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 – Judges Retirement Fund

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. 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 Judges Retirement Fund 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 2.50% 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 317 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 48.6
- Average salary at hire is $153,700
- 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.

The State of Minnesota provides supplemental contributions to the fund equal to $6.0 million annually until the plan reaches 100% funding (on an Actuarial Value of Assets basis), or July 1, 2048, if earlier. This supplemental contribution is projected to end July 1, 2048 in the 6.0% and 7.5% investment return scenarios and July 1, 2039 in the 9.0% investment return scenario.

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 7.5% 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 2037 and 2051, and that the plan would begin paying 2.0% benefit increases on January 1, 2038 and 2.5% benefit increases on January 1, 2052. This assumption is reflected in the 7.5% rate of return projection scenario.

Under the 9.0% rate of return scenario, the funded status of the plan is expected to improve. 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 9.0%. This projection indicated the plan would begin paying a 2.0% benefit increase on January 1, 2029 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 2038 to 2029 and from 2052 to 2037, we assumed the accrued liability and normal cost would increase by a proportionate amount between 2018 and 2029. Based on present expectations, the 9.0% rate of return scenario is a very low probability outcome.

Under the 6.0% rate of return scenario, the funded status of the plan is expected to deteriorate. As the plan experiences lower than expected investment return 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 (benefit increases change from 1.75% to 2.0% on January 1, 2038 and from 2.0% to 2.5% on January 1, 2052) to an assumption that benefit increases remain at 1.75% for all years would occur by 2031.

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.
- Although the plan has a small contribution sufficiency as of July 1, 2018, the 7.5% investment return scenario projects that the plan will not attain full funding within the 30-year period. Over the next 30 years, as payroll grows, the $6.0 million annual supplemental contribution remains level as a dollar amount, but declines as a percentage of payroll from 12.0% of pay to less than 6.0% of pay by the end of the projection period. A contribution deficiency persists through the statutory amortization date of June 30, 2048. The plan is projected to achieve full funding under the 7.5% investment return scenario in approximately 40 years.
- The enclosed projections are based on assumptions as outlined in the Judges Retirement Fund 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.
- In the 9% investment return scenario, 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 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.

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 but is not 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.

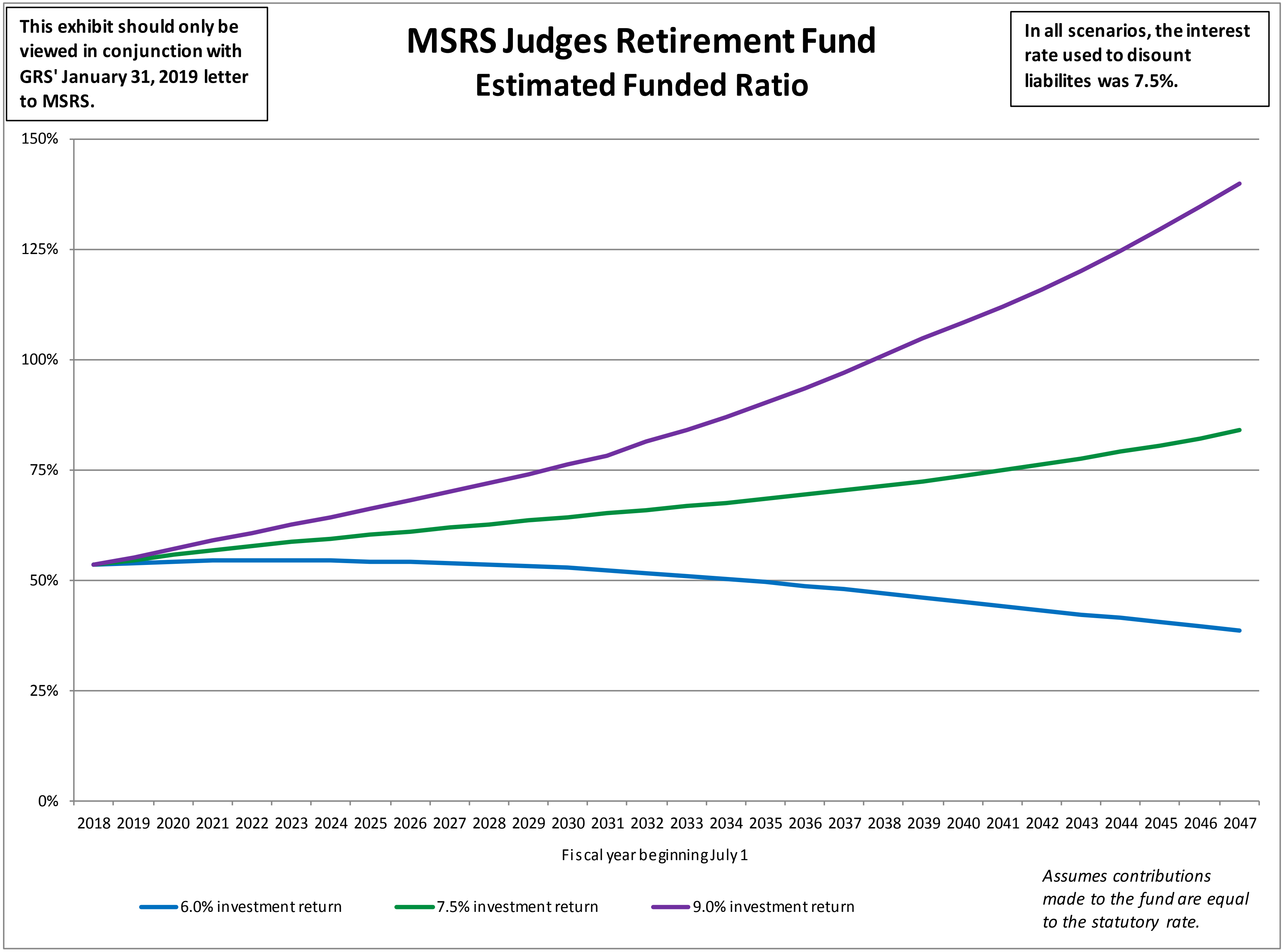
Limitations of Funded Status Measurements

