CavMac
Actuarial Consulting Services

January 17, 2025

Mr. Tim Maurer
Interim Executive Director
Teachers Retirement Association of Minnesota
60 Empire Drive, Suite 400
St. Paul, MN 55103

Re: LCPR Required Projection of Future Actuarial Results

Dear Tim:

The Standards for Actuarial Work, as specified by the Legislative Commission on Pension and Retirement, require that a sensitivity analysis for the Teacher Retirement Association (TRA) be performed every two years. This involves modeling projections of future valuation results assuming future investment returns that are 1.5% higher and lower than the actuarial assumed rate of return in all years. Given that the assumed rate of return is currently 7.0%, the resulting investment return scenarios that are modeled are:

(1) 5.5% for all years,
(2) 7.0% for all years, and
(3) 8.5% for all years.

Attached to this letter are both graphs and tables of numerical results that provide the estimated funded status, required and statutory contribution rates, contributions and benefit payment amounts, and the unfunded actuarial accrued liability (UAAL) under the three required investment return scenarios. These projections are based on the valuation assumptions and statutory benefit provisions used in the July 1, 2024 valuation.

While the actual investment returns earned in future years change under the three different scenarios, the investment return assumption of 7.0%, used in the valuation, is not changed, as specified by the LCPR Standards. As a result, the actuarial accrued liability and normal cost are the same for all three scenarios. It should be noted that these projections are strictly for the purpose of sensitivity analysis, as required by the LCPR. The scenarios that reflect a rate of return of 5.5% or 8.5% do not represent reasonable outcomes, because neither change to the contribution rates or the benefit structure are assumed to be implemented despite the trends disclosed in future valuation results. If the funding results in either of those scenarios were to actually occur, changes to the contributions and/or benefit provisions would most likely be made, as past experience has demonstrated.

The projections are developed by first creating a demographic profile of recent new entrants. Next, the membership population from the July 1, 2024 valuation is projected forward one year assuming all demographic assumptions are met. Members who are assumed to leave active employment are replaced with an equal number of new members from the new entrant demographic profile mentioned earlier so the number of active members remains constant. Then, a valuation is performed as of July 1, 2025 to determine the various liability and cost measurements. The last two steps are repeated in each future year until projections have been performed through the July 1, 2054 valuation.

In preparing these exhibits, we have followed the LCPR Standards for Actuarial Work, with the following exceptions which are permitted. Because of the expected changes in the active membership demographics over time as members of the pre-July 1, 1989 tier leave covered employment and are replaced by new employees with different retirement eligibility provisions as well as different demographic patterns, we have modeled future populations and valued them directly by using an open group projection. We believe that this approach provides a better reflection of future valuation results than would be produced by using a simplified methodology and assumptions of a constant normal cost rate and fixed growth in covered payroll.

Disclaimers, Caveats, and Limitations

In order to prepare the results, we have utilized actuarial models that were developed to measure liabilities and develop actuarial costs. These models include tools that we have produced and tested, along with commercially available valuation software that we have reviewed to confirm the appropriateness and accuracy of the output. In utilizing these models, we develop and use input parameters and assumptions about future contingent events along with recognized actuarial approaches to develop the needed results. Future actuarial results may differ significantly from the current results presented in this letter due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law.

The projection results are based upon the July 1, 2024 actuarial valuation results and the projection model prepared by TRA's actuary, CavMac. Significant items are noted below:

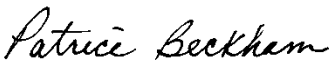
- The investment returns in all future years, as described earlier in this letter, are assumed to apply to the market value of assets.
- All actuarial assumptions other than the investment return, which include mortality, disability, retirement, salary increases, and termination of employment, are assumed to be met exactly in each year in the future, including mortality improvements (longer lifetimes) in the current assumption.

- It is possible that changes to other programs may have an effect on future retirement patterns. For example, if changes in Social Security and/or Medicare are implemented to reduce benefits or delay eligibility for those programs, retirements from TRA are likely to also be delayed, thereby lowering the cost of the plan and vice versa. However, because such changes cannot be reasonably anticipated, they are not reflected in this analysis.
- The number of active members covered by TRA in the future is assumed to remain level (neither growth nor decline in the active membership count). As active members leave employment, they are assumed to be replaced by new employees who have a similar demographic profile as recent new hires. With the departure of current active members who were hired before July 1, 1989, whose benefit structure has different retirement eligibility provisions from those of members hired since then, the demographic composition of the membership may gradually change over time.
- Plan provision changes being phased in (such as scheduled contribution rate increases) are assumed to occur as provided in current law.
- The funding methods, including the entry age normal cost method, the asset smoothing method, and the amortization method and period, are as set out in statute.
- The current supplementary contributions made by the state are assumed to continue to be paid at approximately the same dollar amount until the System is fully funded.
- The actuaries relied upon the membership data provided by TRA for the actuarial valuation. The numerical results depend on the integrity of this information. If there are material inaccuracies in this data, the results presented herein may be different and the projections may need to be revised.

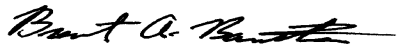
Models are designed to identify anticipated trends and to compare various scenarios rather than predicting some future state of events. These projections are based on TRA's estimated financial status on July 1, 2024, and project future events using several sets of assumptions out of a range of many possibilities. The projections do not predict TRA's financial condition or its ability to pay benefits in the future and do not provide any guarantee of future financial soundness of the System. Over time, a defined benefit plan's total cost will depend on a number of factors, including the amount of benefits paid, the number of people paid benefits, the duration of the benefit payments, plan expenses, and the amount of earnings on assets invested to pay benefits. These amounts and other variables are uncertain and unknowable at the time the projections were made. The actuarial assumptions will not unfold exactly as expected so actual valuation results in the future will differ from those in the projections. To the extent that actual experience deviates significantly from the assumptions, results could be significantly better or significantly worse than indicated in this letter. **Decisions about making changes to the benefit structure, funding the plan, or investment policy should not be made based on these projections as the purpose of this information is only to provide a sensitivity analysis of the actual versus expected investment return.**

We, Patrice A. Beckham, Brent A. Banister, and Ben Mobley are members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein. We are available to answer any questions on the material in this letter or to provide explanations or further details as appropriate. Ms. Beckham and Dr. Banister also meet the requirements of "approved actuary" under Minnesota Statutes, Section 356.215, Subdivision1, Paragraph (c).

