%	13.6%	13.9%	14.2%	14.7%	15.2%	15.7%	16.0%	16.0%	16.0%	15.8%
Median	13.9%	13.6%	13.5%	13.1%	12.9%	12.8%	12.6%	12.5%	12.3%	12.1%	11.8%
75th Percentile	13.9%	13.6%	13.0%	12.0%	11.1%	10.1%	9.1%	8.5%	8.0%	7.5%	6.9%
95th Percentile	13.9%	13.6%	12.2%	10.3%	8.1%	5.7%	3.2%	1.2%	-0.2%	-1.2%	-2.1%

GRS
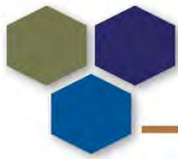
Dividend Rates
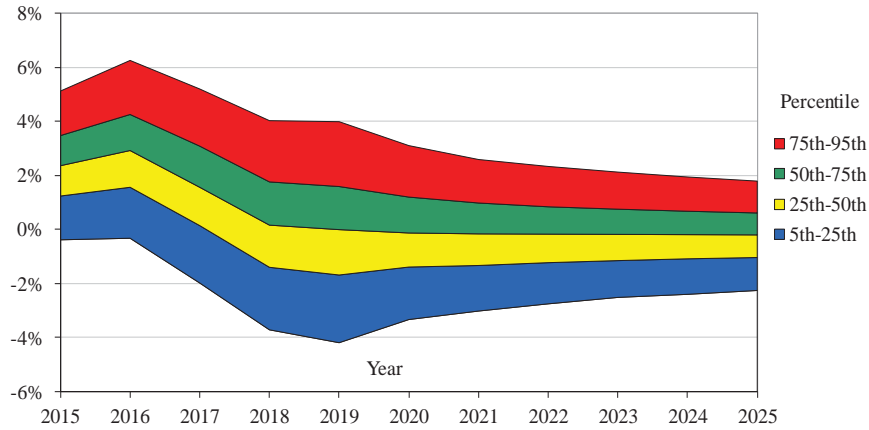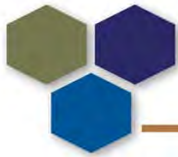## Scenario 1 – 5.0%ER, 9.3%SD

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	-0.4%	-0.3%	-2.0%	-3.7%	-4.2%	-3.3%	-3.0%	-2.8%	-2.5%	-2.4%	-2.3%
25th Percentile	1.2%	1.6%	0.1%	-1.4%	-1.7%	-1.4%	-1.3%	-1.2%	-1.2%	-1.1%	-1.0%
Median	2.4%	2.9%	1.6%	0.2%	0.0%	-0.1%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
75th Percentile	3.5%	4.3%	3.1%	1.8%	1.6%	1.2%	1.0%	0.8%	0.8%	0.7%	0.6%
95th Percentile	5.1%	6.3%	5.2%	4.0%	4.0%	3.1%	2.6%	2.3%	2.1%	1.9%	1.8%

GRS

Dividend Rates
Scenario 2 – 6.0%ER, 11.9%SD

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	-1.3%	-1.3%	-3.0%	-4.7%	-5.2%	-3.8%	-3.3%	-2.9%	-2.5%	-2.4%	-2.2%
25th Percentile	1.0%	1.4%	0.0%	-1.4%	-1.5%	-1.0%	-0.9%	-0.7%	-0.6%	-0.5%	-0.4%
Median	2.6%	3.3%	2.1%	0.8%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
75th Percentile	4.1%	5.2%	4.2%	3.1%	3.1%	2.6%	2.4%	2.2%	2.1%	2.0%	1.9%
95th Percentile	6.5%	8.1%	7.3%	6.3%	6.4%	5.3%	4.6%	4.4%	4.1%	3.8%	3.6%

