GRS Retirement Consulting

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January 31, 2019

CONFIDENTIAL

Ms. Erin Leonard
Executive Director
Minnesota State Retirement System
60 Empire Drive, Suite 300
St. Paul, MN 55103

Re: Projection of Contributions and Funding Status – State Employees Plan

Dear Erin:

Attached are 30-year projections of estimated funded status, required contributions, and statutory contributions under three asset return scenarios for the State Employees Retirement Plan. These projections, including the underlying investment return assumptions, are required by the Minnesota Standards for Actuarial Work. Unless noted otherwise, the estimates are based on participant data, assets, and plan provisions as outlined in the State Employees Retirement Plan actuarial funding valuation as of July 1, 2018.

Basis for Projections

For all enclosed projections, liabilities are determined using the statutory investment return assumption of 7.5%. As required by the Minnesota Standards for Actuarial Work, the projections reflect three asset return scenarios (7.5%, 6.0% and 9.0%). Note that we believe the 9.0% rate of return assumption is outside of the range of reasonable expected returns for this plan.

The estimates are based on the market value of assets with no smoothing of investment gains or losses. Payroll is assumed to increase approximately 3.25% per year over the long-term, consistent with the valuation assumption for total payroll growth.

The projection is an open group projection; meaning, active members projected to retire or otherwise terminate in the future are replaced with new active members so that the total active membership of the fund remains at 51,223 members. The profile of these new members is the same as new members hired between July 1, 2012 and July 1, 2017:

- Average age at hire is 37.4
- Average salary at hire is $45,500
- Approximately 56% female, 44% male

If actuarial accrued liability exceeds assets, the unfunded actuarial accrued liability is amortized through June 30, 2048 per Minnesota Statute 356.215, Subdivision 11. Per Minnesota Statute 356.215, Subdivision 11 (l), a negative unfunded actuarial accrued liability (i.e., when assets exceed liability) is amortized over a rolling 30-year period.

Comments

The reader should keep the following in mind when reviewing these results:

- Investment experience that has occurred since the measurement date is not reflected in this report.
- The enclosed projections are based on assumptions as outlined in the State Employees Retirement Plan actuarial funding valuation as of July 1, 2018. Please see that report for comments regarding the 7.5% statutory investment return assumption, and sensitivity test results based on alternate assumptions.
- Note that plan changes reflected in the July 1, 2018 valuation report may result in behavior changes that are not anticipated in the current assumptions.
- In the 7.5% and 9.0% investment return scenarios, surplus assets reduce the projected required contributions to amounts less than normal cost, and eventually to zero. We would typically recommend the contribution be at least equal to the normal cost of the plan.
- We typically suggest that plans with considerable surplus assets investigate the pros and cons of reducing the risk of the plan's investment allocation to preserve surplus assets.
- Note that as funding ratios decline, as they are expected to in one of the investment return scenarios shown in this letter, it will be increasingly difficult for the plan to attain the assumed scenario investment return. Each year, a larger proportion of assets is paid out in benefits, and less capital is available to invest.

Disclosures

To the best of our knowledge and belief, the calculations were completed in accordance with the requirements of Minnesota Statutes, Section 356.215, and the requirements of the Standards for Actuarial Work established by the Legislative Commission on Pensions and Retirement.

This report should not be relied upon for any purpose other than the purpose described herein. Determinations of the financial results associated with the benefits described in this report in a manner other than the intended purpose may produce significantly different results. GRS is not responsible for the consequences of any unauthorized use.

The valuation was based upon information furnished by the Minnesota State Retirement System (MSRS), concerning benefits, financial transactions, plan provisions and active members, terminated members, retirees and beneficiaries. We checked for internal and year-to-year consistency, but did not audit the data. We are not responsible for the accuracy or completeness of the information provided by MSRS.

The contribution rates shown in this report have been determined using the actuarial assumptions and methods disclosed in the Actuarial Basis section of the July 1, 2018 valuation report. This valuation report includes risk metrics on page 9, but does not include a robust assessment of the risks of future experience not meeting the actuarial assumptions. Additional assessment of risks was outside the scope of this assignment.

The projections assume the continuing ability of the plan sponsor to make the contributions necessary to fund this plan. A determination regarding whether or not the plan sponsor is actually able to do so is outside our scope of expertise and was not performed.