Sincerely,



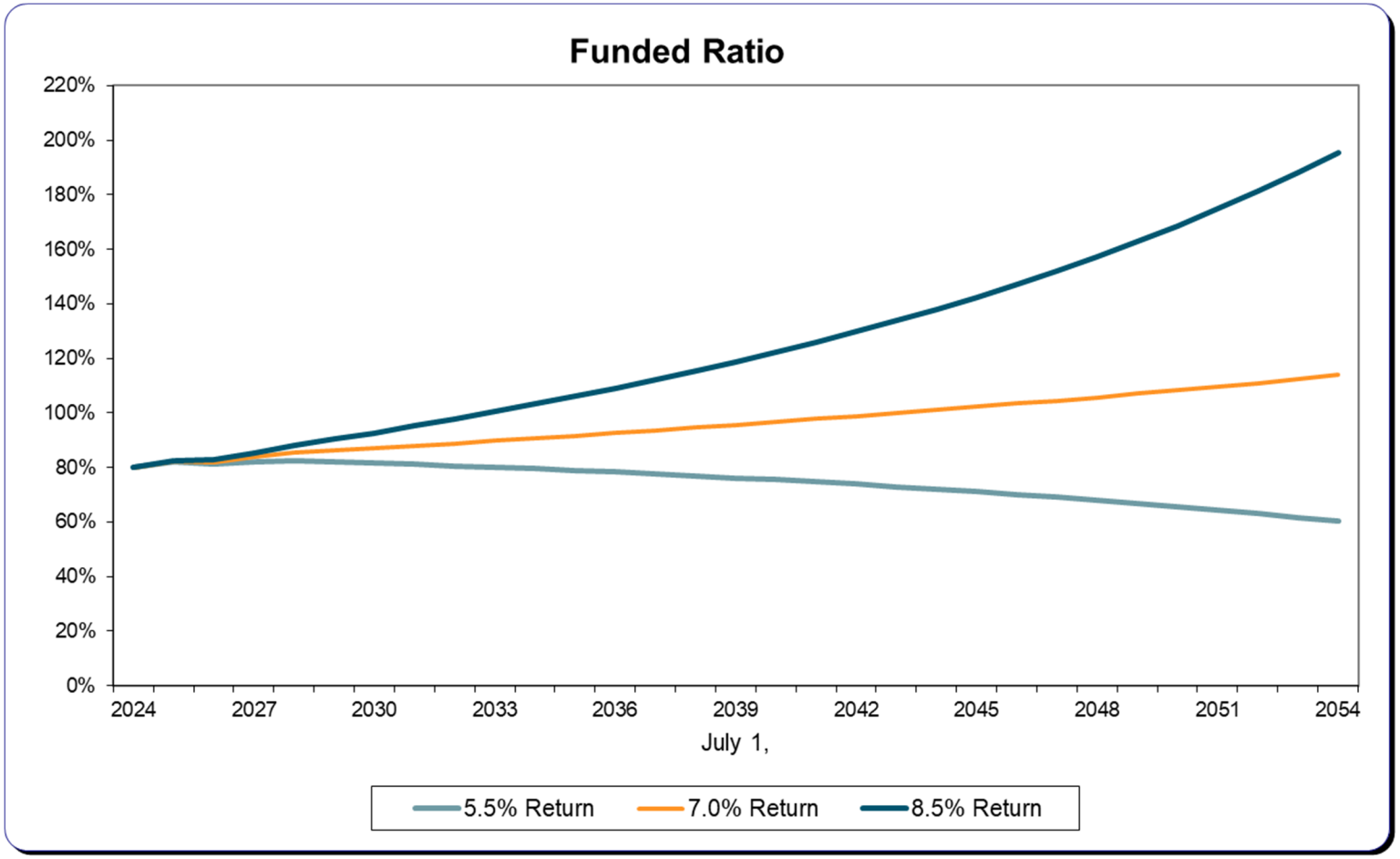
Patrice A. Beckham, FSA, EA, FCA, MAAA
Consulting Actuary



Brent A. Banister, PhD, FSA, EA, FCA, MAAA
Chief Actuary

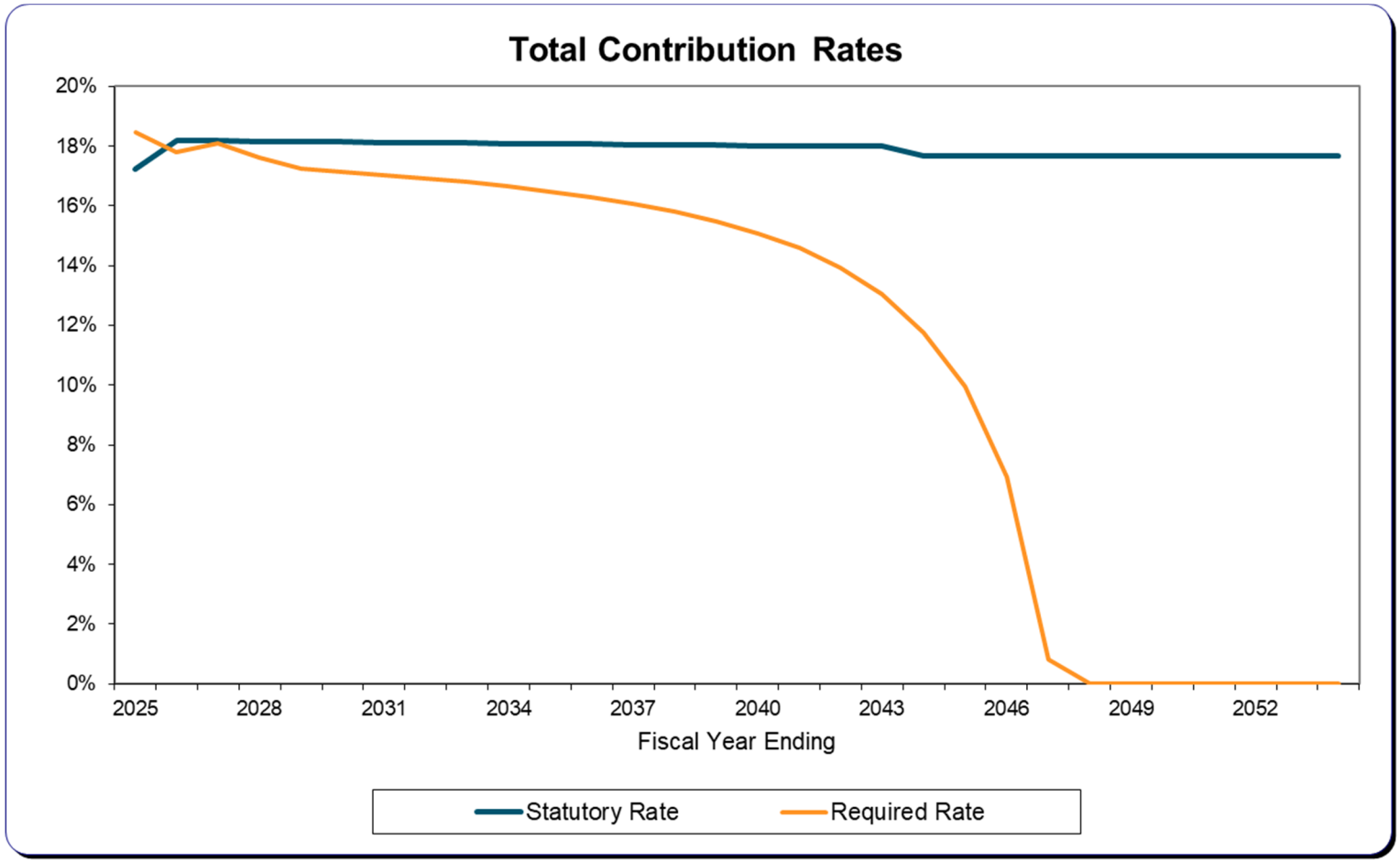
Ben Mobley, ASA, FCA, MAAA
Consulting Actuary

Exhibit A
All Investment Return Scenarios



Results are modeled based on specified investment returns and assuming all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from CavMac dated January 17, 2025 for important details regarding assumptions and methodology.

Exhibit B-1
7.0% Actual Investment Return in Future Years



Results are modeled based on a specified investment return and assuming all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from CavMac dated January 17, 2025 for important details regarding assumptions and methodology.

