



Cavanaugh Macdonald

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January 28, 2014

Ms. Laurie Hacking
Executive Director
Teacher Retirement Association of Minnesota
60 Empire Drive, Suite 400
St. Paul, MN 55103

Re: Projection of Future Actuarial Results

Dear Laurie:

Attached are both graphs and tables that show the estimated funded status, required and statutory contribution rates, contributions and benefit payments, and the unfunded actuarial accrued liability (UAAL) under three investment return scenarios for the Teachers Retirement Association of Minnesota (TRA). These projections are for a thirty year period beginning with the July 1, 2013 actuarial valuation. As required by the Legislative Commission on Pensions and Retirement (LCPR) Standards for Actuarial Work, projections of key valuation results are shown assuming future investment returns equal to the actuarial assumed rate of return and a return 1.5% higher and lower than the assumed rate of return. The resulting investment return scenarios for these projections are:

- (1) 6.5% for the first four years and 7.0% thereafter,
- (2) 8.0% for the first four years and 8.5% thereafter, and
- (3) 9.5% for the next four years and 10.0% thereafter.

While the actual investment returns earned in future years changed under the different scenarios, the select and ultimate investment return assumption of 8.0% for the next four years and 8.5% thereafter that is used in the actuarial valuation was not changed, as specified by the LCPR standards. As a result, the actuarial accrued liability is the same under all three scenarios.

The projections are developed by first creating a demographic profile of recent new entrants. Next, the membership population from the July 1, 2013 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. Then, a valuation is performed as of July 1, 2014 to determine the various actuarial liabilities and cost measurements. The last two steps are repeated in each future year until projections have been performed through the July 1, 2043 valuation. To model the possibility of the cost of living adjustment (COLA) returning to 2.5% at some future date, projections were also performed using a 2.5% COLA assumption for future years.

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We have reflected the current benefits and contributions provided by law. In particular, we have reflected the scheduled contribution rate increases of 1% (shared between employees and employers) effective July 1, 2014. The estimated valuation results presented in this letter are shown under two contribution scenarios. The first is a fixed contribution rate scenario, assuming that the Board does not utilize the stabilizer mechanism, as described in Minnesota Statutes Chapter 354.42, to adjust future contribution rates. The second scenario assumes that the contribution stabilizer applies in all years in which it is applicable, beginning after June 30, 2015. Our understanding is that the contribution stabilizer may be used at the Board's discretion, so these two scenarios reflect a range of possible outcomes. See Exhibit A for a summary of the TRA provisions regarding the contribution rate stabilizer.

Based on the operation of the contribution stabilizer, the projected statutory contribution rate in 2025 is shown in the table below to provide a comparison of results under the three investment return scenarios. Use of a date later than 2025 tends to produce results that may be distorted due to the short nature of the amortization period.

Assumed Investment Return	Statutory Contribution Rate in 2025
6.5% for 4 years, then 7.0%	23.02%
8.0% for 4 years, then 8.5%	18.52%
9.5% for 4 years, then 10.0%	14.38%

Postretirement Benefit Increases

One of the key assumptions that affect the projected valuation results is the expectation of annual increases in the benefit amounts paid to retirees and beneficiaries. Under current law, if the plan reaches a funded ratio of 90% (using the market value of assets) in the future, postretirement adjustment increases will revert to the 2.5% level (currently 2.0%). Our projections reflect an annual COLA of 2.0% until the funding of TRA improves. Once the market value of assets exceeds 90% of the actuarial accrued liability, measured with a 2.5% future COLA assumption, then the 2.5% COLA is assumed to be granted in all future years. For valuations between now and the implementation of the 2.5% COLA, the methodology for anticipating the future COLA increase has not yet been determined by the LCPR. In keeping with the most recent valuation approach of assuming a 2% COLA indefinitely, we have used this approach in the modeling as a reasonable interpretation of the intent of the guiding legislation. Based on our approach, the projections indicate that the funded status of the Plan is expected to reach 90%, assuming a 2.5% COLA in future years, in the following years:

Assumed Investment Return	Estimated Date to Reach 90% Funding Ratio
6.5%/7.0% without stabilizer	*
6.5%/7.0% with stabilizer	2038
8.0%/8.5% without stabilizer	*
8.0%/8.5% with stabilizer	2033
9.5%/10.0% without stabilizer	2023
9.5%/10.0% with stabilizer	2023

*Not projected to reach 90% funding ratio within the 30 year projection period.



In the absence of guidance from the LCPR regarding how the change in the anticipated COLA should be handled in valuations, each of the funds in conjunction with their consulting actuaries has had to make an interpretation for purposes of these projections. Because the projected results for TRA are expected to be compared with the projections for the Public Employees Retirement Association of Minnesota (PERA) and the Minnesota State Retirement System (MSRS), it is important to note that a different approach has been used in completing the projection studies for PERA and MSRS. Based on our discussions with Gabriel Roeder Smith (GRS), the actuarial firm retained by PERA and MSRS, projections were discontinued once the criteria for reinstating the 2.5% COLA was met. We have continued to show the projection results for the remainder of the thirty year period for TRA assuming the 2.5% COLA will be granted in all future years following the reinstatement of the 2.5% COLA. We would note that the other systems have differences in funded status, current COLA provisions, and contribution sufficiency that may result in a shorter timeframe for moving to the 2.5% COLA than what is expected for TRA.

The calculation of the required contribution rate for TRA uses a closed amortization period of 24 years for the July 1, 2013 valuation. Because the amortization period is closed, it eventually reaches one year in the July 1, 2036 valuation and remains at one year for all subsequent years if the actuarial accrued liability is greater than the actuarial value of assets. If the actuarial value of assets is greater than the actuarial accrued liability, the amortization period is reset to an open thirty (30) year period. Under several of the scenarios, the short amortization period leads to required contribution rates that are very large and/or volatile in the last few years of the projection period. If those scenarios occur, there would likely be changes made to prevent such a contribution pattern before the amortization period reached one year, but the requirements of the Standards for Actuarial Work preclude us from reflecting any change in the amortization period in our projections. This fact should be considered when viewing the results in the later years of the projection study.

In preparing these exhibits, we have followed the Standards for Actuarial Work, with the following exceptions which are allowed by the Standards. Because of the expected changes in active membership demographics over time as the pre-July 1, 1989 tier leaves covered employment and current Baby Boomers are replaced by new employees, we have modeled future populations and valued them directly. We believe that this provides a better reflection of future valuation results than would be produced by assuming a constant normal cost rate and fixed growth in covered payroll.

Disclaimers, Caveats, and Limitations

The projection results are based upon the July 1, 2013 actuarial valuation results, the actuarial assumptions used in the valuation, and the projection model prepared by the Fund's actuary, Cavanaugh Macdonald Consulting. 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 demographic assumptions regarding mortality, disability, retirement, salary increases, and termination of employment are assumed to be met exactly in each year in the future. Please note that the actuarial assumption assumes that mortality will improve in the future (i.e. people will live longer).
- Changes in 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. Because such changes cannot be reasonably anticipated, however, 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 gradual departure of current active members who were hired before July 1, 1989, and have the retirement eligibility in effect at that time, the demographic composition of the membership may gradually change over time.
- Plan provisions and scheduled contribution rate increases are assumed to remain unchanged from current law. As noted earlier, the contribution stabilizer could be used to adjust the contribution rate, but because it is discretionary, we have not reflected its usage unless specifically noted.
- 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. When the amortization period reaches a duration of one year with the July 1, 2036 valuation, it is assumed to remain at one year for all future valuations.
- The current supplementary contributions made by the state are assumed to continue to be paid at approximately the same dollar amount as currently paid.
- 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, 2013, and project future events using one set of assumptions out of a range of many possibilities. The projections do not predict the Fund's financial condition or its ability to pay benefits in the future and do not provide any guarantee of future financial soundness of the Fund. 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. Because not all of the assumptions will unfold exactly as expected, actual results will differ from 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 change to the benefit structure, funding the plan, or investment policy should not be made on the basis of these projections, but only after comprehensive analysis of alternative sets of assumptions.

We, Patrice A. Beckham and Brent A. Banister, 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. We also meet the requirements of "approved actuary" under Minnesota Statutes, Section 356.215, Subdivision 1, Paragraph (c).

Sincerely,

A handwritten signature in black ink that reads "Patrice Beckham".

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

A handwritten signature in black ink that reads "Brent A. Banister".