GRS

Dividend Rates
Scenario 3 – 7.0%ER,15.9%SD
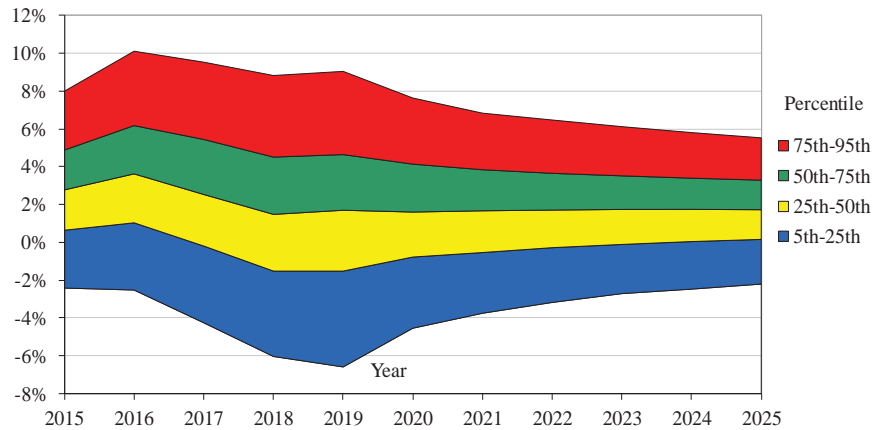
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	-2.4%	-2.5%	-4.3%	-6.0%	-6.6%	-4.5%	-3.8%	-3.2%	-2.7%	-2.5%	-2.2%
25th Percentile	0.6%	1.0%	-0.2%	-1.5%	-1.5%	-0.8%	-0.5%	-0.3%	-0.1%	0.0%	0.2%
Median	2.8%	3.6%	2.5%	1.5%	1.7%	1.6%	1.7%	1.7%	1.7%	1.7%	1.7%
75th Percentile	4.9%	6.2%	5.4%	4.5%	4.6%	4.1%	3.8%	3.6%	3.5%	3.4%	3.3%
95th Percentile	8.0%	10.1%	9.5%	8.8%	9.0%	7.6%	6.8%	6.5%	6.1%	5.8%	5.5%

GRS

Dividend Rates
Scenario 4 – 7.2%ER,16.8%SD
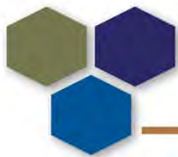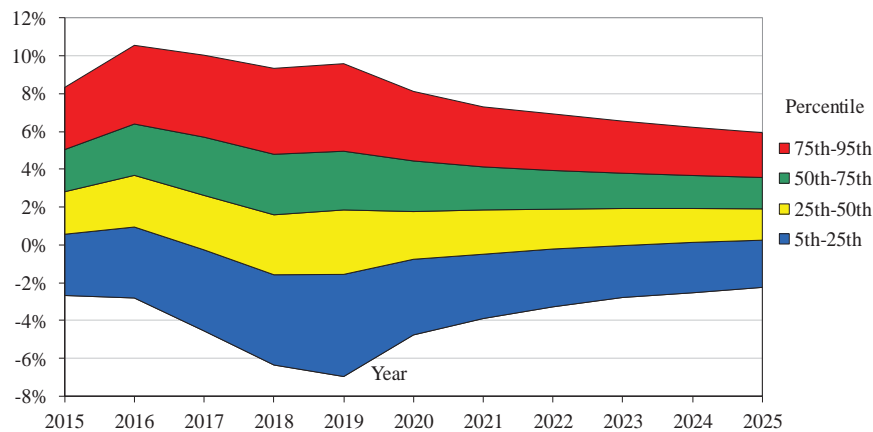

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	-2.7%	-2.8%	-4.6%	-6.4%	-7.0%	-4.8%	-3.9%	-3.3%	-2.8%	-2.5%	-2.2%
25th Percentile	0.6%	0.9%	-0.3%	-1.6%	-1.6%	-0.8%	-0.5%	-0.2%	0.0%	0.1%	0.2%
Median	2.8%	3.7%	2.6%	1.6%	1.8%	1.8%	1.8%	1.9%	1.9%	1.9%	1.9%
75th Percentile	5.0%	6.4%	5.7%	4.8%	5.0%	4.4%	4.1%	3.9%	3.8%	3.7%	3.6%
95th Percentile	8.3%	10.6%	10.0%	9.3%	9.6%	8.1%	7.3%	6.9%	6.5%	6.2%	5.9%

GRS

Dividend Rates
Scenario 5 – 8.0%ER,20.6%SD

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	-3.8%	-4.0%	-5.9%	-7.8%	-8.6%	-5.7%	-4.6%	-3.8%	-3.1%	-2.8%	-2.5%
25th Percentile	0.2%	0.6%	-0.6%	-1.9%	-1.8%	-0.7%	-0.4%	0.0%	0.2%	0.5%	0.6%
Median	3.0%	3.9%	3.0%	2.0%	2.4%	2.4%	2.5%	2.6%	2.6%	2.6%	2.6%
75th Percentile	5.7%	7.3%	6.7%	6.0%	6.2%	5.6%	5.3%	5.1%	4.9%	4.8%	4.7%
95th Percentile	9.7%	12.4%	12.1%	11.6%	11.8%	10.1%	9.2%	8.7%	8.3%	7.9%	7.6%

