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January 31, 2017

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 – Judges Plan

Dear Erin:

Attached are 30-year projections of estimated funded status, required contributions, and statutory contributions under three asset return scenarios for the Judges Retirement Fund. Unless noted otherwise, the estimates are based on participant data, assets, and plan provisions as outlined in the Judges Retirement Fund actuarial funding valuation as of July 1, 2016.

An experience study was completed in 2016. In the report, GRS recommended many changes to the valuation assumptions. The recommended assumptions were used to determine the enclosed results. The recommended demographic assumptions are summarized in the *Minnesota Judges Retirement Fund, 4-Year Experience Study*, dated July 26, 2016.

As required by the Minnesota Standards for Actuarial Work, the projections reflect three asset return scenarios. The statutory investment return assumption is 8.0%. The scenarios assume future investment returns of 1.5% more than the assumed rate, the assumed rate, and 1.5% less than the assumed rate. Note that we believe the 9.5% rate of return assumption is outside of the range of reasonable expected returns for this plan. In fact, according to the *Minnesota State Employees Retirement Fund 6-Year Experience Study*, dated June 30, 2015, the probability of achieving the 8.0% assumption is only 37%. The study further indicates that in order to have a 50% chance of achieving the assumed earnings rate, the rate would have to be lowered to 7.0%. Please see the aforementioned experience study report for additional information.

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 investment return. Each year, a larger proportion of assets is paid out in benefits, and less capital is available to invest.

The estimates are based on the market value of assets with no smoothing of investment gains or losses. In all scenarios, the valuation interest rate used to discount liabilities was 8.0%. Payroll is assumed to increase approximately 2.75% 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 311 members. The profile of these new members is the same as new members of each fund hired between July 1, 2010 and July 1, 2015:

- Average age at hire is 49.8
- Average salary at hire is $149,900
- Approximately 51% female, 49% male

If actuarial accrued liability exceeds assets, the unfunded actuarial accrued liability is amortized through June 30, 2039 per Minnesota Statute 356.215, Subdivision 11. As directed by MSRS, the statutory amortization date is assumed to be changed to June 30, 2069 once the current period expires in 2039. 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.

Post-Retirement Benefit Increases

A very significant assumption affecting the projected estimates is the expectation of annual increases in the benefits being paid to retirees and beneficiaries. The current benefit increase rate is 1.75%. If the plan reaches a funding ratio of 70% (based on a 2.0% post-retirement benefit increase assumption) on a market value of assets basis for two consecutive years in the future, post-retirement increases will increase from 1.75% to 2.0%. Similarly, if the plan reaches a funding ratio of 90% (based on a 2.5% post-retirement benefit increase assumption) on a market value of assets basis for two consecutive years in the future, post-retirement increases will increase from 2.0% to 2.5%.

For the 8.0% scenario, an actuarial projection was performed to estimate when this plan is expected to attain the threshold required to pay a 2.0% or 2.5% post-retirement benefit increase. The projection indicated that if all assumptions were met, the thresholds are expected to be attained in the years 2040 and 2053, and that the plan would begin paying 2.0% benefit increases on January 1, 2041 and 2.5% benefit increases on January 1, 2054. This assumption is reflected in the 8.0% rate of return projection scenario.

Under the 9.5% rate of return scenario, the funded status of the plan is expected to improve. Based on present expectations, the 9.5% rate of return scenario is a very low probability outcome. As the plan experiences greater than expected investment return each year, the assumed 2.0%/2.5% benefit increase dates are accelerated. We performed a projection to estimate when the plan is expected to attain the threshold required to pay a 2.0% or 2.5% post-retirement benefit increase if future investment returns are 9.5%. This projection indicated the plan would begin paying a 2.0% benefit increase on January 1, 2030 and a 2.5% benefit increase on January 1, 2037. To approximate the acceleration of the assumed 2.0%/2.5% benefit increase dates from 2041 to 2030 and from 2054 to 2037, we assumed the accrued liability and normal cost would increase by a proportionate amount between 2016 and 2030.