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



EXHIBIT A

Contribution Stabilizer

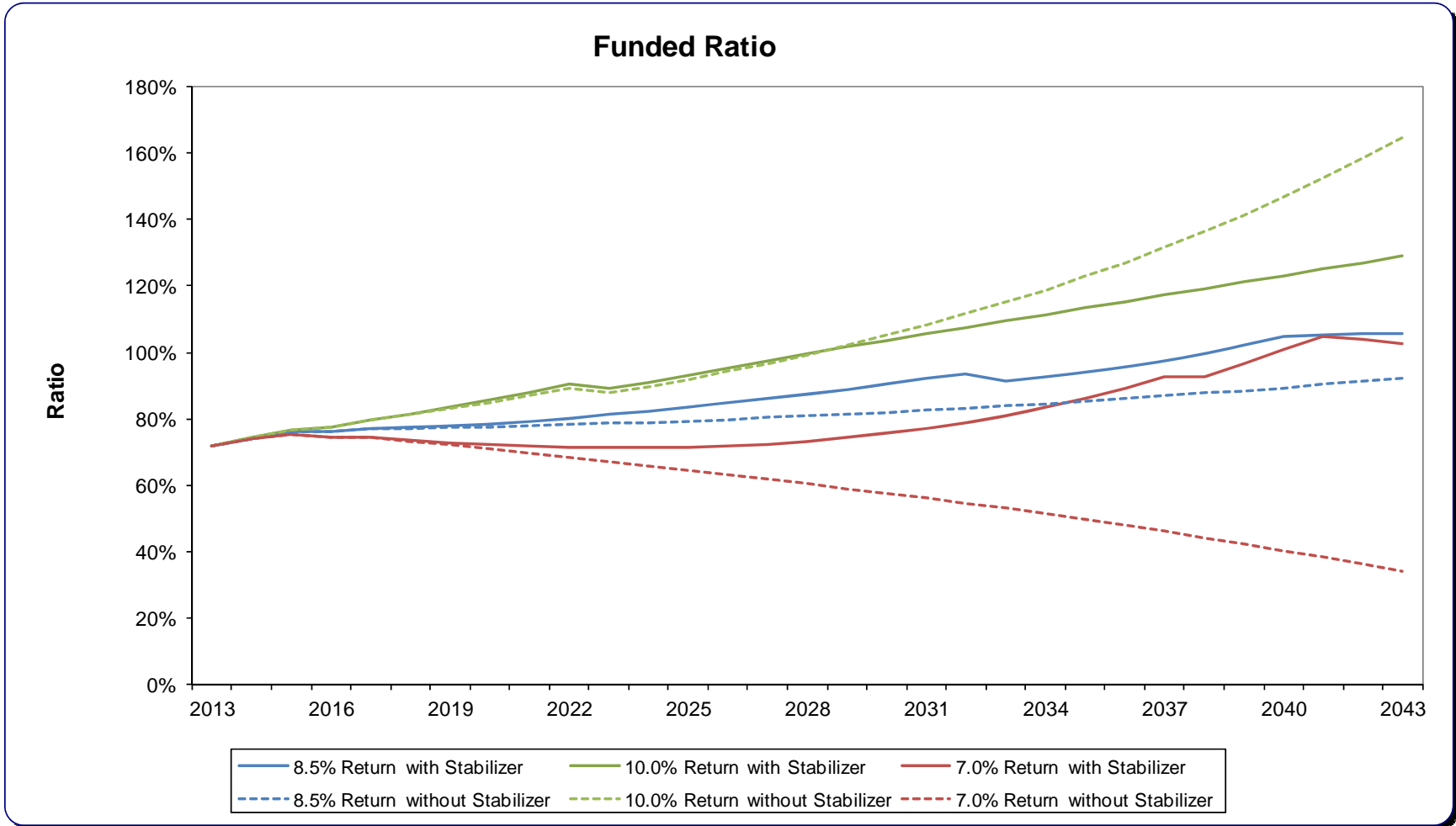
After June 30, 2015, member and employer contribution rates may be adjusted by the Board as follows:

- If a contribution sufficiency of at least 1.00% has existed for two consecutive years, the member and employer contribution rates may be decreased to a level that is necessary to maintain a 1% sufficiency
- If a contribution deficiency of at least 0.25% has existed for two consecutive years, the member and employer contribution rates may each be increased as shown below:

Contribution Deficiency in Most Recent Year	Allowable Increase in Member and Employer Contribution Rates
< 2% of pay	0.25% of pay
2% to 4% of pay	0.50% of pay
>4% of pay	0.75% of pay



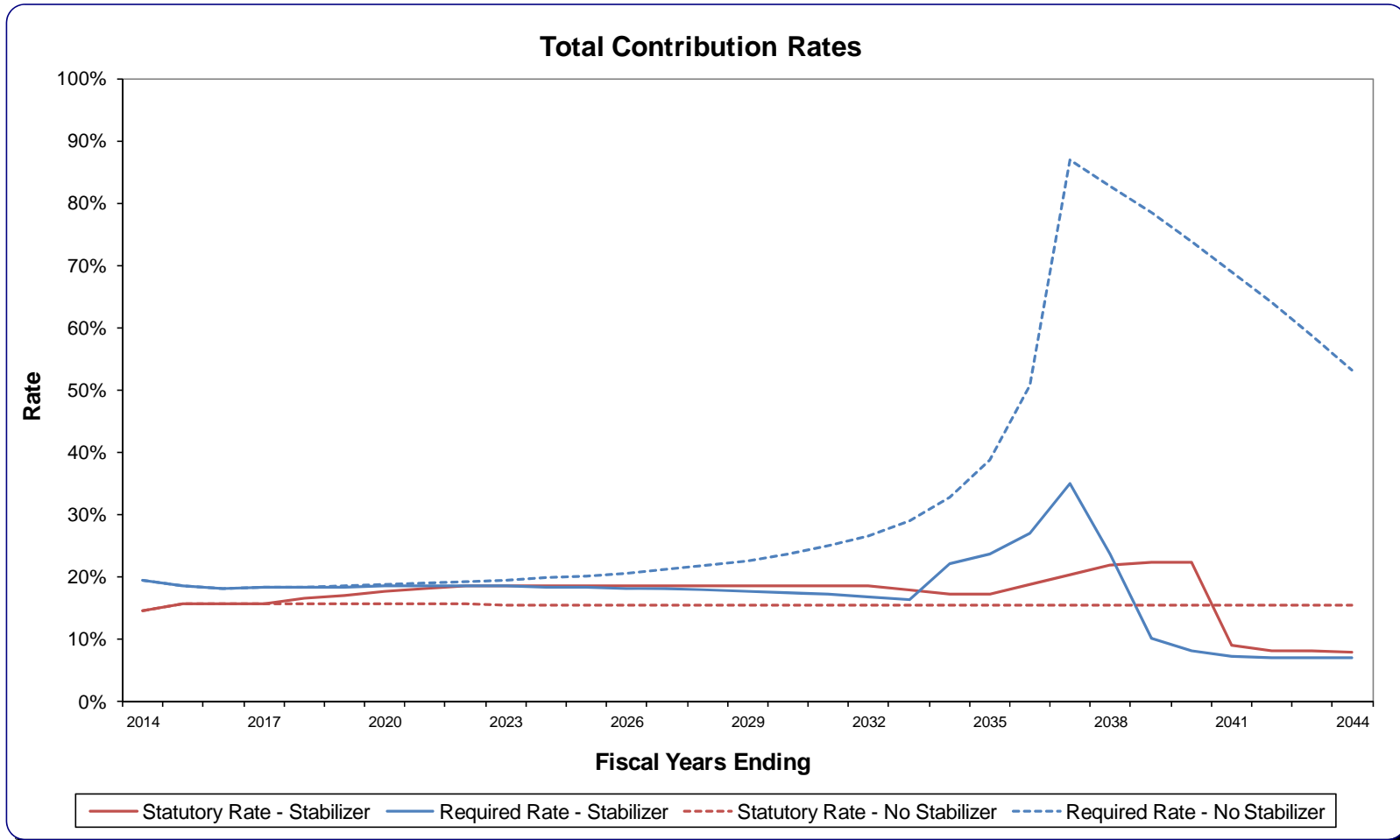
Exhibit B
All Investment Return Scenarios



Results are based on specified investment return and all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from Cavanaugh Macdonald dated January 31, 2014 for important details regarding assumptions and methodology. **Returns in the first four years are assumed to be 0.50% less than indicated.**



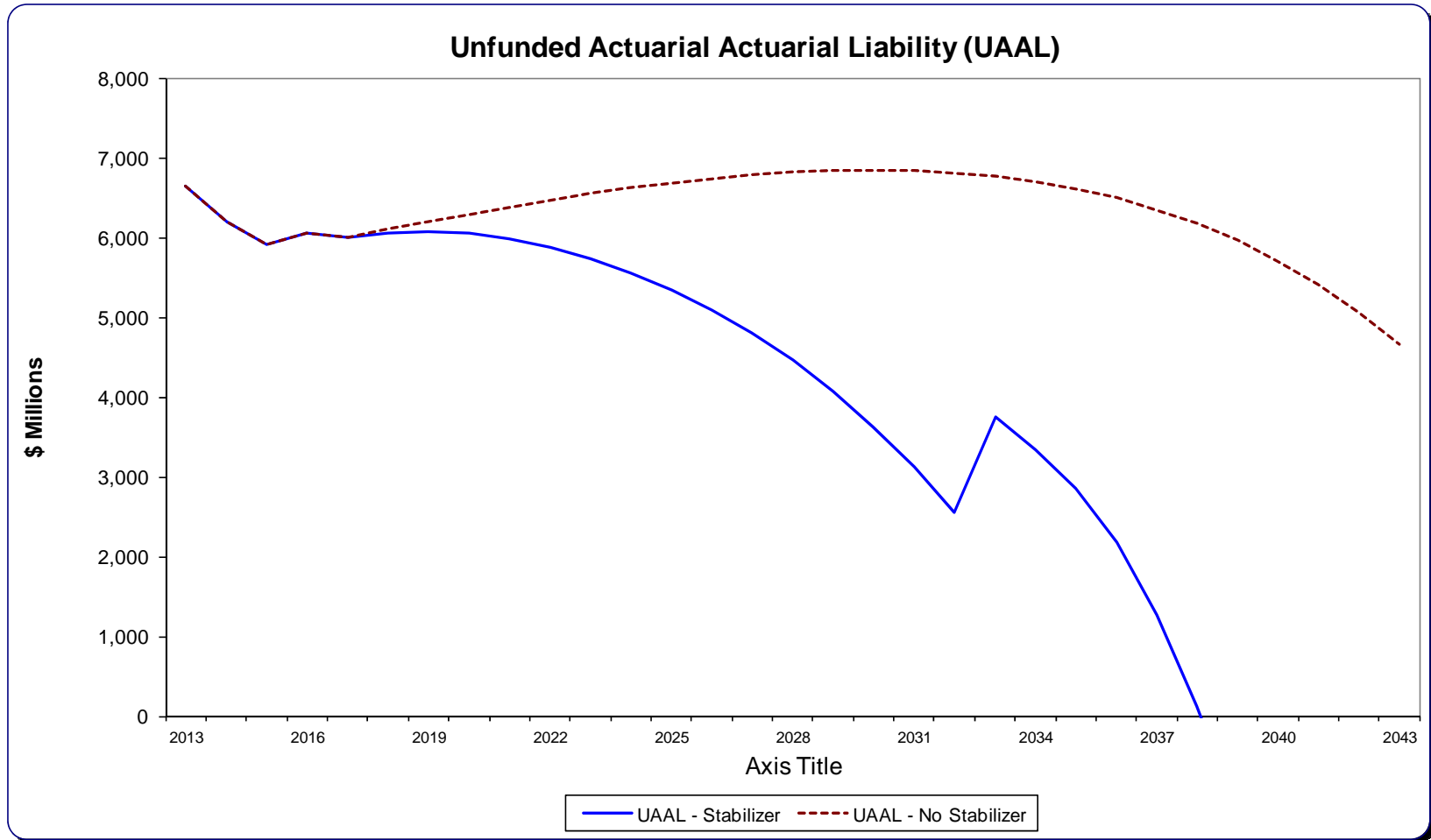
Exhibit C-1
8.5% Actual Investment Return in Future Years