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GRS

Dividend Rates
Scenario 6 – 9.0%ER,25.9%SD

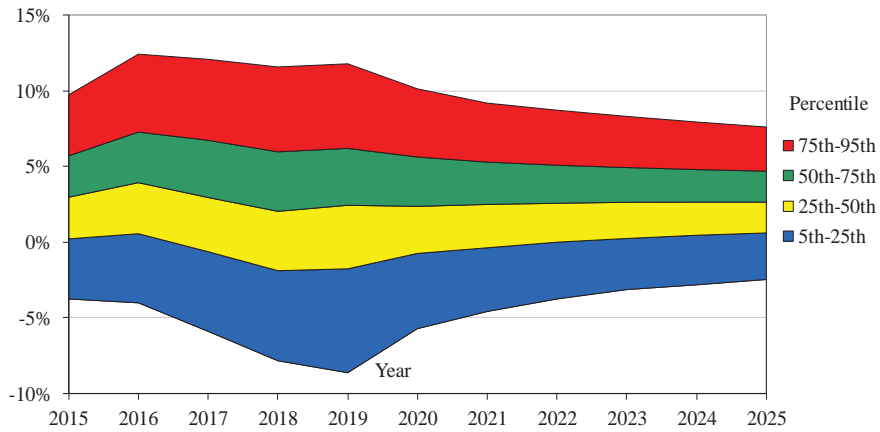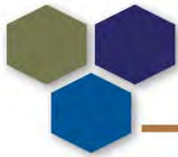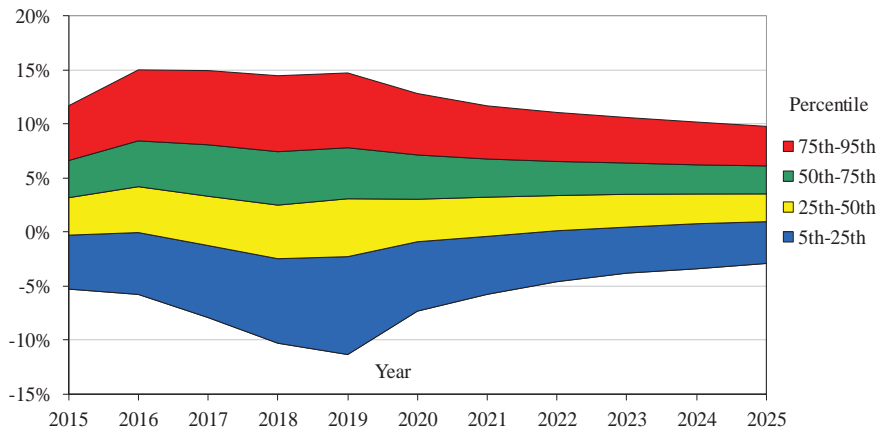|	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	-5.3%	-5.8%	-7.9%	-10.3%	-11.3%	-7.3%	-5.8%	-4.6%	-3.8%	-3.4%	-2.9%
25th Percentile	-0.3%	0.0%	-1.2%	-2.5%	-2.3%	-0.9%	-0.4%	0.1%	0.5%	0.8%	1.0%
Median	3.2%	4.2%	3.3%	2.5%	3.1%	3.0%	3.2%	3.4%	3.5%	3.5%	3.5%
75th Percentile	6.6%	8.4%	8.1%	7.4%	7.8%	7.1%	6.8%	6.5%	6.4%	6.2%	6.1%
95th Percentile	11.7%	15.0%	14.9%	14.5%	14.7%	12.8%	11.7%	11.1%	10.6%	10.2%	9.8%

