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Montana Teachers' Retirement System

Experience Study Results
July 1, 2013 to July 1, 2017

Presented May 18, 2018

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Actuarial Assumptions

- Used to forecast future contingent events that impact the timing and amount of benefit payments
- Assumptions are long term estimates
  - Experience emerges short term
  - Year to year fluctuations expected
- Should be “best guess” based on both:
  - Past history (actual experience)
    - Strong indicator for some assumptions like mortality
    - Less valuable for other assumptions
  - Future expectations
- Should be explicit – each assumption is individually reasonable and best estimate

Actuarial Assumptions

- No “correct” assumptions
  - Blend of art and science
  - Range of acceptable assumptions
- More aggressive assumptions are more likely to generate actuarial losses in future years; more conservative are likely to generate actuarial gains
- Most powerful assumption is the investment return assumption (also called the discount rate)
- Ultimate responsibility for selection of assumptions generally lies with the Board of Trustees

Actuarial Assumptions

- Two types of assumptions
  - Demographic (things that happen to people)
    - Retirement
    - Disability
    - Pre-retirement death
    - Termination of employment
    - Sick leave conversion
    - Death after retirement
  - Economic
    - Investment return/interest rate
    - Salary increases
    - Payroll growth
    - Price inflation

Demographic Assumptions

- Assumptions Reviewed
  - Rates of Withdrawal
  - Rates of Pre-Retirement Mortality
  - Rates of Disability Retirement
  - Rates of Service Retirement
  - Rates of Post-Retirement Mortality
  - Rates of Salary Increase

- Actuarial Standard of Practice (ASOP) No. 35, *"Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations"*, which provides guidance to actuaries in selecting demographic assumptions for measuring obligations under defined benefit plans.

Demographic Assumptions

- Study compares what actually happened during the study period (7/1/2013 through 7/1/2017) with what was expected to happen.
- Assumption changes recommended if actual experience differs significantly from expected.
- Judgment required to extrapolate future experience from past experience.

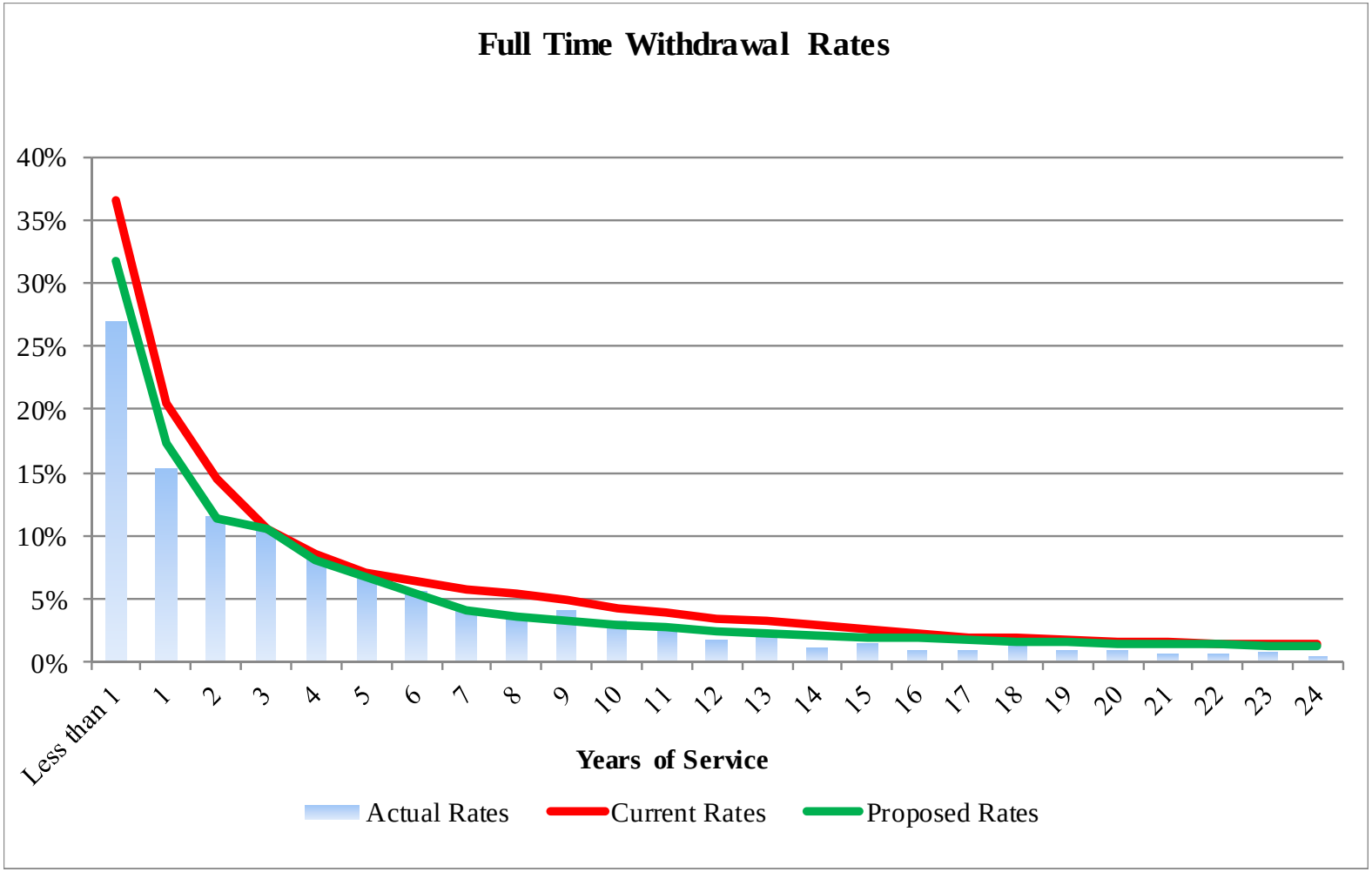
Demographic Assumptions (Withdrawal Rates)

- Reviewed experience separately for full time vs. part time members
- Actual/expected ratios where 79% and 157% respectively for full time members and part time members
- A ratio that is less than 100% indicates there were less withdrawals during the experience period than anticipated by the assumption
- A ratio that is greater than 100% indicates there were more withdrawals during the experience period than anticipated by the assumption

Demographic Assumptions (Withdrawal Rates)

- Recommend updating the assumed rates of withdrawal based on full time and part time members

Demographic Assumptions (Withdrawal Rates)

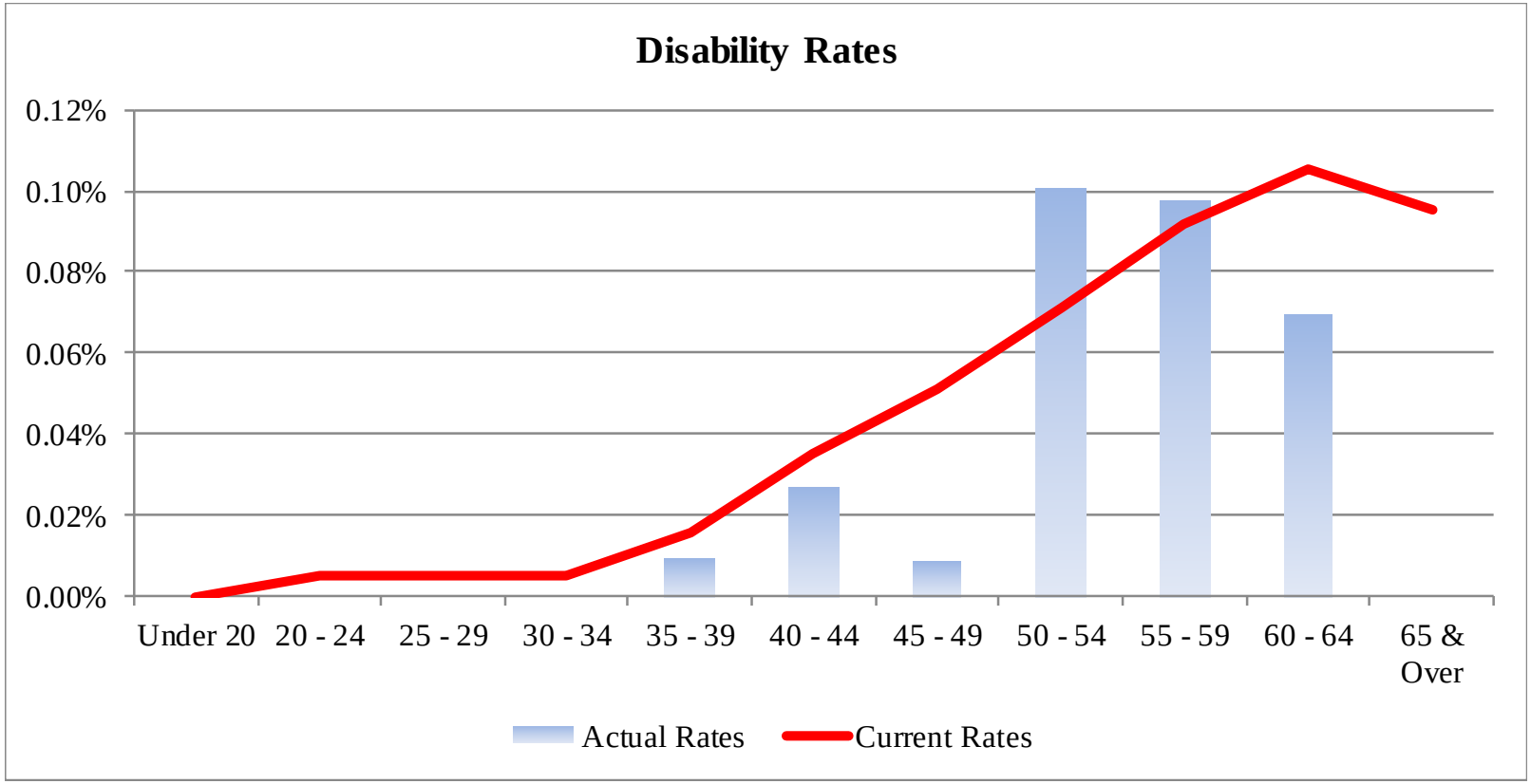


Demographic Assumptions (Withdrawal Rates)

Demographic Assumptions (Disability Retirements)

- Experience yielded an actual/expected ratio of 78%.
- An actual/expected ratio that is less than 100% indicates that the number of disability retirements over the experience period was less than anticipated
- Disability retirements represent a small component of the Retirement System's obligation (35 total disability retirements occurred during the experience period)
- When combining experience from the last experience study the actual/expected ratio is 97%
- Recommend no change in this assumption