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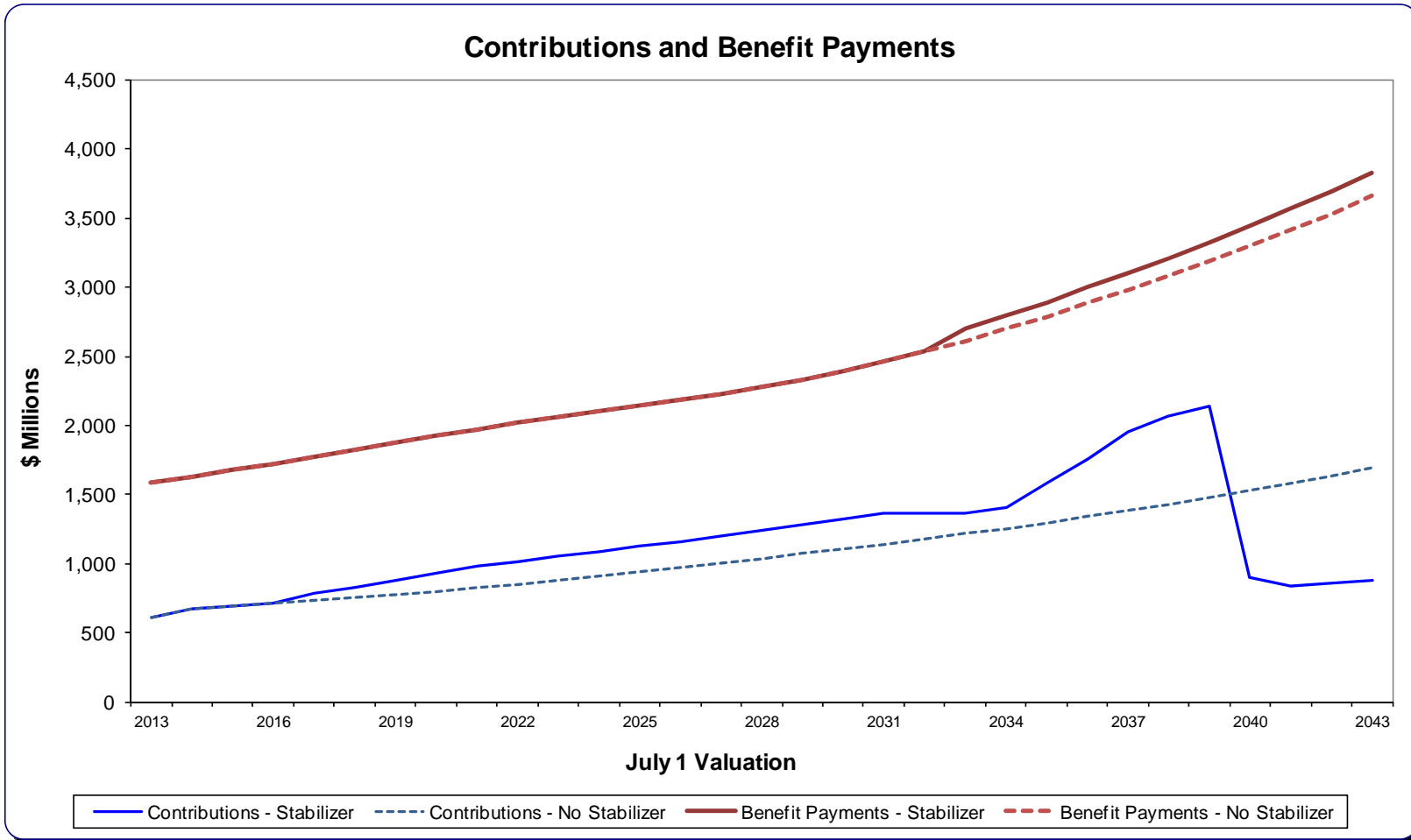
Exhibit C-2
8.5% Actual Investment Return in Future Years



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Exhibit C-3
8.5% Actual Investment Return in Future Years



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Teachers Retirement Association of Minnesota
Exhibit D-1
8.5% Actual Investment Return in Future Years
With Contribution Stabilizer



July 1	Asset Values		Actuarial Accrued Liability	Unfunded Actuarial Accrued Liability	Funded Ratio	Contribution Rates			Total Contributions	Benefit Payments
	Actuarial	Market				Statutory	Required	Sufficiency/ (Deficiency)		
2013	\$16,774.6	\$18,015.2	\$23,418.6	\$6,644.0	72%	14.67%	19.41%	-4.74%	\$616.9	\$1,587.4
2014	17,824.5	18,447.8	24,034.2	6,209.7	74%	15.66%	18.65%	-2.99%	678.1	1,627.5
2015	18,740.4	18,937.1	24,663.0	5,922.6	76%	15.64%	18.16%	-2.51%	695.8	1,676.1
2016	19,230.5	19,433.4	25,299.0	6,068.6	76%	15.63%	18.37%	-2.74%	715.2	1,723.5
2017	19,940.1	19,940.1	25,945.1	6,004.9	77%	16.62%	18.27%	-1.65%	783.2	1,771.2
2018	20,605.9	20,605.9	26,662.3	6,056.5	77%	17.11%	18.39%	-1.28%	830.5	1,821.6
2019	21,325.0	21,325.0	27,399.4	6,074.3	78%	17.59%	18.48%	-0.89%	880.1	1,873.7
2020	22,102.6	22,102.6	28,156.4	6,053.7	78%	18.08%	18.53%	-0.45%	932.3	1,925.3
2021	22,947.0	22,947.0	28,936.3	5,989.2	79%	18.57%	18.53%	0.04%	987.7	1,974.1
2022	23,870.1	23,870.1	29,744.8	5,874.7	80%	18.56%	18.49%	0.07%	1,018.8	2,020.8
2023	24,855.2	24,855.2	30,587.2	5,731.9	81%	18.55%	18.42%	0.13%	1,051.9	2,063.2
2024	25,914.4	25,914.4	31,471.9	5,557.5	82%	18.53%	18.32%	0.21%	1,087.1	2,102.7
2025	27,059.2	27,059.2	32,407.0	5,347.8	83%	18.52%	18.21%	0.31%	1,123.8	2,141.8
2026	28,298.8	28,298.8	33,397.9	5,099.1	85%	18.51%	18.09%	0.42%	1,161.6	2,183.1
2027	29,640.2	29,640.2	34,448.1	4,807.9	86%	18.50%	17.94%	0.56%	1,200.5	2,227.7
2028	31,089.7	31,089.7	35,559.6	4,469.9	87%	18.49%	17.76%	0.73%	1,240.3	2,277.6
2029	32,651.8	32,651.8	36,732.6	4,080.8	89%	18.48%	17.54%	0.94%	1,281.0	2,332.9
2030	34,331.5	34,331.5	37,967.3	3,635.8	90%	18.47%	17.24%	1.23%	1,322.6	2,393.9
2031	36,133.9	36,133.9	39,263.7	3,129.8	92%	18.46%	16.86%	1.60%	1,365.4	2,460.6
2032	38,064.5	38,064.5	40,621.7	2,557.2	94%	17.85%	16.31%	1.55%	1,363.6	2,533.2
2033	40,081.7	40,081.7	43,843.1	3,761.4	91%	17.31%	22.01%	-4.70%	1,364.9	2,698.6
2034	42,099.5	42,099.5	45,440.8	3,341.3	93%	17.30%	23.65%	-6.36%	1,408.8	2,792.9
2035	44,236.3	44,236.3	47,096.5	2,860.2	94%	18.79%	26.91%	-8.12%	1,580.7	2,892.3
2036	46,630.1	46,630.1	48,811.2	2,181.0	96%	20.28%	35.01%	-14.73%	1,762.6	2,997.2
2037	49,307.7	49,307.7	50,585.5	1,277.8	97%	21.77%	23.68%	-1.90%	1,955.4	3,103.9
2038	52,302.6	52,302.6	52,424.2	121.6	100%	22.27%	10.20%	12.06%	2,067.1	3,211.2
2039	55,556.6	55,556.6	54,333.3	(1,223.2)	102%	22.26%	8.07%	14.19%	2,136.6	3,323.3
2040	59,042.8	59,042.8	56,315.3	(2,727.5)	105%	9.07%	7.19%	1.89%	900.7	3,441.4
2041	61,414.9	61,414.9	58,371.6	(3,043.3)	105%	8.19%	7.08%	1.11%	840.8	3,563.1
2042	63,799.6	63,799.6	60,506.4	(3,293.2)	105%	8.08%	7.01%	1.07%	859.0	3,688.8
2043	66,274.9	66,274.9	62,723.7	(3,551.2)	106%	8.01%	6.95%	1.06%	881.9	3,824.8