Under the 6.5% rate of return scenario, the funded status of the plan is expected to deteriorate. Based on present expectations, this is the only scenario that has a better than 50% chance of being achieved. As the plan experiences lower than expected investment returns each year, the assumed 2.0%/2.5% benefit increase dates become later each year until they are no longer projected to be attained. We assumed for purposes of this projection that this transition from the current assumption (that the benefit increase will change from 1.75% to 2.0% on January 1, 2041 and from 2.0% to 2.5% on January 1, 2054) to an assumption that the benefit increase will remain at 1.75% for all years would occur by July 1, 2030.

Comments

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.

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.

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

The signing actuaries are independent of the plan sponsor. We are not aware of any relationship that would impair the objectivity of our work.

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. In addition, Mr. Murphy meets the requirements of "approved actuary" under Minnesota Statutes Section 356.215, Subdivision 1, Paragraph (c).

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 Judges Retirement Fund 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.

Sincerely,

Bonita J. Wurst

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

Brian B. Murphy

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

BJW/BBM:mrb
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 8.0% on the market value of assets), it is expected that:

(1) The unfunded actuarial accrued liabilities will be fully amortized after approximately 40 years,
(2) The funded status of the plan will increase gradually, 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.

Other Observations

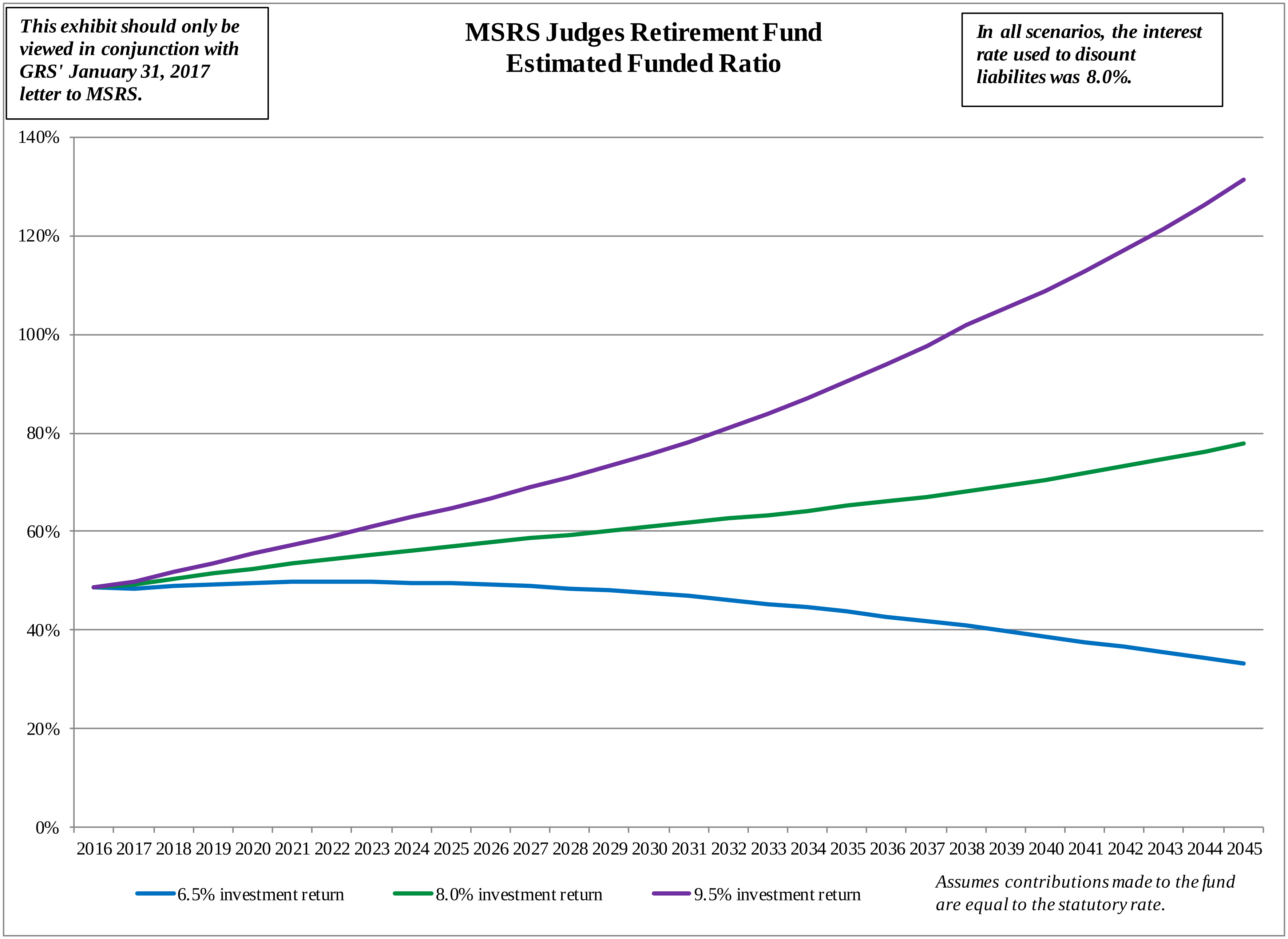
<u>Discount Rate Assumption</u>

In a 2015 analysis of long-term rate of investment return and inflation assumptions, GRS suggested that an investment return assumption in the range of 7.00% to 8.00% would be reasonable. The current assumed rate, which is mandated by Minnesota Statutes, is 8.00% and is at the upper end of the reasonable range. This report also concluded that the probability of exceeding the current 8.00% assumption over 20 years is only 37%. Please see the report, *Minnesota State Employees Retirement Fund 6-Year Experience Study*, dated June 30, 2015 for additional information.