Exhibit B-2
7.0% Actual Investment Return in Future Years

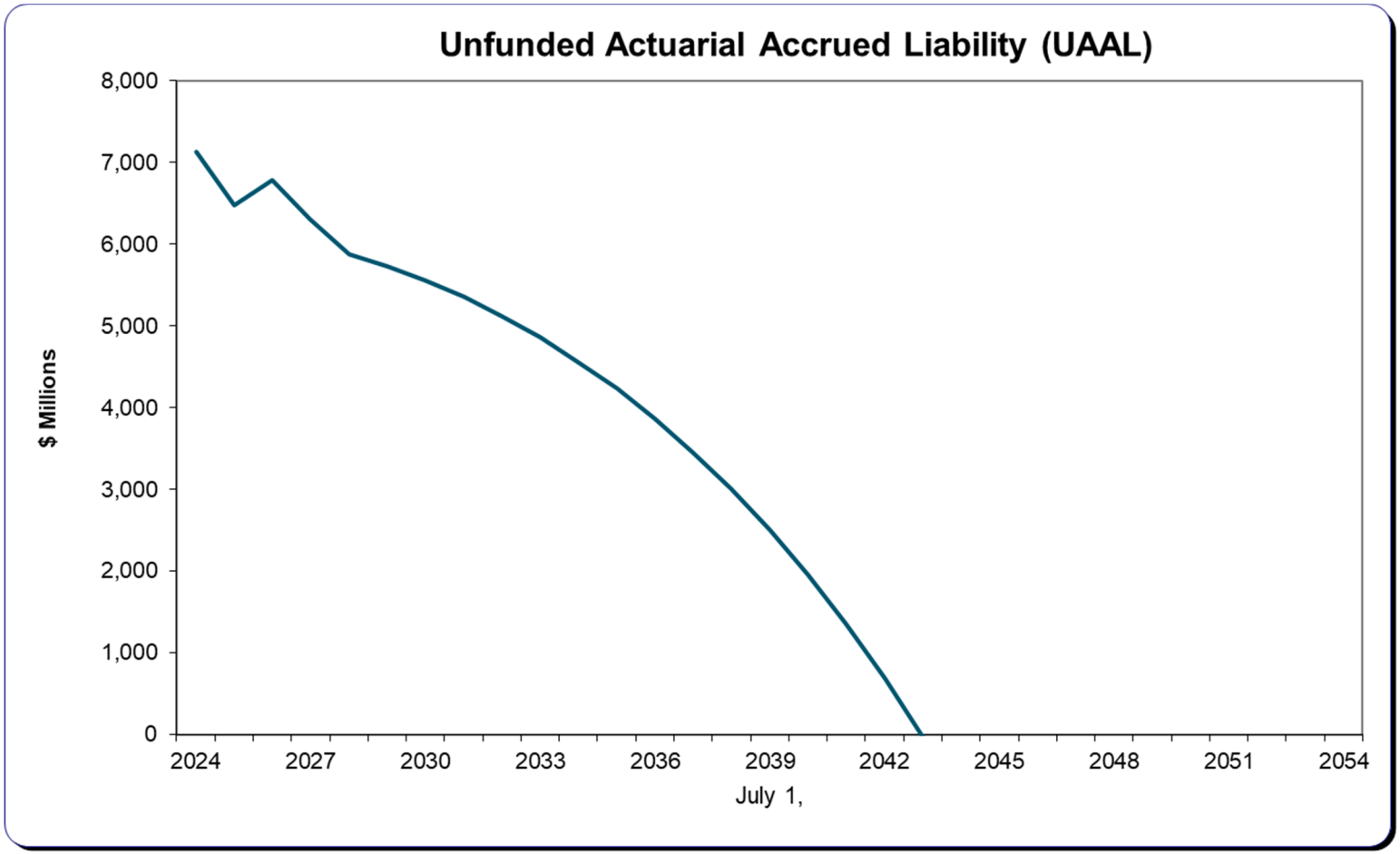


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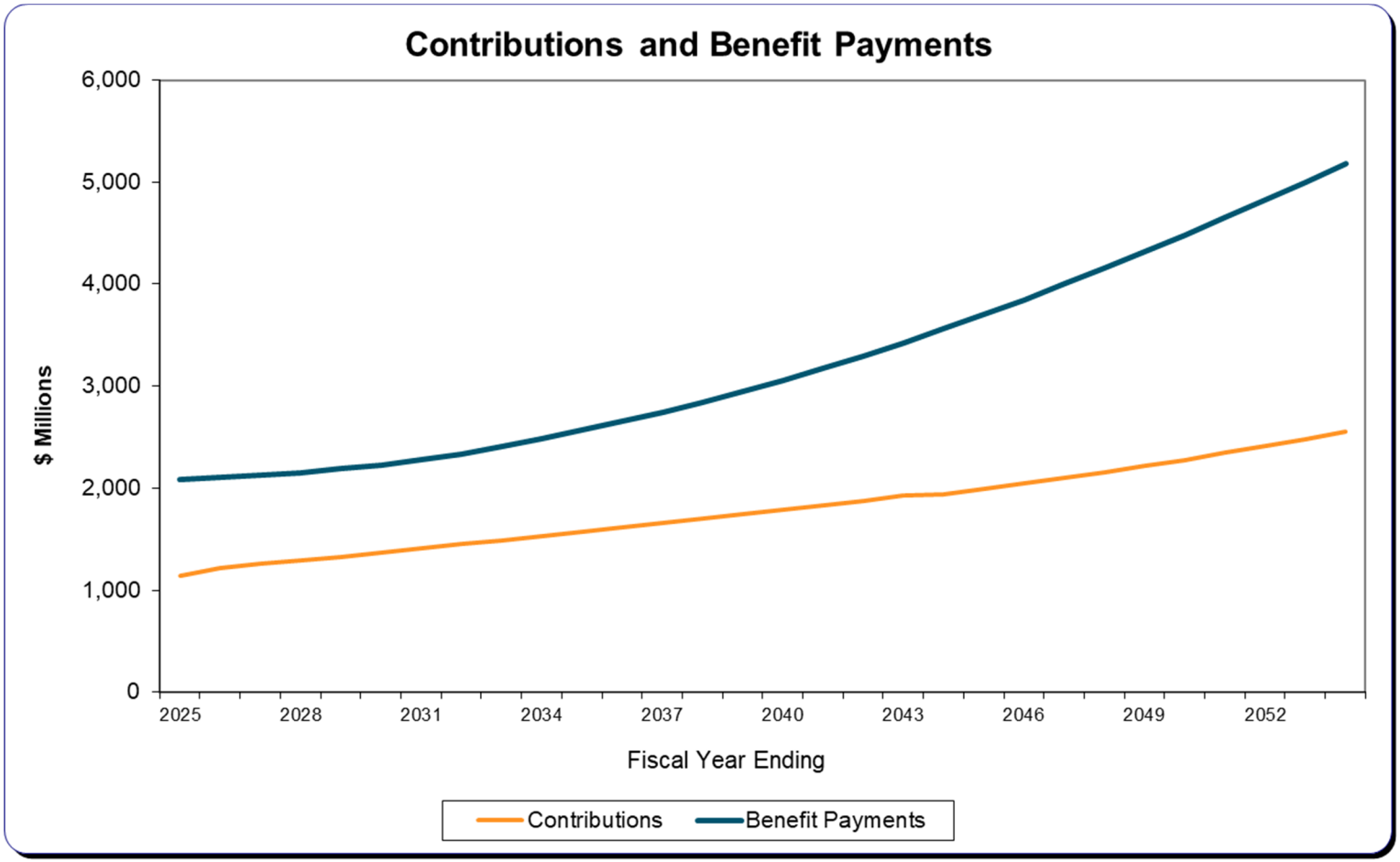
Exhibit B-3
7.0% Actual Investment Return in Future Years



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Teachers Retirement Association of Minnesota