Results are based on specified investment return and all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from Cavanaugh Macdonald dated January 31, 2014 for important details regarding assumptions and methodology. **Returns in the first four years are assumed to be 0.50% less than indicated.**

Teachers Retirement Association of Minnesota
Exhibit D-2
8.5% Actual Investment Return in Future Years
Without Contribution Stabilizer

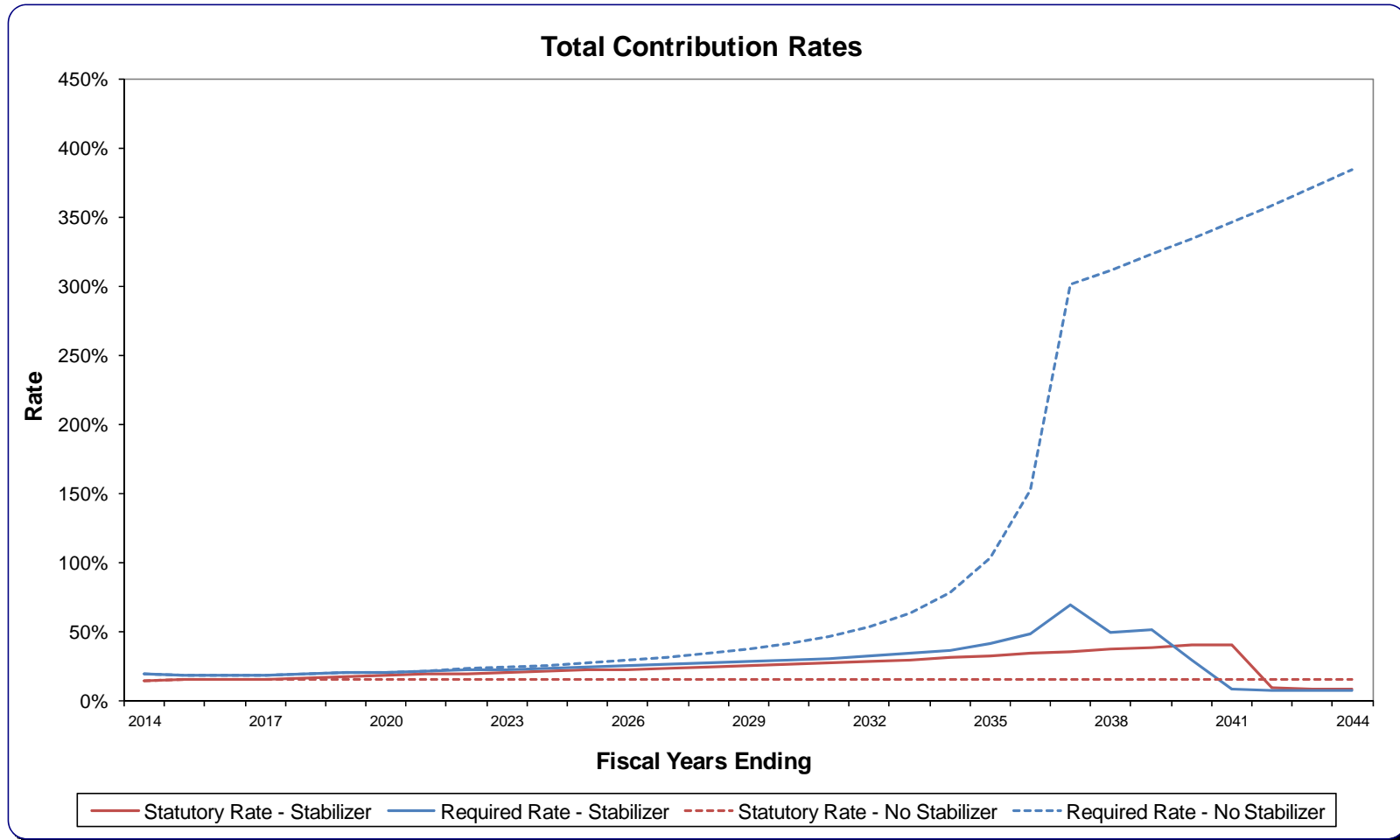


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2014	17,824.5	18,447.8	24,034.2	6,209.7	74%	15.66%	18.65%	-2.99%	678.1	1,627.5
2015	18,740.4	18,937.1	24,663.0	5,922.6	76%	15.64%	18.16%	-2.51%	695.8	1,676.1
2016	19,230.5	19,433.4	25,299.0	6,068.6	76%	15.63%	18.37%	-2.74%	715.2	1,723.5
2017	19,940.1	19,940.1	25,945.1	6,004.9	77%	15.62%	18.27%	-2.65%	736.1	1,771.2
2018	20,556.8	20,556.8	26,662.3	6,105.6	77%	15.61%	18.47%	-2.86%	757.6	1,821.6
2019	21,195.9	21,195.9	27,399.4	6,203.5	77%	15.59%	18.69%	-3.10%	780.1	1,873.7
2020	21,858.3	21,858.3	28,156.4	6,298.0	78%	15.58%	18.94%	-3.36%	803.4	1,925.3
2021	22,547.7	22,547.7	28,936.3	6,388.6	78%	15.57%	19.20%	-3.63%	828.1	1,974.1
2022	23,270.6	23,270.6	29,744.8	6,474.2	78%	15.56%	19.51%	-3.95%	854.1	2,020.8
2023	24,033.2	24,033.2	30,587.2	6,554.0	79%	15.55%	19.84%	-4.29%	881.7	2,063.2
2024	24,845.3	24,845.3	31,471.9	6,626.6	79%	15.53%	20.21%	-4.68%	911.1	2,102.7
2025	25,715.9	25,715.9	32,407.0	6,691.0	79%	15.52%	20.65%	-5.13%	941.8	2,141.8
2026	26,651.8	26,651.8	33,397.9	6,746.1	80%	15.51%	21.18%	-5.67%	973.4	2,183.1
2027	27,657.1	27,657.1	34,448.1	6,791.0	80%	15.50%	21.82%	-6.32%	1,005.8	2,227.7
2028	28,735.2	28,735.2	35,559.6	6,824.3	81%	15.49%	22.61%	-7.12%	1,039.0	2,277.6
2029	29,887.7	29,887.7	36,732.6	6,844.9	81%	15.48%	23.60%	-8.12%	1,073.0	2,332.9
2030	31,115.8	31,115.8	37,967.3	6,851.5	82%	15.47%	24.88%	-9.41%	1,107.8	2,393.9
2031	32,421.1	32,421.1	39,263.7	6,842.6	83%	15.46%	26.61%	-11.15%	1,143.5	2,460.6
2032	33,805.0	33,805.0	40,621.7	6,816.7	83%	15.45%	29.03%	-13.57%	1,180.3	2,533.2
2033	35,269.2	35,269.2	42,041.0	6,771.8	84%	15.45%	32.66%	-17.21%	1,218.2	2,612.1
2034	36,815.2	36,815.2	43,520.9	6,705.7	85%	15.44%	38.69%	-23.26%	1,257.4	2,697.8
2035	38,444.0	38,444.0	45,060.1	6,616.1	85%	15.43%	50.76%	-35.33%	1,298.0	2,788.7
2036	40,159.0	40,159.0	46,659.2	6,500.2	86%	15.42%	86.94%	-71.52%	1,340.2	2,885.2
2037	41,963.3	41,963.3	48,318.5	6,355.2	87%	15.41%	82.76%	-67.34%	1,384.3	2,983.6
2038	43,864.3	43,864.3	50,042.0	6,177.7	88%	15.41%	78.37%	-62.97%	1,430.3	3,082.5
2039	45,871.7	45,871.7	51,835.6	5,964.0	88%	15.40%	73.79%	-58.39%	1,478.2	3,186.5
2040	47,991.3	47,991.3	53,701.5	5,710.2	89%	15.39%	69.00%	-53.60%	1,528.1	3,296.5
2041	50,228.5	50,228.5	55,640.3	5,411.8	90%	15.39%	63.97%	-48.58%	1,580.3	3,410.2
2042	52,591.8	52,591.8	57,656.0	5,064.1	91%	15.38%	58.71%	-43.33%	1,635.0	3,528.0
2043	55,090.4	55,090.4	59,752.2	4,661.8	92%	15.37%	53.21%	-37.84%	1,691.9	3,655.9

Results are based on specified investment return and all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from Cavanaugh Macdonald dated January 31, 2014 for important details regarding assumptions and methodology. **Returns in the first four years are assumed to be 0.50% less than indicated.**