Actuarial assumptions, including discount rates, mortality tables and others identified in this report, are prescribed by Minnesota Statutes Section 356.215 the Legislative Commission on Pensions and Retirement (LCPR), and the Board of Directors. These parties are responsible for selecting the plan's funding policy, actuarial valuation methods, asset valuation methods, and assumptions. The policies, methods and assumptions used in this valuation are those that have been so prescribed and are described in the Actuarial Basis of the valuation report, except as noted. MSRS is solely responsible for communicating to GRS any changes required thereto.

In a 2018 analysis of long-term rate of investment return and inflation assumptions, GRS suggested that the current statutory investment return assumption of 7.5% is at the top of the reasonable range. Please see our draft letter dated September 17, 2018 for additional information. If capital markets decline further from the present levels, the 7.5% return assumption might not comply with actuarial standards for the July 1, 2019 valuation.

The 2018 analysis also concluded that the probability of exceeding the current 7.5% assumption over 20 years is less than 50%. The statutory requirement for projections that are 1.5% above and 1.5% below the assumed rate may give the reader the impression that the 7.5% projection is an accurate (middle of the road) representation of the expected future results. Based on the modeling we have done, the 7.5% scenario is optimistic and not representative of the expected (median) result. We caution against adjusting contribution rates without full consideration of the median results.

Future actuarial measurements may differ significantly from the current measurements presented in this report 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.

Professional Qualifications

This report has been prepared by actuaries who have substantial experience valuing public employee retirement systems. To the best of our knowledge and belief, the information contained in this report is accurate and fairly presents the actuarial position of the State Employees Retirement Plan as of the valuation date and was performed in accordance with the requirements of Minnesota Statutes Section 356.215, and the requirements of the Standards for Actuarial Work established by the LCPR. All calculations have been made in conformity with generally accepted actuarial principles and practices, and with the Actuarial Standards of Practice issued by the Actuarial Standards Board and with applicable statutes.

Bonita J. Wurst and Brian B. Murphy are Members of the American Academy of Actuaries (MAAA) and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein. The signing actuaries are independent of the plan sponsor. We are not aware of any relationship that would impair the objectivity of our work.

Sincerely,

Bonita J. Wurst

Bonita J. Wurst, ASA, EA, FCA, MAAA

Brian B. Murphy

Brian B. Murphy, FSA, EA, FCA, MAAA, PhD

BJW/BBM:sc
Enclosures

Other Observations

General Implications of Contribution Allocation Procedure or Funding Policy on Future Expected Plan Contributions and Funded Status

Given the plan's contribution allocation procedure, if there are no changes in benefits or contributions and all actuarial assumptions are met (including the assumption of the plan earning 7.50% on the market value of assets), it is expected that:

(1) The normal cost of the plan is expected to remain approximately level as a percent of pay,
(2) The funded status of the plan is expected to gradually improve and is expected to be 100% funded within the next 30 years, and
(3) The unfunded liability will grow initially as a dollar amount before beginning to decline.

