

Employees Retirement System of the City of St. Louis



Actuarial Experience Study

April 28, 2020

Presented by

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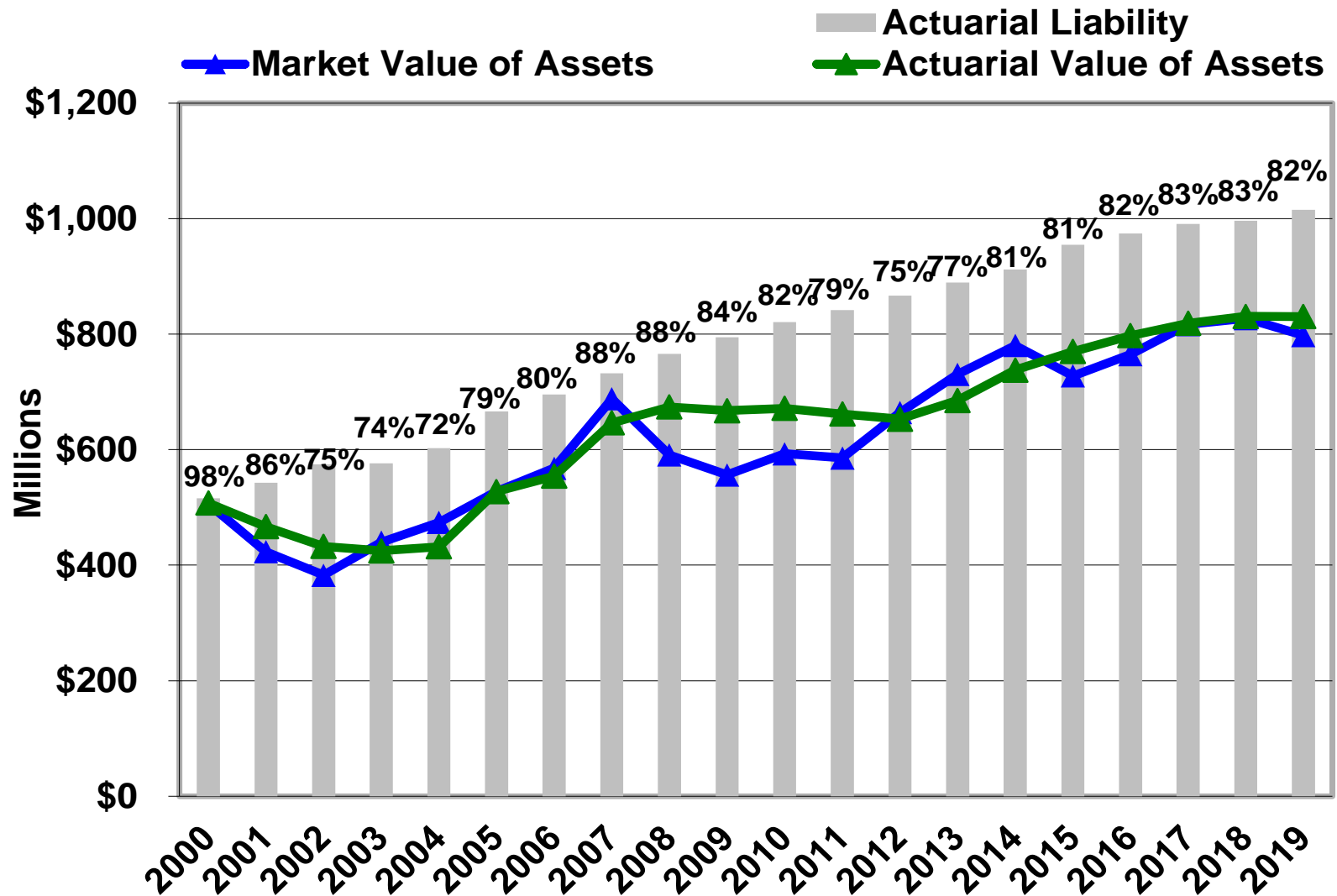
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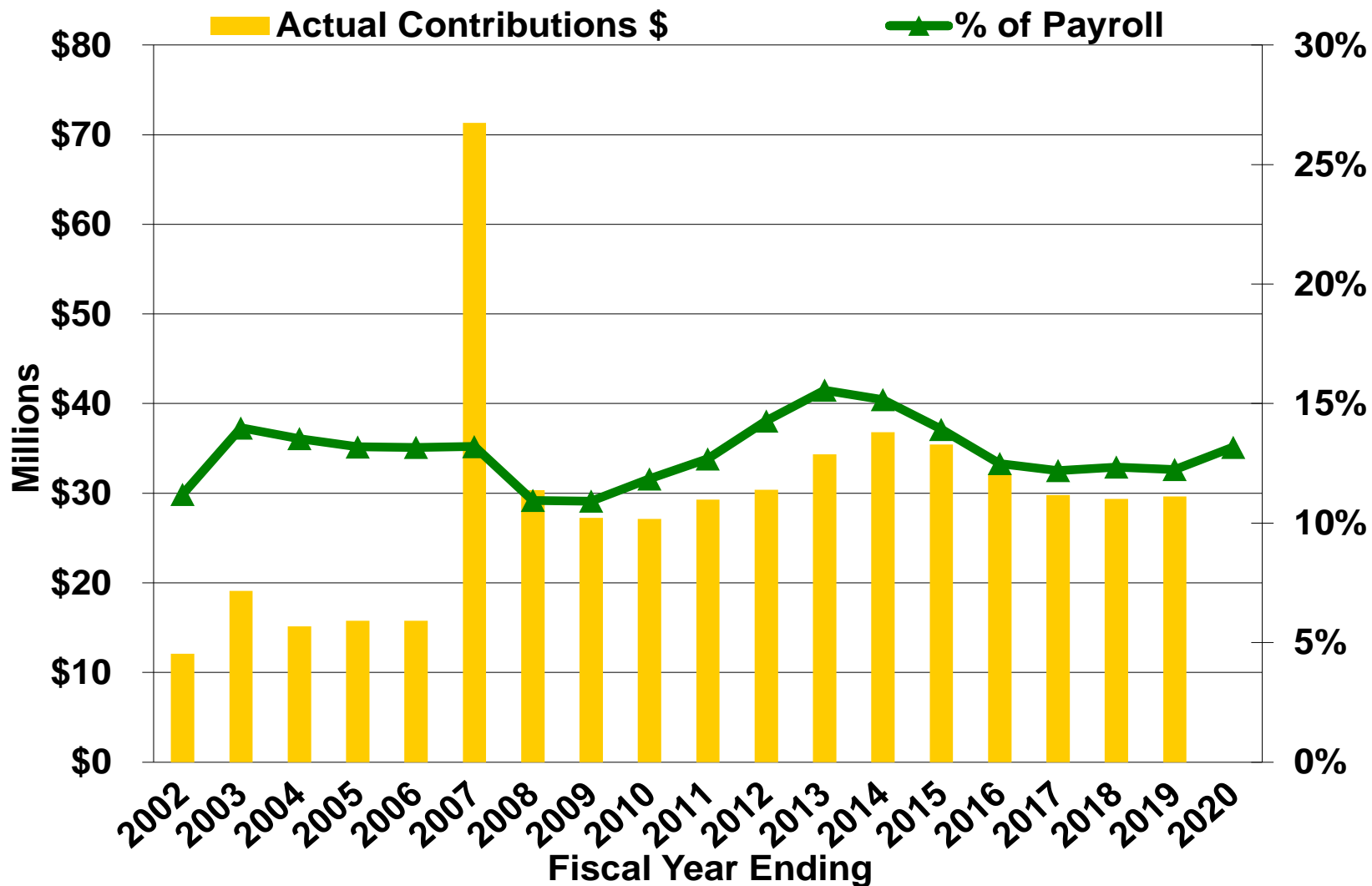


- Historical Review
- Summary of Recommendations
- Demographic Assumptions
- Economic Assumptions
- Actuarial Methods
- Cost Impact