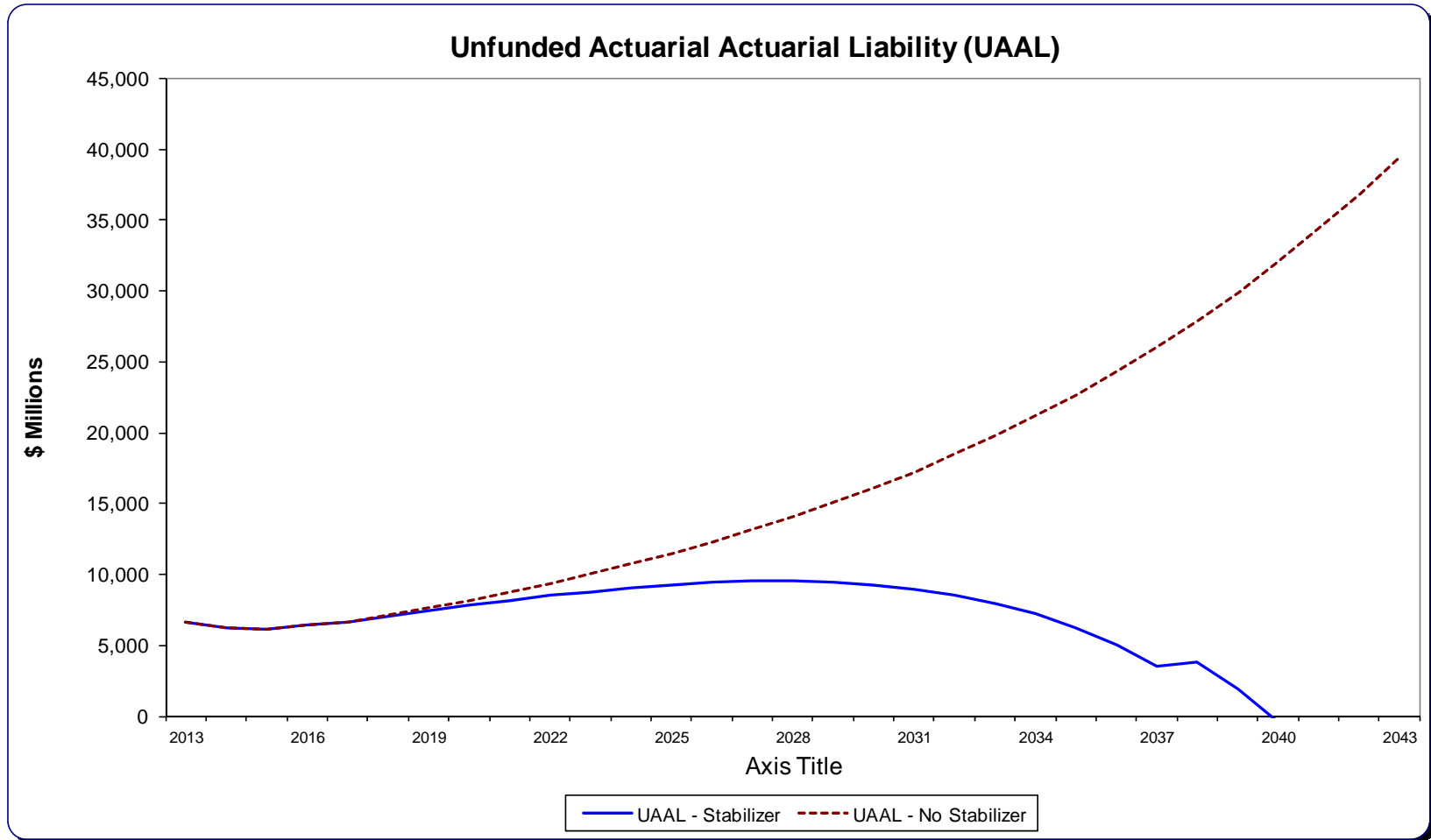
Exhibit E-1
7.0% Actual Investment Return in Future Years



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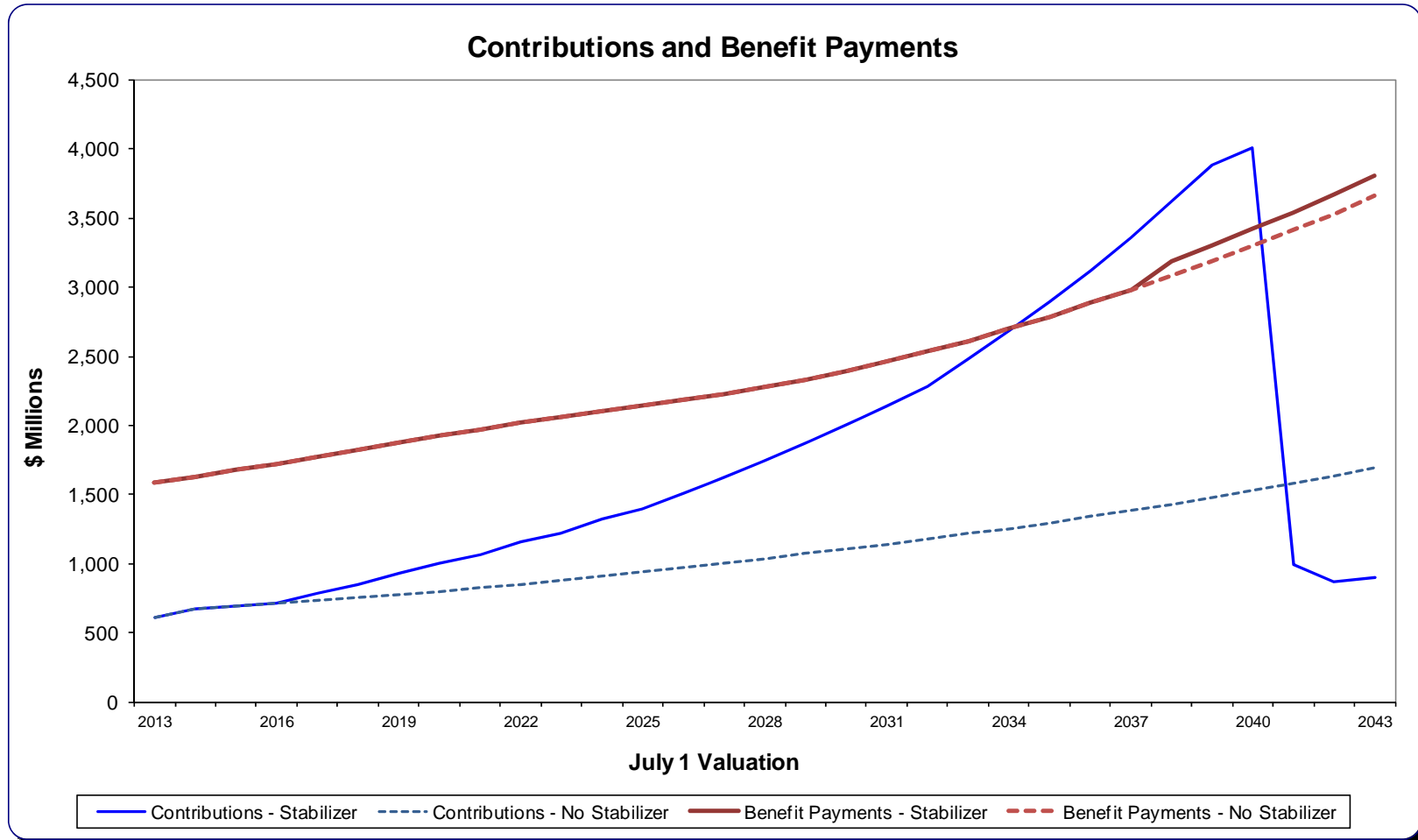
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Exhibit E-3
7.0% Actual Investment Return in Future Years



Results are based on specified investment return and all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from Cavanaugh Macdonald dated January 31, 2014 for important details regarding assumptions and methodology. **Returns in the first four years are assumed to be 0.50% less than indicated.**

Teachers Retirement Association of Minnesota
Exhibit F-1
7.0% Actual Investment Return in Future Years
With Contribution Stabilizer



July 1	Asset Values		Actuarial Accrued Liability	Unfunded Actuarial Accrued Liability	Funded Ratio	Contribution Rates			Total Contributions	Benefit Payments
	Actuarial	Market				Statutory	Required	Sufficiency/ (Deficiency)		
2013	\$16,774.6	\$18,015.2	\$23,418.6	\$6,644.0	72%	14.67%	19.41%	-4.74%	\$616.9	\$1,587.4
2014	17,771.9	18,184.6	24,034.2	6,262.3	74%	15.66%	18.73%	-3.07%	678.1	1,627.5
2015	18,560.9	18,386.9	24,663.0	6,102.1	75%	15.64%	18.45%	-2.80%	695.8	1,676.1
2016	18,847.4	18,570.5	25,299.0	6,451.6	74%	15.63%	19.00%	-3.37%	715.2	1,723.5
2017	19,274.2	18,737.0	25,945.1	6,670.9	74%	16.62%	19.37%	-2.75%	783.2	1,771.2
2018	19,569.1	19,026.5	26,662.3	7,093.3	73%	17.61%	20.10%	-2.49%	854.7	1,821.6
2019	19,907.6	19,358.3	27,399.4	7,491.7	73%	18.59%	20.82%	-2.23%	930.1	1,873.7
2020	20,295.0	19,737.3	28,156.4	7,861.3	72%	19.58%	21.54%	-1.96%	1,009.7	1,925.3
2021	20,739.6	20,171.8	28,936.3	8,196.7	72%	20.07%	22.24%	-2.17%	1,067.5	1,974.1
2022	21,225.6	20,646.0	29,744.8	8,519.2	71%	21.06%	23.00%	-1.94%	1,156.0	2,020.8
2023	21,789.5	21,196.6	30,587.2	8,797.7	71%	21.55%	23.73%	-2.18%	1,222.0	2,063.2
2024	22,418.1	21,810.2	31,471.9	9,053.9	71%	22.53%	24.51%	-1.98%	1,321.7	2,102.7
2025	23,153.9	22,529.0	32,407.0	9,253.1	71%	23.02%	25.30%	-2.28%	1,396.8	2,141.8
2026	23,979.8	23,335.4	33,397.9	9,418.2	72%	24.01%	26.19%	-2.18%	1,506.8	2,183.1
2027	24,935.9	24,269.2	34,448.1	9,512.2	72%	25.00%	27.13%	-2.13%	1,622.3	2,227.7
2028	26,034.0	25,341.8	35,559.6	9,525.6	73%	25.99%	28.16%	-2.17%	1,743.3	2,277.6
2029	27,284.5	26,563.1	36,732.6	9,448.1	74%	26.98%	29.31%	-2.33%	1,870.1	2,332.9
2030	28,698.6	27,943.9	37,967.3	9,268.7	76%	27.97%	30.62%	-2.65%	2,002.9	2,393.9
2031	30,288.1	29,495.5	39,263.7	8,975.6	77%	28.96%	32.21%	-3.25%	2,141.9	2,460.6
2032	32,065.8	31,230.6	40,621.7	8,556.0	79%	29.95%	34.22%	-4.26%	2,287.8	2,533.2
2033	34,045.8	33,162.8	42,041.0	7,995.2	81%	31.45%	36.99%	-5.54%	2,480.1	2,612.1
2034	36,284.2	35,347.7	43,520.9	7,236.7	83%	32.94%	41.06%	-8.13%	2,682.7	2,697.8
2035	38,803.0	37,806.3	45,060.1	6,257.1	86%	34.43%	48.48%	-14.05%	2,896.3	2,788.7
2036	41,628.4	40,564.1	46,659.2	5,030.9	89%	35.92%	69.27%	-33.35%	3,121.7	2,885.2
2037	44,788.5	43,648.3	48,318.5	3,530.0	93%	37.41%	49.88%	-12.46%	3,360.0	2,983.6
2038	48,318.2	47,093.0	52,136.3	3,818.1	93%	38.91%	51.81%	-12.91%	3,611.8	3,189.7
2039	52,145.7	50,826.1	54,047.6	1,901.9	96%	40.40%	29.57%	10.83%	3,877.7	3,301.9
2040	56,403.4	54,979.5	56,031.3	(372.1)	101%	40.39%	8.66%	31.74%	4,009.8	3,420.1
2041	60,976.4	59,438.0	58,089.0	(2,887.4)	105%	9.67%	7.17%	2.50%	992.8	3,541.8
2042	62,606.3	60,961.9	60,225.1	(2,381.3)	104%	8.18%	7.54%	0.64%	869.6	3,667.7
2043	64,059.1	62,334.9	62,443.1	(1,615.9)	103%	8.17%	8.04%	0.13%	899.5	3,803.6