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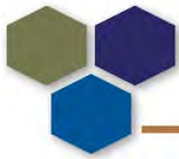
Dividend Rates
Scenario 7 – 10.0%ER,32.3%SD
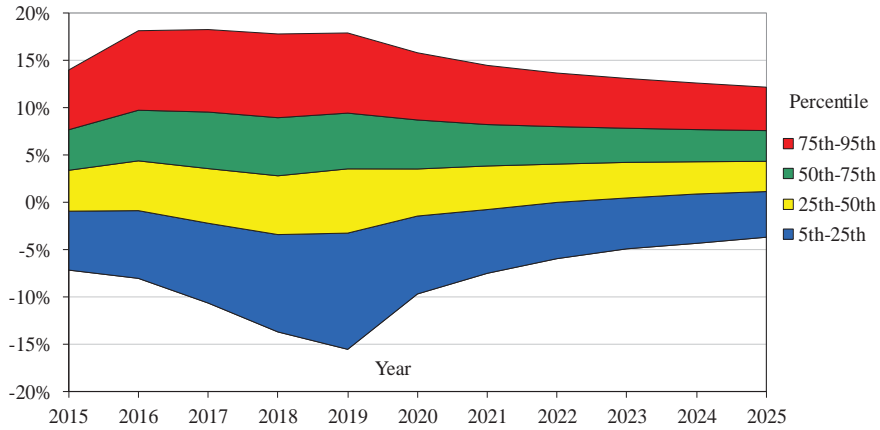
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5th Percentile	-7.2%	-8.0%	-10.6%	-13.7%	-15.5%	-9.7%	-7.5%	-6.0%	-4.9%	-4.3%	-3.7%
25th Percentile	-0.9%	-0.9%	-2.2%	-3.4%	-3.3%	-1.4%	-0.8%	0.0%	0.5%	0.9%	1.1%
Median	3.4%	4.4%	3.6%	2.8%	3.5%	3.5%	3.8%	4.0%	4.2%	4.3%	4.3%
75th Percentile	7.7%	9.7%	9.6%	9.0%	9.4%	8.7%	8.2%	8.0%	7.8%	7.7%	7.6%
95th Percentile	14.0%	18.2%	18.3%	17.8%	17.9%	15.8%	14.5%	13.7%	13.1%	12.6%	12.2%
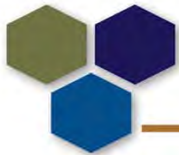
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Contribution rate summary under alternate scenarios - median