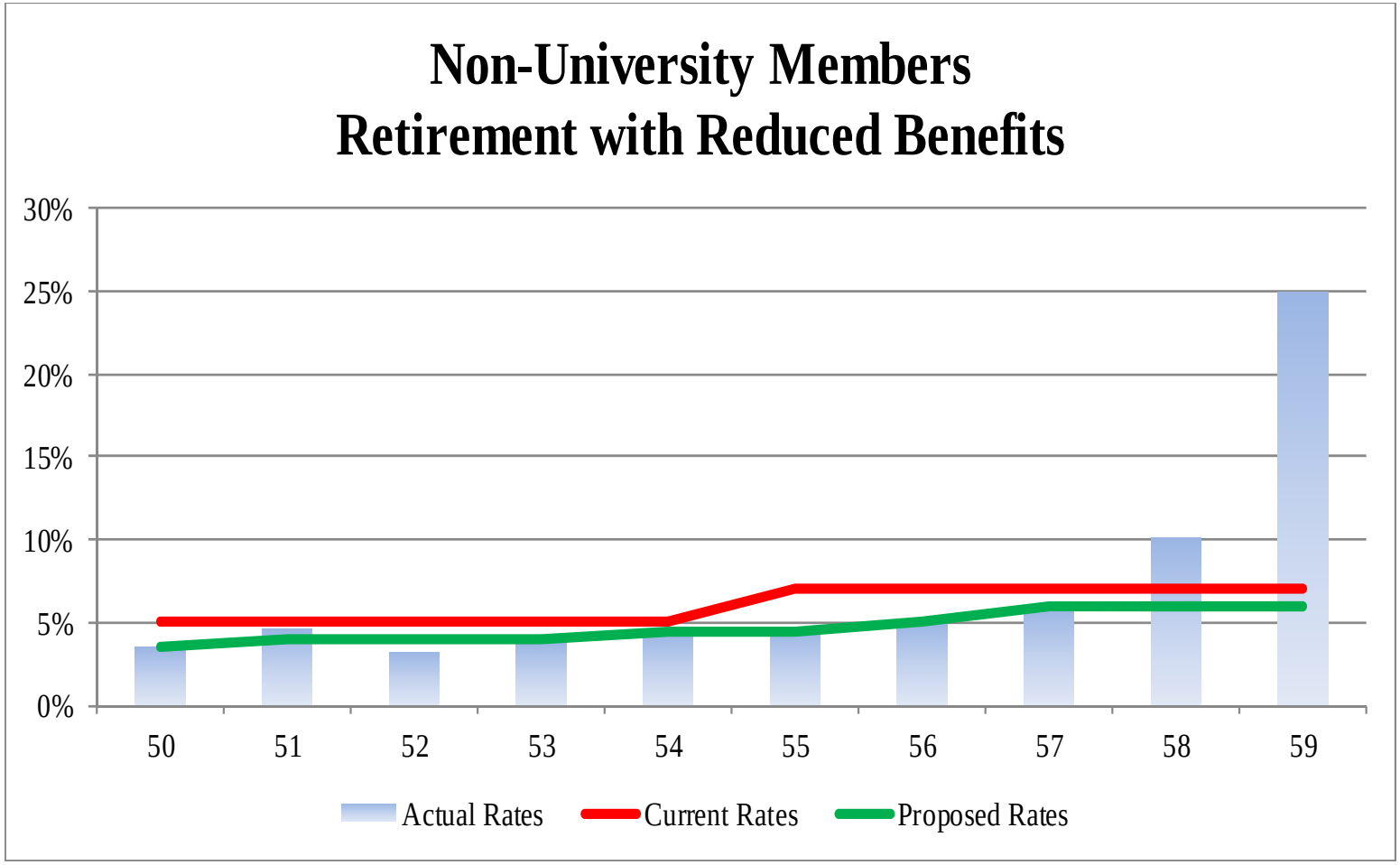
Demographic Assumptions (Disability Retirements)



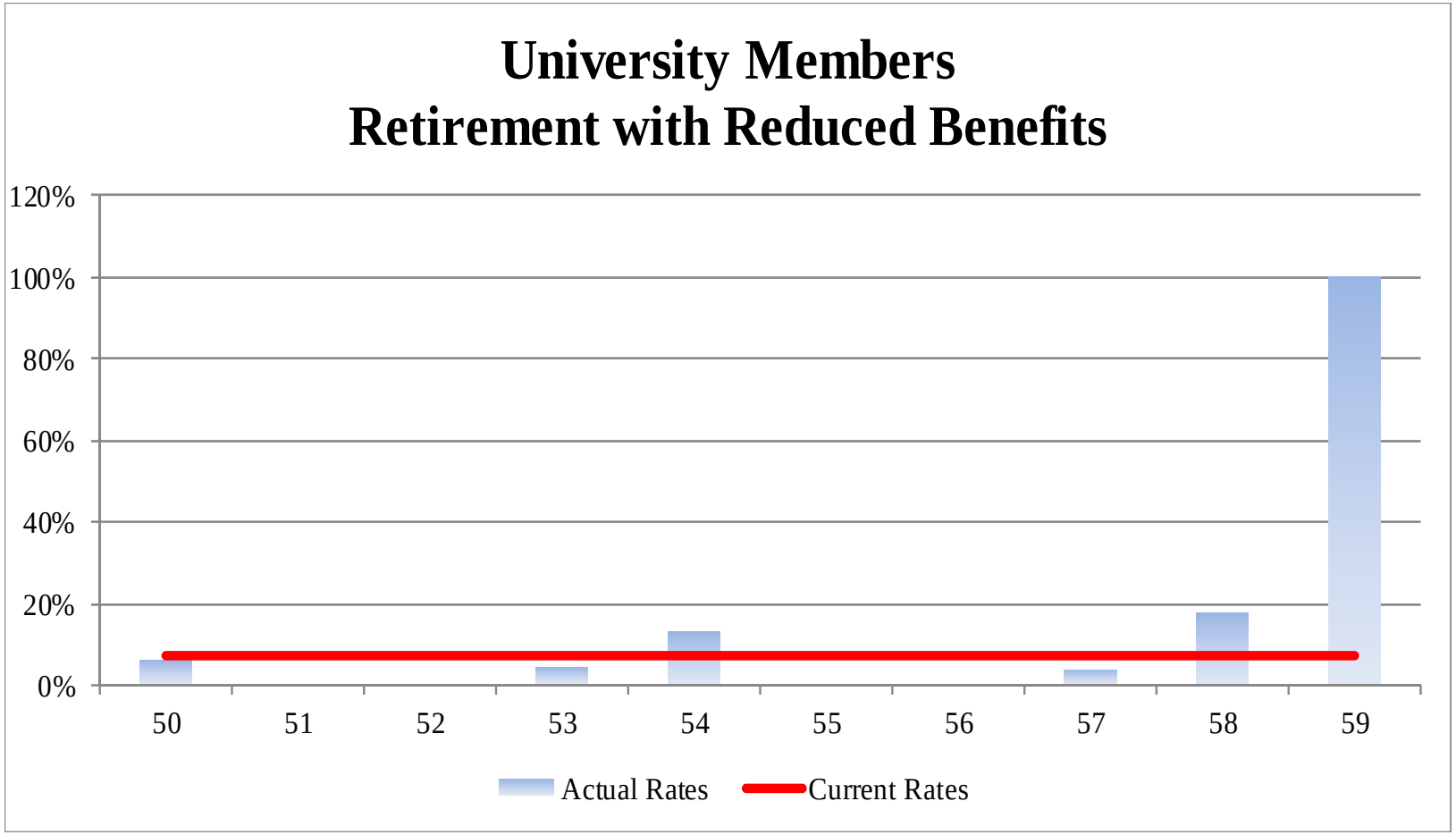
Demographic Assumptions (Service Retirements)

- Reduced retirement benefit
  - Experience yielded actual/expected ratios of 113% and 82% respectively for Non-University and University members
  - In general, non-university member retirements less than anticipated for ages 50 to 55 and more than anticipated for ages 56 to 59
  - Recommend updating current assumption for reduced retirement benefit eligibility for non-university members.
  - University members represent a small declining portion of the membership, therefore recommend no change to the current assumption

Demographic Assumptions (Service Retirements)



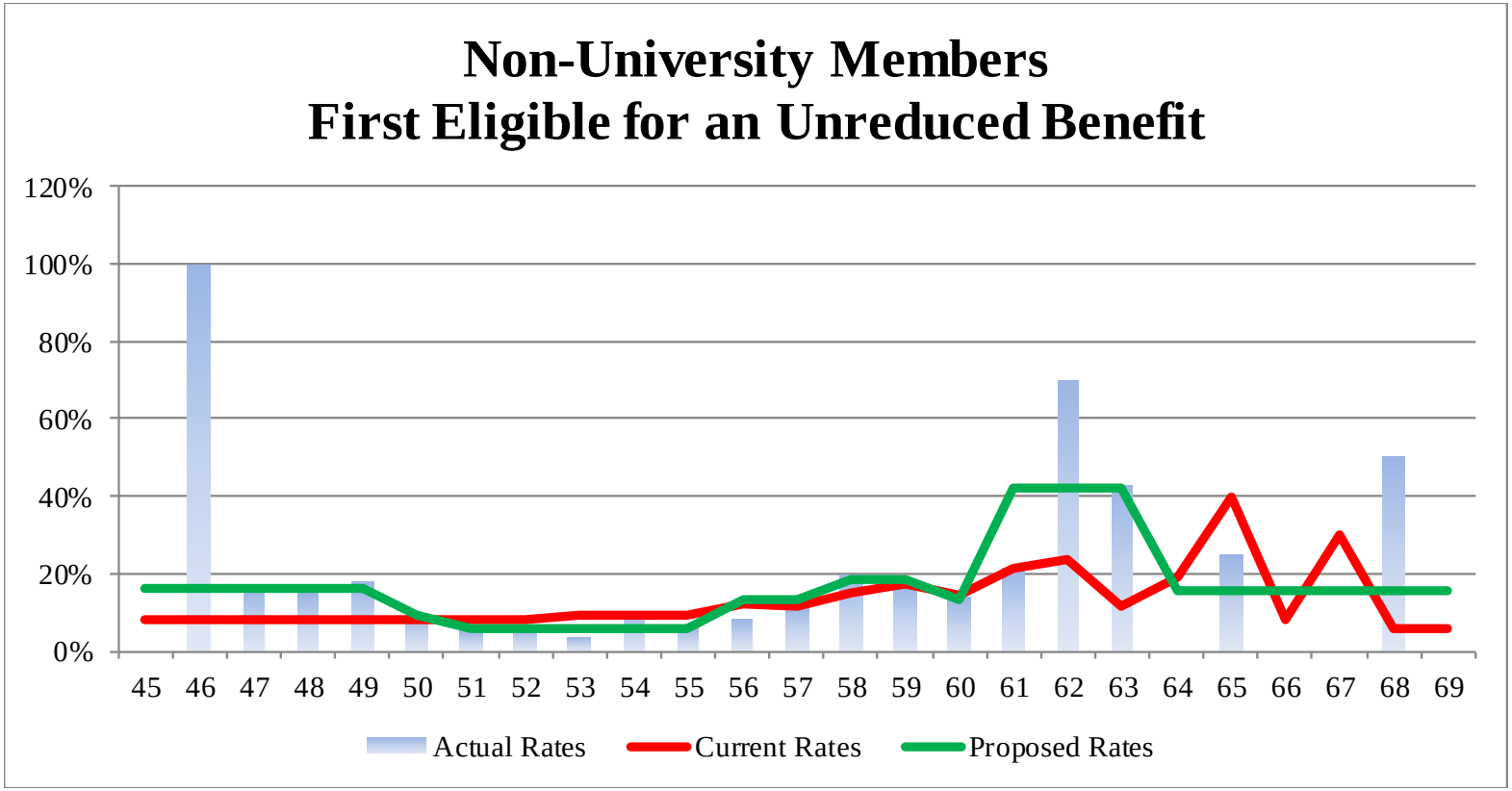
Demographic Assumptions (Service Retirements)