Results are based on specified investment return and all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from Cavanaugh Macdonald dated January 31, 2014 for important details regarding assumptions and methodology. **Returns in the first four years are assumed to be 0.50% less than indicated.**

Teachers Retirement Association of Minnesota
Exhibit F-2



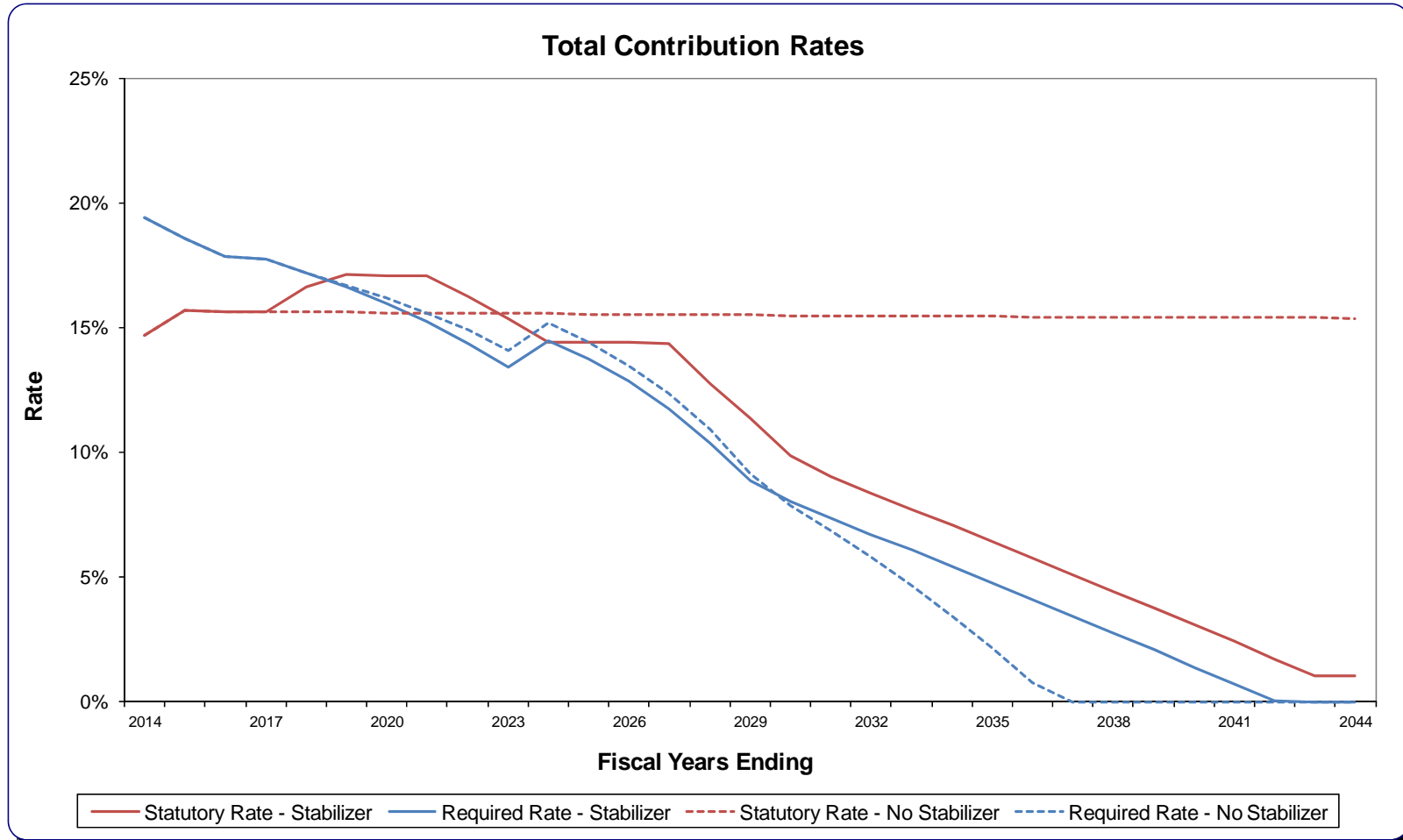
7.0% Actual Investment Return in Future Years
Without Contribution Stabilizer

July 1	Asset Values		Actuarial Accrued Liability	Unfunded Actuarial Accrued Liability	Funded Ratio	Contribution Rates			Total Contributions	Benefit Payments
	Actuarial	Market				Statutory	Required	Sufficiency/ (Deficiency)		
2013	\$16,774.6	\$18,015.2	\$23,418.6	\$6,644.0	72%	14.67%	19.41%	-4.74%	\$616.9	\$1,587.4
2014	17,771.9	18,184.6	24,034.2	6,262.3	74%	15.66%	18.73%	-3.07%	678.1	1,627.5
2015	18,560.9	18,386.9	24,663.0	6,102.1	75%	15.64%	18.45%	-2.80%	695.8	1,676.1
2016	18,847.4	18,570.5	25,299.0	6,451.6	74%	15.63%	19.00%	-3.37%	715.2	1,723.5
2017	19,274.2	18,737.0	25,945.1	6,670.9	74%	15.62%	19.37%	-3.75%	736.1	1,771.2
2018	19,520.1	18,977.8	26,662.3	7,142.3	73%	15.61%	20.18%	-4.57%	757.6	1,821.6
2019	19,753.7	19,205.7	27,399.4	7,645.7	72%	15.59%	21.08%	-5.49%	780.1	1,873.7
2020	19,972.8	19,418.8	28,156.4	8,183.5	71%	15.58%	22.08%	-6.50%	803.4	1,925.3
2021	20,177.8	19,617.6	28,936.3	8,758.5	70%	15.57%	23.19%	-7.62%	828.1	1,974.1
2022	20,371.6	19,805.4	29,744.8	9,373.2	68%	15.56%	24.45%	-8.89%	854.1	2,020.8
2023	20,556.8	19,984.9	30,587.2	10,030.4	67%	15.55%	25.86%	-10.31%	881.7	2,063.2
2024	20,738.9	20,161.7	31,471.9	10,733.0	66%	15.53%	27.47%	-11.94%	911.1	2,102.7
2025	20,922.8	20,340.4	32,407.0	11,484.1	65%	15.52%	29.34%	-13.82%	941.8	2,141.8
2026	21,110.5	20,522.9	33,397.9	12,287.4	63%	15.51%	31.57%	-16.06%	973.4	2,183.1
2027	21,301.1	20,708.1	34,448.1	13,147.0	62%	15.50%	34.23%	-18.73%	1,005.8	2,227.7
2028	21,492.0	20,893.8	35,559.6	14,067.5	60%	15.49%	37.50%	-22.01%	1,039.0	2,277.6
2029	21,678.8	21,075.2	36,732.6	15,053.8	59%	15.48%	41.60%	-26.12%	1,073.0	2,332.9
2030	21,856.1	21,247.3	37,967.3	16,111.2	58%	15.47%	46.87%	-31.40%	1,107.8	2,393.9
2031	22,018.2	21,404.3	39,263.7	17,245.5	56%	15.46%	53.93%	-38.47%	1,143.5	2,460.6
2032	22,158.9	21,540.3	40,621.7	18,462.8	55%	15.45%	63.81%	-48.35%	1,180.3	2,533.2
2033	22,271.4	21,648.7	42,041.0	19,769.6	53%	15.45%	78.64%	-63.19%	1,218.2	2,612.1
2034	22,348.5	21,722.2	43,520.9	21,172.4	51%	15.44%	103.35%	-87.92%	1,257.4	2,697.8
2035	22,381.5	21,752.8	45,060.1	22,678.6	50%	15.43%	152.75%	-137.32%	1,298.0	2,788.7
2036	22,363.6	21,733.4	46,659.2	24,295.6	48%	15.42%	300.91%	-285.49%	1,340.2	2,885.2
2037	22,287.0	21,656.7	48,318.5	26,031.5	46%	15.41%	311.71%	-296.29%	1,384.3	2,983.6
2038	22,147.2	21,518.4	50,042.0	27,894.8	44%	15.41%	322.83%	-307.43%	1,430.3	3,082.5
2039	21,941.2	21,315.5	51,835.6	29,894.4	42%	15.40%	334.31%	-318.91%	1,478.2	3,186.5
2040	21,661.2	21,040.5	53,701.5	32,040.3	40%	15.39%	346.16%	-330.76%	1,528.1	3,296.5
2041	21,297.7	20,684.0	55,640.3	34,342.7	38%	15.39%	358.32%	-342.93%	1,580.3	3,410.2
2042	20,843.4	20,239.0	57,656.0	36,812.5	36%	15.38%	370.77%	-355.39%	1,635.0	3,528.0
2043	20,290.4	19,697.6	59,752.2	39,461.8	34%	15.37%	383.63%	-368.26%	1,691.9	3,655.9