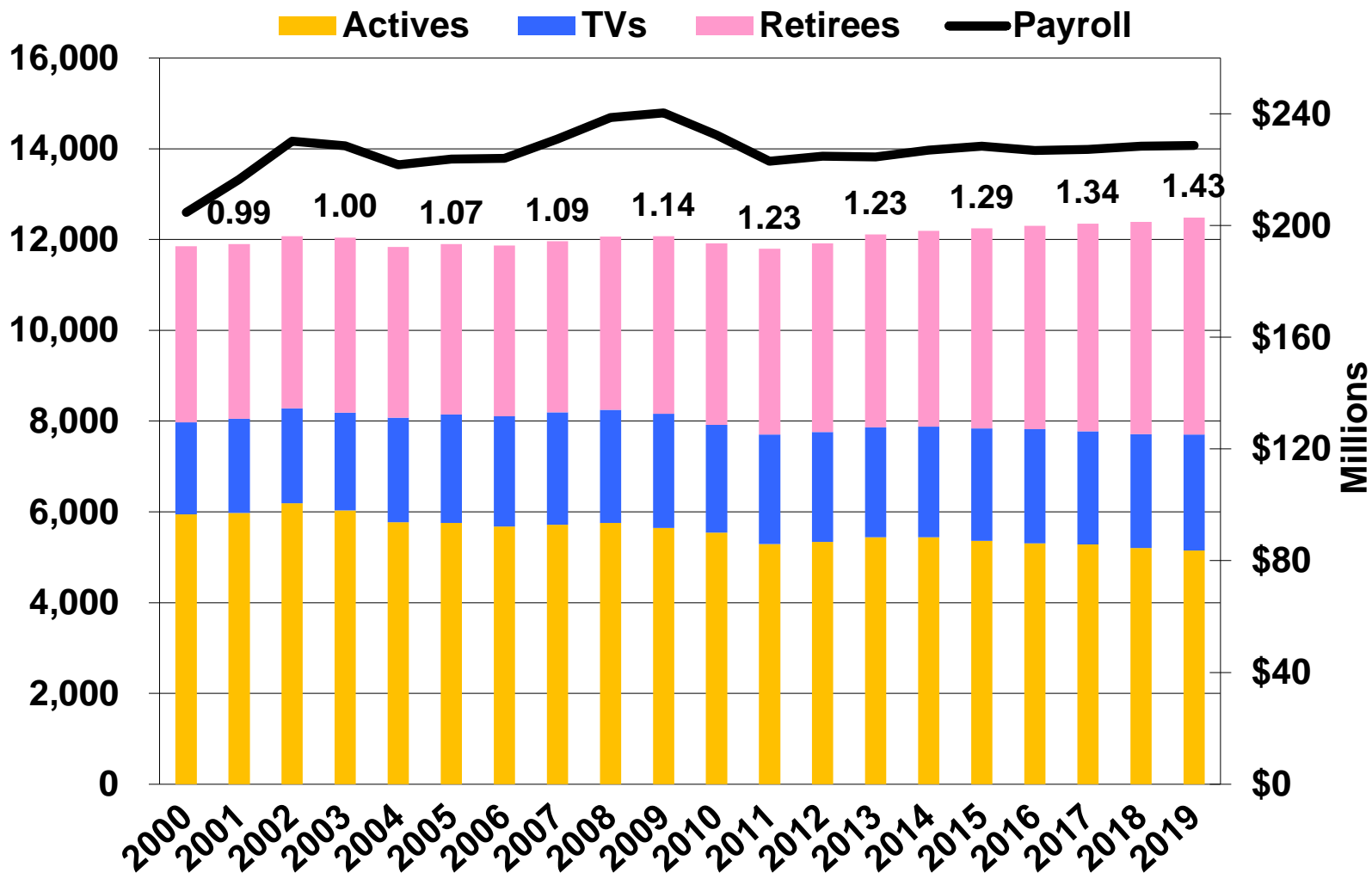
Asset and Liability Trends



Contribution Trends

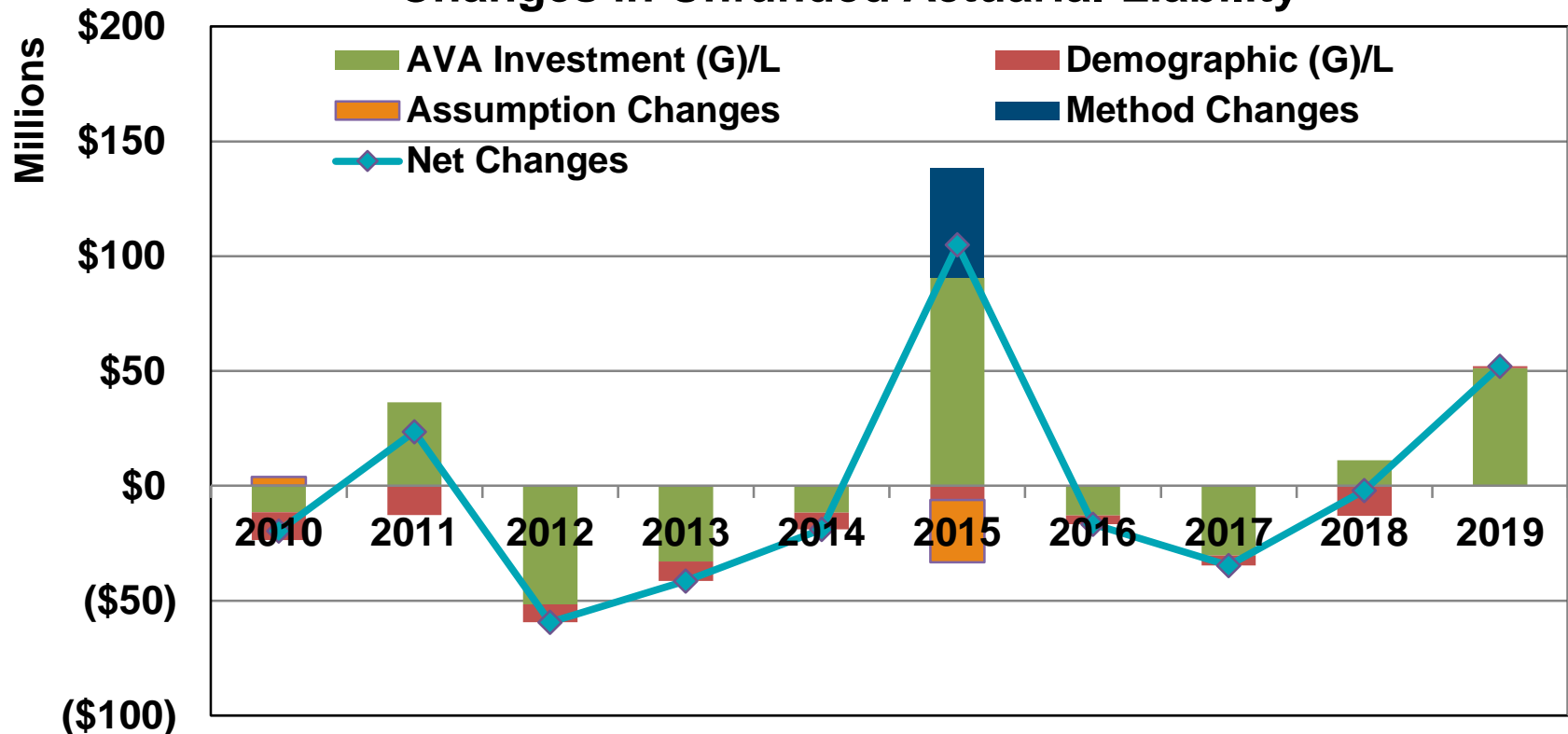


Participation Trends





Changes in Unfunded Actuarial Liability





- Demographic Assumptions
 - Mortality: Update to appropriate Pub-2010 tables with generational improvements
 - Disability: Adopt slightly modified tables that better reflect recent experience
 - Termination: Adopt modified tables with increased rates that better reflect recent experience
 - Retirement/DROP: Adopt modified separate retirement and DROP assumptions



- Economic Assumptions
 - Inflation: Remain at 2.5%
 - Wage growth: Reduce from 3.0% to 2.5%
 - Salary scale: Modify service-based rates
 - Investment return: Discuss surveys and investment consultant inputs related to current assumption of 7.50%



Demographic Assumptions



- Actuarial assumptions are long-term in nature
 - Must be individually reasonable, as well as consistent in aggregate
- Cheiron has evaluated current demographic assumptions against experience over the past five years
 - Actual/Expected (A/E) ratio gives a sense of how recent experience has matched assumption



- Last year the Society of Actuaries published a comprehensive set of public sector mortality tables
 - Separate tables by job classification
 - General (PubG-2010)
 - Public Safety (PubS-2010)
 - Teachers (PubT-2010)
 - In general, life expectancies for teachers are longer than general employees, and life expectancies for public safety are shorter than general employees
 - Tables for each status – Active, Retiree, Disabled, Contingent Survivor
 - Separate tables for median, above median and below median income levels



- Process in selecting a mortality table
 - Select a standard mortality table that is, based on experience, most closely matching the anticipated experience of ERS
 - Compare actual ERS experience to what would have been predicted by the selected standard table for the period of the experience study
 - Adjust the standard table depending on the level of credibility for ERS



- Mortality rates for should be modified to introduce anticipated future improvements in mortality according to ASOP No. 35
 - Current mortality improvement scale AA was published by the Society of Actuaries (SOA) in 1995 based on experience from 1977 to 1993 with factors varying only by attained age
 - In 2014, SOA introduced scale MP-2014 based upon mortality data through 2009
 - Factors vary both by age and by year of birth
 - SOA updates the factors every year with the most recent table being MP-2019

Mortality Assumptions



- Current Assumptions:

- Generational mortality improvements using Scale AA

- Healthy Retirees and Employees: RP2000 Combined Healthy Tables with 3-year set-forward
 - Disabled Retirees: RP2000 Combined Disabled Tables with 3-year set-forward

- Proposed Assumptions:

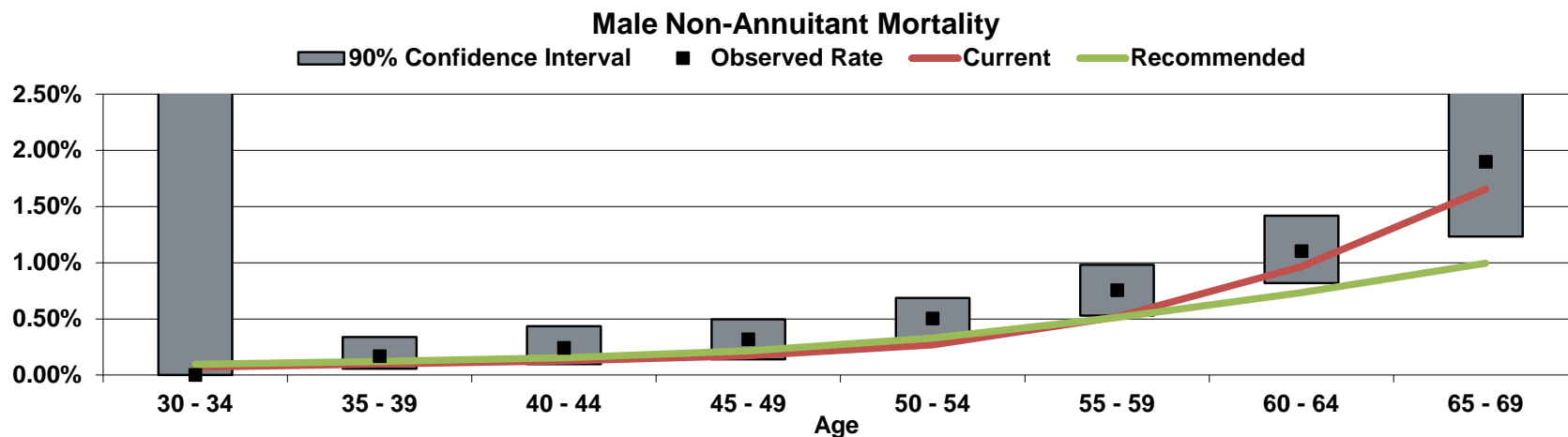
- Generational mortality improvements using MP-2019 projection scale

- Healthy Employees: Pub-2010 General Employee Below-Median Income Weighted mortality table with a 135% adjustment for males and 155% adjustment for females
 - Healthy Retirees: Pub-2010 General Healthy Retiree Below-Median Income Weighted mortality table with a 125% adjustment for males and 120% adjustment for females
 - Disabled Retirees: Pub-2010 Non-Safety Disabled Retiree mortality table with a 120% adjustment for males and 110% adjustment for females

Healthy Employee Mortality - Male



- Recommend updated generational table
 - PubG-2010(B) Employee, 135% Adjustment

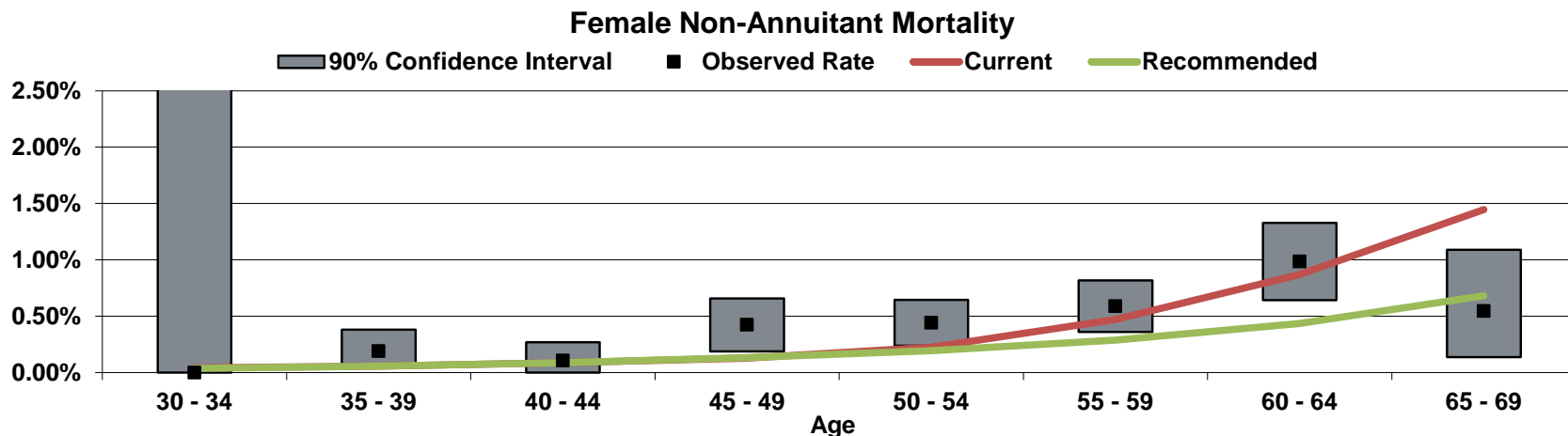


Non-Annuitant Mortality - Base Table for Males						
Age Band	Exposures	Deaths			A/E Ratio	
		Actual	Current	Recommended	Current	Recommended
20 - 29	1,177	0	0	1	0%	0%
30 - 39	3,241	3	3	4	107%	85%
40 - 49	4,899	14	8	9	186%	151%
50 - 59	7,754	49	31	33	160%	149%
60 - 69	4,225	55	48	34	115%	163%
70 +	329	7	15	5	46%	149%
Total	21,625	128	105	85	122%	151%