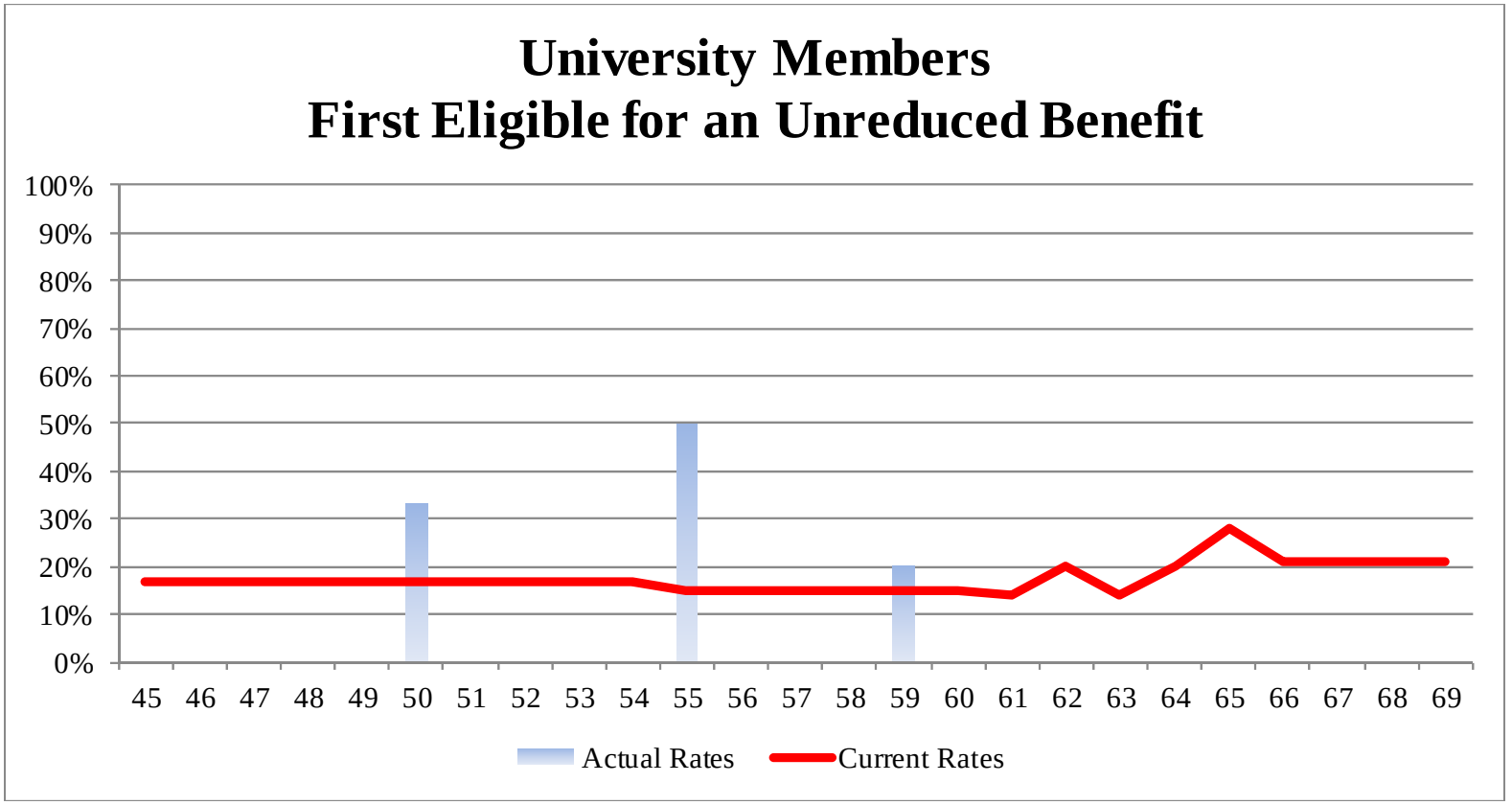
Demographic Assumptions (Service Retirements)

- First eligible for an unreduced retirement benefit
  - Experience yielded actual/expected ratios of 114% and 33% respectively for Non-University and University members
  - In general, there where more retirements than expected under age 50 and over age 60
  - Recommend updating current assumption for non-university members
  - University members represent a small declining portion of the membership, therefore recommend no change to the current assumption

Demographic Assumptions (Service Retirements)



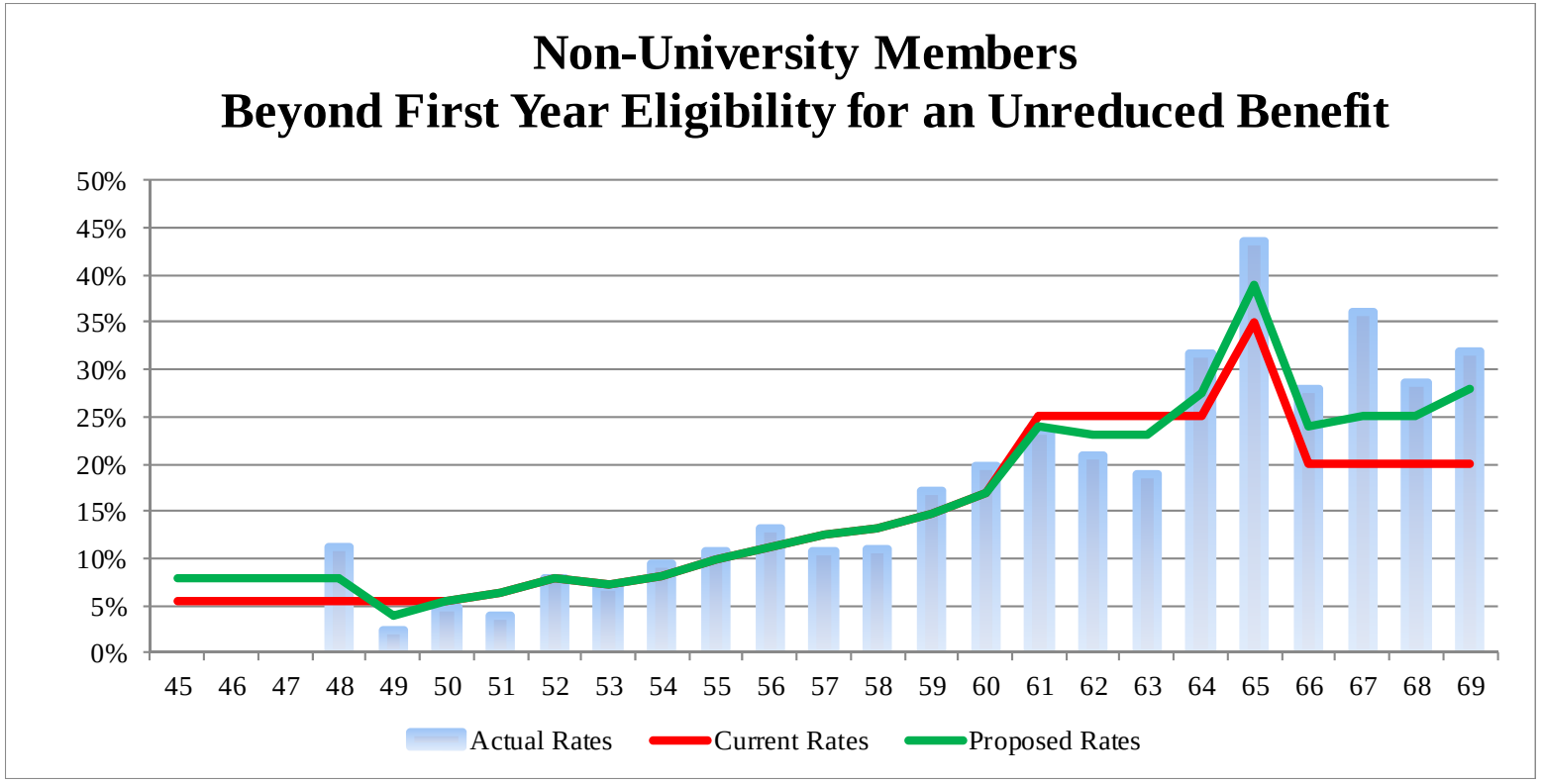
Demographic Assumptions (Service Retirements)



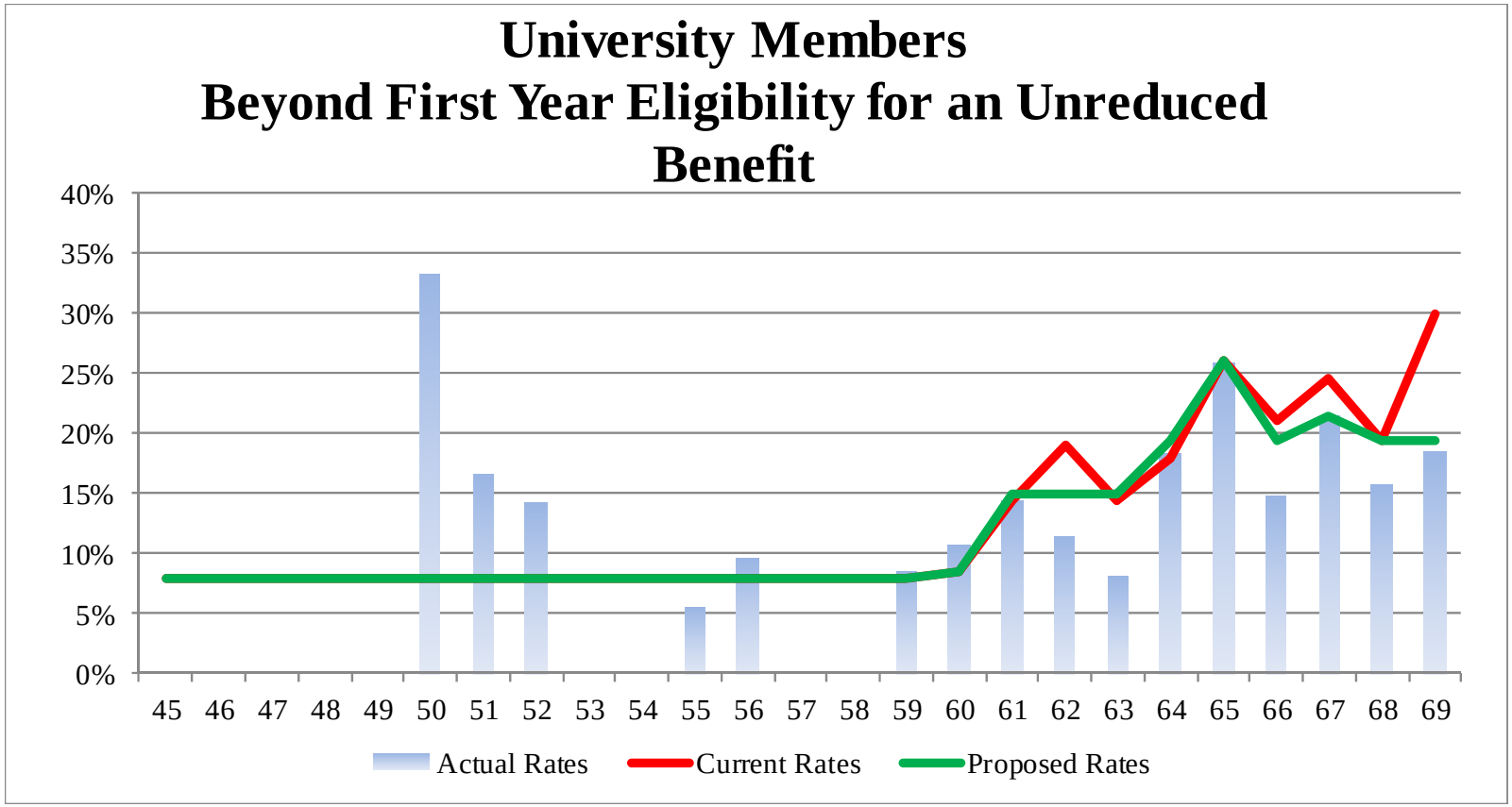
Demographic Assumptions (Service Retirements)