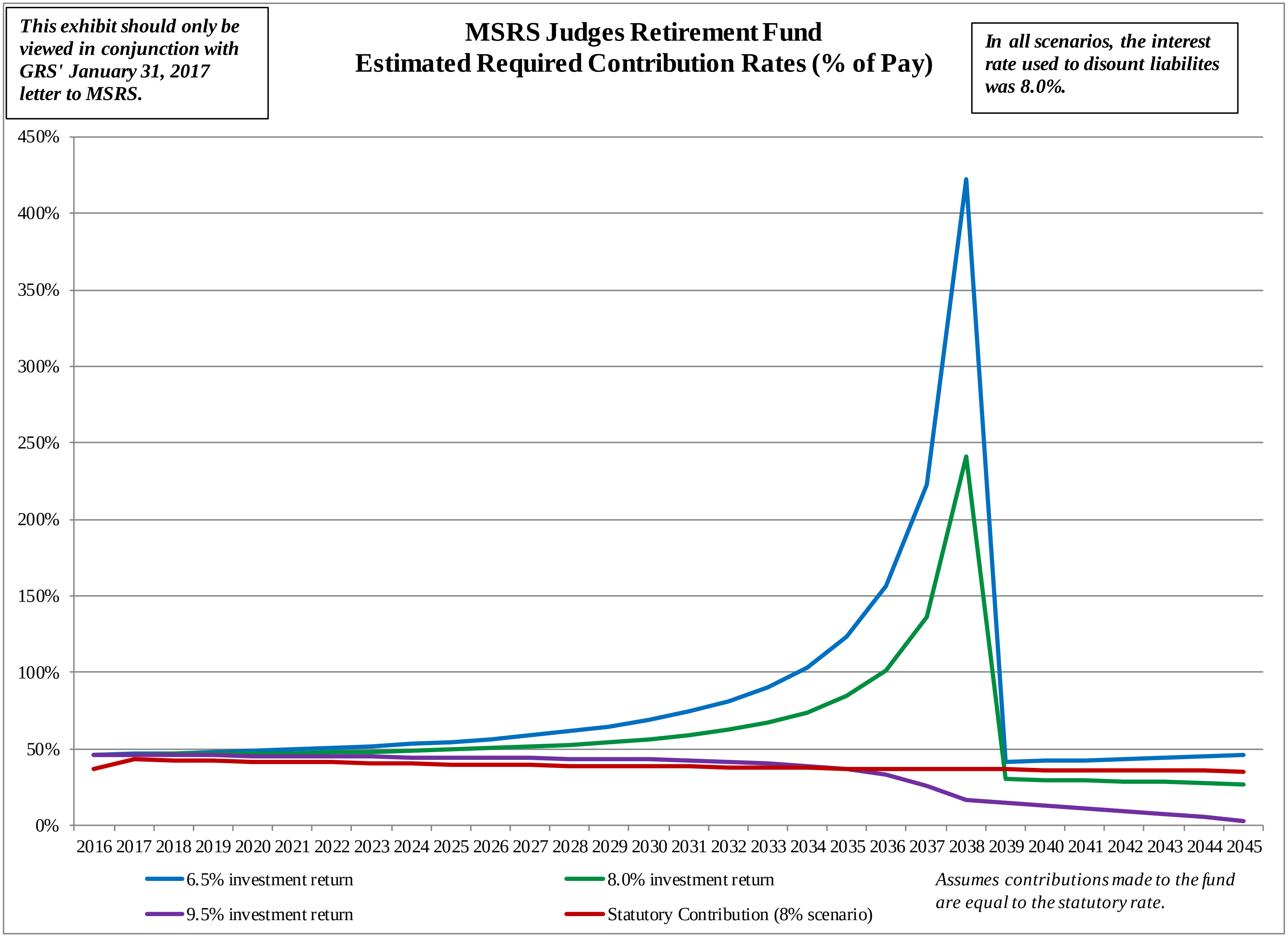
Professional standards require GRS to evaluate this assumption each year. If an assumption is deemed unreasonable based on current information, we would have to qualify the work that we do for MSRS.

In May 2016, the Minnesota State Board of Investment (SBI) affirmed that the 8.00% return rate is attainable in the long-term, while acknowledging short-term challenges. Also in May 2016, the LCPR's Actuary supported the reasonableness of the current rate by reviewing historical returns by investment class, projected returns from other investment consultants, and considering the SBI's projections. GRS believes the 8.00% return rate is within the reasonable range for this valuation as of July 1, 2016, but cautions MSRS that declining capital market and inflation expectations may result in 8.00% being deemed unreasonable for future valuations. In such an instance, we would still comply with statutes and produce the valuation based upon 8.00%, but Actuarial Standards would require us to issue a "qualified" report.

If a discount rate of 7.50% were used in the July 1, 2016 valuation instead of 8.00%, we estimate that the unfunded liability would be approximately $14 million higher than estimated in the 2016 valuation. This estimate incorporates lower salary scale rates due to lower inflation expectations, as well as a delay in the assumed payment of 2.0%/2.5% post-retirement benefit increases.



This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.
MSRS Judges Retirement Fund
Estimated Funded Ratio
In all scenarios, the interest rate used to disount liabilites was 8.0%.
140%
120%
100%
80%
60%
40%
20%
0%
2016 2017 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
6.5% investment return
8.0% investment return
9.5% 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, 2017 letter to MSRS.
MSRS Judges Retirement Fund
Estimated Required Contribution Rates (% of Pay)
In all scenarios, the interest rate used to disount liabilites was 8.0%.
450%
400%
350%
300%
250%
200%
150%
100%
50%
0%
2016 2017 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
6.5% investment return
8.0% investment return
9.5% investment return
Statutory Contribution (8% scenario)
Assumes contributions made to the fund are equal to the statutory rate.

This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.