Healthy Employee Mortality - Female



- Recommend updated generational table – PubG-2010(B) Employee, 155% Adjustment

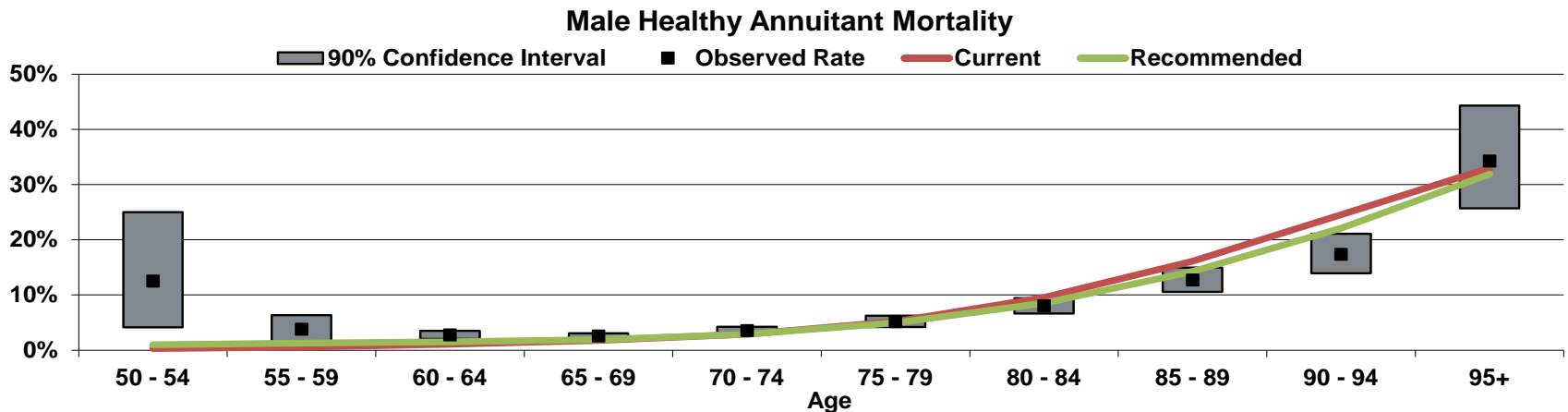


Non-Annuitant Mortality - Base Table for Females						
Age Band	Exposures	Deaths			A/E Ratio	
		Actual	Current	Recommended	Current	Recommended
20 - 29	1,094	0	0	0	0%	0%
30 - 39	2,926	3	1	1	206%	220%
40 - 49	3,994	11	4	4	253%	248%
50 - 59	5,999	31	21	15	148%	213%
60 - 69	3,068	27	31	15	87%	178%
70 +	315	6	14	4	44%	170%
Total	17,396	78	72	39	109%	199%

Healthy Retiree Mortality - Male



- Recommend updated generational table
 - PubG-2010(B) Healthy Retiree, 125% Adjustment

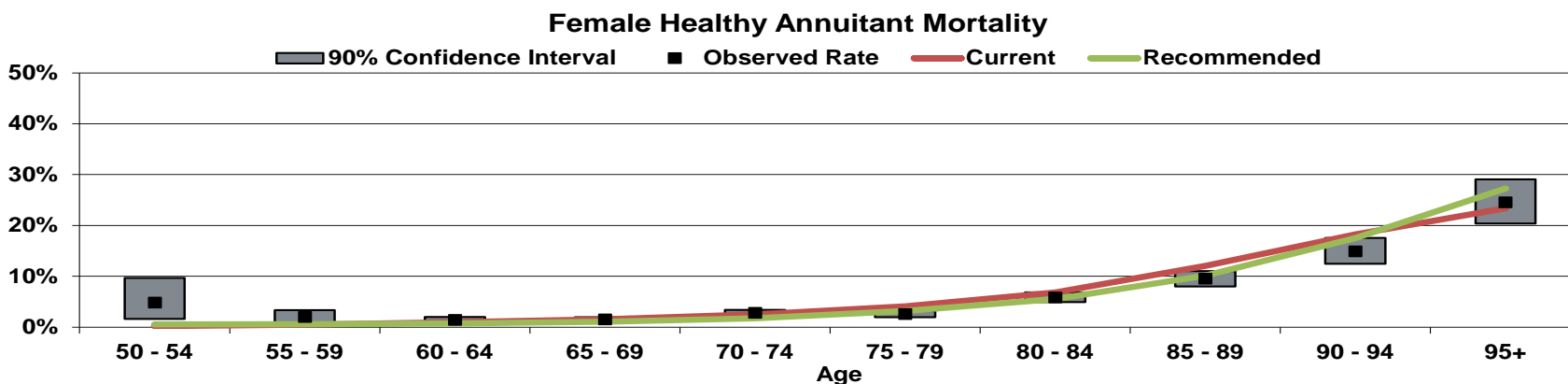


Healthy Annuitant Mortality - Base Table for Males						
Age Band	Exposures	Deaths			A/E Ratios	
		Actual	Current	Recommended	Current	Recommended
50 - 54	24	3	0	0	4449%	1292%
55 - 59	157	6	1	2	675%	300%
60 - 64	1,308	36	14	20	255%	183%
65 - 69	2,849	73	51	54	143%	135%
70 - 74	2,015	72	58	59	124%	123%
75 - 79	1,332	69	69	66	100%	105%
80 - 84	1,006	81	96	86	84%	94%
85 - 89	614	78	99	87	79%	89%
90 - 94	294	51	72	65	71%	78%
95 +	70	24	23	22	104%	108%
Total	9,669	493	484	461	102%	107%

Healthy Retiree Mortality - Female



- Recommend updated generational table
 - PubG-2010(B) Healthy Retiree, 120% Adjustment

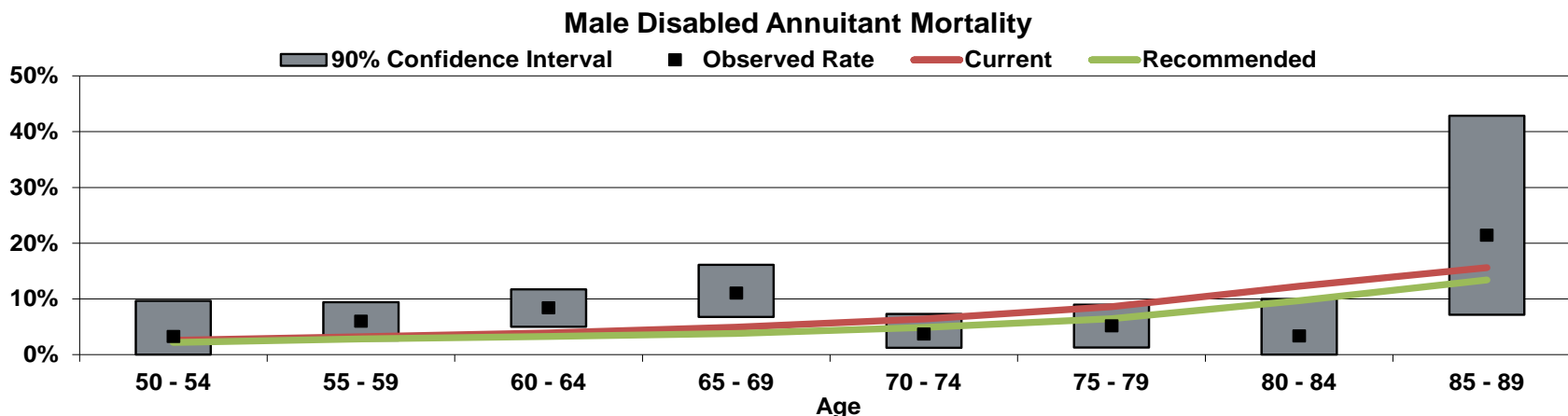


Healthy Annuitant Mortality - Base Table for Females						
Age Band	Exposures	Deaths			A/E Ratios	
		Actual	Current	Recommended	Current	Recommended
50 - 54	62	3	0	0	2135%	913%
55 - 59	298	6	2	2	394%	337%
60 - 64	1,259	18	12	9	150%	197%
65 - 69	2,663	41	42	28	98%	146%
70 - 74	2,166	61	54	38	113%	160%
75 - 79	1,796	46	74	57	62%	81%
80 - 84	1,606	94	110	89	86%	106%
85 - 89	998	95	120	101	79%	94%
90 - 94	530	79	97	93	82%	85%
95 +	265	65	62	72	105%	90%
Total	11,643	508	572	489	89%	104%

Disabled Mortality - Male



- Recommend updated generational table
 - PubG-2010 Disabled, 120% Adjustment

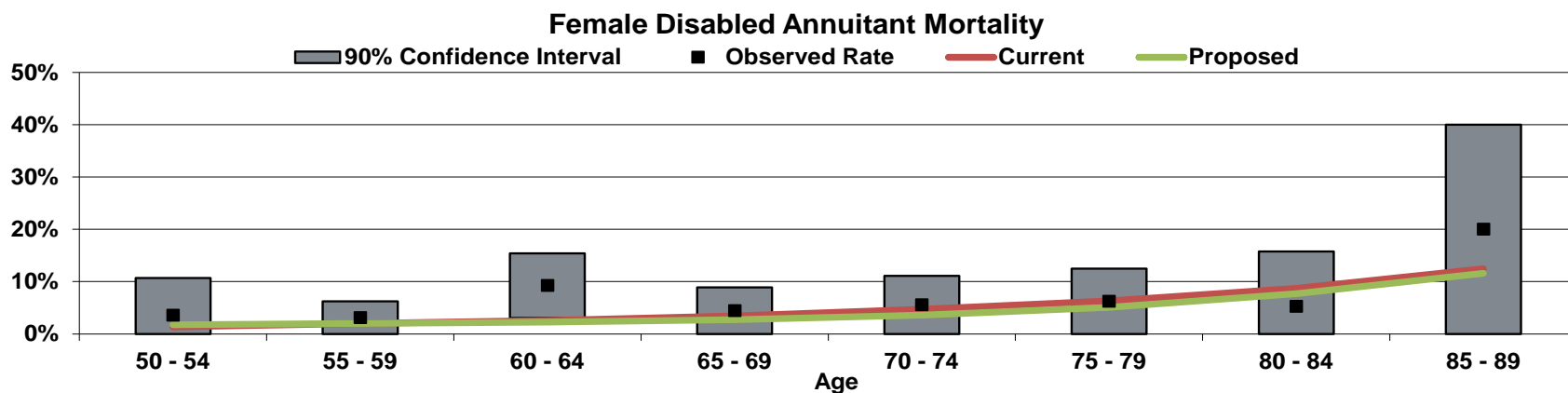


Disabled Annuitant Mortality - Base Table for Males						
Age Band	Exposures	Death			A/E Ratios	
		Actual	Current	Recommended	Current	Recommended
50 - 54	31	1	1	1	124%	147%
55 - 59	117	7	4	3	187%	213%
60 - 64	179	15	7	6	215%	255%
65 - 69	118	13	6	5	224%	288%
70 - 74	82	3	5	4	57%	75%
75 - 79	78	4	7	5	60%	79%
80 - 84	30	1	4	3	27%	34%
85 - 89	14	3	2	2	137%	160%
90 - 94	0	0	0	0	0%	0%
Total	649	47	35	28	134%	167%

Disabled Mortality - Female



- Recommend updated generational table
 - PubG-2010 Disabled, 110% Adjustment



Disabled Annuitant Mortality - Base Table for Females						
Age Band	Exposures	Deaths			A/E Ratios	
		Actual	Current	Recommended	Current	Recommended
50 - 54	28	1	0	0	266%	203%
55 - 59	64	2	1	1	156%	155%
60 - 64	65	6	2	1	358%	408%
65 - 69	45	2	2	1	129%	165%
70 - 74	36	2	2	1	118%	154%
75 - 79	32	2	2	2	99%	123%
80 - 84	19	1	2	1	60%	68%
85 - 89	10	2	1	1	161%	173%
90 - 94	2	0	0	0	0%	0%
Total	301	18	12	10	152%	174%