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Dividend rate summary under alternate scenarios - median
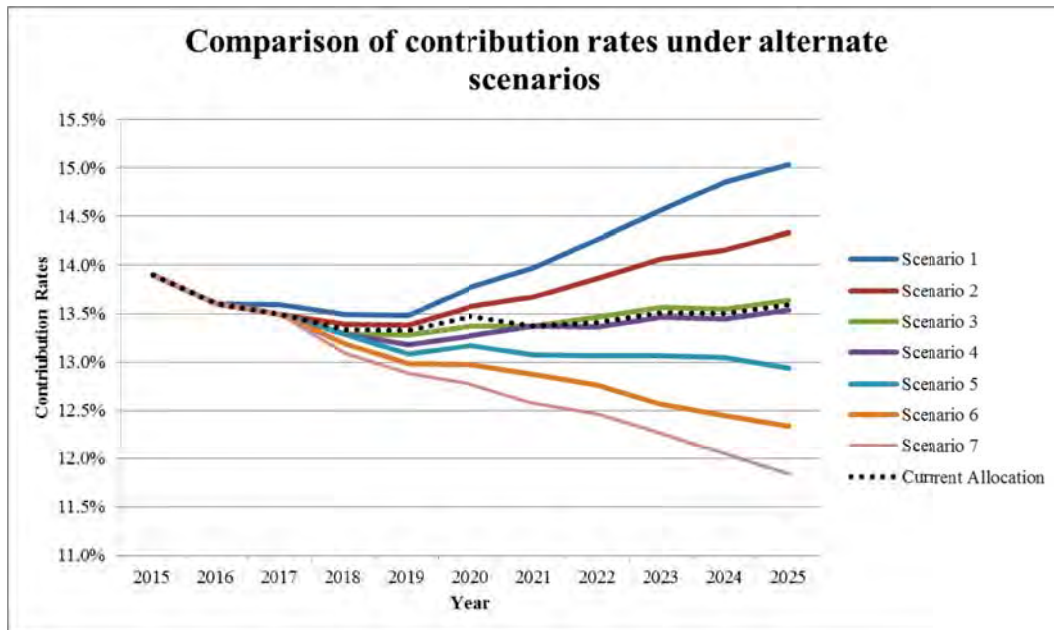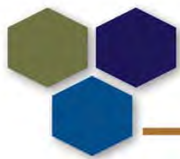
Comparison of dividend rates under alternate scenarios
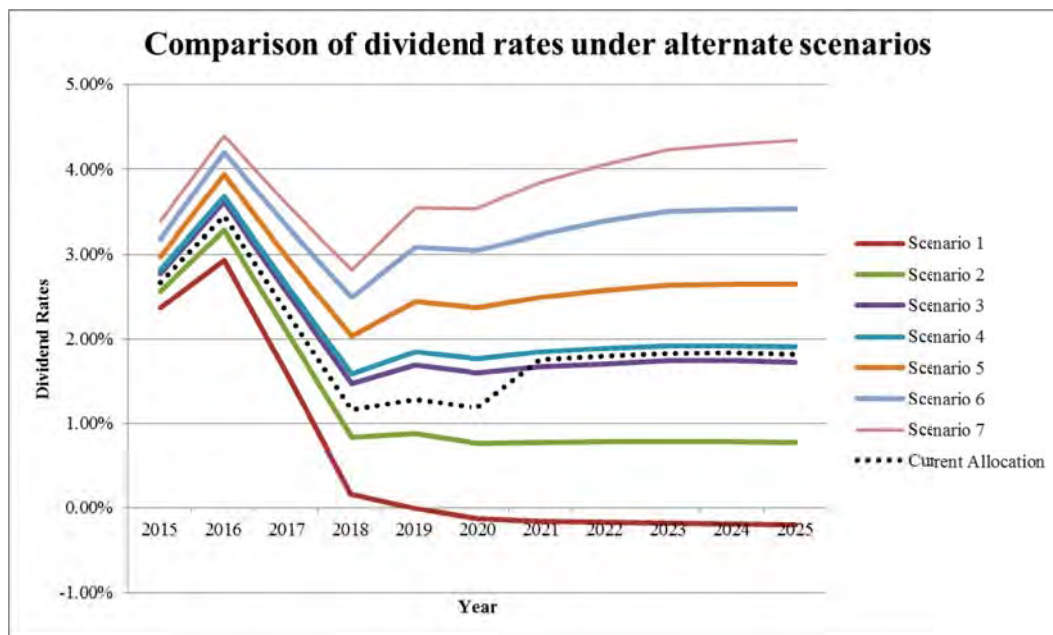
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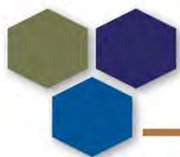
Comments on Monte Carlo Simulations

- Based on normal market fluctuations, there is a wide range of probable outcomes – even if the long-term average rate of return is exactly as assumed

- Market returns of last decade have been volatile asset returns my not be normally distributed.

- Maturing plans such as WRS are increasingly exposed to the effects of market volatility.

- The unique benefit structure of WRS enables it to deal with volatility to an extent not feasible in most public sector retirement systems.

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Dividend
Discussion

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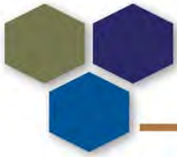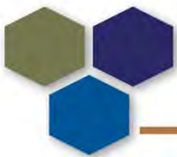
Dividend Discussion

- As of December 31, 2014, the total retiree liability was about $47.1 billion.

- Of the $47.1 billion, about $4.6 billion (or 11%) is attributable to dividends with the remaining $42.5 billion attributable to the current floor benefit.

- While retirees cannot fall below the floor benefit, it is possible the asset pool could fall below this level.

- Returns above 5% will help increase the 11% dividend pool and returns below 5% will erode it.

- Dividend erosion is not uniform – people who retired a long time ago lose a larger share of their current benefit than more recent retirees

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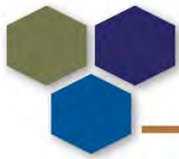
Discussion of Dividend

Liability for Remaining Dividend (Billions)

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Discussion of Dividend

Probability that Dividend will be Depleted by Year

	Expected ROR	Standard Deviation	Year				
			1	5	10	20	50
1	5.0%	9.3%	0.0%	4.3%	11.4%	18.3%	30.5%
2	6.0%	11.9%	0.0%	7.9%	11.1%	8.3%	3.2%
3	7.0%	15.9%	0.0%	12.0%	12.2%	6.1%	0.8%
4	7.2%	16.8%	0.0%	12.8%	12.6%	6.0%	0.7%
5	8.0%	20.6%	0.1%	15.9%	14.0%	5.9%	0.5%
6	9.0%	25.9%	0.4%	19.7%	16.4%	6.8%	0.5%
7	10.0%	32.3%	1.4%	23.2%	19.7%	8.7%	0.8%