Results are based on specified investment return and all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from Cavanaugh Macdonald dated January 31, 2014 for important details regarding assumptions and methodology. **Returns in the first four years are assumed to be 0.50% less than indicated.**



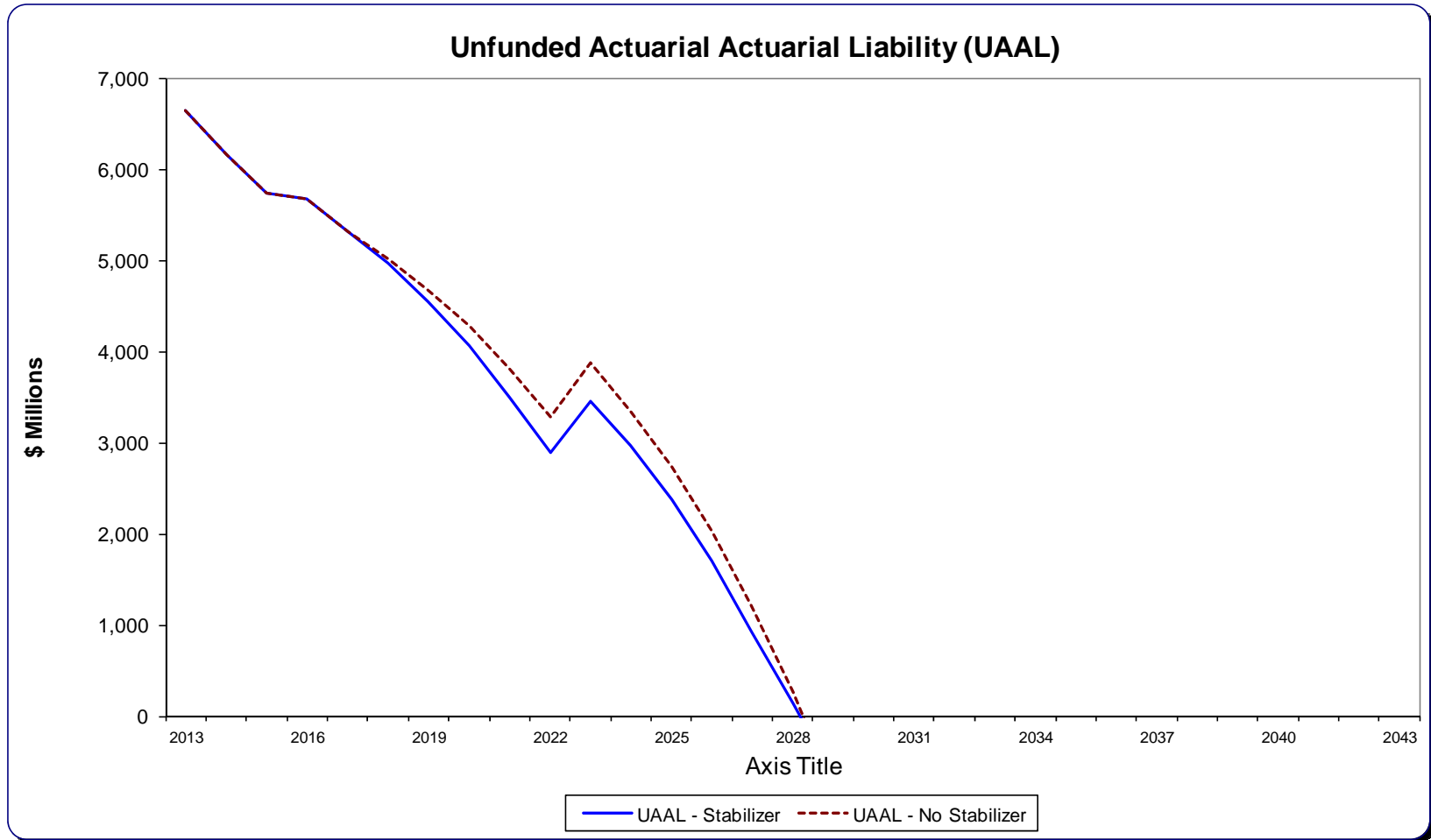
Exhibit G-1
10.0% Actual Investment Return in Future Years



Results are based on specified investment return and all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from Cavanaugh Macdonald dated January 31, 2014 for important details regarding assumptions and methodology. **Returns in the first four years are assumed to be 0.50% less than indicated.**



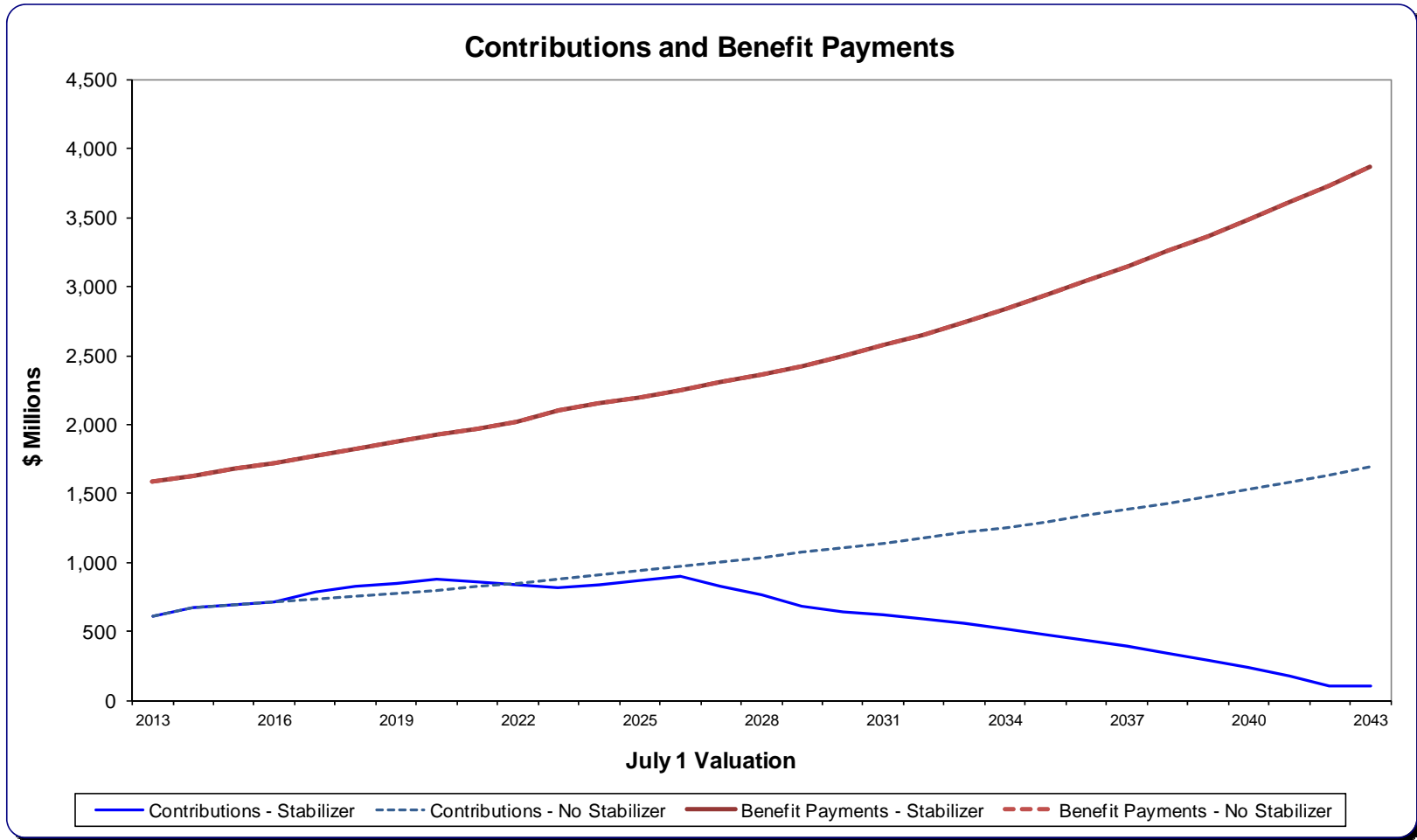
Exhibit G-2
10.0% Actual Investment Return in Future Years



Results are based on specified investment return and all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from Cavanaugh Macdonald dated January 31, 2014 for important details regarding assumptions and methodology. **Returns in the first four years are assumed to be 0.50% less than indicated.**



Exhibit G-3
10.0% Actual Investment Return in Future Years



Results are based on specified investment return and all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from Cavanaugh Macdonald dated January 31, 2014 for important details regarding assumptions and methodology. **Returns in the first four years are assumed to be 0.50% less than indicated.**

Teachers Retirement Association of Minnesota
Exhibit H-1
10.0% Actual Investment Return in Future Years
With Contribution Stabilizer