Judges Retirement Fund
Scenario: 8.0% investment return for all years
Fiscal year beginning July 1

$ in Thousands	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Contributions (% of Payroll)										
Statutory - Chapter 490	37.1%	42.8%	42.4%	42.0%	41.6%	41.3%	40.9%	40.6%	40.2%	39.9%
Required - Chapter 356 (MVA)	46.2%	46.3%	46.4%	46.6%	46.9%	47.1%	47.5%	47.9%	48.5%	49.3%
Sufficiency / (Deficiency)	(9.2)%	(3.5)%	(4.0)%	(4.6)%	(5.3)%	(5.9)%	(6.6)%	(7.4)%	(8.3)%	(9.4)%
Contributions										
Statutory - Chapter 490	17,815	21,140	21,491	21,867	22,261	22,667	23,079	23,507	23,943	24,395
Required - Chapter 356 (MVA)	22,210	22,844	23,529	24,273	25,077	25,884	26,789	27,777	28,887	30,119
Sufficiency / (Deficiency)	(4,395)	(1,704)	(2,038)	(2,406)	(2,816)	(3,217)	(3,710)	(4,270)	(4,944)	(5,724)
Funding Ratios										
Current Assets (MVA)	165,905	173,813	184,521	194,863	204,986	215,190	225,436	235,606	245,630	255,610
Actuarial Accrued Liability (AAL)	340,777	353,623	366,301	378,503	390,408	402,314	414,165	425,827	437,215	448,427
Unfunded AAL	174,872	179,810	181,780	183,640	185,422	187,124	188,729	190,221	191,585	192,817
Funding Ratio	49%	49%	50%	51%	53%	53%	54%	55%	56%	57%
Benefit Payments	22,872	24,110	25,634	27,013	28,106	29,253	30,524	31,870	33,117	34,261

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.

Judges Retirement Fund

Scenario: 8.0% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Contributions (% of Payroll)										
Statutory - Chapter 490	39.6%	39.3%	39.0%	38.7%	38.4%	38.2%	37.9%	37.6%	37.4%	37.2%
Required - Chapter 356 (MVA)	50.2%	51.2%	52.5%	54.1%	56.3%	58.9%	62.4%	67.2%	74.0%	84.2%
Sufficiency / (Deficiency)	(10.6)%	(11.9)%	(13.5)%	(15.4)%	(17.8)%	(20.8)%	(24.5)%	(29.6)%	(36.6)%	(47.0)%
Contributions										
Statutory - Chapter 490	24,865	25,348	25,845	26,352	26,873	27,420	27,978	28,554	29,150	29,765
Required - Chapter 356 (MVA)	31,503	33,041	34,795	36,847	39,346	42,340	46,083	50,981	57,667	67,448
Sufficiency / (Deficiency)	(6,638)	(7,693)	(8,950)	(10,495)	(12,473)	(14,920)	(18,105)	(22,427)	(28,517)	(37,683)
Funding Ratios										
Current Assets (MVA)	265,665	275,817	286,073	296,458	306,783	317,204	327,838	338,744	350,034	361,876
Actuarial Accrued Liability (AAL)	459,572	470,649	481,636	492,536	503,139	513,583	523,955	534,288	544,665	555,221
Unfunded AAL	193,907	194,832	195,563	196,078	196,356	196,379	196,117	195,544	194,631	193,345
Funding Ratio	58%	59%	59%	60%	61%	62%	63%	63%	64%	65%
Benefit Payments	35,407	36,568	37,726	39,086	40,304	41,444	42,554	43,597	44,526	45,507

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.