- Beyond first eligibility for an unreduced retirement benefit
  - Experience yielded actual/expected ratios of 102% and 82% respectively for Non-University and University members
  - Retirements for non-university members were greater than expected under age 50 and over age 60
  - Retirements for University members for ages 60 and over where less than assumed
  - Recommend updating current assumption for both non-university and university members

Demographic Assumptions (Service Retirements)



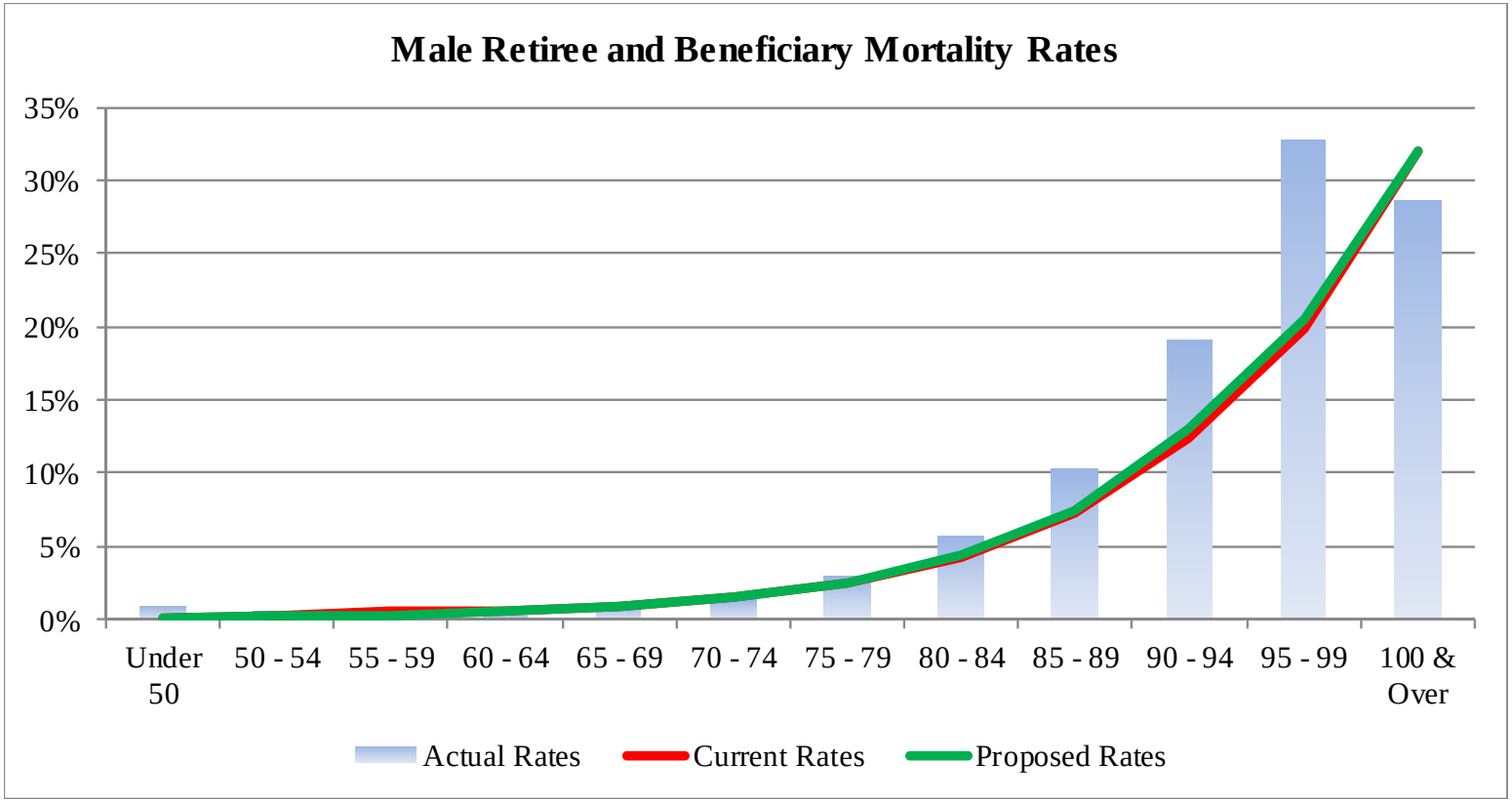
Demographic Assumptions (Service Retirements)



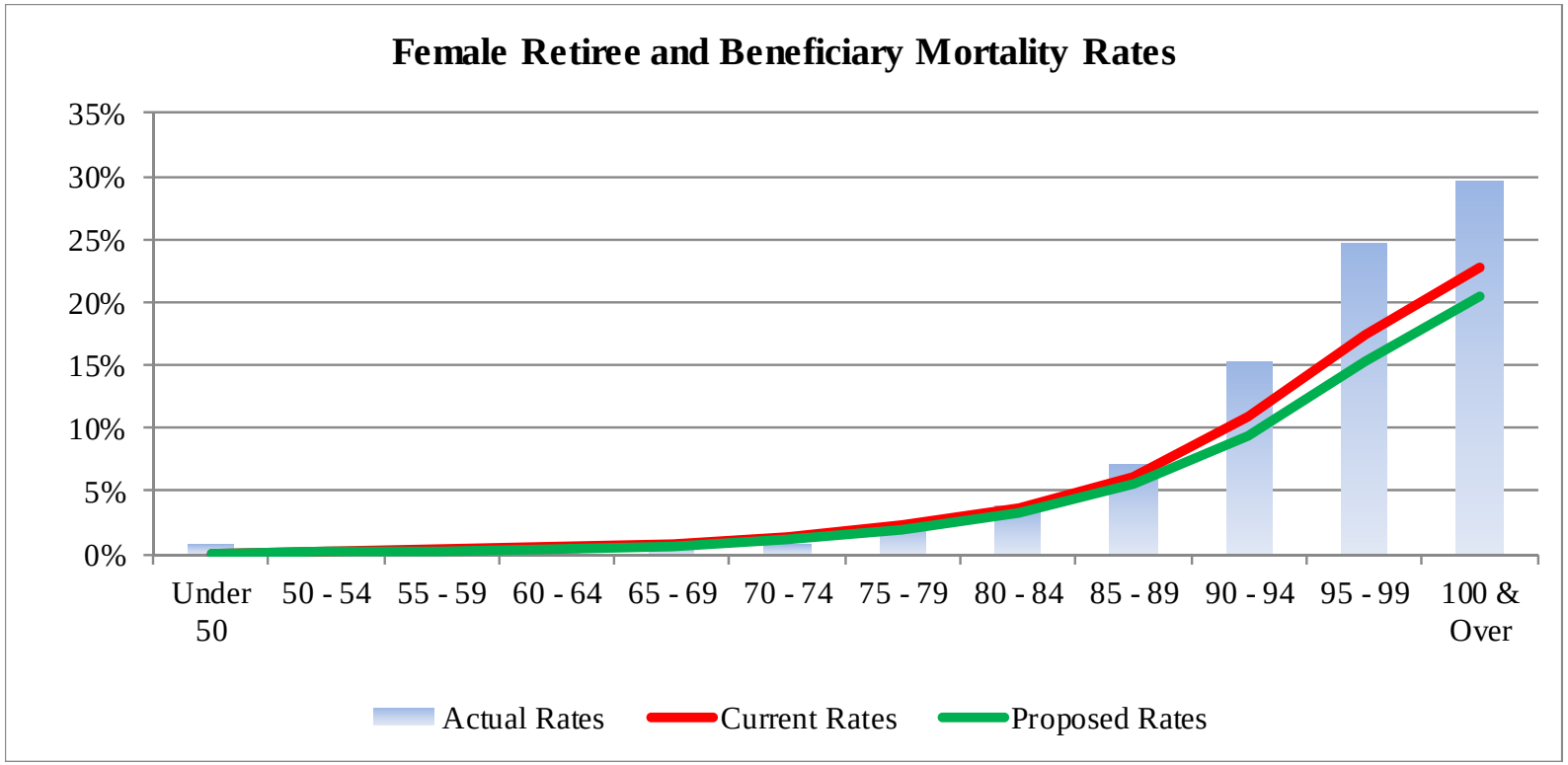
Demographic Assumptions (Healthy Mortality)

- Experience yielded actual/expected ratios of 123% and 106% respectively for healthy male and female mortality experience
- Mortality table assumption must provide a margin for mortality improvement which is indicated by an actual/expected ratio greater than 100%
- Recommend change in healthy mortality to the RP-2000 Healthy Combined Mortality Table projected to 2022 adjusted for partial credibility setback for two years for both males and females
- Actual/expected ratio under proposed assumption is 122% and 122% for males and females respectively provides a significant margin for improvement
- Active mortality experience is not credible to develop a unique mortality assumption, therefore active mortality follows the same assumption as the healthy post-retirement mortality assumptions.