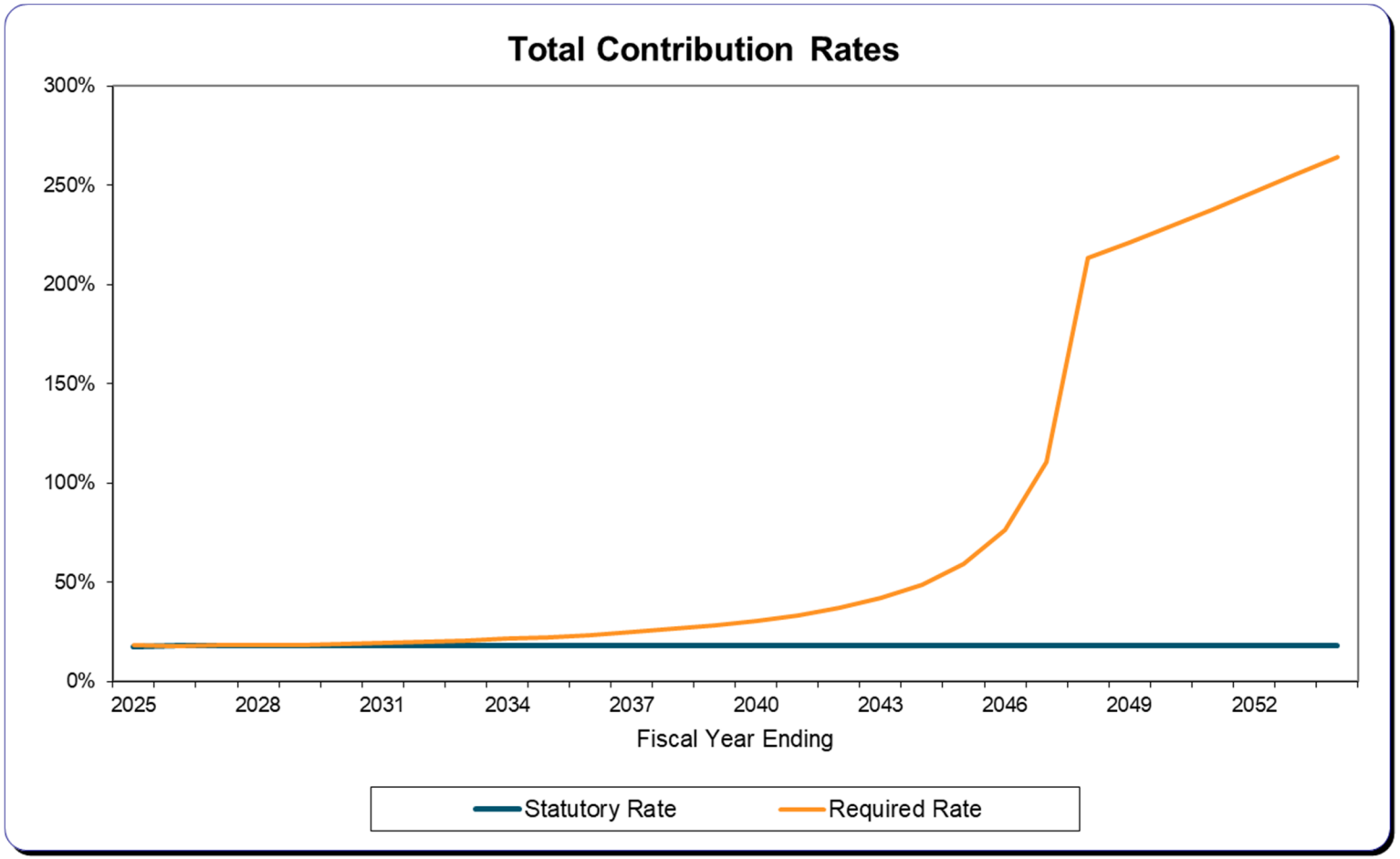
Exhibit C

7.0% Actual Investment Return in Future Years

July 1	Asset Values Actuarial	Asset Values Market	Actuarial Accrued Liability	Unfunded Actuarial Accrued Liability	Funded Ratio	Contribution Rates Statutory	Contribution Rates Required	Contribution Rates Sufficiency/ (Deficiency)	Total Contributions	Benefit Payments
2024	$28,322.80	$29,092.48	$35,446.80	$7,124.00	80%	17.21%	18.46%	-1.25%	$1,147.13	$2,087.57
2025	29,968.49	30,156.15	36,448.96	6,480.47	82%	18.19%	17.79%	0.40%	1,220.14	2,106.01
2026	30,741.43	31,350.74	37,525.42	6,783.98	82%	18.18%	18.09%	0.09%	1,255.74	2,126.95
2027	32,372.82	32,644.10	38,681.92	6,309.10	84%	18.16%	17.63%	0.53%	1,292.72	2,154.08
2028	34,038.18	34,038.18	39,917.31	5,879.13	85%	18.15%	17.24%	0.91%	1,330.56	2,188.68
2029	35,533.20	35,533.20	41,261.59	5,728.39	86%	18.13%	17.15%	0.98%	1,367.36	2,230.17
2030	37,128.03	37,128.03	42,681.50	5,553.47	87%	18.12%	17.03%	1.09%	1,408.82	2,280.42
2031	38,825.40	38,825.40	44,176.54	5,351.14	88%	18.11%	16.92%	1.19%	1,449.87	2,339.26
2032	40,623.17	40,623.17	45,743.08	5,119.90	89%	18.09%	16.79%	1.30%	1,490.72	2,408.53
2033	42,517.41	42,517.41	47,375.18	4,857.77	90%	18.08%	16.64%	1.44%	1,531.55	2,484.79
2034	44,507.59	44,507.59	49,070.53	4,562.94	91%	18.07%	16.48%	1.59%	1,572.79	2,566.44
2035	46,595.28	46,595.28	50,828.15	4,232.87	92%	18.06%	16.29%	1.77%	1,614.63	2,653.95
2036	48,781.87	48,781.87	52,646.73	3,864.87	93%	18.05%	16.07%	1.98%	1,657.00	2,747.18
2037	51,068.91	51,068.91	54,525.18	3,456.27	94%	18.04%	15.80%	2.24%	1,699.95	2,844.29
2038	53,460.01	53,460.01	56,464.28	3,004.27	95%	18.03%	15.48%	2.55%	1,743.93	2,946.12
2039	55,958.65	55,958.65	58,464.17	2,505.52	96%	18.02%	15.08%	2.94%	1,788.56	3,055.01
2040	58,565.73	58,565.73	60,522.46	1,956.73	97%	18.01%	14.58%	3.43%	1,833.87	3,170.81
2041	61,282.39	61,282.39	62,636.62	1,354.23	98%	18.00%	13.92%	4.08%	1,880.20	3,293.09
2042	64,110.65	64,110.65	64,804.82	694.16	99%	17.99%	13.03%	4.96%	1,927.92	3,422.42
2043	67,052.47	67,052.47	67,024.90	(27.57)	100%	17.66%	11.77%	5.89%	1,941.37	3,558.13
2044	70,073.76	70,073.76	69,295.04	(778.72)	101%	17.66%	9.96%	7.70%	1,992.33	3,700.58
2045	73,211.90	73,211.90	71,612.67	(1,599.22)	102%	17.66%	6.92%	10.74%	2,044.96	3,848.63
2046	76,471.01	76,471.01	73,976.69	(2,494.32)	103%	17.66%	0.82%	16.84%	2,099.55	4,001.26
2047	79,856.84	79,856.84	76,387.18	(3,469.65)	105%	17.66%	0.00%	17.66%	2,156.80	4,157.15
2048	83,377.64	83,377.64	78,846.04	(4,531.60)	106%	17.66%	0.00%	17.66%	2,216.94	4,317.02
2049	87,041.73	87,041.73	81,354.30	(5,687.43)	107%	17.66%	0.00%	17.66%	2,279.64	4,480.77
2050	90,857.79	90,857.79	83,913.19	(6,944.60)	108%	17.66%	0.00%	17.66%	2,344.91	4,649.50
2051	94,833.95	94,833.95	86,522.94	(8,311.01)	110%	17.66%	0.00%	17.66%	2,412.87	4,822.24
2052	98,980.05	98,980.05	89,185.23	(9,794.82)	111%	17.66%	0.00%	17.66%	2,483.85	4,997.89
2053	103,308.11	103,308.11	91,903.17	(11,404.94)	112%	17.66%	0.00%	17.66%	2,558.15	5,178.16
2054	107,829.52	107,829.52	94,677.86	(13,151.66)	114%	17.66%	0.00%	17.66%	2,635.14	5,363.76

Results are modeled based on a specified investment return and assuming all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from CavMac dated January 17, 2025 for important details regarding assumptions and methodology.