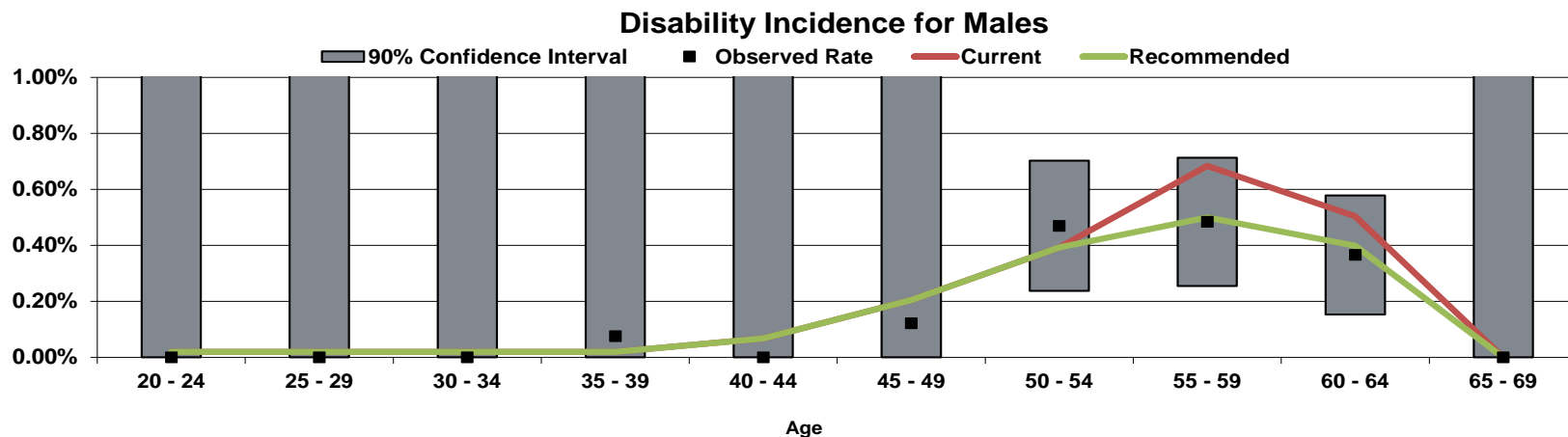


- Current assumptions:
 - Age-based tables
 - Separate tables for males and females
- Recommended assumptions
 - Continue separate tables for males and females
 - Very few total cases to base experience
 - Adjust rates slightly to better reflect limited plan experience

Disability Rates – Male



- Minor modification to age-based table
– Reduce rates starting at age 55

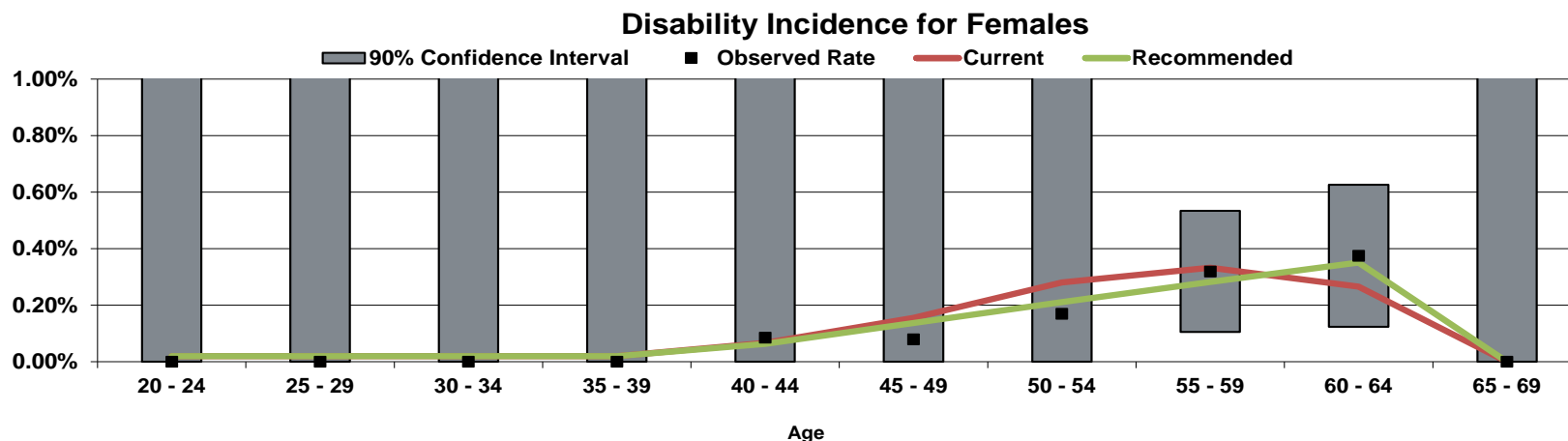


Disability Incidence Rates for Males						
Age Band	Exposures	Disabilities			Actual to Expected Ratios	
		Actual	Current	Recommended	Current	Recommended
20 - 24	224	0.00	0.04	0.04	0%	0%
25 - 29	928	0.00	0.19	0.19	0%	0%
30 - 34	1,241	0.00	0.25	0.25	0%	0%
35 - 39	1,322	1.00	0.26	0.26	378%	378%
40 - 44	1,447	0.00	0.98	0.98	0%	0%
45 - 49	1,643	2.00	3.36	3.36	59%	59%
50 - 54	2,341	11.00	9.19	9.19	120%	120%
55 - 59	2,479	12.00	16.95	12.40	71%	97%
60 - 64	2,186	8.00	11.03	8.72	73%	92%
65 - 69	1,022	0.00	0.00	0.00	0%	0%
70 +	0.00	0.00	0.00	0.00	0%	0%
Total	14,833	34	42	35	80%	96%

Disability Rates – Female



- Minor modification to age-based table
 - Reduce rates starting at age 40, then increase to double previous rate at age 64



Age

Disability Incidence Rates for Females						
Age Band	Exposures	Disabilities			Actual to Expected Ratios	
		Actual	Current	Recommended	Current	Recommended
20 - 24	195	0.00	0.04	0.04	0%	0%
25 - 29	881	0.00	0.18	0.18	0%	0%
30 - 34	1,163	0.00	0.23	0.23	0%	0%
35 - 39	1,112	0.00	0.22	0.22	0%	0%
40 - 44	1,167	1.00	0.78	0.74	128%	135%
45 - 49	1,265	1.00	1.96	1.74	51%	58%
50 - 54	1,762	3.00	4.94	3.71	61%	81%
55 - 59	1,878	6.00	6.25	5.31	96%	113%
60 - 64	1,600	6.00	4.25	5.61	141%	107%
65 - 69	720	0.00	0.00	0.00	0%	0%
70 +	0.00	0.00	0.00	0.00	0%	0%
Total	11,743	17	19	18	90%	96%

Termination Assumptions

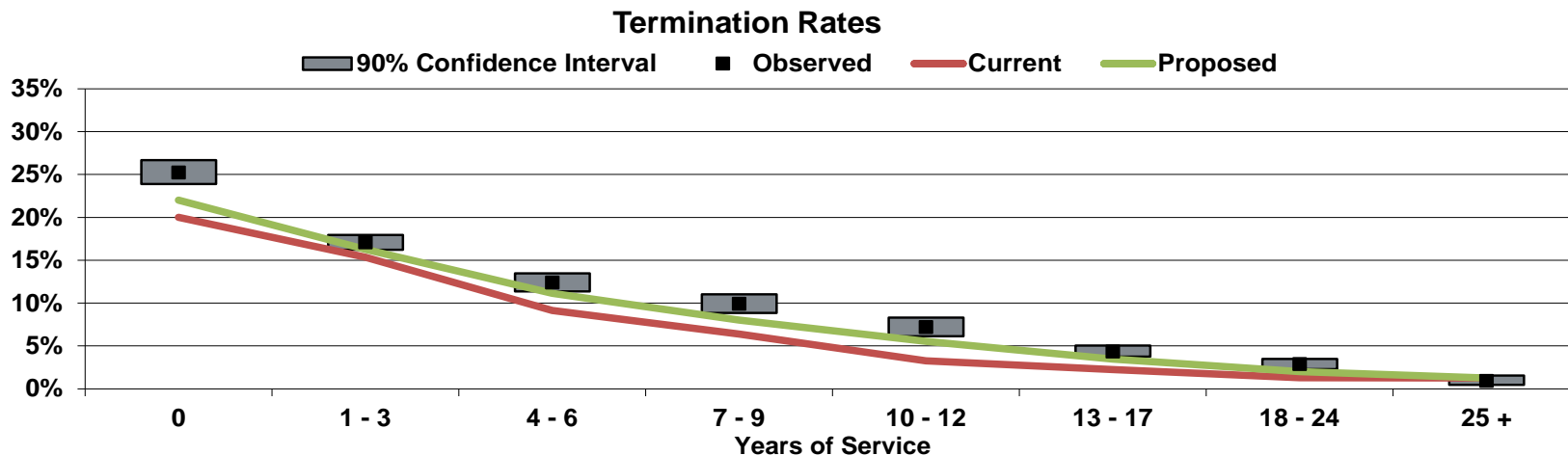


- Current assumptions:
 - Service-based unisex tables
- Recommended assumptions
 - Increase rates at all years of service up to 25 years of service
 - Termination rates range from 22% for new hires to 1.25% for 25+ years of service

Termination Rates



- Increase rates up to 25 years of service



Termination Rates						
Service	Exposures	Termination Rates			A/E Ratios	
		Actual	Current	Proposed	Current	Proposed
0	2,629	25.26%	20.00%	22.00%	126%	115%
1 - 3	5,238	17.09%	15.36%	16.29%	111%	105%
4 - 6	2,660	12.41%	9.14%	11.14%	136%	111%
7 - 9	2,003	9.94%	6.38%	8.03%	156%	124%
10 - 12	1,551	7.22%	3.26%	5.53%	221%	131%
13 - 17	2,673	4.38%	2.24%	3.48%	196%	126%
18 - 24	2,209	2.90%	1.31%	2.00%	221%	145%
25 +	843	0.95%	1.25%	1.25%	76%	76%
Total	19,806	12.06%	9.35%	10.71%	129%	113%

Retirement Assumptions



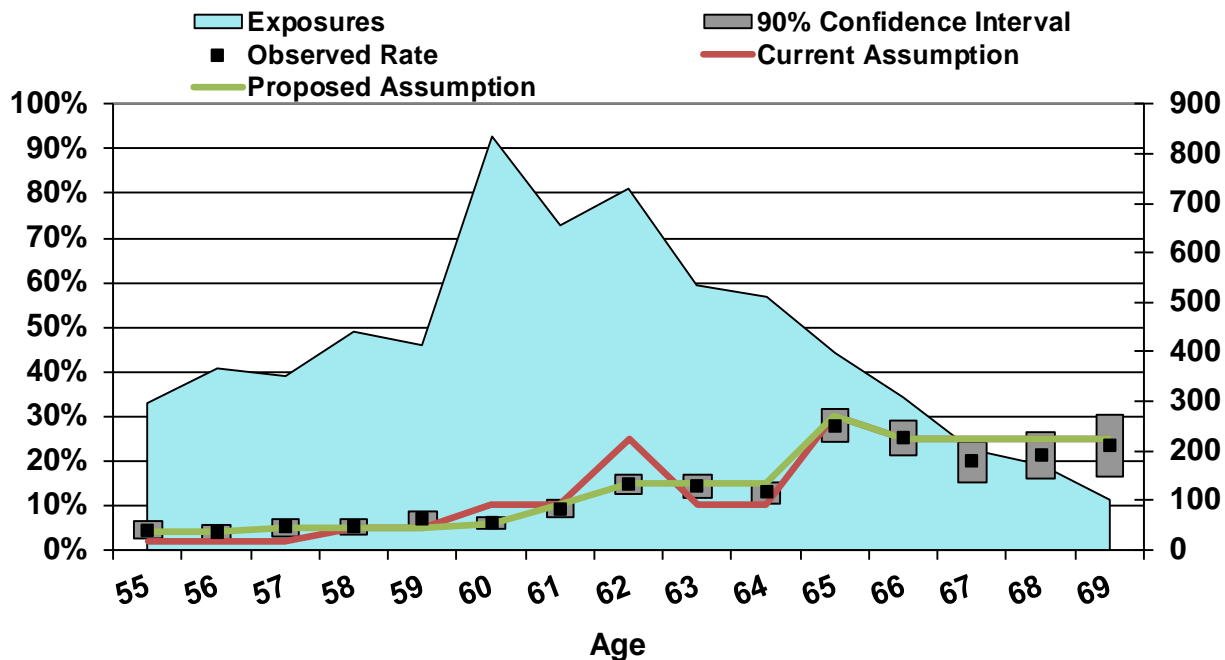
- Current retirement rates vary depending upon the age of the member
- Based upon most recent experience, recommend increases in rates from ages 55-57 and decreases in rates at age 60 and for ages 62-64