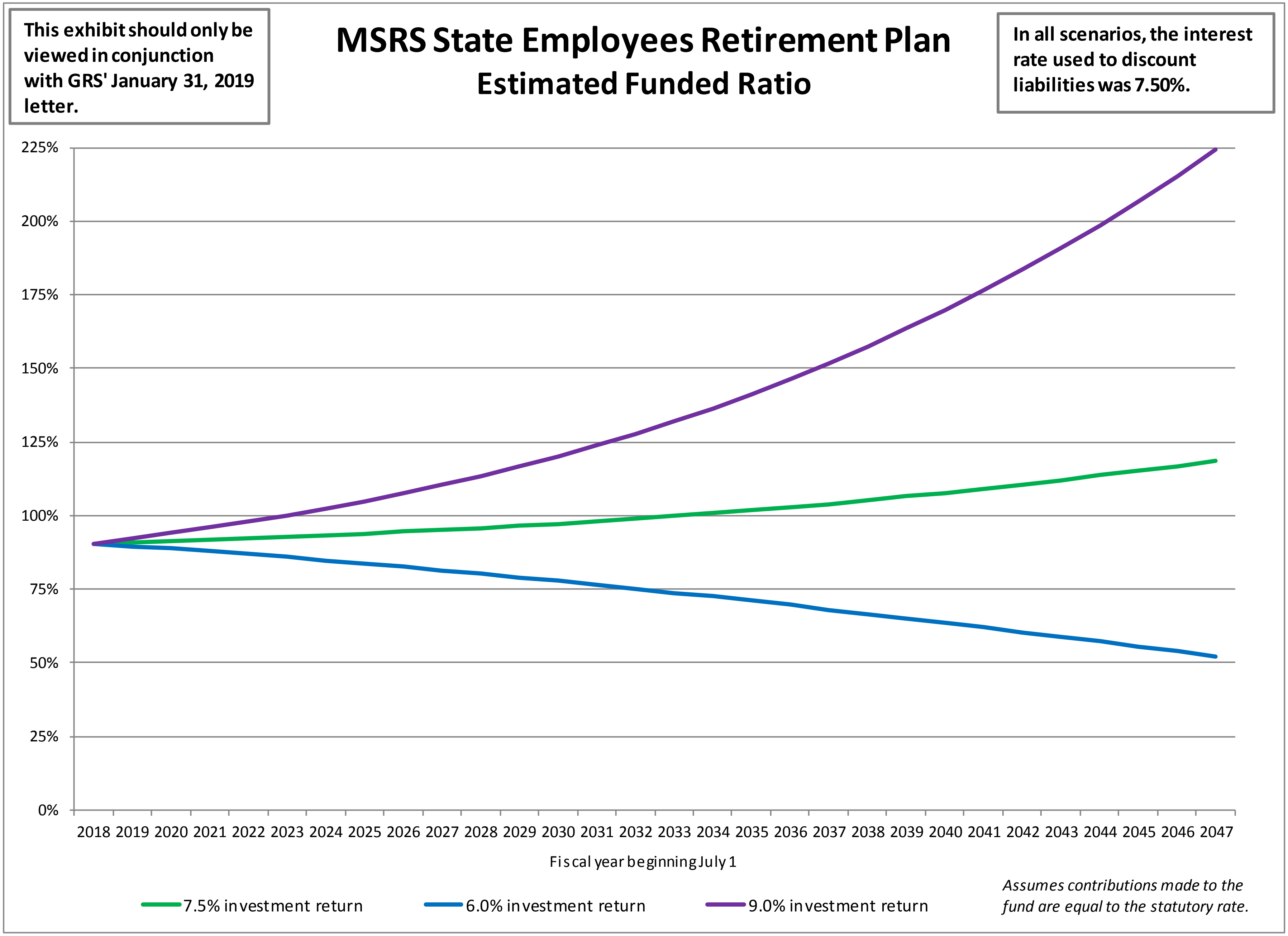
Limitations of Funded Status Measurements

Unless otherwise indicated, a funded status measurement presented in this report is based upon the actuarial accrued liability and the market value of assets. Unless otherwise indicated, with regard to any funded status measurements presented in this report:

(1) The measurement is inappropriate for assessing the sufficiency of plan assets to cover the estimated cost of settling the plan's benefit obligations, in other words of transferring the obligations to an unrelated third party in an arm's length market value type transaction.
(2) The measurement is dependent upon the actuarial cost method which, in combination with the plan's amortization policy, affects the timing and amounts of future contributions. The amounts of future contributions will most certainly differ from those assumed in this report due to future actual experience differing from assumed experience based upon the actuarial assumptions. A funded status measurement in this report of 100% is not synonymous with no required future contributions. If the funded status were 100%, the plan would still require future normal cost contributions (i.e., contributions to cover the cost of the active membership accruing an additional year of service credit).
(3) The measurement would produce a different result if the actuarial value of assets were used instead of the market value of assets.