Exhibit D-1
5.5% Actual Investment Return in Future Years

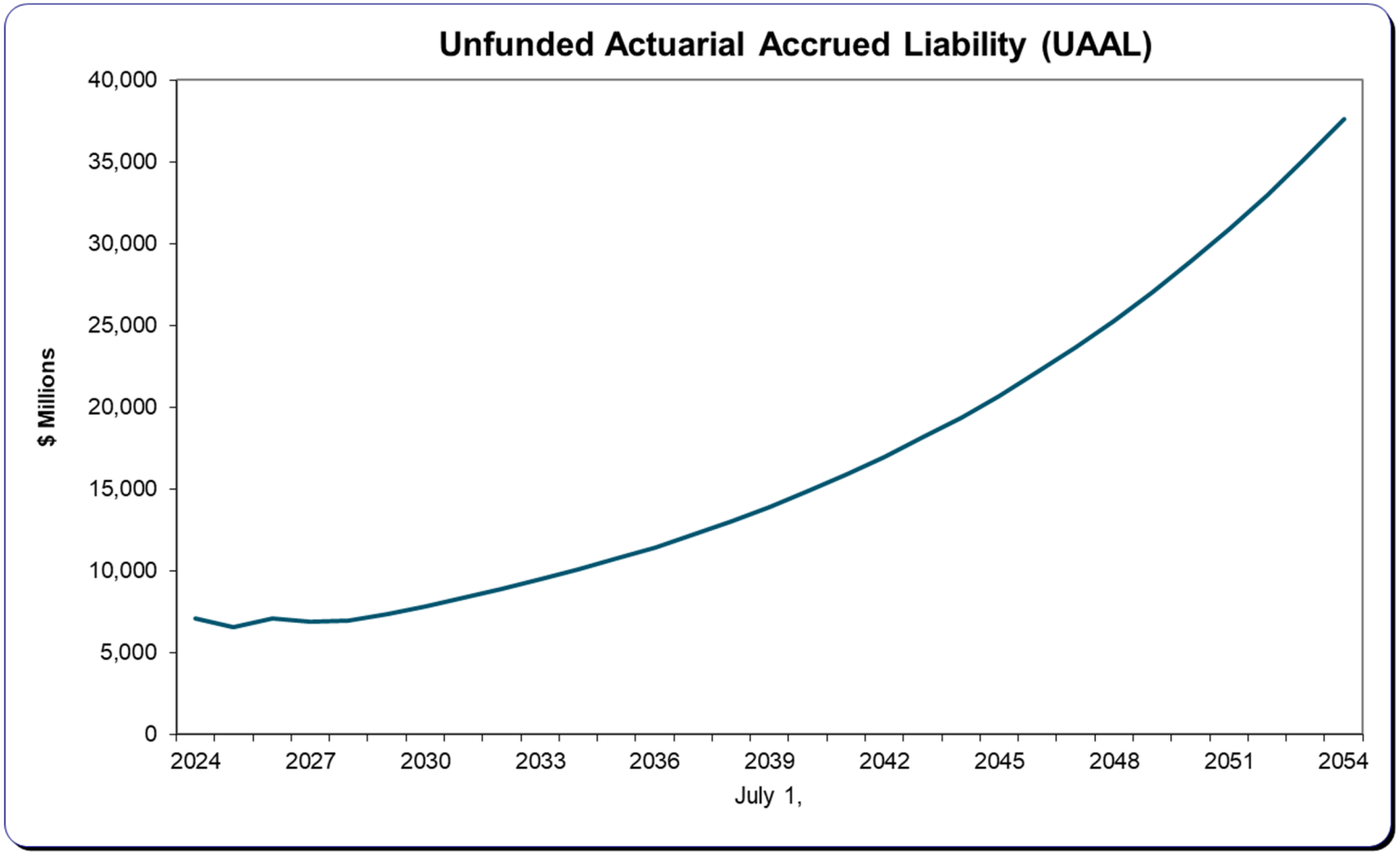


Results are modeled based on a specified investment return and assuming all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from CavMac dated January 17, 2025 for important details regarding assumptions and methodology.

Teachers Retirement Association of Minnesota

Exhibit D-2

5.5% Actual Investment Return in Future Years



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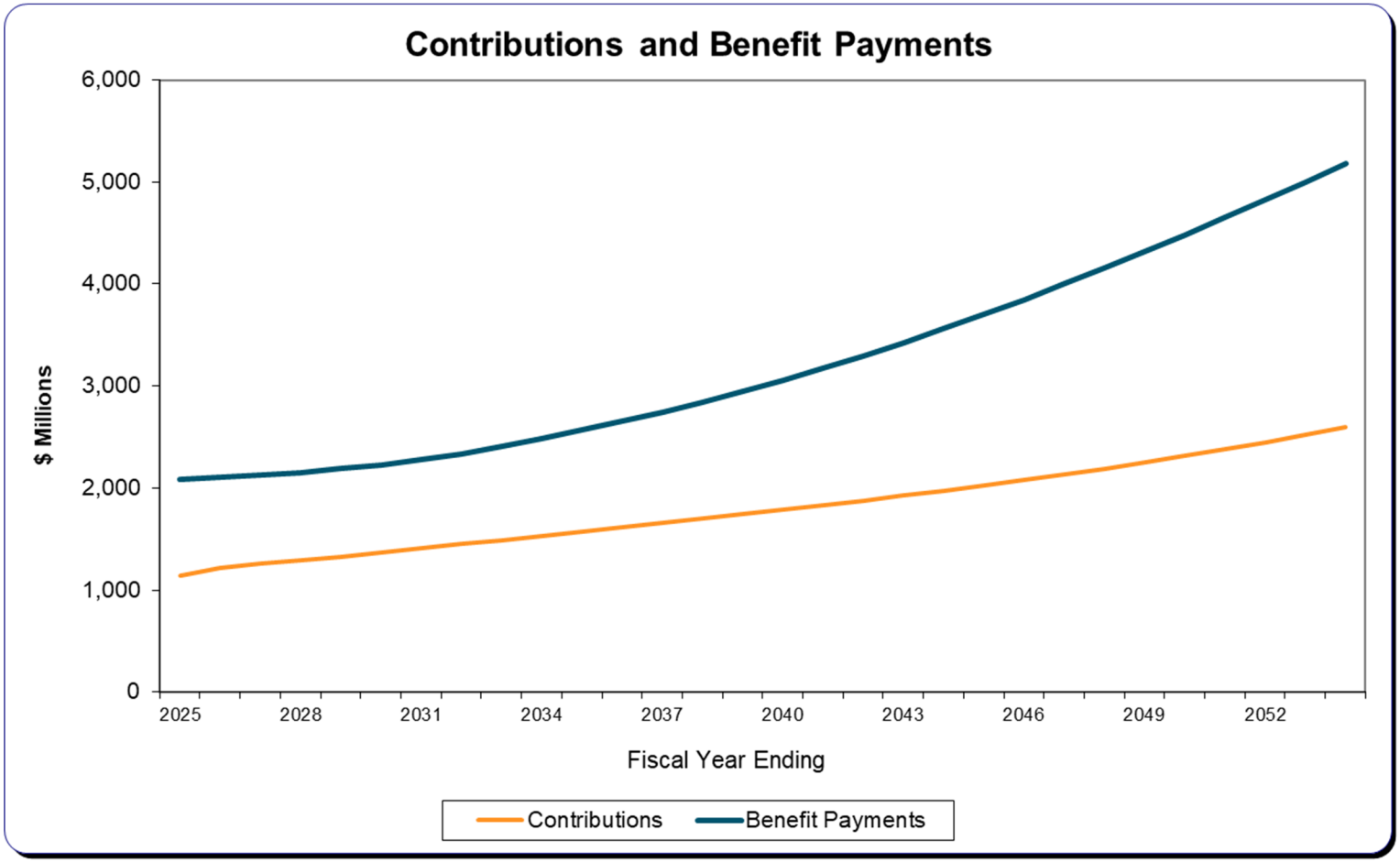
Teachers Retirement Association of Minnesota