Retirement Rates



- Recommended adjustments are shown below

Active/DROP >> Retired: All Years of Service



Age	Current	Proposed
<= 54	2.0%	2.0%
55	2.0%	4.0%
56	2.0%	4.0%
57	2.0%	5.0%
58	5.0%	5.0%
59	5.0%	5.0%
60	10.0%	6.0%
61	10.0%	10.0%
62	25.0%	15.0%
63	10.0%	15.0%
64	10.0%	15.0%
65	30.0%	30.0%
66	25.0%	25.0%
67	25.0%	25.0%
68	25.0%	25.0%
69	25.0%	25.0%

Current A/E Ratio: 0.912 Proposed A/E Ratio: 0.947



- Current DROP assumptions vary by age
 - In addition for first year satisfying Rule of 85, rates are as follows:
 - 75% for ages 56 and younger
 - 60% for age 57 to 60
 - 50% for ages 61 to 65
 - 15% for ages greater than 65
- Based on experience, we recommend reduction of age based rates for ages 55 and over
 - In addition for first year satisfying Rule of 85, rates are as follows:
 - 70% for ages 56 and younger
 - 55% for age 57 to 62
 - 30% for ages 63 to 65
 - 15% for ages greater than 65



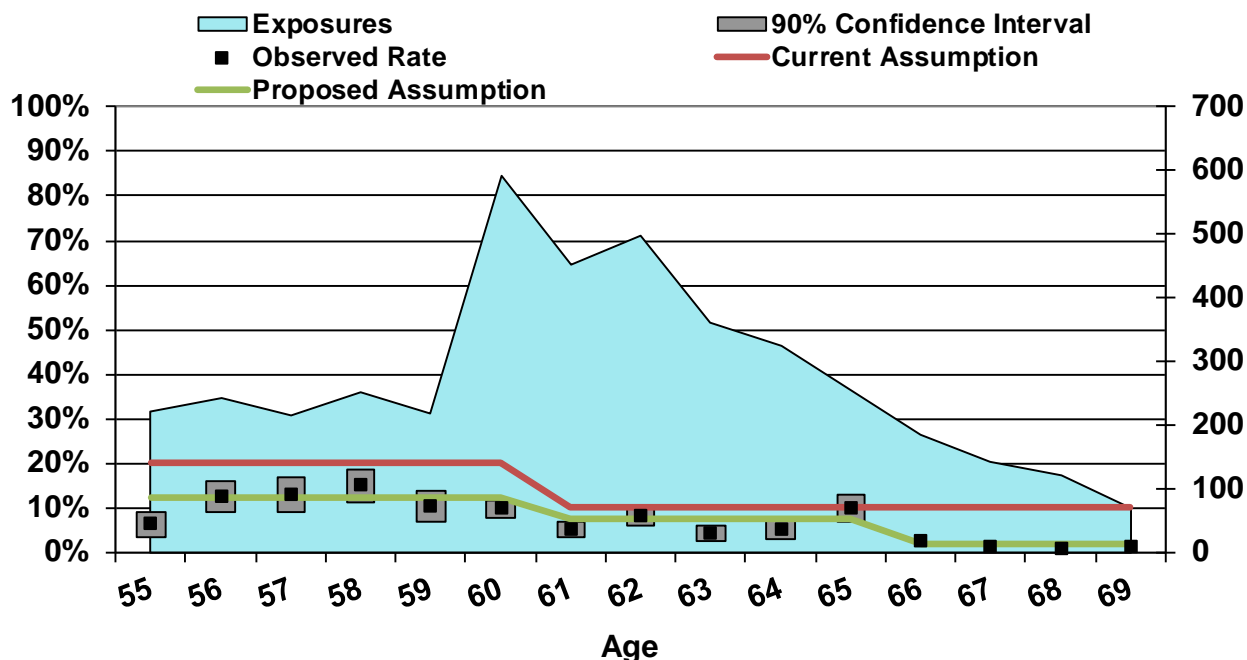
- Current DROP assumption is that 50% of members will return to active status from DROP and will work an additional two years
- We recommend maintaining the assumption is that 50% of members will return to active status but that members will work an additional three years

DROP Rates – Not Rule of 85



- Recommend reduction of rates for ages 55 and over

Active >> DROP: All Ex Rule of 85 Years of Service



Age	Current	Proposed
<= 54	0.0%	0.0%
55	20.0%	12.5%
56	20.0%	12.5%
57	20.0%	12.5%
58	20.0%	12.5%
59	20.0%	12.5%
60	20.0%	12.5%
61	10.0%	7.5%
62	10.0%	7.5%
63	10.0%	7.5%
64	10.0%	7.5%
65	10.0%	7.5%
66	10.0%	2.0%
67	10.0%	2.0%
68	10.0%	2.0%
69	10.0%	2.0%

Current A/E Ratio: 0.546

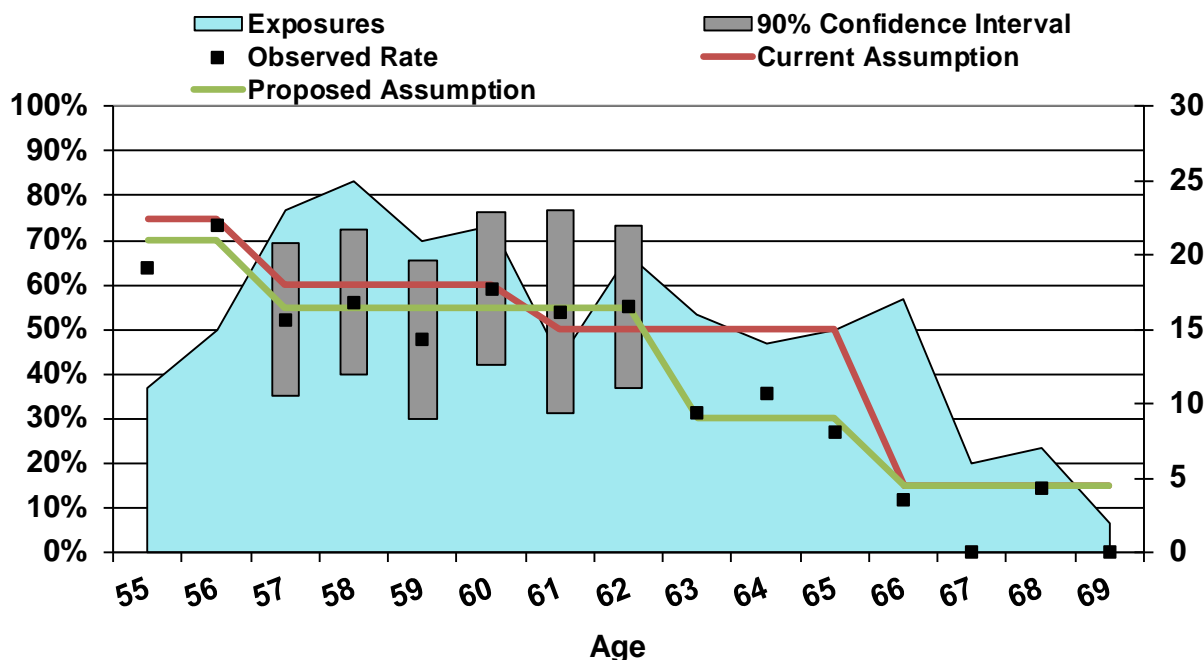
Proposed A/E Ratio: 0.870

DROP Rates – Rule of 85



- Recommend modifications to DROP assumptions based on Rule of 85

Active >> DROP: Rule of 85 Years of Service



Age	Current	Proposed
<= 54	0.0%	0.0%
55	75.0%	70.0%
56	75.0%	70.0%
57	60.0%	55.0%
58	60.0%	55.0%
59	60.0%	55.0%
60	60.0%	55.0%
61	50.0%	55.0%
62	50.0%	55.0%
63	50.0%	30.0%
64	50.0%	30.0%
65	50.0%	30.0%
66	15.0%	15.0%
67	15.0%	15.0%
68	15.0%	15.0%
69	15.0%	15.0%

Current A/E Ratio: 0.865

Proposed A/E Ratio: 0.974



- Retirement age for terminated vested participants
 - Currently age 61
 - Experience study shows average age of 62.7
 - Recommend increase to age 62



- Spouse age difference
 - Currently assume male is 3 years older
 - Actual average difference 3.04
 - Recommend no change
- Percent Married
 - Recommend current assumption of 80% for all participants



Economic Assumptions



- What other Funds are doing
- Past experience of the Fund
- Historical data in general
- Outlook for the future
- Risk preference of the Board

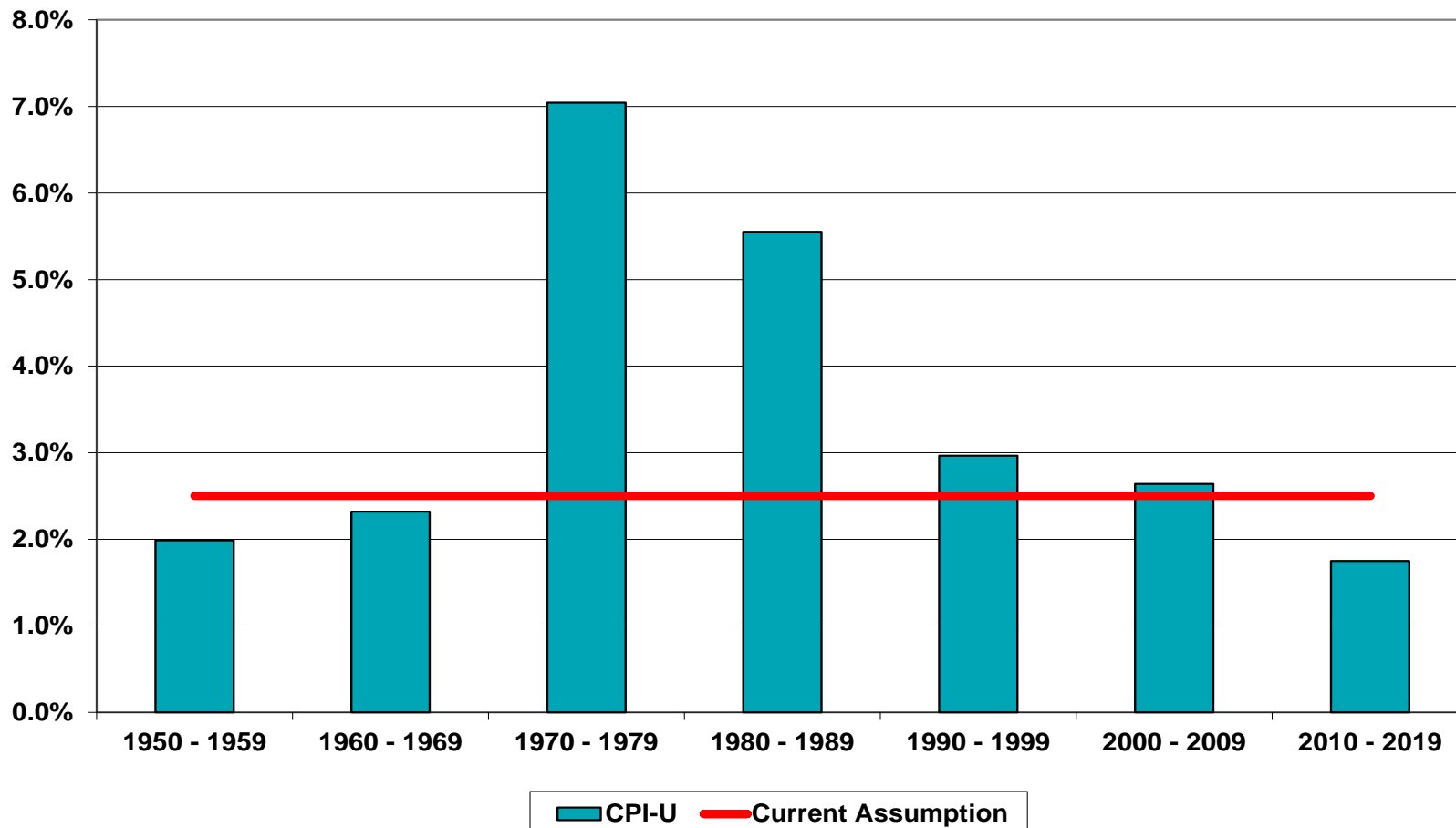


- Inflation
- Salary Increases
 - Inflation component
 - Real wage growth
 - Merit or step increase
- Investment Return
- Administrative Expenses