Current Allocation → (row 2)

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Discussion of Dividend

Probability of Negative Dividend by Year

	Expected ROR	Standard Deviation	Year				
			1	5	10	20	50
1	5.0%	9.3%	7.9%	50.2%	56.0%	54.9%	54.4%
2	6.0%	11.9%	13.8%	40.6%	34.0%	30.1%	30.1%
3	7.0%	15.9%	18.9%	36.6%	24.6%	19.8%	20.5%
4	7.2%	16.8%	19.8%	36.1%	23.4%	18.9%	19.5%
5	8.0%	20.6%	23.5%	35.2%	20.9%	16.1%	16.8%
6	9.0%	25.9%	26.7%	35.4%	19.5%	14.8%	15.5%
7	10.0%	32.3%	29.6%	36.6%	20.0%	15.0%	16.0%

Current Allocation → (row 3)

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Discussion of Dividend

Worst Case Scenario of Cumulative Dividend Percent
(% of Floor Benefit that is funded)

	Expected ROR	Standard Deviation	Year				
			1	5	10	20	50
1	5.0%	9.3%	109%	93%	85%	80%	68%
2	6.0%	11.9%	109%	86%	79%	81%	86%
3	7.0%	15.9%	107%	77%	72%	78%	105%
4	7.2%	16.8%	106%	75%	70%	77%	108%
5	8.0%	20.6%	105%	66%	61%	72%	118%
6	9.0%	25.9%	102%	54%	49%	62%	124%
7	10.0%	32.3%	99%	40%	34%	46%	115%

Current Allocation → (row 3)

Worst Case Scenario based on 1st Percentile (i.e. 1% probability)

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Dividend Observations

- The low risk scenarios are actually risky in the sense that, for example, 5% expected return has much higher chance of dividend depletion in later years than higher risk scenarios

- Must balance short and long term volatility

- Consider probability of dividend depletion

- Consider level of worst case scenario that is acceptable

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Combination of all Scenarios

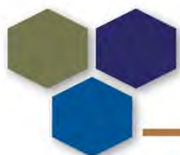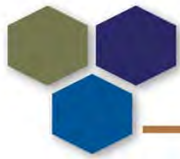|			Sharpe	Leverage	2025 Results						Worst Case
					Contribution Rates			Dividend Rates			Retiree FS
	ROR	StdDev	Ratio	Ratio	Better	Median	Worse	Better	Median	Worse	
1	5.0%	9.3%	0.48	1.00	12.6%	15.0%	17.1%	1.8%	-0.2%	-2.3%	68% in year 50
2	6.0%	11.9%	0.46	1.03	10.6%	14.3%	17.3%	3.6%	0.8%	-2.2%	79% in year 10
3	7.0%	15.9%	0.40	1.38	8.3%	13.6%	17.6%	5.5%	1.7%	-2.2%	72% in year 10
4	7.2%	16.8%	0.40	1.46	7.7%	13.5%	17.7%	5.9%	1.9%	-2.2%	70% in year 10
5	8.0%	20.6%	0.36	1.78	5.5%	12.9%	18.2%	7.6%	2.6%	-2.5%	61% in year 10
6	9.0%	25.9%	0.33	2.25	2.1%	12.3%	19.0%	9.8%	3.5%	-2.9%	49% in year 10
7	10.0%	32.3%	0.29	2.80	0.0%	11.8%	20.8%	12.2%	4.3%	-3.7%	34% in year 10

Current Allocation (→ points to rows 2, 3, 4)

At least with respect to the 2025 outcome, there is a much narrower range on the worse results than on the better results, indicating a potential justification for risk above the minimum illustrated. After scenario 4, the worse results degrade at a high rate. Also the worst case scenario for the retiree dividend pool fall below 70% for scenarios 1, 5, 6 and 7. So do 2, 3, and 4 comprise a "Goldilocks Zone?"