Exhibit D-3

5.5% Actual Investment Return in Future Years



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Teachers Retirement Association of Minnesota

Exhibit E

5.5% Actual Investment Return in Future Years

July 1	Asset Values Actuarial	Asset Values Market	Actuarial Accrued Liability	Unfunded Actuarial Accrued Liability	Funded Ratio	Contribution Rates Statutory	Contribution Rates Required	Contribution Rates Sufficiency/ (Deficiency)	Total Contributions	Benefit Payments
2024	$28,322.80	$29,092.48	$35,446.80	$7,124.00	80%	17.21%	18.46%	-1.25%	$1,147.13	$2,087.57
2025	29,882.58	29,726.61	36,448.96	6,566.38	82%	18.19%	17.88%	0.31%	1,220.14	2,106.01
2026	30,451.66	30,451.67	37,525.42	7,073.76	81%	18.18%	18.38%	-0.20%	1,255.74	2,126.95
2027	31,756.22	31,231.66	38,681.92	6,925.70	82%	18.16%	18.24%	-0.08%	1,292.72	2,154.08
2028	32,966.38	32,064.67	39,917.31	6,950.93	83%	18.15%	18.30%	-0.15%	1,330.56	2,188.68
2029	33,871.99	32,946.82	41,261.59	7,389.60	82%	18.13%	18.81%	-0.68%	1,367.36	2,230.17
2030	34,822.82	33,872.67	42,681.50	7,858.69	82%	18.12%	19.35%	-1.23%	1,408.82	2,280.42
2031	35,816.90	34,840.42	44,176.54	8,359.64	81%	18.11%	19.97%	-1.86%	1,449.87	2,339.26
2032	36,847.18	35,843.11	45,743.08	8,895.89	81%	18.09%	20.68%	-2.59%	1,490.72	2,408.53
2033	37,904.51	36,871.77	47,375.18	9,470.67	80%	18.08%	21.49%	-3.41%	1,531.55	2,484.79
2034	38,982.91	37,920.61	49,070.53	10,087.62	79%	18.07%	22.43%	-4.36%	1,572.79	2,566.44
2035	40,078.20	38,985.64	50,828.15	10,749.95	79%	18.06%	23.53%	-5.47%	1,614.63	2,653.95
2036	41,185.70	40,062.33	52,646.73	11,461.03	78%	18.05%	24.81%	-6.76%	1,657.00	2,747.18
2037	42,300.60	41,146.00	54,525.18	12,224.58	78%	18.04%	26.34%	-8.30%	1,699.95	2,844.29
2038	43,419.73	42,233.64	56,464.28	13,044.55	77%	18.03%	28.19%	-10.16%	1,743.93	2,946.12
2039	44,539.44	43,321.67	58,464.17	13,924.73	76%	18.02%	30.45%	-12.43%	1,788.56	3,055.01
2040	45,653.04	44,403.55	60,522.46	14,869.42	75%	18.01%	33.30%	-15.29%	1,833.87	3,170.81
2041	46,753.63	45,472.53	62,636.62	15,882.99	75%	18.00%	36.96%	-18.96%	1,880.20	3,293.09
2042	47,834.73	46,522.30	64,804.82	16,970.08	74%	17.99%	41.86%	-23.87%	1,927.92	3,422.42
2043	48,889.28	47,545.97	67,024.90	18,135.63	73%	17.99%	48.71%	-30.72%	1,977.13	3,558.13
2044	49,910.62	48,537.11	69,295.04	19,384.42	72%	17.98%	58.99%	-41.01%	2,028.09	3,700.58
2045	50,891.64	49,488.78	71,612.67	20,721.03	71%	17.97%	76.13%	-58.16%	2,080.72	3,848.63
2046	51,825.96	50,394.78	73,976.69	22,150.73	70%	17.96%	110.39%	-92.43%	2,135.31	4,001.26
2047	52,708.17	51,249.92	76,387.18	23,679.01	69%	17.95%	213.07%	-195.12%	2,192.56	4,157.15
2048	53,534.71	52,050.77	78,846.04	25,311.33	68%	17.94%	221.12%	-203.18%	2,252.70	4,317.02
2049	54,301.33	52,793.23	81,354.30	27,052.97	67%	17.94%	229.39%	-211.45%	2,315.40	4,480.77
2050	55,003.34	53,472.73	83,913.19	28,909.84	66%	17.93%	237.87%	-219.94%	2,380.66	4,649.50
2051	55,634.68	54,083.34	86,522.94	30,888.26	64%	17.92%	246.56%	-228.64%	2,448.62	4,822.24
2052	56,190.05	54,619.91	89,185.23	32,995.18	63%	17.91%	255.41%	-237.50%	2,519.60	4,997.89
2053	56,665.34	55,078.48	91,903.17	35,237.83	62%	17.91%	264.43%	-246.52%	2,593.91	5,178.16
2054	57,054.79	55,453.42	94,677.86	37,623.07	60%	17.90%	273.67%	-255.77%	2,670.90	5,363.76

Results are modeled based on a specified investment return and assuming all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from CavMac dated January 17, 2025 for important details regarding assumptions and methodology.