July 1	Asset Values		Actuarial Accrued Liability	Unfunded Actuarial Accrued Liability	Funded Ratio	Contribution Rates			Total Contributions	Benefit Payments
	Actuarial	Market				Statutory	Required	Sufficiency/ (Deficiency)		
2013	\$16,774.6	\$18,015.2	\$23,418.6	\$6,644.0	72%	14.67%	19.41%	-4.74%	\$616.9	\$1,587.4
2014	17,877.2	18,711.1	24,034.2	6,157.1	74%	15.66%	18.56%	-2.90%	678.1	1,627.5
2015	18,921.5	19,495.2	24,663.0	5,741.5	77%	15.64%	17.87%	-2.22%	695.8	1,676.1
2016	19,620.8	20,321.5	25,299.0	5,678.3	78%	15.63%	17.74%	-2.11%	715.2	1,723.5
2017	20,625.5	21,196.9	25,945.1	5,319.6	79%	16.62%	17.15%	-0.53%	783.2	1,771.2
2018	21,684.2	22,280.4	26,662.3	4,978.1	81%	17.11%	16.62%	0.49%	830.5	1,821.6
2019	22,844.6	23,468.9	27,399.4	4,554.7	83%	17.09%	15.97%	1.12%	855.1	1,873.7
2020	24,091.6	24,747.5	28,156.4	4,064.8	86%	17.08%	15.22%	1.86%	880.8	1,925.3
2021	25,435.9	26,126.7	28,936.3	3,500.4	88%	16.23%	14.35%	1.88%	863.2	1,974.1
2022	26,845.6	27,574.3	29,744.8	2,899.2	90%	15.36%	13.42%	1.94%	843.1	2,020.8
2023	28,327.6	29,096.5	31,787.3	3,459.7	89%	14.41%	14.48%	-0.07%	817.1	2,105.2
2024	29,844.0	30,655.2	32,809.4	2,965.5	91%	14.39%	13.74%	0.65%	844.2	2,153.4
2025	31,492.0	32,347.6	33,876.6	2,384.6	93%	14.38%	12.84%	1.54%	872.6	2,201.3
2026	33,286.0	34,188.7	34,995.2	1,709.1	95%	14.37%	11.73%	2.64%	901.8	2,251.5
2027	35,238.6	36,192.1	36,168.9	930.4	97%	12.72%	10.37%	2.35%	825.4	2,304.9
2028	37,251.6	38,259.6	37,400.7	149.2	100%	11.37%	8.88%	2.49%	762.7	2,363.6
2029	39,340.8	40,406.5	38,691.3	(649.6)	102%	9.88%	8.01%	1.87%	684.9	2,427.8
2030	41,493.4	42,619.2	40,041.2	(1,452.2)	104%	9.01%	7.35%	1.66%	645.3	2,497.5
2031	43,750.1	44,938.5	41,450.8	(2,299.3)	106%	8.36%	6.72%	1.64%	618.5	2,573.0
2032	46,128.9	47,382.4	42,920.5	(3,208.4)	107%	7.71%	6.07%	1.65%	589.2	2,654.3
2033	48,632.9	49,954.7	44,450.3	(4,182.5)	109%	7.07%	5.42%	1.65%	557.3	2,741.8
2034	51,265.4	52,659.1	46,040.0	(5,225.4)	111%	6.42%	4.75%	1.66%	522.7	2,836.1
2035	54,029.5	55,498.7	47,688.6	(6,340.9)	113%	5.75%	4.08%	1.67%	483.7	2,935.4
2036	56,928.6	58,477.2	49,397.1	(7,531.5)	115%	5.08%	3.41%	1.67%	441.7	3,040.2
2037	59,967.7	61,599.5	51,166.0	(8,801.7)	117%	4.41%	2.74%	1.68%	396.5	3,146.9
2038	63,155.6	64,874.7	52,999.8	(10,155.8)	119%	3.75%	2.06%	1.68%	347.9	3,254.0
2039	66,503.4	68,314.2	54,904.8	(11,598.6)	121%	3.06%	1.38%	1.68%	293.7	3,366.1
2040	70,016.4	71,923.3	56,883.3	(13,133.1)	123%	2.39%	0.70%	1.70%	237.6	3,484.0
2041	73,703.0	75,710.8	58,936.7	(14,766.3)	125%	1.71%	0.01%	1.70%	175.3	3,605.5
2042	77,570.5	79,684.2	61,069.2	(16,501.3)	127%	1.02%	0.00%	1.02%	108.4	3,731.2
2043	81,628.2	83,853.0	63,284.7	(18,343.5)	129%	1.01%	0.00%	1.01%	111.5	3,867.0

Results are based on specified investment return and all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from Cavanaugh Macdonald dated January 31, 2014 for important details regarding assumptions and methodology. **Returns in the first four years are assumed to be 0.50% less than indicated.**

Teachers Retirement Association of Minnesota
Exhibit H-2
10.0% Actual Investment Return in Future Years
Without Contribution Stabilizer



July 1	Asset Values		Actuarial Accrued Liability	Unfunded Actuarial Accrued Liability	Funded Ratio	Contribution Rates			Total Contributions	Benefit Payments
	Actuarial	Market				Statutory	Required	Sufficiency/ (Deficiency)		
2013	\$16,774.6	\$18,015.2	\$23,418.6	\$6,644.0	72%	14.67%	19.41%	-4.74%	\$616.9	\$1,587.4
2014	17,877.2	18,711.1	24,034.2	6,157.1	74%	15.66%	18.56%	-2.90%	678.1	1,627.5
2015	18,921.5	19,495.2	24,663.0	5,741.5	77%	15.64%	17.87%	-2.22%	695.8	1,676.1
2016	19,620.8	20,321.5	25,299.0	5,678.3	78%	15.63%	17.74%	-2.11%	715.2	1,723.5
2017	20,625.5	21,196.9	25,945.1	5,319.6	79%	15.62%	17.15%	-1.53%	736.1	1,771.2
2018	21,635.1	22,230.9	26,662.3	5,027.3	81%	15.61%	16.70%	-1.09%	757.6	1,821.6
2019	22,715.1	23,338.2	27,399.4	4,684.2	83%	15.59%	16.18%	-0.59%	780.1	1,873.7
2020	23,871.9	24,524.9	28,156.4	4,284.4	85%	15.58%	15.58%	0.00%	803.4	1,925.3
2021	25,115.2	25,800.8	28,936.3	3,821.1	87%	15.57%	14.89%	0.68%	828.1	1,974.1
2022	26,458.0	27,179.0	29,744.8	3,286.8	89%	15.56%	14.08%	1.48%	854.1	2,020.8
2023	27,914.1	28,673.2	31,787.3	3,873.2	88%	15.55%	15.20%	0.35%	881.7	2,105.2
2024	29,457.2	30,257.3	32,809.4	3,352.2	90%	15.53%	14.43%	1.10%	911.1	2,153.4
2025	31,135.8	31,980.1	33,876.6	2,740.8	92%	15.52%	13.48%	2.04%	941.8	2,201.3
2026	32,965.1	33,857.0	34,995.2	2,030.0	94%	15.51%	12.34%	3.17%	973.4	2,251.5
2027	34,958.7	35,902.3	36,168.9	1,210.3	97%	15.50%	10.91%	4.59%	1,005.8	2,304.9
2028	37,130.2	38,130.0	37,400.7	270.6	99%	15.49%	9.13%	6.36%	1,039.0	2,363.6
2029	39,492.7	40,553.8	38,691.3	(801.4)	102%	15.48%	7.87%	7.61%	1,073.0	2,427.8
2030	42,060.5	43,188.3	40,041.2	(2,019.3)	105%	15.47%	6.86%	8.61%	1,107.8	2,497.5
2031	44,849.3	46,049.6	41,450.8	(3,398.5)	108%	15.46%	5.80%	9.66%	1,143.5	2,573.0
2032	47,876.3	49,155.3	42,920.5	(4,955.8)	112%	15.45%	4.65%	10.81%	1,180.3	2,654.3
2033	51,160.4	52,524.9	44,450.3	(6,710.0)	115%	15.45%	3.43%	12.02%	1,218.2	2,741.8
2034	54,722.1	56,179.4	46,040.0	(8,682.0)	119%	15.44%	2.12%	13.31%	1,257.4	2,836.1
2035	58,583.6	60,141.6	47,688.6	(10,894.9)	123%	15.43%	0.73%	14.70%	1,298.0	2,935.4
2036	62,771.2	64,438.4	49,397.1	(13,374.0)	127%	15.42%	0.00%	15.42%	1,340.2	3,040.2
2037	67,313.6	69,099.3	51,166.0	(16,147.6)	132%	15.41%	0.00%	15.41%	1,384.3	3,146.9
2038	72,246.5	74,160.6	52,999.8	(19,246.6)	136%	15.41%	0.00%	15.41%	1,430.3	3,254.0
2039	77,610.3	79,663.8	54,904.8	(22,705.4)	141%	15.40%	0.00%	15.40%	1,478.2	3,366.1
2040	83,445.1	85,650.2	56,883.3	(26,561.7)	147%	15.39%	0.00%	15.39%	1,528.1	3,484.0
2041	89,793.9	92,163.8	58,936.7	(30,857.1)	152%	15.39%	0.00%	15.39%	1,580.3	3,605.5
2042	96,706.9	99,256.1	61,069.2	(35,637.7)	158%	15.38%	0.00%	15.38%	1,635.0	3,731.2
2043	104,238.8	106,983.2	63,284.7	(40,954.1)	165%	15.37%	0.00%	15.37%	1,691.9	3,867.0

Results are based on specified investment return and all other actuarial assumptions being met each year in the future. Please refer to the accompanying letter from Cavanaugh Macdonald dated January 31, 2014 for important details regarding assumptions and methodology. **Returns in the first four years are assumed to be 0.50% less than indicated**