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2013 Observations

- WRS is still a maturing system
- Dividend base for retirees has declined rapidly and is very close to being depleted
- 2013 and 2014 are pivotal years to rebuild the dividend base to a broader cohort of retirees
- Few systems can withstand another '2008' market year in the near future without large increases in contributions
- Continue to investigate strategies to reduce downside risk – may involve a statutory change

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2015 Observations

- 2013 and 2014 results helped rebuild the dividend base somewhat
- 2015 investment results might reduce some of that cushion depending on measured return at December 31
- High expected return/volatility scenarios appear to result in nearer term dividend risk
- Low expected return/volatility scenarios appear to result in longer term dividend risk
- Target 'Goldilocks zone' that provides for positive return with appropriate downside protection

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Disclaimers

- This presentation shall not be construed to provide tax advice, legal advice or investment advice.
- Readers are cautioned to examine original source materials and to consult with subject matter experts before making decisions related to the subject matter of this presentation.
- This presentation expresses the views of the authors and does not necessarily express the views of Gabriel, Roeder, Smith & Company.

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Appendix

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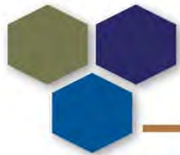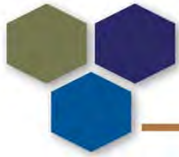
Present & Future Actives
Year by Year results

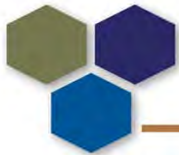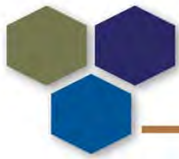| Year	Present Actives	Future Actives	Year	Present Actives	Future Actives
2014	256,100	-	2039	33,616	222,484
2015	236,966	19,134	2040	29,437	226,663
2016	221,275	34,825	2041	25,495	230,605
2017	207,222	48,878	2042	21,768	234,332
2018	194,271	61,829	2043	18,248	237,852
2019	182,137	73,963	2044	14,952	241,148
2020	170,707	85,393	2045	12,060	244,040
2021	159,888	96,212	2046	9,566	246,534
2022	149,629	106,471	2047	7,474	248,626
2023	139,905	116,195	2048	5,769	250,331
2024	130,676	125,424	2049	4,417	251,683
2025	121,838	134,262	2050	3,360	252,740
2026	113,380	142,720	2051	2,534	253,566
2027	105,305	150,795	2052	1,893	254,207
2028	97,603	158,497	2053	1,406	254,694
2029	90,257	165,843	2054	1,038	255,062
2030	83,275	172,825	2055	763	255,337
2031	76,621	179,479	2056	558	255,542
2032	70,255	185,845	2057	406	255,694
2033	64,217	191,883	2058	295	255,805
2034	58,462	197,638	2059	213	255,887
2035	52,969	203,131	2060	150	255,950
2036	47,746	208,354	2061	104	255,996
2037	42,781	213,319	2062	70	256,030
2038	38,067	218,033	2063	46	256,054

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Retiree Population – Present and Future
Year by Year Results

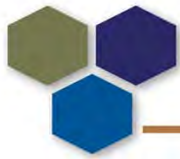| Year	Present Retirees	Future from Deferred	Future from Actives	Year	Present Retirees	Future from Deferred	Future from Actives
2014	185,605	-	-	2039	46,543	104,581	176,576
2015	175,108	17,031	8,890	2040	41,159	105,140	180,927
2016	169,893	20,754	17,396	2041	36,049	105,553	185,074
2017	164,850	24,677	26,011	2042	31,256	105,695	189,113
2018	159,906	28,969	34,646	2043	26,818	105,605	193,002
2019	155,027	33,195	43,289	2044	22,769	105,196	196,764
2020	150,296	37,541	51,828	2045	19,130	104,329	200,405
2021	145,613	42,367	60,220	2046	15,907	103,154	203,851
2022	140,962	47,078	68,432	2047	13,097	101,392	207,106
2023	136,228	52,157	76,424	2048	10,681	99,378	210,150
2024	131,365	57,626	84,182	2049	8,633	97,151	213,032
2025	126,379	62,820	91,722	2050	6,917	94,561	215,757
2026	121,266	67,653	99,108	2051	5,498	91,669	218,276
2027	116,027	72,286	106,310	2052	4,339	88,448	220,639
2028	110,659	76,449	113,323	2053	3,402	84,877	222,842
2029	105,150	80,286	120,149	2054	2,656	80,955	224,922
2030	99,504	83,892	126,747	2055	2,067	76,736	226,858
2031	93,735	87,251	133,159	2056	1,606	72,370	228,659
2032	87,859	90,489	139,364	2057	1,249	67,967	230,323
2033	81,899	93,457	145,330	2058	974	63,587	231,860
2034	75,888	96,497	151,099	2059	762	59,265	233,284
2035	69,863	98,999	156,726	2060	599	55,030	234,596
2036	63,867	100,813	162,079	2061	474	50,917	235,794
2037	57,947	102,236	167,132	2062	378	46,936	236,883
2038	52,156	103,592	171,945	2063	304	43,094	237,863