Teachers Retirement Association of Minnesota

Exhibit F-1

8.5% Actual Investment Return in Future Years

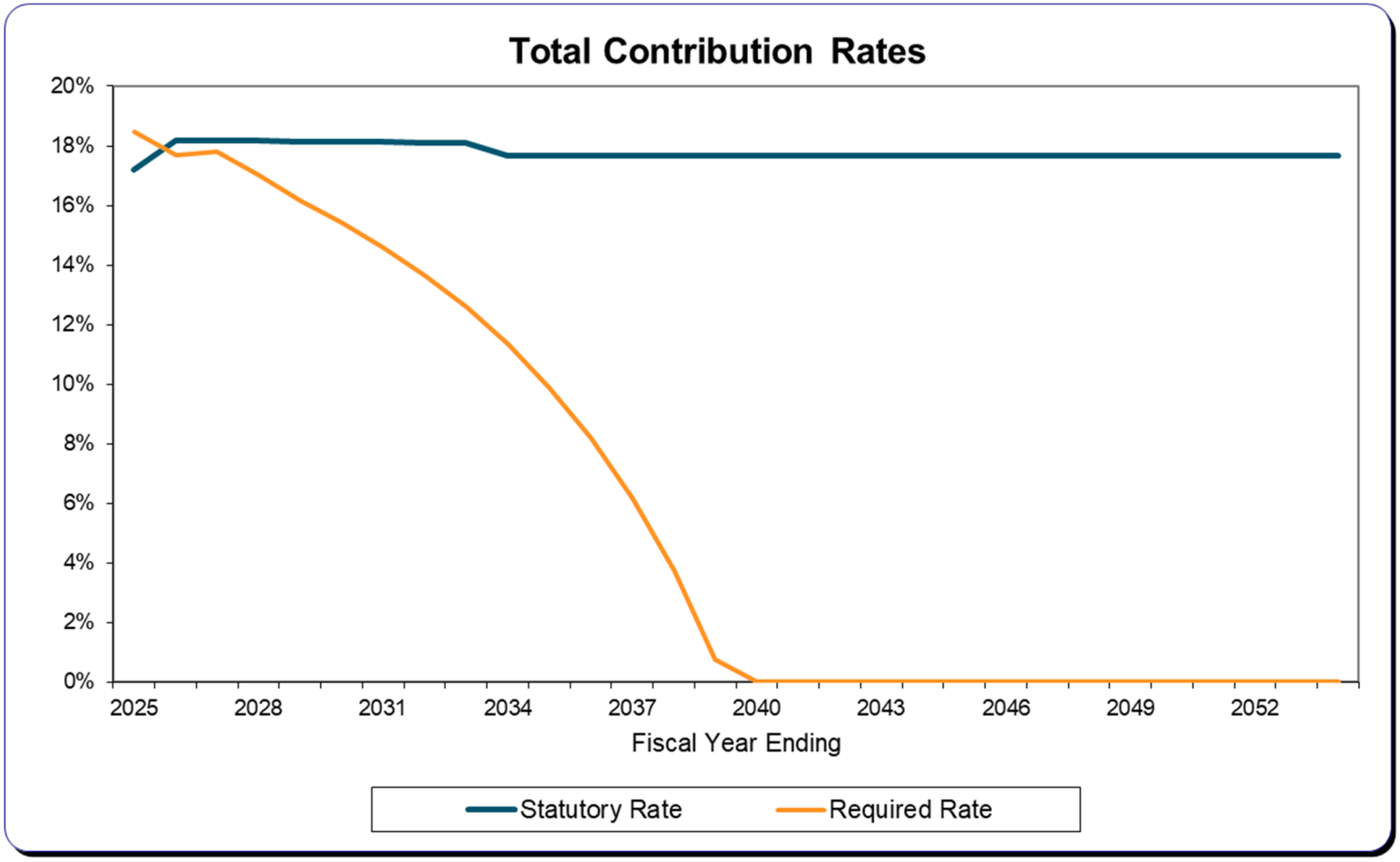

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Exhibit F-2

8.5% Actual Investment Return in Future Years

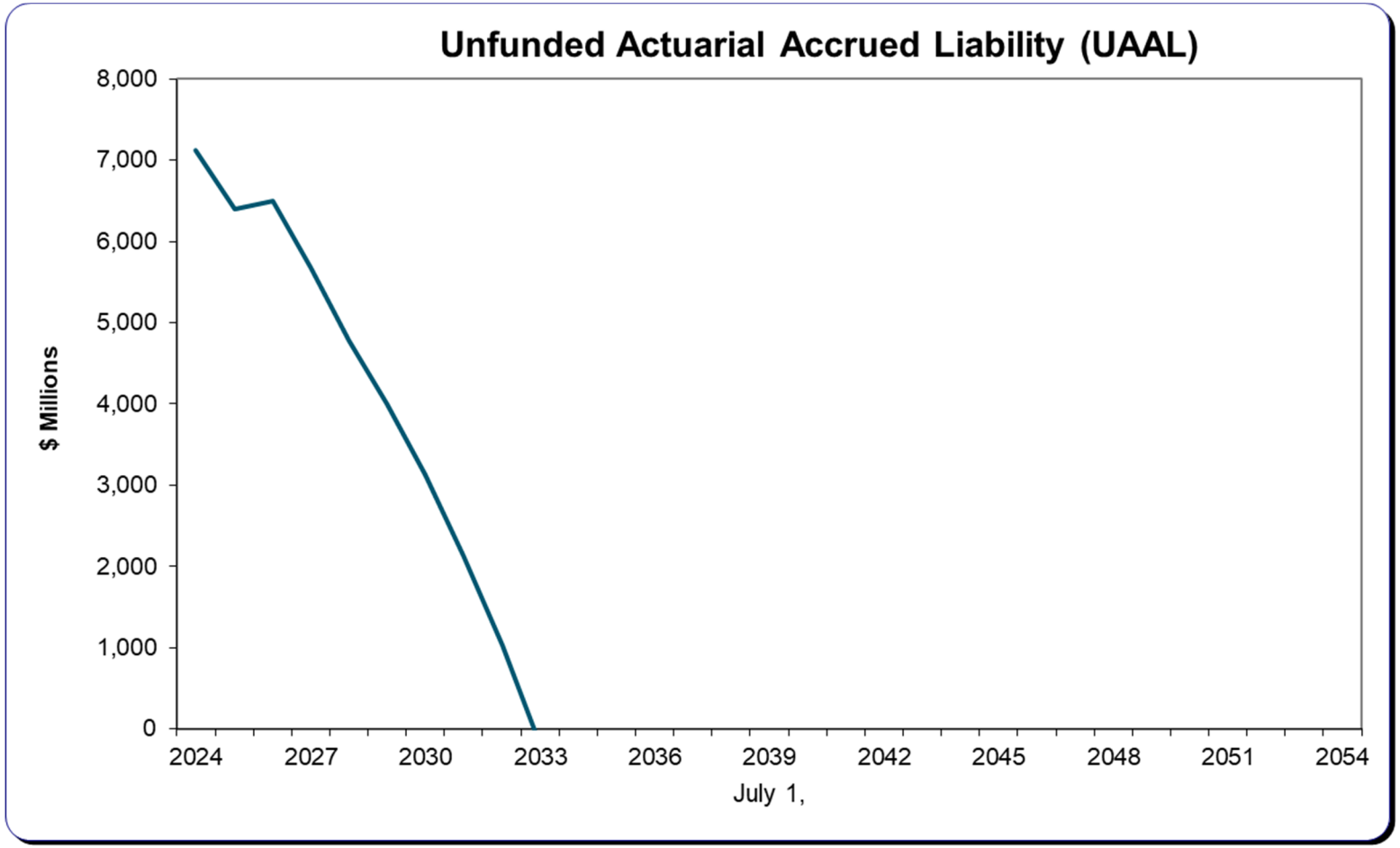

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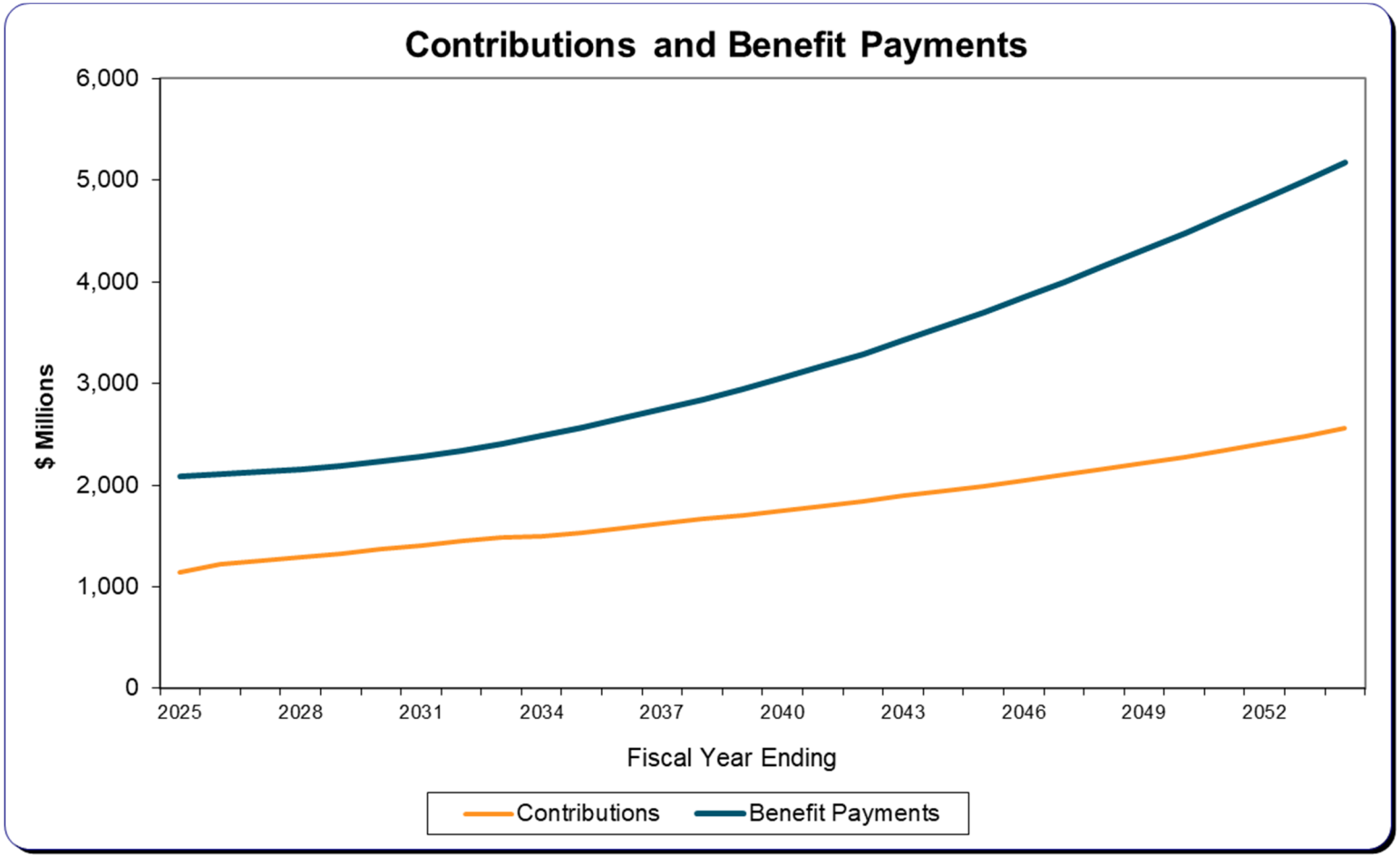
Exhibit F-3

8.5% Actual Investment Return in Future Years



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Teachers Retirement Association of Minnesota

Exhibit G

8.5% Actual Investment Return in Future Years

July 1	Asset Values Actuarial	Asset Values Market	Actuarial Accrued Liability	Unfunded Actuarial Accrued Liability	Funded Ratio	Contribution Rates Statutory	Contribution Rates Required	Contribution Rates Sufficiency/ (Deficiency)	Total Contributions	Benefit Payments
2024	$28,322.80	$29,092.48	$35,446.80	$7,124.00	80%	17.21%	18.46%	-1.25%	$1,147.13	$2,087.57
2025	30,054.41	30,585.75	36,448.96	6,394.55	82%	18.19%	17.70%	0.49%	1,220.14	2,106.01
2026	31,033.82	32,262.78	37,525.42	6,491.60	83%	18.18%	17.80%	0.38%	1,255.74	2,126.95
2027	33,000.97	34,097.64	38,681.92	5,680.95	85%	18.16%	17.01%	1.15%	1,292.72	2,154.08
2028	35,141.05	36,098.71	39,917.31	4,776.26	88%	18.15%	16.15%	2.00%	1,330.56	2,188.68
2029	37,260.35	38,273.25	41,261.59	4,001.25	90%	18.13%	15.42%	2.71%	1,367.36	2,230.17
2030	39,554.66	40,627.74	42,681.50	3,126.85	93%	18.12%	14.59%	3.53%	1,408.82	2,280.42
2031	42,034.84	43,173.21	44,176.54	2,141.71	95%	18.11%	13.66%	4.45%	1,449.87	2,339.26
2032	44,707.50	45,916.51	45,743.08	1,035.58	98%	18.09%	12.58%	5.51%	1,490.72	2,408.53
2033	47,578.18	48,863.39	47,375.18	(202.99)	100%	17.66%	11.32%	6.34%	1,495.79	2,484.79
2034	50,619.60	51,986.61	49,070.53	(1,549.07)	103%	17.66%	9.89%	7.77%	1,537.03	2,566.44
2035	53,878.75	55,333.20	50,828.15	(3,050.60)	106%	17.66%	8.20%	9.46%	1,578.88	2,653.95