Limitations of Project Scope

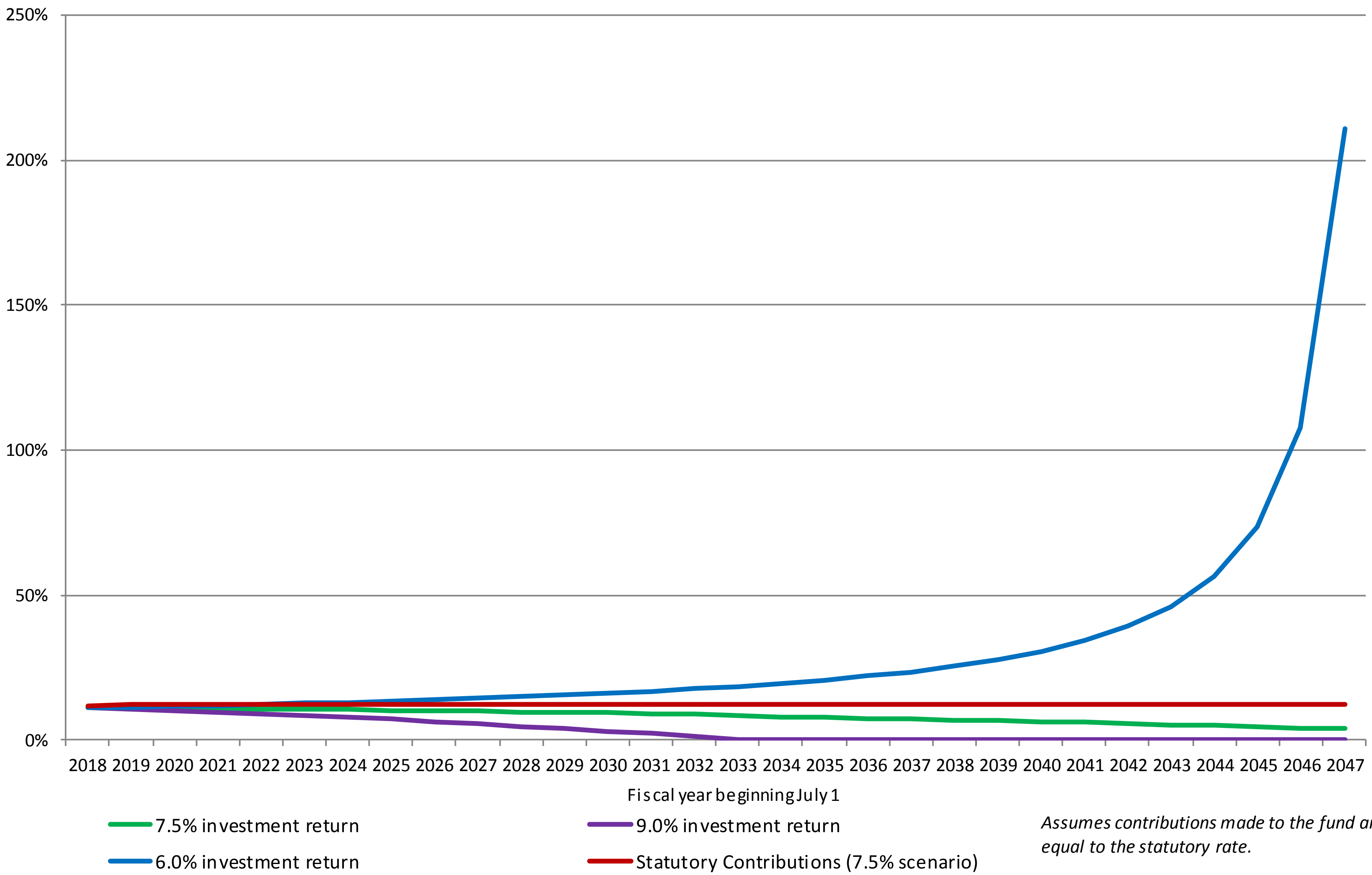
Actuarial standards do not require the actuary to evaluate the ability of the plan sponsor or other contributing entity to make required contributions to the plan when due. Such an evaluation was not within the scope of this project and is not within the actuary's domain of expertise. Consequently, the actuary performed no such evaluation.


This exhibit should only be viewed in conjunction with GRS' January 31, 2019 letter.
MSRS State Employees Retirement Plan
Estimated Funded Ratio
In all scenarios, the interest rate used to discount liabilities was 7.50%.
225%
200%
175%
150%
125%
100%
75%
50%
25%
0%
2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047
Fiscal year beginning July 1
7.5% investment return
6.0% investment return
9.0% investment return
Assumes contributions made to the fund are equal to the statutory rate.

This exhibit should only be viewed in conjunction with GRS' January 31, 2019 letter.

MSRS State Employees Retirement Plan
Estimated Required Contribution Rates (% of Pay)

In all scenarios, the interest rate used to discount liabilities was 7.50%.



Assumes contributions made to the fund are equal to the statutory rate.

This exhibit should only be viewed in conjunction with GRS' January 31, 2019 letter to MSRS.