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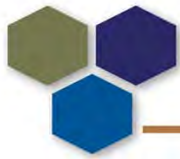| Approach	Theory	Impact on Dividends	Who Bears Cost?
Do Nothing	"Short Term" deficit will be made up by future Investment Return > 5%	No dividends paid until the "deficit" has been filled	Current and near retirees
Let Depletion Flow Through EAR	Fully fund retiree reserve with special reserve transfer, paid over EAR financing period	Dividends may resume very quickly	Participants and employers
Special Amortization	Amortize deficit over 5 years, charge interest at 5% credit (retiree reserve earnings) > 5%	No dividends paid until the "deficit" has been filled	Participants and employers

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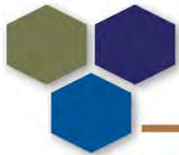
Unfunded Dividend Analysis

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Do Nothing

- This course of action assumes that the deficit is a short-term phenomenon that will be made up by investment gains above 5% in the future.
- No dividends would be paid until the "deficit" has been filled.
- This method applies the full cost of the loss to present and near-term future retirees.
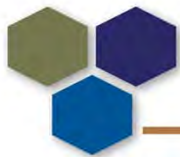- Of course, the conditions that produced the deficit probably affected employer and participant contributions anyway.

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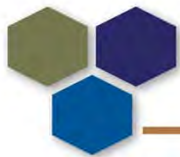
Let It Flow Through the EAR

- This method fully funds the retiree reserve with a special reserve transfer.
- The deficit is thereby transferred to the active reserves and is financed over the EAR financing period.
- The method transfers almost the entire cost of the deficit to participants and employers.
- Dividends might resume very rapidly in such a circumstance, perhaps even the next year.

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Special Amortization

- Set up a 5-year amortization of the deficit.
- Will affect both participant and employer rates.
- Charge the deficit with 5% interest.
- Credit the deficit with employer and participant amortization contributions and earnings on the retiree reserve above 5%.
- No dividends paid until deficit is paid off.
- This method shifts a portion, but not all of the cost back to employers and active participants.

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Deficit Analysis

- Suppose the retiree core fund initially has $40 billion in assets and liabilities and
- The entire dividend reserve has previously been used up and
- At the end of the year the fund has $36 billion in assets and $40 billion in liabilities and
- Going forward all assets earn 7.2%
- How long will it take the assets to catch back up to the liabilities?

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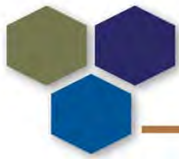
Deficit Analysis

- In this case, the fund would have $36 billion in assets earnings 7.2% each year, 2.2% more than required interest.

- So, an annual payment of 2.2% x $36 billion, which is $720 Million, could be applied to the $4 billion deficit.

- Of course, the deficit is also a debt bearing interest at 5%.

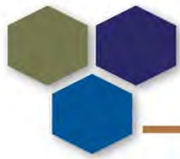- The payoff schedule looks like this.

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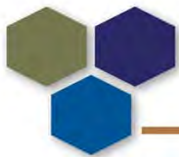
Deficit Payoff Schedule

Year	Beginning Balance	Interest (5%)	Payment	Ending Balance
1	$ 4,000	$ 200	$ 792	$ 3,408
2	3,408	170	792	2,786
3	2,786	139	792	2,134
4	2,134	107	792	1,448
5	1,448	72	792	729
6	729	36	792	(27)

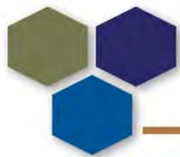In this example, the deficit would be extinguished during the sixth year

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Discussion

- The payoff schedule is perhaps oversimplified.
- It assumes that reserve transfers and regular interest on the existing reserve assets covers benefit payments from the reserve.
- But for deficits on the order of 10%, it might not be too far off.

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More Discussion

- If there were a 25% deficit, a similar calculation would suggest potential payoff in 30 years.
- That might be true, but the assumptions become questionable over such a time horizon.
- More sophisticated modeling would be required to provide a reliable answer.

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