Inflation (CPI – U)



Average Annual CPI-U by Decade



Inflation - Outlook for the Future



Bond Yields as of December 31, 2019

Time to Maturity	Conventional Yield	TIPS Yield	Implied Inflation
10 years	1.92%	0.15%	1.77%
20 years	2.25%	0.39%	1.86%
30 years	2.39%	0.58%	1.81%

Inflation – NASRA Average by Year



Year	Average
2001	3.97%
2005	3.66%
2009	3.51%
2010	3.39%
2011	3.30%
2013	3.17%
2020	2.68%



- Historical inflation by decade has varied widely
- Inflation in last decade was lower than the current assumption of 2.5% but prior two decades were each higher than 2.5%
- Implied inflation in long-term bonds at December 31, 2019, was about 1.8%
- Most recent NASRA survey has an average inflation assumption of 2.7%
- Inflation assumption consistent with Marquette Associates capital market assumptions is 2.25%
- Recommend keeping inflation assumption at 2.5%

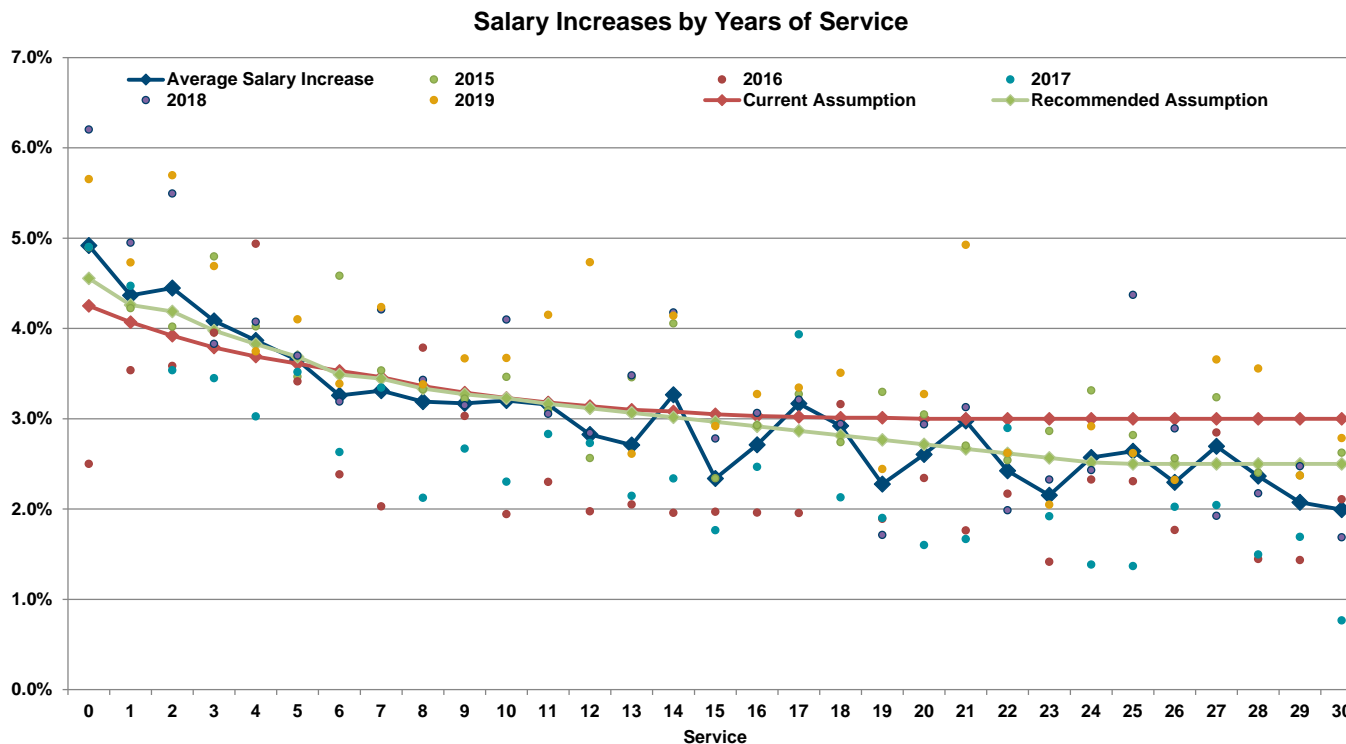


- Salary growth current assumption equals:
 - Inflation (currently 2.50%), plus
 - Real wage growth (currently 0.5%), plus
 - Merit and promotional increases (currently from 0% to 1.25% based on age)
- For the five years ended 9/30/2019, average payroll for ERS increased by 1.3% per year compared to average inflation of 1.5% per year
- Recommend that real wage increase assumption be reduced to 0.0%, such that wage growth will equal the inflation rate of 2.5%

Salary Experience



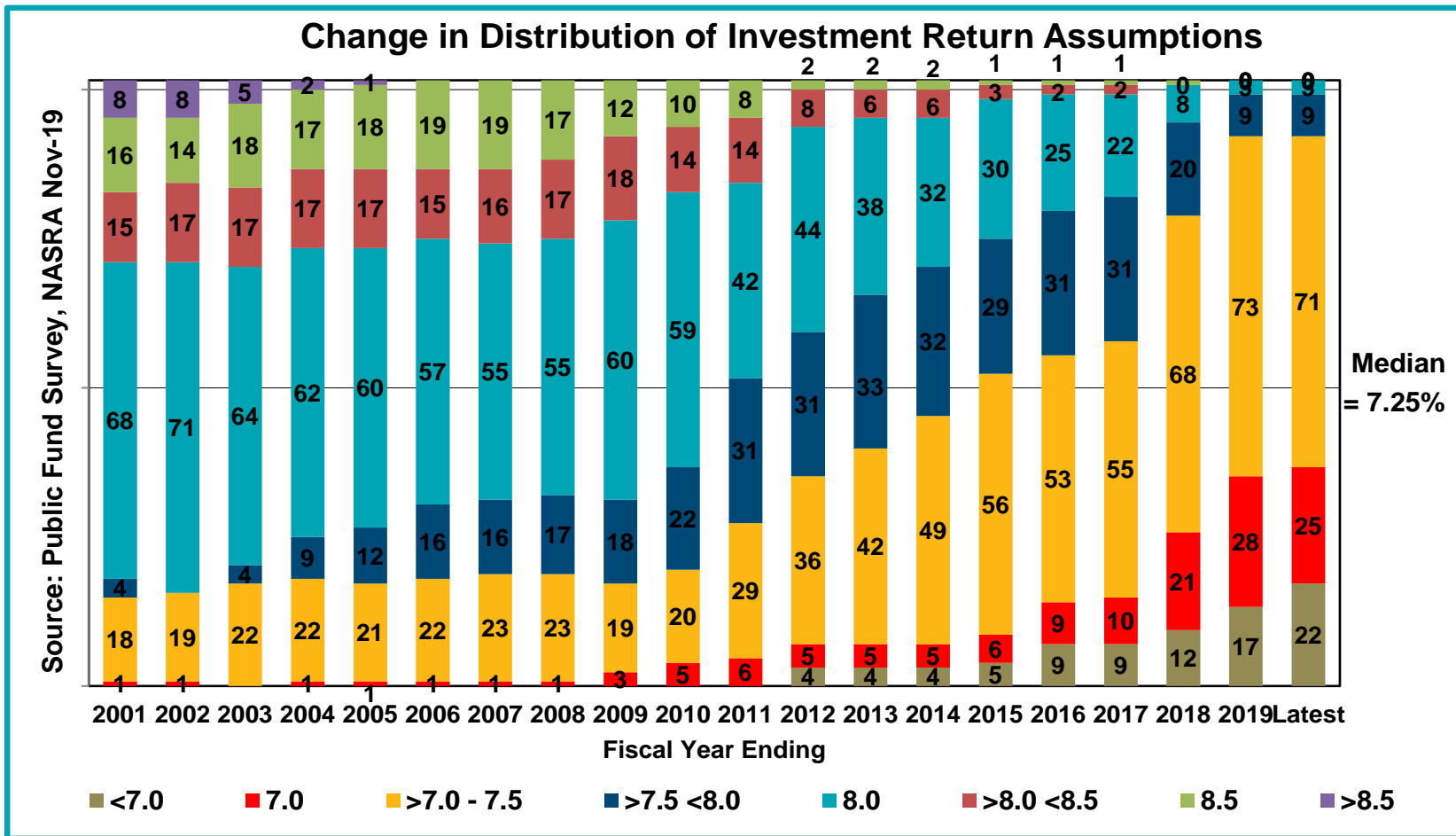
- Recommend increased salary growth rates for five years of service or less and decreased rates for all other years



Service	Current	Recommended	Actual
0	4.25%	4.55%	4.92%
1	4.07%	4.26%	4.37%
2	3.92%	4.19%	4.45%
3	3.79%	3.98%	4.08%
4	3.69%	3.83%	3.87%
5	3.61%	3.69%	3.65%
6	3.53%	3.49%	3.26%
7	3.46%	3.44%	3.31%
8	3.36%	3.33%	3.19%
9	3.29%	3.27%	3.17%
10	3.23%	3.23%	3.20%
11	3.18%	3.17%	3.16%
12	3.14%	3.12%	2.83%
13	3.10%	3.07%	2.71%
14	3.08%	3.02%	3.27%
15	3.05%	2.97%	2.34%
16	3.03%	2.92%	2.71%
17	3.02%	2.87%	3.17%
18	3.01%	2.82%	2.92%
19	3.01%	2.77%	2.28%
20	3.00%	2.72%	2.61%
21	3.00%	2.67%	2.97%
22	3.00%	2.62%	2.42%
23	3.00%	2.57%	2.15%
24	3.00%	2.52%	2.57%
25	3.00%	2.50%	2.64%
26	3.00%	2.50%	2.29%
27	3.00%	2.50%	2.69%
28	3.00%	2.50%	2.37%
29	3.00%	2.50%	2.07%
30 +	3.00%	2.50%	1.99%

April 28, 2020

Investment Return Assumption



Source: NASRA Public Fund Survey Summary of Findings

Investment Return – NASRA Average



Year	Average (Mean)
2001	8.06%
2005	7.98%
2009	7.96%
2010	7.91%
2011	7.85%
2012	7.75%
2013	7.72%
2017	7.52%
Latest	7.22%



- Other Retirement Systems in Missouri

System	Discount Rate
Kansas City Employees	7.50%
Kansas City Firefighters	7.25%
Kansas City Police	7.45%
St. Louis Firefighters (FRP)	7.25%
St. Louis Firefighters (FRS)	7.00%
St. Louis Police	7.50%
MOSERS	7.10%
PSRS/PEERS	7.50%

Investment Return - History



Investment Returns on Market Value of Assets Year Ending September 30,	Return
2009	-3.1%
2010	10.1%
2011	1.8%
2012	17.0%
2013	13.0%
2014	9.6%
2015	-3.8%
2016	9.3%
2017	11.6%
2018	6.1%
2019	1.2%
Compounded Averages up to September 30, 2019	
Last 5 Years (2015 - 2019)	4.7%
Last 10 Years (2010 - 2019)	7.4%
Last 13 Years (2007 - 2019)	5.4%



- Marquette Associates has developed average annualized 10-year returns for the asset allocation strategy recently adopted by the Board
- Annualized expected 10-year return is 7.68%
- Marquette also provided the probability of not being able to attain the following hypothetical assumed rates of return:

7.50% 48.1%

7.25% 45.8%

7.00% 42.6%



- Horizon Actuarial Services produces a survey each year of the capital market assumptions for many investment consultants. The 2019 survey included 34 firms