Demographic Assumptions (Healthy Mortality)



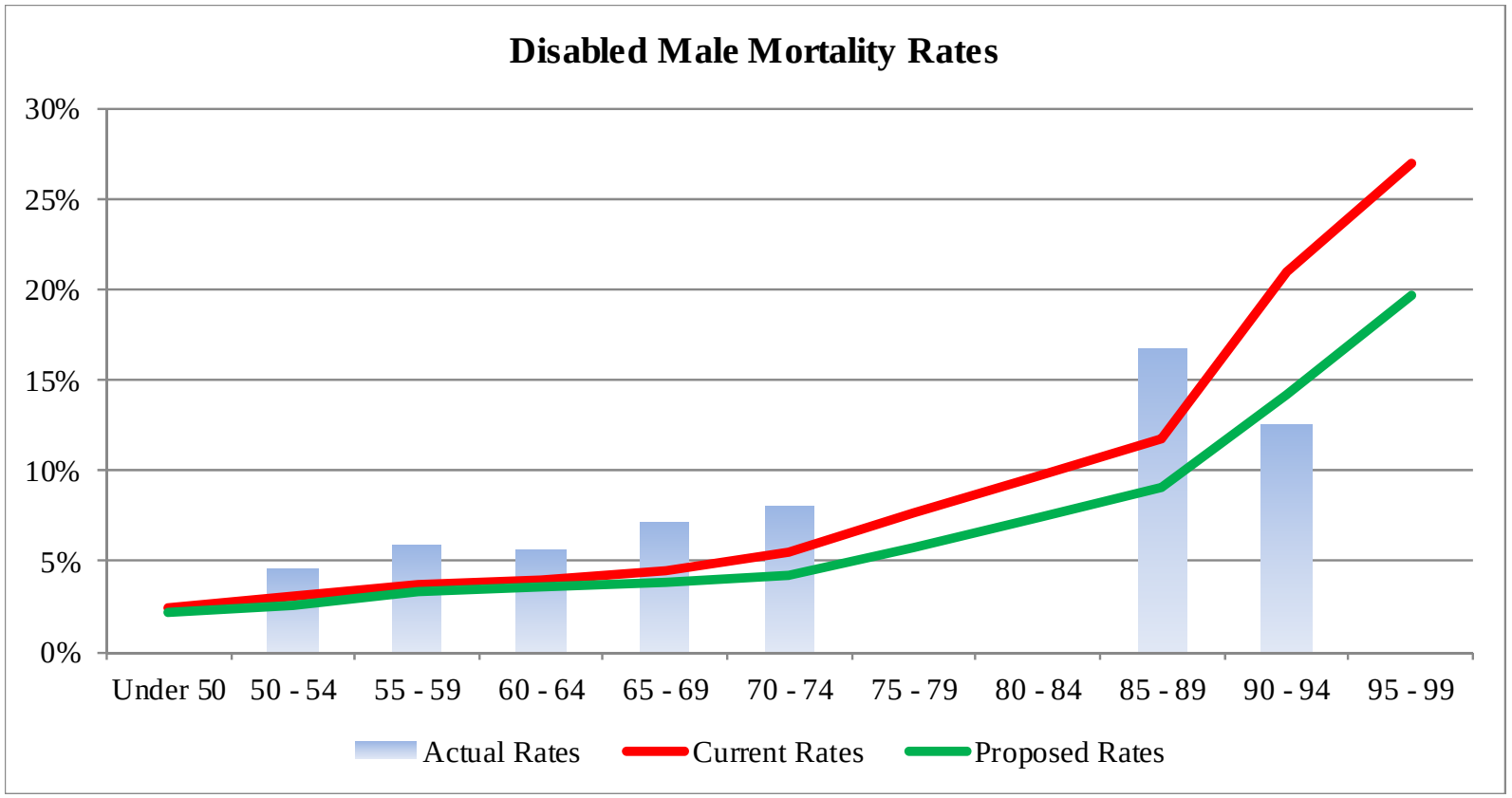
Demographic Assumptions (Healthy Mortality)



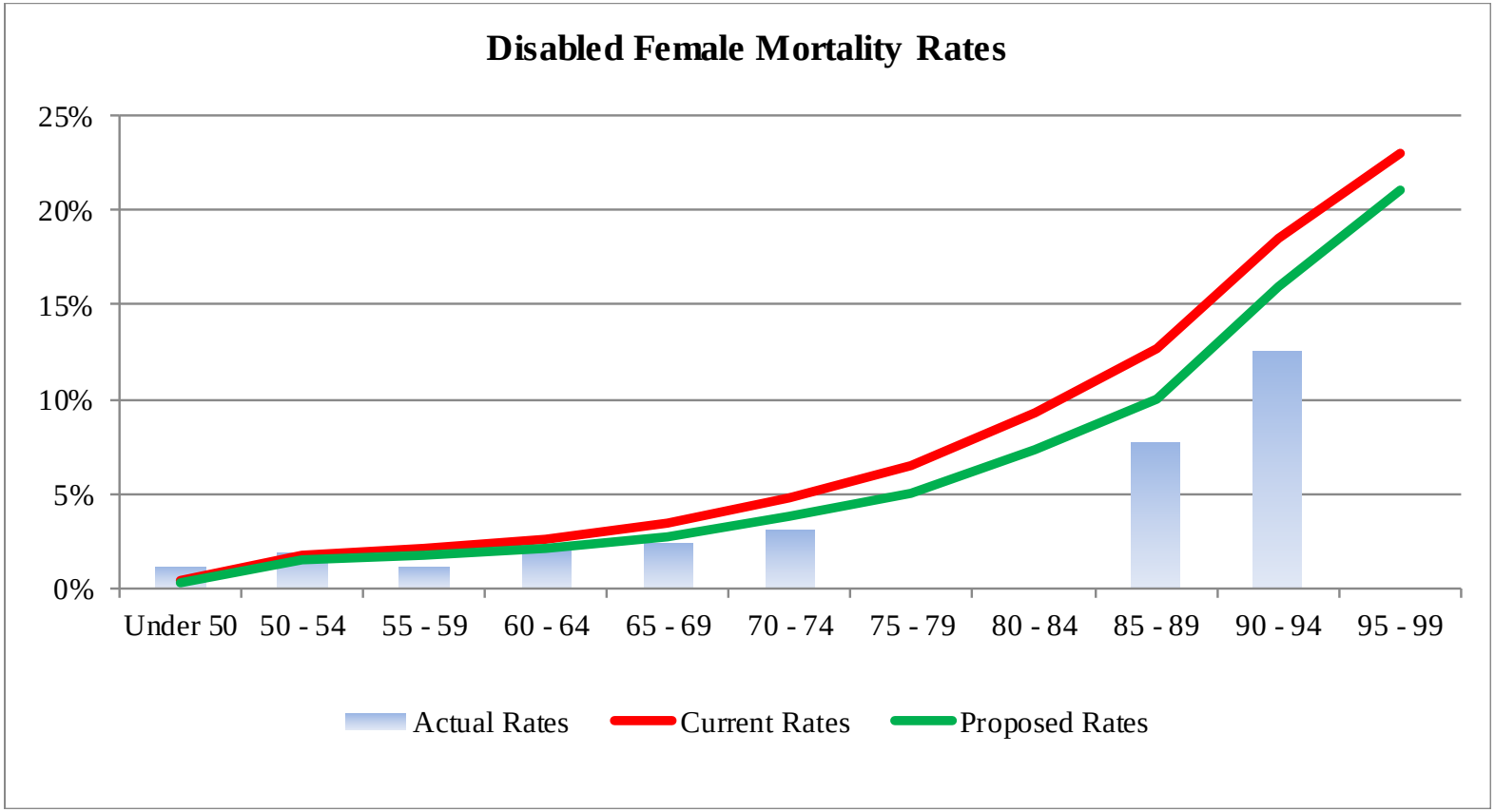
Demographic Assumptions (Disabled Mortality)

- Experience yielded actual/expected ratios of 88% and 89% respectively for disabled male and female mortality experience
- Recommend change to the RP-2000 Disabled Mortality Table projected to 2022 using the BB projection scale, set back 3 years for males and set forward 2 years for females to maintain consistency with healthy mortality assumptions
- Actual/expected ratios under proposed assumption is 111% for both disabled males and females

Demographic Assumptions (Disabled Mortality)



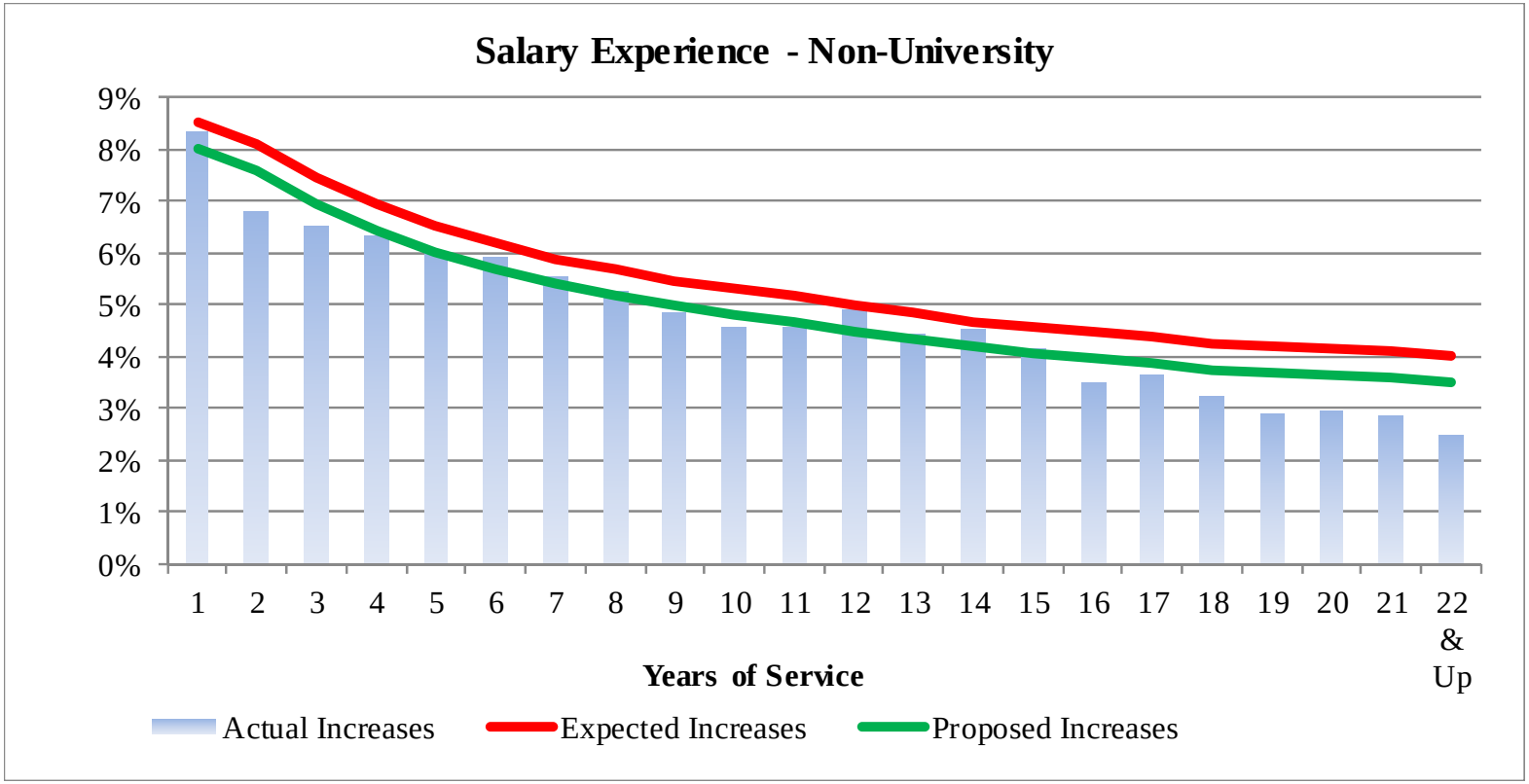
Demographic Assumptions (Disabled Mortality)