2036	57,368.74	58,916.69	52,646.73	(4,722.01)	109%	17.66%	6.18%	11.48%	1,621.24	2,747.18
2037	61,103.86	62,751.80	54,525.18	(6,578.68)	112%	17.66%	3.74%	13.92%	1,664.19	2,844.29
2038	65,101.53	66,856.47	56,464.28	(8,637.25)	115%	17.66%	0.75%	16.91%	1,708.17	2,946.12
2039	69,380.31	71,249.77	58,464.17	(10,916.14)	119%	17.66%	0.00%	17.66%	1,752.80	3,055.01
2040	73,957.55	75,949.59	60,522.46	(13,435.09)	122%	17.66%	0.00%	17.66%	1,798.11	3,170.81
2041	78,852.28	80,975.45	62,636.62	(16,215.66)	126%	17.66%	0.00%	17.66%	1,844.44	3,293.09
2042	84,085.96	86,349.41	64,804.82	(19,281.15)	130%	17.66%	0.00%	17.66%	1,892.16	3,422.42
2043	89,681.70	92,095.14	67,024.90	(22,656.79)	134%	17.66%	0.00%	17.66%	1,941.37	3,558.13
2044	95,665.32	98,239.16	69,295.04	(26,370.28)	138%	17.66%	0.00%	17.66%	1,992.33	3,700.58
2045	102,064.77	104,810.12	71,612.67	(30,452.10)	143%	17.66%	0.00%	17.66%	2,044.96	3,848.63
2046	108,911.45	111,840.22	73,976.69	(34,934.76)	147%	17.66%	0.00%	17.66%	2,099.55	4,001.26
2047	116,240.76	119,365.76	76,387.18	(39,853.57)	152%	17.66%	0.00%	17.66%	2,156.80	4,157.15
2048	124,093.18	127,428.22	78,846.04	(45,247.15)	157%	17.66%	0.00%	17.66%	2,216.94	4,317.02
2049	132,512.12	136,072.11	81,354.30	(51,157.82)	163%	17.66%	0.00%	17.66%	2,279.64	4,480.77
2050	141,544.39	145,345.47	83,913.19	(57,631.21)	169%	17.66%	0.00%	17.66%	2,344.91	4,649.50
2051	151,239.66	155,299.30	86,522.94	(64,716.72)	175%	17.66%	0.00%	17.66%	2,412.87	4,822.24
2052	161,652.95	165,990.06	89,185.23	(72,467.72)	181%	17.66%	0.00%	17.66%	2,483.85	4,997.89
2053	172,845.46	177,480.50	91,903.17	(80,942.29)	188%	17.66%	0.00%	17.66%	2,558.15	5,178.16
2054	184,882.08	189,837.25	94,677.86	(90,204.22)	195%	17.66%	0.00%	17.66%	2,635.14	5,363.76

Results are modeled based on a specified investment return and assuming all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from CavMac dated January 17, 2025 for important details regarding assumptions and methodology.