State Employees Retirement Plan

Scenario: 7.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Contributions (% of Payroll)										
Statutory - Chapter 352	11.6%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%
Required - Chapter 356 (MVA)	11.1%	11.0%	10.9%	10.8%	10.7%	10.6%	10.5%	10.3%	10.2%	10.0%
Sufficiency / (Deficiency)	0.6%	1.2%	1.3%	1.4%	1.6%	1.7%	1.8%	2.0%	2.1%	2.3%
Contributions										
Statutory - Chapter 352	364,411	393,895	406,494	419,110	432,162	445,689	459,693	474,258	489,346	505,005
Required - Chapter 356 (MVA)	346,244	354,166	362,068	369,876	377,534	384,985	392,141	398,951	405,274	410,996
Sufficiency / (Deficiency)	18,167	39,729	44,426	49,234	54,628	60,705	67,552	75,307	84,072	94,009
Funding Ratios										
Current Assets (MVA)	13,293,422	13,767,962	14,254,889	14,739,427	15,226,296	15,718,406	16,215,458	16,718,246	17,229,389	17,752,639
Actuarial Accrued Liability (AAL)	14,679,489	15,148,210	15,605,688	16,053,312	16,495,959	16,935,820	17,371,795	17,803,805	18,233,494	18,663,611
Unfunded AAL	1,386,067	1,380,248	1,350,799	1,313,885	1,269,663	1,217,414	1,156,338	1,085,559	1,004,106	910,972
Funding Ratio	90.6%	90.9%	91.3%	91.8%	92.3%	92.8%	93.3%	93.9%	94.5%	95.1%
Benefit Payments	857,966	909,552	959,325	1,004,391	1,047,246	1,091,231	1,135,271	1,177,749	1,217,723	1,255,468
Ratio of Assets to Benefit Payments	15.49	15.14	14.86	14.67	14.54	14.40	14.28	14.20	14.15	14.14

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 7.5%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2019 letter to MSRS.

State Employees Retirement Plan

Scenario: 7.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Contributions (% of Payroll)										
Statutory - Chapter 352	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%
Required - Chapter 356 (MVA)	9.8%	9.6%	9.3%	9.1%	8.7%	8.4%	8.1%	7.9%	7.6%	7.3%
Sufficiency / (Deficiency)	2.5%	2.7%	2.9%	3.2%	3.5%	3.9%	4.1%	4.4%	4.7%	4.9%
Contributions										
Statutory - Chapter 352	521,208	537,869	554,992	572,641	590,829	609,550	628,842	648,700	669,183	690,291
Required - Chapter 356 (MVA)	415,901	419,703	422,156	422,972	421,730	417,891	416,989	416,429	414,851	412,137
Sufficiency / (Deficiency)	105,307	118,165	132,836	149,669	169,099	191,659	211,854	232,271	254,331	278,154
Funding Ratios										
Current Assets (MVA)	18,291,796	18,850,835	19,433,421	20,043,525	20,684,306	21,360,184	22,074,972	22,832,401	23,636,263	24,491,234
Actuarial Accrued Liability (AAL)	19,096,853	19,536,034	19,983,604	20,442,247	20,913,695	21,400,835	21,905,860	22,430,710	22,977,287	23,548,201
Unfunded AAL	805,057	685,199	550,183	398,721	229,389	40,652	(169,112)	(401,690)	(658,976)	(943,034)
Funding Ratio	95.8%	96.5%	97.3%	98.1%	98.9%	99.8%	100.8%	101.8%	102.9%	104.0%
Benefit Payments	1,291,058	1,325,001	1,357,267	1,388,992	1,419,198	1,448,784	1,478,145	1,507,482	1,536,278	1,564,004
Ratio of Assets to Benefit Payments	14.17	14.23	14.32	14.43	14.57	14.74	14.93	15.15	15.39	15.66

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 7.5%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2019 letter to MSRS.