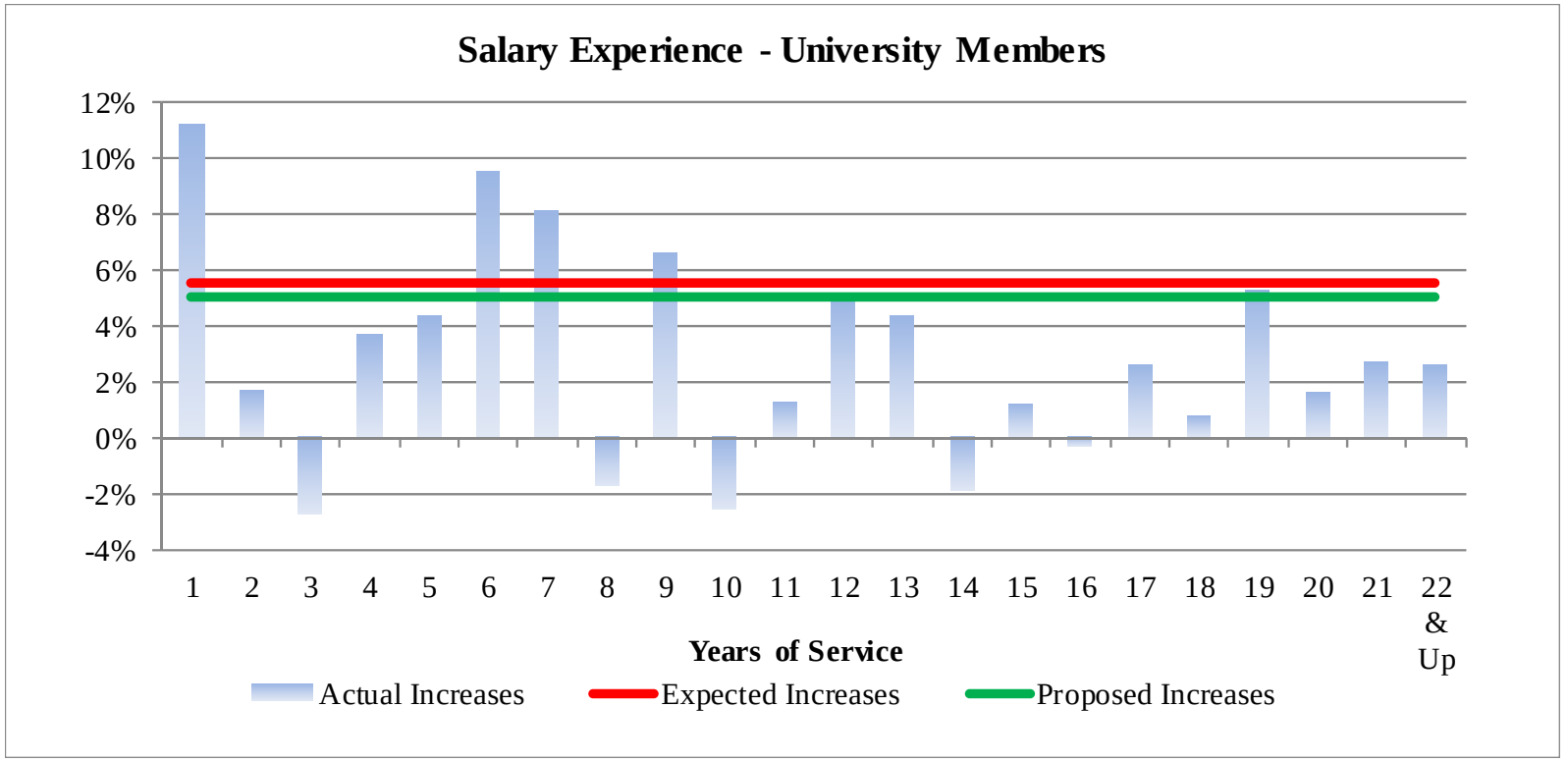
Demographic Assumptions (Salary Increase Experience)

- Salary increases were less than expected for the investigation period.
- This is primarily due to low wage growth during the experience period
- As a result, no changes to the merit component of the salary scales are recommended at this time.
- The decrease in real wage growth assumption (covered later) was reflected in the final salary scales.

Demographic Assumptions (Salary Increase Experience)



Demographic Assumptions (Salary Increase Experience)



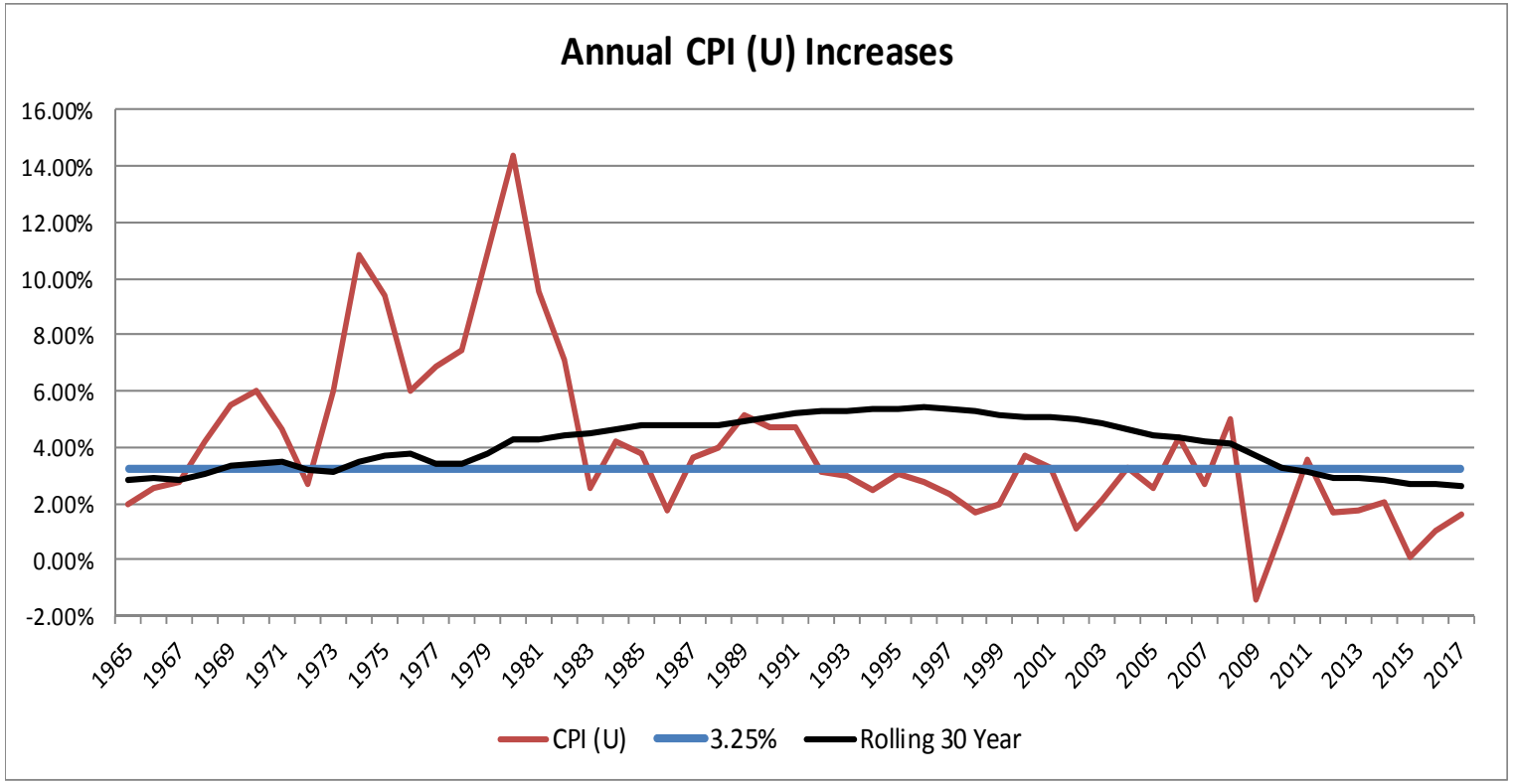
Economic Assumptions

- Assumptions reviewed
  - Price inflation
  - Investment return
  - Wage inflation
- Actuarial Standard of Practice (ASOP) No. 27, *"Selection of Economic Assumptions for Measuring Pension Obligations"* provides guidance to actuaries in selecting economic assumptions for measuring obligations under defined benefit plans.
- Recommendations

Item	Current	Proposed
Price Inflation	3.25%	2.50%
Real Rate of Return	4.50%	5.00%
Investment Return	7.75%	7.50%
Price Inflation	3.25%	2.50%
Real Wage Growth	0.75%	0.75%
Wage Inflation	4.00%	3.25%

Economic Assumptions
Price Inflation

- Current assumption: 3.25%
- Historical data: Annual CPI (U) Increases



Economic Assumptions
Price Inflation

- Historical data: Annual CPI (U) Increases

Period	Average Annual Rate of Inflation
2007 – 2017	1.63%
1997 – 2017	2.14%
1987 – 2017	2.60%
1977 – 2017	3.55%
1967 – 2017	4.07%
1957 – 2017	3.67%
1926 – 2017	2.91%

Economic Assumptions
Price Inflation

- Bond Market Expectation of Inflation

Years to Maturity	Bond Nominal Yield	TIPS Nominal Yield	Breakeven Rate of Inflation
10	2.32%	0.55%	1.77%
20	2.65%	0.84%	1.82%
30	2.88%	1.01%	1.88%

Economic Assumptions
Price Inflation

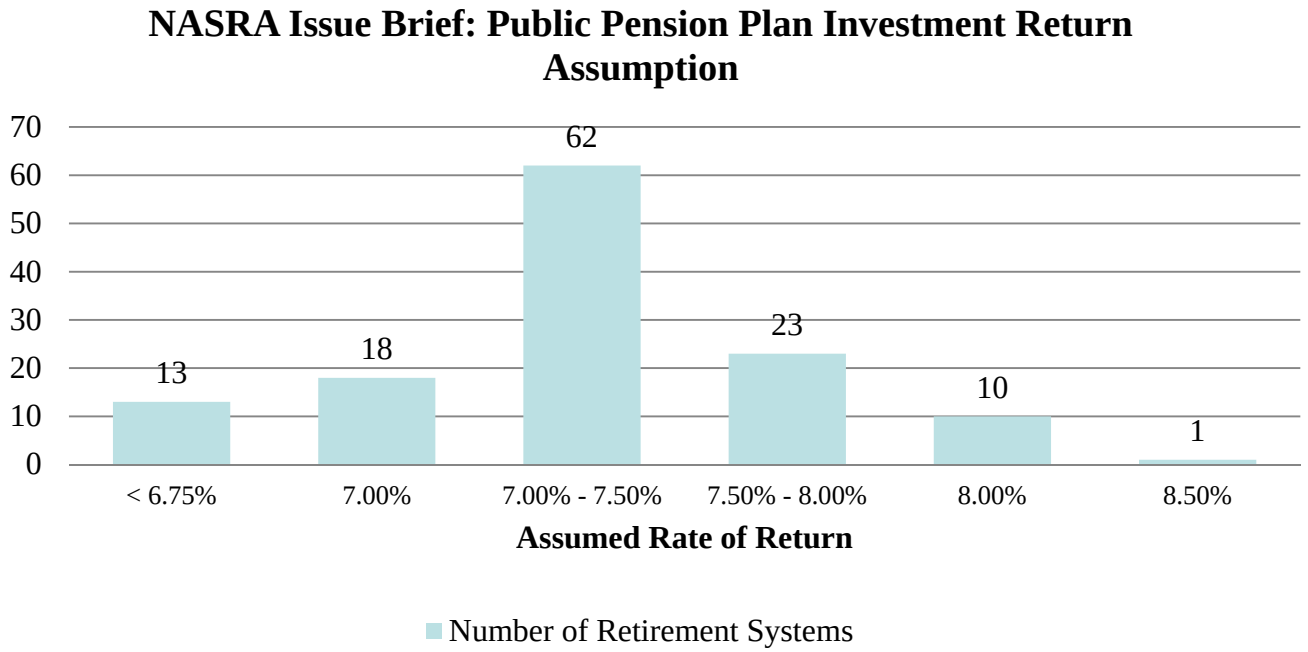
- Recommendation:

Price Inflation Assumption	
Current	3.25%
Reasonable Range	2.00% - 3.00%
Recommended	2.50%

Economic Assumptions
Investment Return

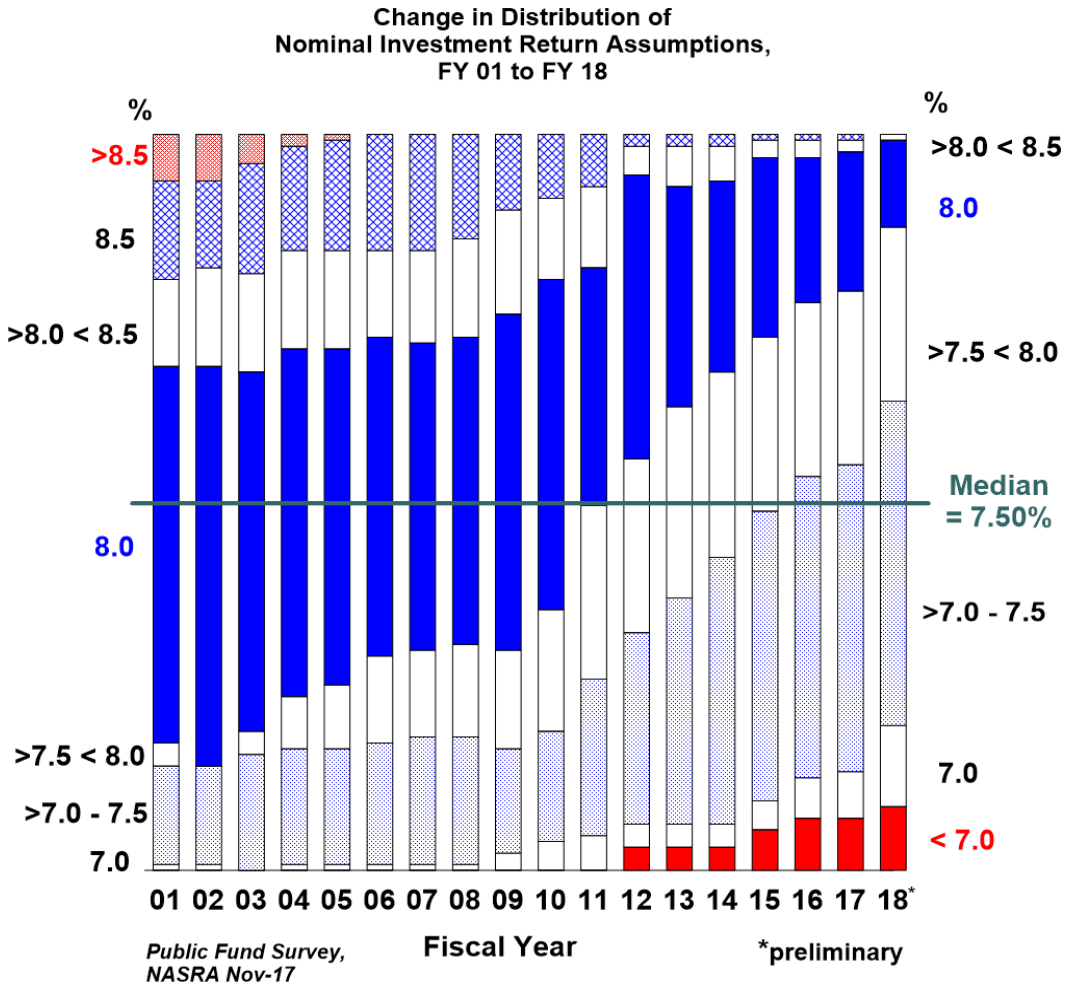
- Current Assumption
  - Price inflation 3.25%
  - Real rate of return 4.50%
  - Total return (net of investment) 7.75%

Economic Assumptions
Investment Return



The average assumed rate of return among Public Retirement Systems is 7.32% according to the February 2018 NASRA Issue Brief: "Public Pension Plan Investment Return Assumptions"

Economic Assumptions
Investment Return



Economic Assumptions
Investment Return

- Recent Experience

Nominal Total Rate of Return					
Year Ending 6/30	Market Value	Actuarial Value	Year Ending 6/30	Market Value	Actuarial Value
2000	7.8%	12.8%	2009	(20.8)%	(10.3)%
2001	(5.1)%	9.2%	2010	12.9%	9.8%
2002	(7.3)%	3.8%	2011	21.7%	(0.1)%
2003	6.2%	1.6%	2012	2.2%	3.2%
2004	13.3%	2.1%	2013	12.9%	12.0%
2005	8.0%	2.7%	2014	17.1%	13.2%
2006	8.9%	8.5%	2015	4.6%	9.6%
2007	17.6%	10.2%	2016	2.1%	8.8%
2008	(4.9)%	7.2%	2017	11.9%	8.2%

Economic Assumptions
Investment Return

- Recent Experience

Nominal Total Rate of Return		
Year Ending 6/30	Market Value	Actuarial Value
Average	**5.9%**	**6.4%**
15 Year Avg.	**7.1%**	**5.6%**
10 Year Avg.	**5.3%**	**5.9%**
5 Year Avg.	**9.6%**	**10.3%**

Economic Assumptions
Investment Return

- Stochastic projection expected range of real rates of return, net of expenses (RVK)

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	4.35%	12.95%	(15.51)%	(4.74)%	3.55%	12.56%	26.91%
5	3.71%	5.74%	(5.45)%	(0.24)%	3.55%	7.49%	13.41%
10	3.63%	4.05%	(2.90)%	0.86%	3.55%	6.32%	10.43%
20	3.59%	2.86%	**(1.05)%**	1.64%	3.55%	5.50%	8.37%
30	3.58%	2.34%	(0.22)%	1.99%	3.55%	5.14%	7.47%
50	3.57%	1.81%	0.61%	**2.34%**	3.55%	**4.78%**	6.57%

- Based on current capital market assumptions and policy target asset allocation.

Economic Assumptions
Investment Return

- Stochastic projection expected range of real rates of return, net of expenses (Horizon Survey)

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	5.72%	11.74%	(12.42)%	(2.49)%	5.07%	13.22%	26.06%
5	5.20%	5.21%	(3.15)%	1.62%	5.07%	8.64%	13.99%
10	5.14%	3.68%	(0.81)%	2.62%	5.07%	7.58%	11.30%
20	5.10%	2.60%	**0.88%**	3.33%	5.07%	6.84%	9.44%
30	5.09%	2.12%	1.64%	3.65%	5.07%	6.51%	8.62%
50	5.08%	1.65%	2.40%	**3.97%**	5.07%	**6.19%**	7.81%

Economic Assumptions
Investment Return

- Recommendation
  - ASOP No. 27 approach
  - Projection results – 50 years

Item	25th Percentile	50th Percentile	75th Percentile
Real Rate of Return	3.97%	5.07%	6.19%
Inflation	2.50%	2.50%	2.50%
Net Investment Return	6.47%	7.57%	8.69%

- Capital Market Assumptions are net of investment expense

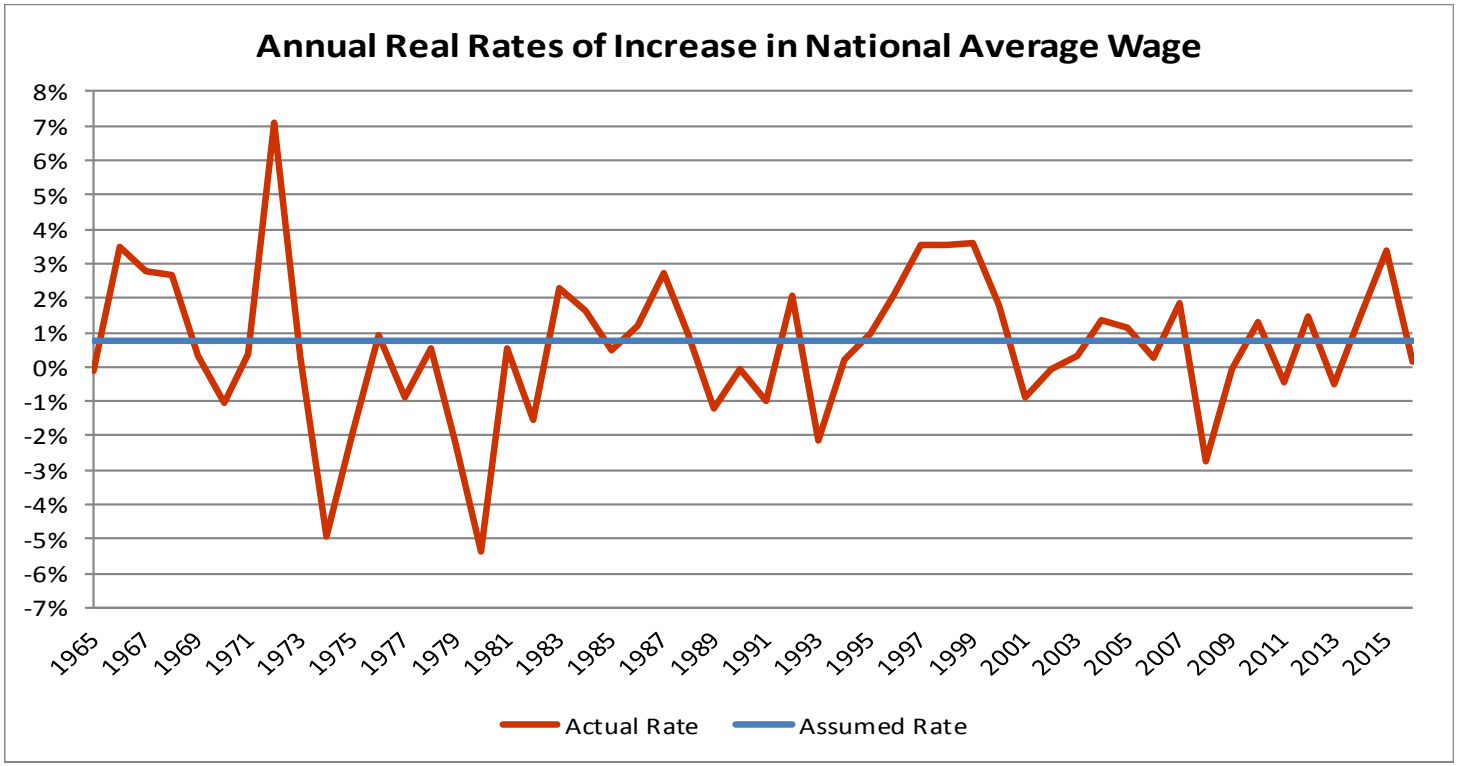
Economic Assumptions
Investment Return

- Recommend reducing the assumed rate of return from 7.75% to 7.50%

Investment Return Assumption	
Current	7.75%
Recommended	7.50%

Economic Assumptions
Wage Inflation

- Current assumption: 4.00%, which is 0.75% above prior price inflation assumption of 3.25%
- Social Security Administration data