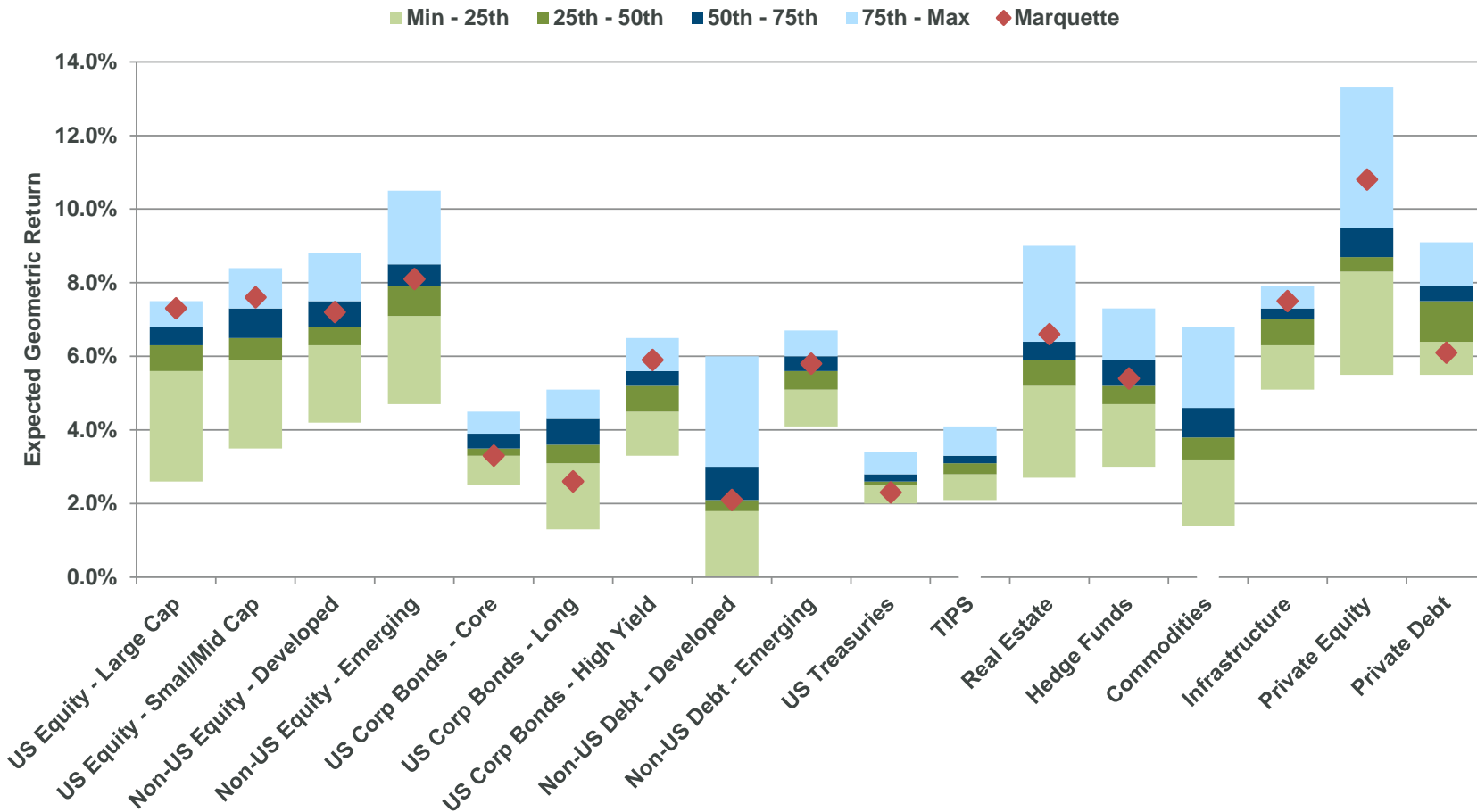
Expected Distribution of Average Annual Return Based on Horizon Survey

Percentile	Portfolio E	
	Time Horizon	
	10 Years	20 Years
95th	13.42%	12.39%
75th	9.45%	9.62%
50th	6.77%	7.74%
25th	4.16%	5.88%
5th	0.52%	3.27%

Other Investment Consultant Input



Comparison to Horizon 10-Year Assumptions





- Negative cash flow (contributions minus benefit payments and expenses) of almost 6% of plan assets
 - Negative cash flow tends to result in lower returns over time than the median returns developed by investment consultants
- Risk preference of plan sponsor
 - Consider probability of not meeting assumed rate
 - What is the effect on future contribution levels if expected returns are not achieved?



- Other public systems have generally been lowering investment return assumption
- Relatively large variance in capital market assumptions developed by consulting firms
- Risk tolerance of the Board with respect to future adverse return

Administrative Expenses



- Administrative expenses of 0.30% are included as an addition to normal cost
 - Administrative expenses were \$875,268 (0.38% of payroll) in 2019 and \$962,177 (0.42% of payroll) in 2018
 - Recommend increasing to 0.40% of payroll for administrative expense assumption



- IRS benefit and compensation limits
 - Current: 2.5%
 - Recommended: 2.5%
- Social Security Taxable Wage Base
 - Current: 3.0%
 - Recommended: 2.5%



Actuarial Methods



- Actuarial Cost Method
 - Entry Age Normal Method
 - EAN is used by the great majority of public retirement funds and is consistent with GASB 67
- UAL Amortization Method
 - 20 year “layered” amortization periods as level percent of payroll
 - This method is consistent with current actuarial best practices
- Actuarial Asset Method
 - Differences between actual and assumed investment returns are recognized in the actuarial value of assets over five years
 - This method is commonly used and meets Actuarial Standards of Practice



Cost Impact

Impact on Actuarial Liability



(\$ in thousands)	Accrued Liability	Percent Change	Funded Ratio
10/1/2019 Valuation Results	\$1,015,455		81.80%
Change 1 - Mortality	36,414	3.59%	(2.83)%
Change 2 - Disability	(2)	(0.00)%	0.00%
Change 3 - Termination	(1,377)	(0.13)%	0.10%
Change 4 – Retirement/DROP	(15,905)	(1.51)%	1.22%
Change 5 – Salary Scale	(5,468)	(0.53)%	0.43%
All Proposed Changes – 10/1/2019 Valuation Results	\$1,029,117	1.41%	80.72%

Impact on Annual Contribution



(\$ in thousands)	EAN NC + Admin	UAL Pmt	Total	% of Pay
10/1/2019 Valuation Results	\$14,053	\$16,069	\$30,122	13.17%
Change 1 - Mortality	338	2,757	3,095	1.35%
Change 2 - Disability	(5)	(0)	(5)	(0.00)%
Change 3 - Termination	(1,151)	(105)	(1,256)	(0.55)%
Change 4 – Retirement/DROP	(362)	(1,204)	(1,566)	(0.68)%
Change 5 – Salary Scale	(234)	155	(79)	(0.03)%
Admin Assumption Increase	229		229	0.10%
All Proposed Changes – 10/1/2019 Valuation Results	\$12,868	\$17,672	\$30,540	13.36%

Investment Return - Changes

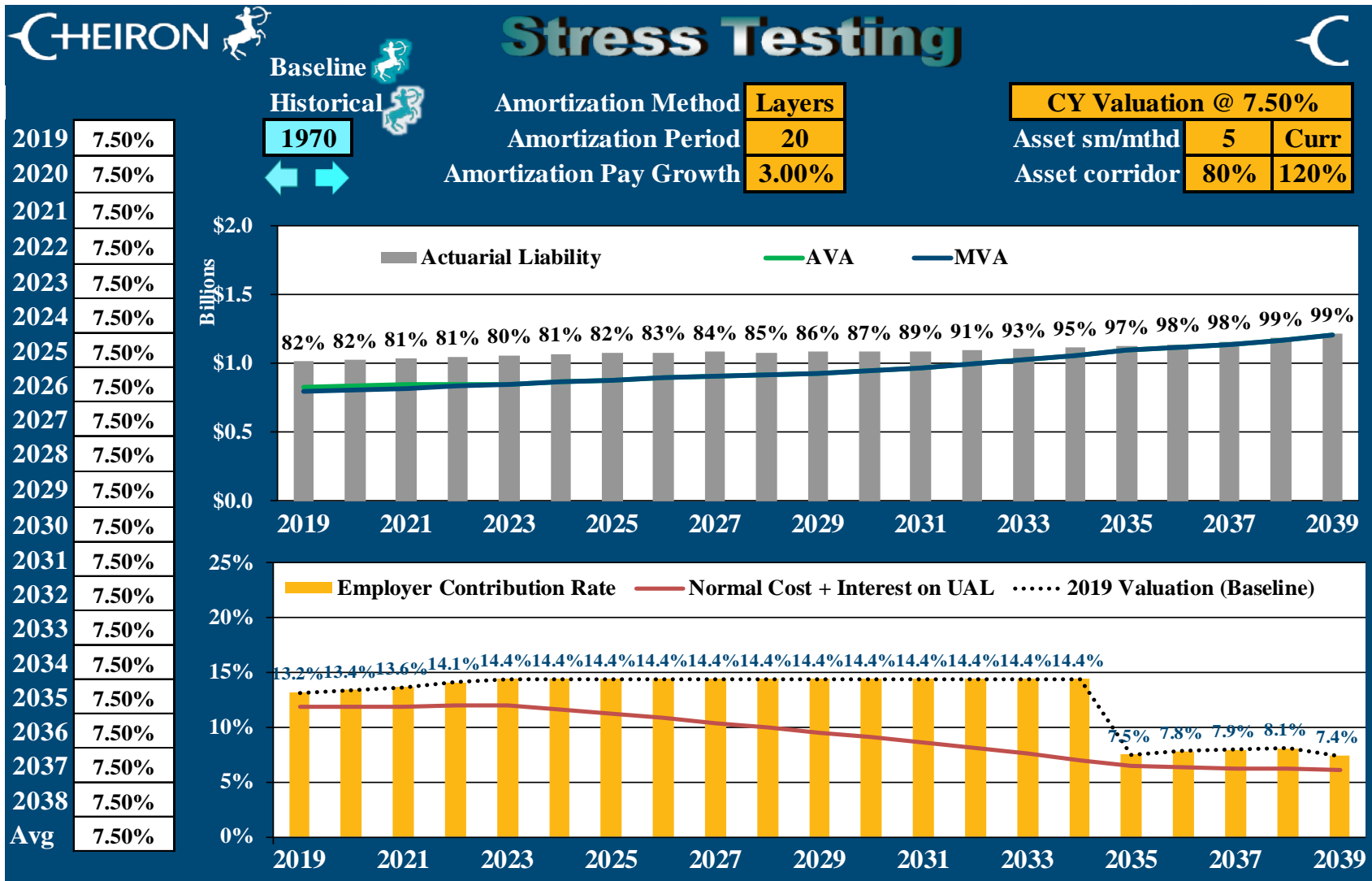


(\$ in thousands)	Accrued Liability	Funded Ratio	Total Contribution	Contribution as % of Pay
2019 Valuation Results	\$1,015,455	81.80%	\$30,122	13.17%
Proposed assumptions at 7.50%	\$1,029,117	80.72%	\$30,540	13.36%
Proposed assumptions at 7.25%	\$1,053,353	78.86%	\$32,832	14.36%
Proposed assumptions at 7.00%	\$1,078,590	77.02%	\$35,179	15.38%