State Employees Retirement Plan

Scenario: 7.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Contributions (% of Payroll)										
Statutory - Chapter 352	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%
Required - Chapter 356 (MVA)	7.0%	6.7%	6.4%	6.1%	5.7%	5.4%	5.0%	4.6%	4.2%	3.8%
Sufficiency / (Deficiency)	5.2%	5.5%	5.9%	6.2%	6.5%	6.9%	7.2%	7.6%	8.0%	8.4%
Contributions										
Statutory - Chapter 352	712,002	734,299	757,189	780,793	805,158	830,265	856,138	882,791	910,353	938,886
Required - Chapter 356 (MVA)	408,137	402,713	395,744	387,160	376,812	364,504	350,069	333,307	314,078	292,157
Sufficiency / (Deficiency)	303,864	331,585	361,445	393,633	428,347	465,761	506,069	549,484	596,275	646,729
Funding Ratios										
Current Assets (MVA)	25,402,892	26,377,296	27,419,758	28,534,912	29,727,863	31,004,620	32,371,048	33,832,441	35,393,789	37,060,260
Actuarial Accrued Liability (AAL)	24,146,825	24,776,866	25,441,131	26,141,578	26,880,353	27,660,282	28,483,831	29,352,642	30,267,789	31,230,141
Unfunded AAL	(1,256,067)	(1,600,430)	(1,978,627)	(2,393,334)	(2,847,510)	(3,344,338)	(3,887,218)	(4,479,798)	(5,126,000)	(5,830,119)
Funding Ratio	105.2%	106.5%	107.8%	109.2%	110.6%	112.1%	113.7%	115.3%	116.9%	118.7%
Benefit Payments	1,590,571	1,617,127	1,644,714	1,673,329	1,702,518	1,732,835	1,765,278	1,800,534	1,838,923	1,879,649
Ratio of Assets to Benefit Payments	15.97	16.31	16.67	17.05	17.46	17.89	18.34	18.79	19.25	19.72

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 7.5%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2019 letter to MSRS.

State Employees Retirement Plan

Scenario: 6.0% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Contributions (% of Payroll)										
Statutory - Chapter 352	11.6%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%
Required - Chapter 356 (MVA)	11.1%	11.4%	11.7%	12.0%	12.3%	12.7%	13.1%	13.5%	13.9%	14.4%
Sufficiency / (Deficiency)	0.6%	0.9%	0.6%	0.3%	(0.1)%	(0.4)%	(0.8)%	(1.2)%	(1.7)%	(2.2)%
Contributions										
Statutory - Chapter 352	364,411	393,895	406,494	419,110	432,162	445,689	459,693	474,258	489,346	505,005
Required - Chapter 356 (MVA)	346,244	365,824	386,961	409,773	434,431	461,137	490,113	521,671	556,100	593,804
Sufficiency / (Deficiency)	18,167	28,070	19,533	9,336	(2,268)	(15,448)	(30,421)	(47,413)	(66,754)	(88,799)
Funding Ratios										
Current Assets (MVA)	13,293,422	13,572,338	13,844,952	14,095,296	14,326,898	14,541,347	14,736,929	14,912,930	15,070,349	15,211,175
Actuarial Accrued Liability (AAL)	14,679,489	15,148,210	15,605,688	16,053,312	16,495,959	16,935,820	17,371,795	17,803,805	18,233,494	18,663,611
Unfunded AAL	1,386,067	1,575,872	1,760,736	1,958,016	2,169,061	2,394,473	2,634,867	2,890,874	3,163,145	3,452,436
Funding Ratio	90.6%	89.6%	88.7%	87.8%	86.9%	85.9%	84.8%	83.8%	82.7%	81.5%
Benefit Payments	857,966	909,552	959,325	1,004,391	1,047,246	1,091,231	1,135,271	1,177,749	1,217,723	1,255,468
Ratio of Assets to Benefit Payments	15.49	14.92	14.43	14.03	13.68	13.33	12.98	12.66	12.38	12.12

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 7.5%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2019 letter to MSRS.

State Employees Retirement Plan

Scenario: 6.0% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Contributions (% of Payroll)										
Statutory - Chapter 352	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%
Required - Chapter 356 (MVA)	14.9%	15.5%	16.1%	16.8%	17.6%	18.5%	19.5%	20.7%	22.0%	23.6%
Sufficiency / (Deficiency)	(2.7)%	(3.3)%	(3.9)%	(4.6)%	(5.4)%	(6.3)%	(7.3)%	(8.4)%	(9.8)%	(11.3)%
Contributions										
Statutory - Chapter 352	521,208	537,869	554,992	572,641	590,829	609,550	628,842	648,700	669,183	690,291
Required - Chapter 356 (MVA)	635,192	680,741	731,143	787,272	850,168	921,147	1,001,929	1,094,736	1,202,585	1,329,523
Sufficiency / (Deficiency)	(113,984)	(142,873)	(176,151)	(214,631)	(259,339)	(311,597)	(373,087)	(446,036)	(533,402)	(639,233)
Funding Ratios										
Current Assets (MVA)	15,337,282	15,450,549	15,552,364	15,644,230	15,726,635	15,801,116	15,868,371	15,928,772	15,982,499	16,030,335
Actuarial Accrued Liability (AAL)	19,096,853	19,536,034	19,983,604	20,442,247	20,913,695	21,400,835	21,905,860	22,430,710	22,977,287	23,548,201
Unfunded AAL	3,759,571	4,085,484	4,431,240	4,798,017	5,187,060	5,599,719	6,037,489	6,501,938	6,994,788	7,517,866
Funding Ratio	80.3%	79.1%	77.8%	76.5%	75.2%	73.8%	72.4%	71.0%	69.6%	68.1%
Benefit Payments	1,291,058	1,325,001	1,357,267	1,388,992	1,419,198	1,448,784	1,478,145	1,507,482	1,536,278	1,564,004
Ratio of Assets to Benefit Payments	11.88	11.66	11.46	11.26	11.08	10.91	10.74	10.57	10.40	10.25