Economic Assumptions
Wage Inflation

- Historical Experience

Period	Wage Inflation	Price Inflation	Real Wage Growth
2006-2016	2.33%	1.74%	0.58%
1996-2016	3.20	2.18	1.00
1986-2016	3.50	2.66	0.82
1976-2016	4.24	3.68	0.54
1966-2016	4.68	4.10	0.56

Economic Assumptions
Wage Inflation

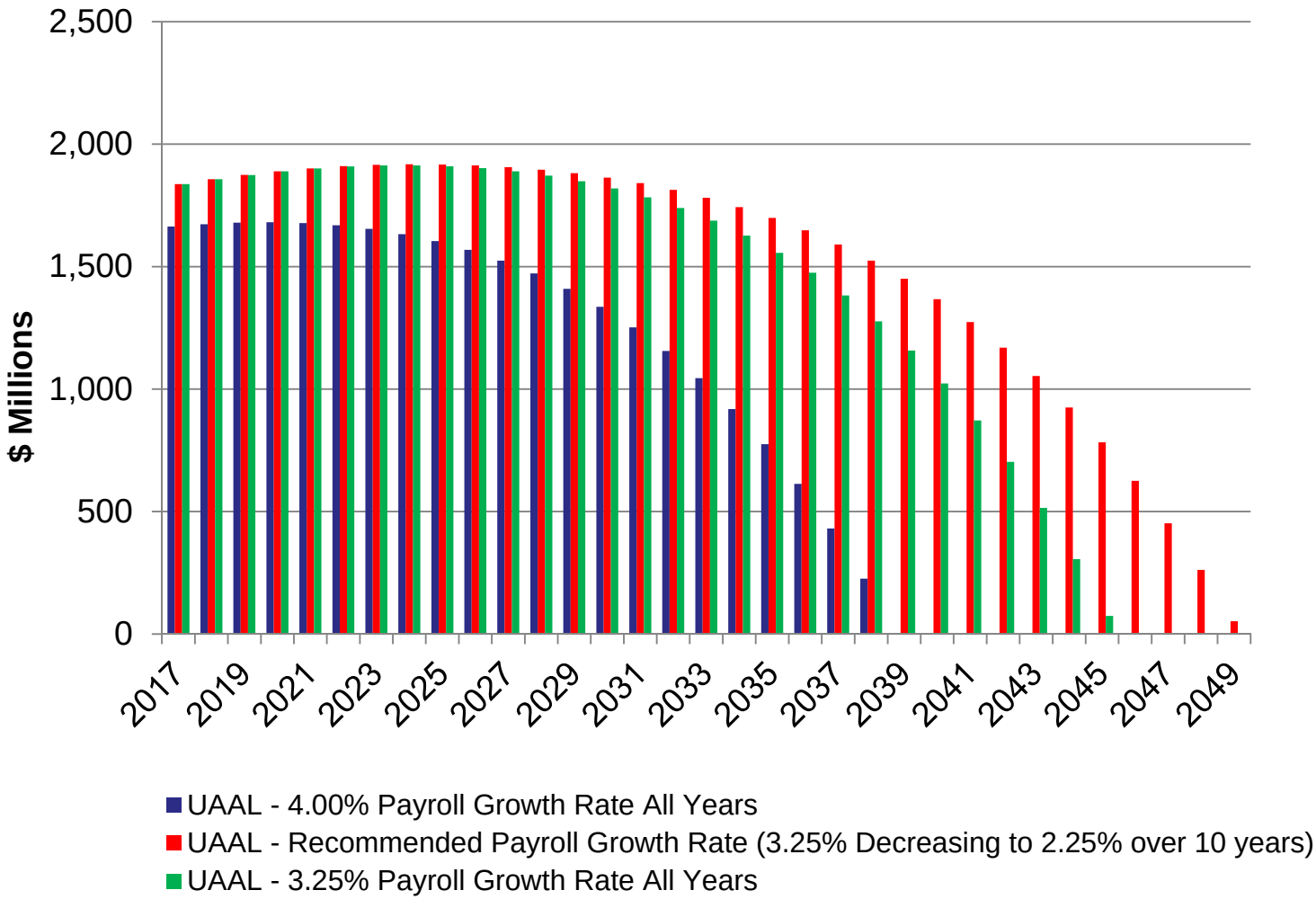
- Social Security 75 year projection of national wage growth assumption is 1.2% greater than price inflation.
- Recommendation

Wage Inflation Assumption		
Current	4.00%	
	Reasonable Range	
Real Wage Growth	0.50%	1.50%
Inflation	2.50%	2.50%
Total	3.00%	4.00%
Recommended	3.25%	

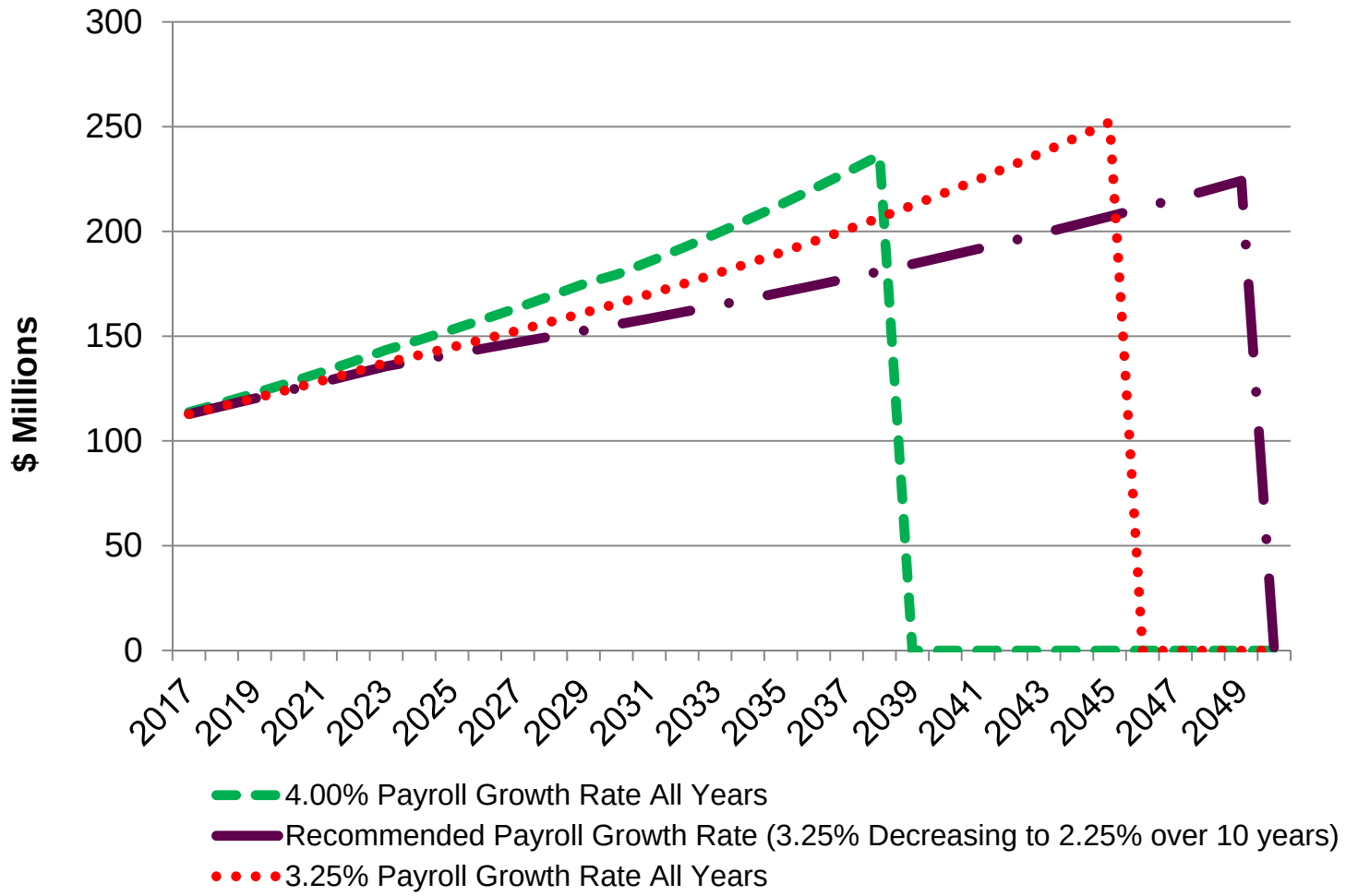
Payroll Growth Assumptions

- Method Changes
  - Since 2009 payroll growth has only averaged 2.25%
  - Decreased payroll growth assumption from 4.00% to 3.25% to be consistent with wage inflation assumption with a step down to 2.25%

Unfunded Actuarial Accrued Liability Balance



Amortization of Unfunded Actuarial Accrued Liability



Effective Amortization Period

- Actuarial valuations are on closed groups and do not take into account new hires
- Tier Two members have a lower normal cost rate
- As Tier One members terminate or retire and are replaced by a Tier Two member, more money will be available to amortize unfunded accrued liability
- This results in amortizing the unfunded actuarial accrued liability faster than what is determined by the valuation
- Effective amortization period is 31 years assuming recommended payroll growth assumption (3.25% decreasing 0.1% per year for 10 years, then remaining at 2.25%)
- Effective amortization period is 28 years assuming payroll growth assumption of 3.25% for all years

Effective Amortization Period

Year	(A) Payroll for Current Employees	(B) Payroll for Future Employees	(C) Total Payroll	(D) Total Rate	(E) UAAL Contributions for Current Employees	(F) UAAL Contributions for Future Employees	(A)x(E) + (B)x(F) UAL Contribution
2017	812,303,078	0	812,303,078	19.51%	9.33%	9.83%	75,787,877
2018	758,144,084	80,558,844	838,702,928	19.61%	9.43%	9.93%	79,492,480
2019	716,973,348	148,148,722	865,122,070	19.71%	9.53%	10.03%	83,186,877
2020	680,609,978	210,898,315	891,508,293	19.81%	9.63%	10.13%	86,906,740
2021	647,764,313	270,043,475	917,807,788	19.91%	9.73%	10.23%	90,652,915
2022	617,304,014	326,661,296	943,965,310	20.01%	9.83%	10.33%	94,425,096
2023	589,251,199	380,673,157	969,924,356	20.11%	9.93%	10.43%	98,216,854
2024	562,965,469	432,661,882	995,627,351	20.11%	9.93%	10.43%	101,029,105
2025	537,821,431	483,194,418	1,021,015,849	20.11%	9.93%	10.43%	103,802,846

Impact of Recommendations

	Valuation July 1, 2017	Demographic Assumption Changes	Economic & Demographic Assumption Changes
Employer Contribution Rate:			
Normal Rate	1.67%	2.07%	1.70%
Admin. Expense Load	0.33%	0.33%	0.33%
UAAL	9.36%	8.96%	9.33%
Total Statutory Employer Rate	11.36%	11.36%	11.36%
Actuarial Accrued Liabillity*	$5,636,842	$5,720,959	$5,810,410
Actuarial Value of Assets*	3,973,519	3,973,519	3,973,519
UAAL*	$1,663,323	$1,747,440	$1,836,891
Amortization Period	22	25	33

* In Thousands