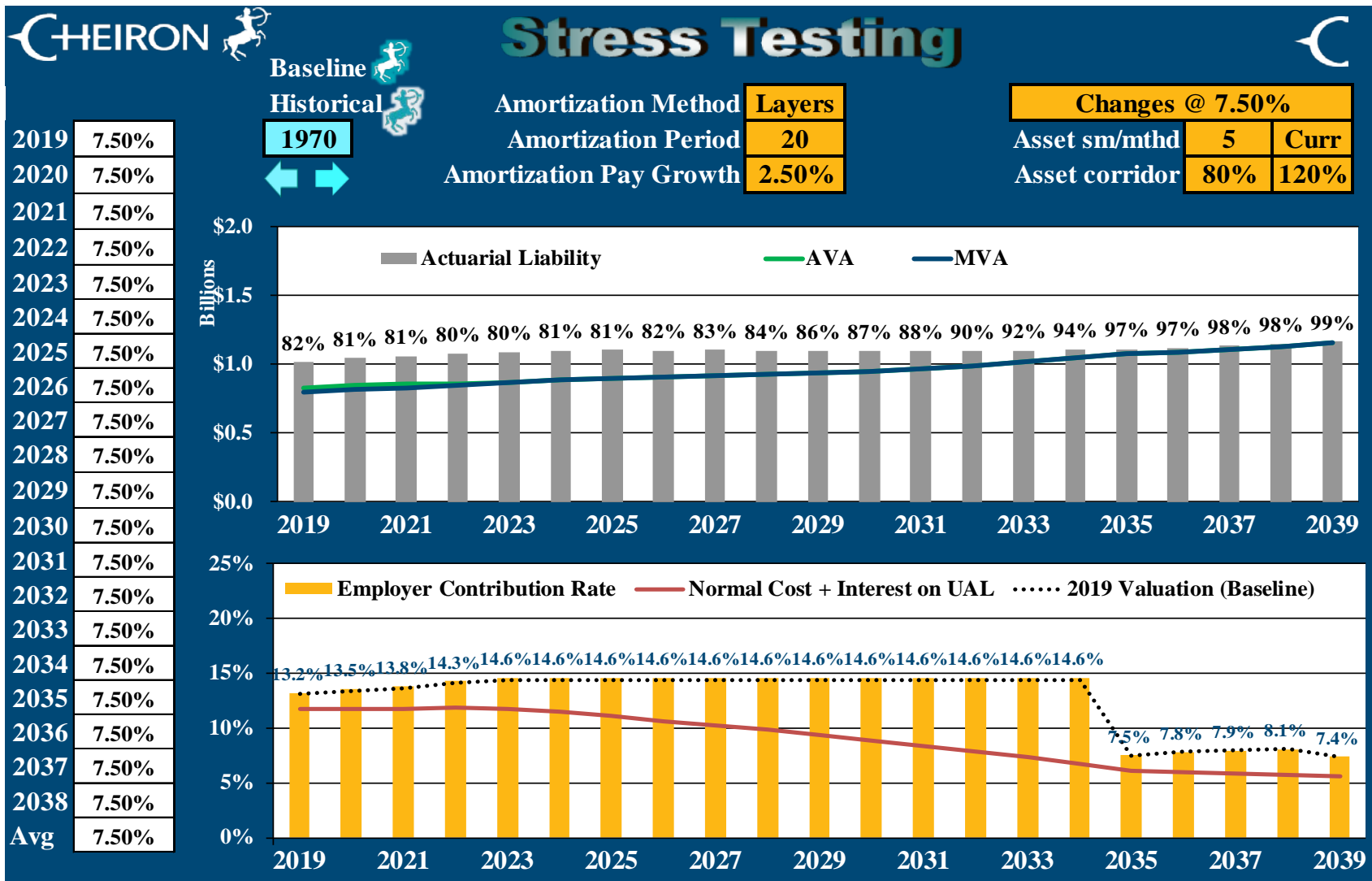


Projections

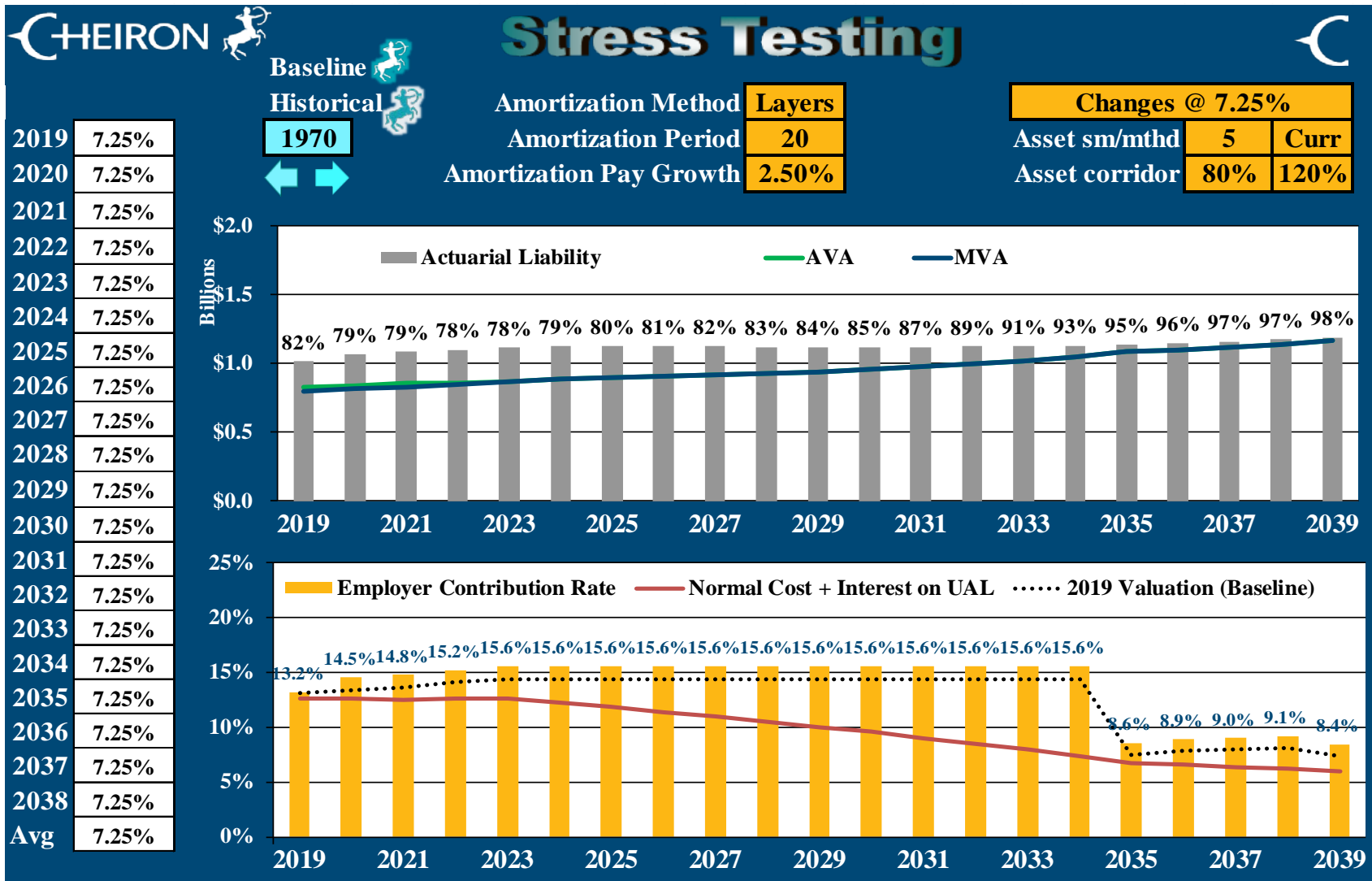
2019 Valuation Assumptions



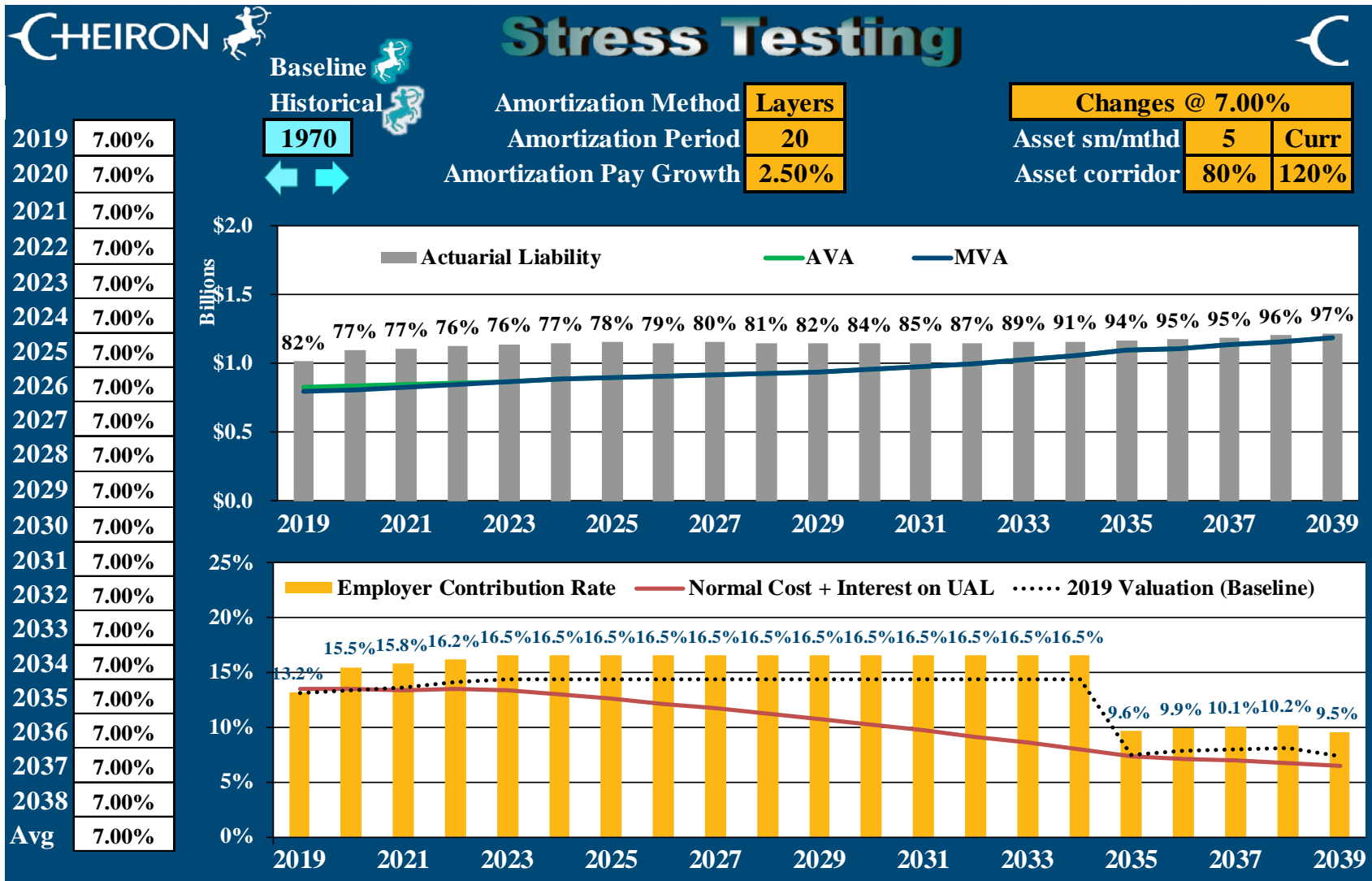
All Assumption Changes @ 7.50%



All Assumption Changes @ 7.25%



All Assumption Changes @ 7.00%





- In preparing this presentation, we relied, without audit, on information supplied by the Employees Retirement System of the City of St. Louis.
- The actuarial assumptions, data and methods are those used in the preparation of the actuarial valuation report prepared for this System are as of October 1, 2019, except as discussed within.
- The assumptions reflect our understanding of the likely future experience of the System and the assumptions as a whole represent our best estimate for the future experience of the System. The results of this report are dependent upon future experience conforming to these assumptions. To the extent that future experience deviates from the actuarial assumptions, the true cost of the plan could vary from our results.
- This presentation and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and practices and our understanding of the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board as well as applicable laws and regulations. Furthermore, as credentialed actuaries, we meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained in this report. This presentation does not address any contractual or legal issues. We are not attorneys and our firm does not provide any legal services or advice.
- Cheiron's presentation was prepared solely for the Employees Retirement System of the City of St. Louis for the purposes described herein. It is not intended to benefit any third party, and Cheiron assumes no duty or liability to any such other party.

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