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 7.5%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2019 letter to MSRS.

State Employees Retirement Plan

Scenario: 6.0% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Contributions (% of Payroll)										
Statutory - Chapter 352	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%
Required - Chapter 356 (MVA)	25.5%	27.8%	30.7%	34.4%	39.3%	46.2%	56.5%	73.7%	108.0%	210.9%
Sufficiency / (Deficiency)	(13.2)%	(15.5)%	(18.4)%	(22.1)%	(27.0)%	(33.9)%	(44.2)%	(61.4)%	(95.7)%	(198.7)%
Contributions										
Statutory - Chapter 352	712,002	734,299	757,189	780,793	805,158	830,265	856,138	882,791	910,353	938,886
Required - Chapter 356 (MVA)	1,481,205	1,665,832	1,895,750	2,190,413	2,582,116	3,128,947	3,947,150	5,307,919	8,024,897	16,165,822
Sufficiency / (Deficiency)	(769,204)	(931,534)	(1,138,561)	(1,409,620)	(1,776,958)	(2,298,682)	(3,091,012)	(4,425,128)	(7,114,544)	(15,226,936)
Funding Ratios										
Current Assets (MVA)	16,073,658	16,113,993	16,151,763	16,186,345	16,217,206	16,244,294	16,266,965	16,283,533	16,291,516	16,288,086
Actuarial Accrued Liability (AAL)	24,146,825	24,776,866	25,441,131	26,141,578	26,880,353	27,660,282	28,483,831	29,352,642	30,267,789	31,230,141
Unfunded AAL	8,073,167	8,662,872	9,289,368	9,955,233	10,663,147	11,415,988	12,216,866	13,069,110	13,976,273	14,942,054
Funding Ratio	66.6%	65.0%	63.5%	61.9%	60.3%	58.7%	57.1%	55.5%	53.8%	52.2%
Benefit Payments	1,590,571	1,617,127	1,644,714	1,673,329	1,702,518	1,732,835	1,765,278	1,800,534	1,838,923	1,879,649
Ratio of Assets to Benefit Payments	10.11	9.96	9.82	9.67	9.53	9.37	9.21	9.04	8.86	8.67

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 7.5%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2019 letter to MSRS.

State Employees Retirement Plan

Scenario: 9.0% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Contributions (% of Payroll)										
Statutory - Chapter 352	11.6%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%
Required - Chapter 356 (MVA)	11.1%	10.7%	10.2%	9.6%	9.0%	8.4%	7.7%	7.1%	6.4%	5.6%
Sufficiency / (Deficiency)	0.6%	1.6%	2.1%	2.6%	3.2%	3.9%	4.5%	5.2%	5.9%	6.6%
Contributions										
Statutory - Chapter 352	364,411	393,895	406,494	419,110	432,162	445,689	459,693	474,258	489,346	505,005
Required - Chapter 356 (MVA)	346,244	342,507	336,819	328,820	318,125	304,471	290,099	273,273	253,715	231,175
Sufficiency / (Deficiency)	18,167	51,388	69,674	90,290	114,037	141,219	169,593	200,985	235,631	273,830
Funding Ratios										
Current Assets (MVA)	13,293,422	13,963,587	14,670,695	15,402,252	16,165,395	16,965,721	17,805,878	18,689,879	19,623,874	20,615,510
Actuarial Accrued Liability (AAL)	14,679,489	15,148,210	15,605,688	16,053,312	16,495,959	16,935,820	17,371,795	17,803,805	18,233,494	18,663,611
Unfunded AAL	1,386,067	1,184,623	934,994	651,060	330,564	(29,901)	(434,083)	(886,075)	(1,390,379)	(1,951,899)
Funding Ratio	90.6%	92.2%	94.0%	95.9%	98.0%	100.2%	102.5%	105.0%	107.6%	110.5%
Benefit Payments	857,966	909,552	959,325	1,004,391	1,047,246	1,091,231	1,135,271	1,177,749	1,217,723	1,255,468
Ratio of Assets to Benefit Payments	15.49	15.35	15.29	15.33	15.44	15.55	15.68	15.87	16.12	16.42

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 7.5%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2019 letter to MSRS.