Judges Retirement Fund

Scenario: 8.0% investment return for all years

Fiscal year beginning July 1

$ in Thousands	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**
Contributions (% of Payroll)										
Statutory - Chapter 490	36.9%	36.7%	36.5%	36.3%	36.1%	35.9%	35.7%	35.6%	35.4%	35.2%
Required - Chapter 356 (MVA)	101.5%	136.2%	240.7%	29.9%	29.4%	29.0%	28.5%	28.0%	27.5%	26.9%
Sufficiency / (Deficiency)	(64.5)%	(99.5)%	(204.2)%	6.4%	6.7%	6.9%	7.2%	7.5%	7.9%	8.3%
Contributions										
Statutory - Chapter 490	30,397	31,047	31,720	32,414	33,127	33,860	34,618	35,398	36,200	37,023
Required - Chapter 356 (MVA)	83,522	115,195	209,197	26,673	26,994	27,345	27,621	27,890	28,091	28,283
Sufficiency / (Deficiency)	(53,125)	(84,148)	(177,477)	5,741	6,133	6,515	6,997	7,508	8,109	8,740
Funding Ratios										
Current Assets (MVA)	374,280	387,265	401,032	415,756	431,555	448,433	466,516	485,986	506,956	529,517
Actuarial Accrued Liability (AAL)	565,932	576,786	587,948	599,545	611,647	624,216	637,330	651,096	665,560	680,742
Unfunded AAL	191,652	189,521	186,916	183,789	180,092	175,783	170,814	165,110	158,604	151,225
Funding Ratio	66%	67%	68%	69%	71%	72%	73%	75%	76%	78%
Benefit Payments	46,529	47,422	48,229	49,017	49,903	50,769	51,579	52,409	53,289	54,247

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.

Judges Retirement Fund

Scenario: 6.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Contributions (% of Payroll)										
Statutory - Chapter 490	37.1%	42.8%	42.4%	42.0%	41.6%	41.3%	40.9%	40.6%	40.2%	39.9%
Required - Chapter 356 (MVA)	46.2%	46.6%	47.2%	47.8%	48.6%	49.4%	50.3%	51.5%	52.8%	54.5%
Sufficiency / (Deficiency)	(9.2)%	(3.8)%	(4.8)%	(5.8)%	(6.9)%	(8.1)%	(9.4)%	(10.9)%	(12.6)%	(14.6)%
Contributions										
Statutory - Chapter 490	17,815	21,140	21,491	21,867	22,261	22,667	23,079	23,507	23,943	24,395
Required - Chapter 356 (MVA)	22,210	23,022	23,913	24,896	25,978	27,110	28,392	29,822	31,449	33,293
Sufficiency / (Deficiency)	(4,395)	(1,882)	(2,422)	(3,029)	(3,717)	(4,443)	(5,313)	(6,315)	(7,506)	(8,898)
Funding Ratios										
Current Assets (MVA)	165,905	171,363	179,328	186,596	193,299	199,713	205,775	211,342	216,319	220,778
Actuarial Accrued Liability (AAL)	340,777	353,582	366,200	378,315	390,099	401,842	413,478	424,862	435,896	446,667
Unfunded AAL	174,872	182,219	186,872	191,719	196,800	202,129	207,703	213,520	219,577	225,889
Funding Ratio	49%	48%	49%	49%	50%	50%	50%	50%	50%	49%
Benefit Payments	22,872	24,110	25,634	27,013	28,106	29,253	30,524	31,870	33,117	34,261