State Employees Retirement Plan

Scenario: 9.0% investment return for all years

Fiscal year beginning July 1

$ in Thousands	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Contributions (% of Payroll)										
Statutory - Chapter 352	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%
Required - Chapter 356 (MVA)	4.8%	4.0%	3.1%	2.2%	1.3%	0.3%	0.0%	0.0%	0.0%	0.0%
Sufficiency / (Deficiency)	7.4%	8.3%	9.1%	10.0%	11.0%	12.0%	12.3%	12.3%	12.3%	12.3%
Contributions										
Statutory - Chapter 352	521,208	537,869	554,992	572,641	590,829	609,550	628,842	648,700	669,183	690,291
Required - Chapter 356 (MVA)	205,307	175,701	142,006	103,857	60,804	12,351	0	0	0	0
Sufficiency / (Deficiency)	315,901	362,167	412,986	468,784	530,026	597,198	628,842	648,700	669,183	690,291
Funding Ratios										
Current Assets (MVA)	21,672,887	22,804,726	24,019,915	25,328,180	26,738,997	28,263,733	29,913,830	31,701,387	33,639,377	35,742,538
Actuarial Accrued Liability (AAL)	19,096,853	19,536,034	19,983,604	20,442,247	20,913,695	21,400,835	21,905,860	22,430,710	22,977,287	23,548,201
Unfunded AAL	(2,576,034)	(3,268,692)	(4,036,311)	(4,885,933)	(5,825,302)	(6,862,898)	(8,007,970)	(9,270,677)	(10,662,090)	(12,194,337)
Funding Ratio	113.5%	116.7%	120.2%	123.9%	127.9%	132.1%	136.6%	141.3%	146.4%	151.8%
Benefit Payments	1,291,058	1,325,001	1,357,267	1,388,992	1,419,198	1,448,784	1,478,145	1,507,482	1,536,278	1,564,004
Ratio of Assets to Benefit Payments	16.79	17.21	17.70	18.23	18.84	19.51	20.24	21.03	21.90	22.85

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 7.5%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2019 letter to MSRS.

State Employees Retirement Plan

Scenario: 9.0% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Contributions (% of Payroll)										
Statutory - Chapter 352	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%
Required - Chapter 356 (MVA)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sufficiency / (Deficiency)	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%	12.3%
Contributions										
Statutory - Chapter 352	712,002	734,299	757,189	780,793	805,158	830,265	856,138	882,791	910,353	938,886
Required - Chapter 356 (MVA)	0	0	0	0	0	0	0	0	0	0
Sufficiency / (Deficiency)	712,002	734,299	757,189	780,793	805,158	830,265	856,138	882,791	910,353	938,886
Funding Ratios										
Current Assets (MVA)	38,027,493	40,512,426	43,215,944	46,157,246	49,357,384	52,839,828	56,629,562	60,752,800	65,237,412	70,113,573
Actuarial Accrued Liability (AAL)	24,146,825	24,776,866	25,441,131	26,141,578	26,880,353	27,660,282	28,483,831	29,352,642	30,267,789	31,230,141
Unfunded AAL	(13,880,668)	(15,735,560)	(17,774,813)	(20,015,668)	(22,477,031)	(25,179,546)	(28,145,732)	(31,400,158)	(34,969,623)	(38,883,432)
Funding Ratio	157.5%	163.5%	169.9%	176.6%	183.6%	191.0%	198.8%	207.0%	215.5%	224.5%
Benefit Payments	1,590,571	1,617,127	1,644,714	1,673,329	1,702,518	1,732,835	1,765,278	1,800,534	1,838,923	1,879,649
Ratio of Assets to Benefit Payments	23.91	25.05	26.28	27.58	28.99	30.49	32.08	33.74	35.48	37.30

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 7.5%.