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

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Judges Retirement Fund

Scenario: 6.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Contributions (% of Payroll)										
Statutory - Chapter 490	39.6%	39.3%	39.0%	38.7%	38.4%	38.2%	37.9%	37.6%	37.4%	37.2%
Required - Chapter 356 (MVA)	56.4%	58.6%	61.3%	64.6%	68.7%	74.0%	80.9%	90.3%	103.4%	123.2%
Sufficiency / (Deficiency)	(16.8)%	(19.3)%	(22.3)%	(25.9)%	(30.3)%	(35.9)%	(43.1)%	(52.6)%	(66.0)%	(86.0)%
Contributions										
Statutory - Chapter 490	24,865	25,348	25,845	26,352	26,873	27,420	27,978	28,554	29,150	29,765
Required - Chapter 356 (MVA)	35,402	37,810	40,618	43,959	48,065	53,209	59,770	68,492	80,614	98,653
Sufficiency / (Deficiency)	(10,537)	(12,462)	(14,773)	(17,607)	(21,192)	(25,789)	(31,792)	(39,938)	(51,464)	(68,888)
Funding Ratios										
Current Assets (MVA)	224,810	228,402	231,524	234,162	236,087	237,414	238,210	238,485	238,295	237,750
Actuarial Accrued Liability (AAL)	457,267	467,680	477,867	487,811	497,277	506,861	516,281	525,564	534,785	544,077
Unfunded AAL	232,457	239,278	246,343	253,649	261,190	269,447	278,071	287,079	296,490	306,327
Funding Ratio	49%	49%	48%	48%	47%	47%	46%	45%	45%	44%
Benefit Payments	35,407	36,568	37,726	39,086	40,304	41,444	42,554	43,597	44,526	45,507

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.

Judges Retirement Fund

Scenario: 6.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**
Contributions (% of Payroll)										
Statutory - Chapter 490	36.9%	36.7%	36.5%	36.3%	36.1%	35.9%	35.7%	35.6%	35.4%	35.2%
Required - Chapter 356 (MVA)	156.3%	222.6%	422.1%	41.4%	42.0%	42.7%	43.3%	44.1%	44.9%	45.9%
Sufficiency / (Deficiency)	(119.3)%	(185.9)%	(385.6)%	(5.1)%	(5.9)%	(6.8)%	(7.6)%	(8.6)%	(9.5)%	(10.7)%
Contributions										
Statutory - Chapter 490	30,397	31,047	31,720	32,414	33,127	33,860	34,618	35,398	36,200	37,023
Required - Chapter 356 (MVA)	128,631	188,334	366,879	36,996	38,529	40,221	41,988	43,913	45,962	48,217
Sufficiency / (Deficiency)	(98,234)	(157,287)	(335,159)	(4,582)	(5,402)	(6,361)	(7,370)	(8,515)	(9,762)	(11,194)
Funding Ratios										
Current Assets (MVA)	236,792	235,371	233,614	231,612	229,394	226,917	224,254	221,473	218,568	215,501
Actuarial Accrued Liability (AAL)	553,405	562,751	572,274	582,092	592,268	602,807	613,826	625,426	637,644	650,496
Unfunded AAL	316,613	327,380	338,660	350,480	362,874	375,890	389,572	403,953	419,076	434,995
Funding Ratio	43%	42%	41%	40%	39%	38%	37%	35%	34%	33%
Benefit Payments	46,529	47,422	48,229	49,017	49,774	50,527	51,225	51,945	52,716	53,556

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

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Judges Retirement Fund

Scenario: 9.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Contributions (% of Payroll)										
Statutory - Chapter 490	37.1%	42.8%	42.4%	42.0%	41.6%	41.3%	40.9%	40.6%	40.2%	39.9%
Required - Chapter 356 (MVA)	46.2%	46.0%	45.8%	45.6%	45.4%	45.1%	44.9%	44.6%	44.4%	44.2%
Sufficiency / (Deficiency)	(9.2)%	(3.2)%	(3.4)%	(3.6)%	(3.8)%	(3.8)%	(4.0)%	(4.1)%	(4.2)%	(4.3)%
Contributions										
Statutory - Chapter 490	17,815	21,140	21,491	21,867	22,261	22,667	23,079	23,507	23,943	24,395
Required - Chapter 356 (MVA)	22,210	22,693	23,199	23,728	24,275	24,775	25,313	25,860	26,439	27,031
Sufficiency / (Deficiency)	(4,395)	(1,553)	(1,708)	(1,861)	(2,014)	(2,108)	(2,234)	(2,353)	(2,496)	(2,636)
Funding Ratios										
Current Assets (MVA)	165,905	176,263	189,788	203,366	217,181	231,573	246,553	262,053	278,061	294,736
Actuarial Accrued Liability (AAL)	340,777	353,881	366,891	379,516	391,945	404,494	417,124	429,718	442,212	454,724
Unfunded AAL	174,872	177,618	177,103	176,150	174,764	172,921	170,571	167,665	164,151	159,988
Funding Ratio	49%	50%	52%	54%	55%	57%	59%	61%	63%	65%
Benefit Payments	22,872	24,110	25,634	27,013	28,106	29,253	30,524	31,870	33,117	34,261

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.

Judges Retirement Fund

Scenario: 9.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Contributions (% of Payroll)										
Statutory - Chapter 490	39.6%	39.3%	39.0%	38.7%	38.4%	38.2%	37.9%	37.6%	37.4%	37.2%
Required - Chapter 356 (MVA)	44.0%	43.7%	43.4%	43.1%	42.9%	42.2%	41.4%	40.3%	38.8%	36.6%
Sufficiency / (Deficiency)	(4.4)%	(4.5)%	(4.5)%	(4.4)%	(4.5)%	(4.1)%	(3.5)%	(2.7)%	(1.4)%	0.6%
Contributions										
Statutory - Chapter 490	24,865	25,348	25,845	26,352	26,873	27,420	27,978	28,554	29,150	29,765
Required - Chapter 356 (MVA)	27,636	28,219	28,794	29,370	29,999	30,344	30,555	30,592	30,276	29,294
Sufficiency / (Deficiency)	(2,771)	(2,871)	(2,949)	(3,018)	(3,126)	(2,924)	(2,577)	(2,038)	(1,126)	471
Funding Ratios										
Current Assets (MVA)	312,266	330,748	350,272	370,951	392,645	415,562	439,925	465,911	493,766	523,803
Actuarial Accrued Liability (AAL)	467,387	480,223	493,238	506,462	519,666	531,665	543,614	555,545	567,542	579,742
Unfunded AAL	155,121	149,475	142,966	135,511	127,021	116,103	103,689	89,634	73,776	55,939
Funding Ratio	67%	69%	71%	73%	76%	78%	81%	84%	87%	90%
Benefit Payments	35,407	36,568	37,726	39,142	40,459	41,699	42,912	44,058	45,092	46,179

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.

Judges Retirement Fund

Scenario: 9.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Contributions (% of Payroll)										
Statutory - Chapter 490	36.9%	36.7%	29.6%	29.6%	29.6%	29.5%	29.5%	29.5%	29.5%	29.5%
Required - Chapter 356 (MVA)	32.9%	25.5%	16.0%	14.5%	12.8%	11.1%	9.2%	7.2%	5.1%	2.9%
Sufficiency / (Deficiency)	4.0%	11.2%	13.6%	15.1%	16.8%	18.5%	20.4%	22.3%	24.5%	26.7%
Contributions										
Statutory - Chapter 490	30,397	31,047	25,720	26,414	27,127	27,860	28,618	29,398	30,200	31,023
Required - Chapter 356 (MVA)	27,065	21,545	13,939	12,907	11,723	10,422	8,885	7,166	5,189	3,000
Sufficiency / (Deficiency)	3,332	9,502	11,781	13,507	15,404	17,438	19,733	22,232	25,011	28,023
Funding Ratios										
Current Assets (MVA)	556,195	591,030	628,595	662,985	700,233	740,588	784,442	832,219	884,300	941,074
Actuarial Accrued Liability (AAL)	592,118	604,558	617,118	629,919	643,023	656,440	670,290	684,680	699,654	715,233
Unfunded AAL	35,923	13,528	(11,477)	(33,066)	(57,210)	(84,148)	(114,152)	(147,539)	(184,646)	(225,841)
Funding Ratio	94%	98%	102%	105%	109%	113%	117%	122%	126%	132%
Benefit Payments	47,411	48,609	49,716	50,796	51,915	52,962	53,946	54,945	55,985	57,086

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.