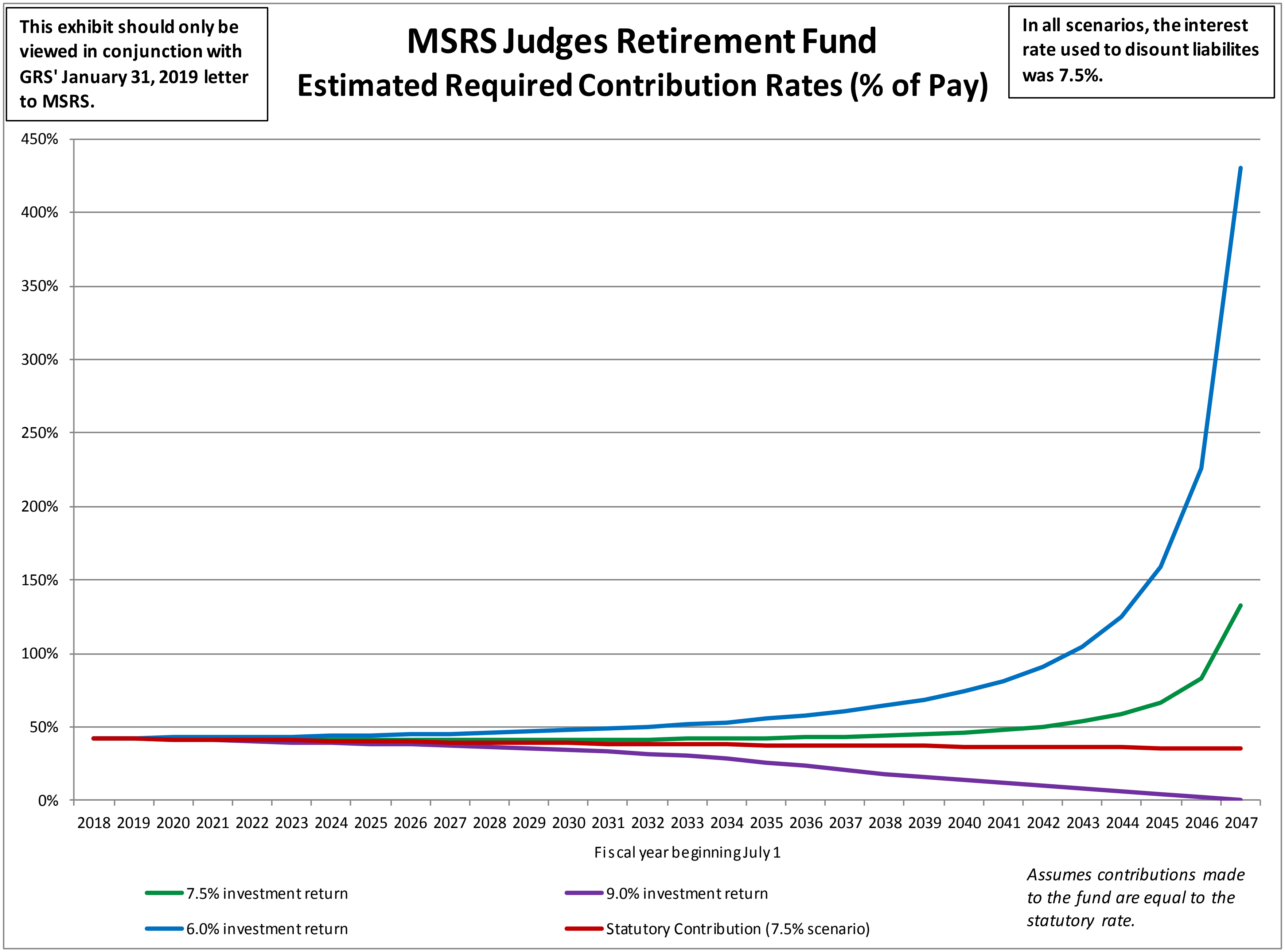
Unless otherwise indicated, a funded status measurement presented in this report is based upon the actuarial accrued liability and the market value of assets. Unless otherwise indicated, with regard to any funded status measurements presented in this report:

(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 to MSRS.
MSRS Judges Retirement Fund
Estimated Funded Ratio
In all scenarios, the interest rate used to disount liabilites was 7.5%.
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
6.0% investment return
7.5% 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 to MSRS.
MSRS Judges Retirement Fund
Estimated Required Contribution Rates (% of Pay)
In all scenarios, the interest rate used to disount liabilites was 7.5%.
450%
400%
350%
300%
250%
200%
150%
100%
50%
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
9.0% investment return
6.0% investment return
Statutory Contribution (7.5% 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, 2019 letter to MSRS.

Judges Retirement Fund

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 490	42.5%	41.9%	41.6%	41.2%	40.9%	40.6%	40.4%	40.1%	39.8%	39.5%
Required - Chapter 356 (MVA)	42.4%	42.0%	41.9%	41.6%	41.5%	41.4%	41.3%	41.2%	41.2%	41.2%
Sufficiency / (Deficiency)	0.1%	(0.1)%	(0.3)%	(0.4)%	(0.6)%	(0.7)%	(0.9)%	(1.2)%	(1.4)%	(1.7)%
Contributions										
Statutory - Chapter 490	21,196	21,373	21,722	22,086	22,455	22,837	23,225	23,628	24,044	24,471
Required - Chapter 356 (MVA)	21,146	21,415	21,901	22,297	22,760	23,233	23,765	24,316	24,904	25,495
Sufficiency / (Deficiency)	50	(42)	(179)	(211)	(305)	(396)	(540)	(688)	(860)	(1,024)
Funding Ratios										
Current Assets (MVA)	201,755	213,348	224,669	235,800	246,851	257,736	268,397	278,926	289,454	300,005
Actuarial Accrued Liability (AAL)	377,925	390,919	403,662	416,100	428,317	440,211	451,723	462,953	474,019	484,928
Unfunded AAL	176,170	177,571	178,993	180,300	181,466	182,475	183,326	184,027	184,565	184,923
Funding Ratio	53%	55%	56%	57%	58%	59%	59%	60%	61%	62%
Benefit Payments	24,542	25,817	27,167	28,410	29,737	31,120	32,403	33,568	34,720	35,858
Ratio of Assets to Benefit Payments	8.22	8.26	8.27	8.30	8.30	8.28	8.28	8.31	8.34	8.37

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.

Judges Retirement Fund

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 490	39.3%	39.0%	38.8%	38.5%	38.3%	38.0%	37.8%	37.6%	37.4%	37.2%
Required - Chapter 356 (MVA)	41.1%	41.1%	41.2%	41.3%	41.5%	41.7%	42.0%	42.3%	42.8%	43.4%
Sufficiency / (Deficiency)	(1.9)%	(2.1)%	(2.5)%	(2.8)%	(3.2)%	(3.7)%	(4.2)%	(4.8)%	(5.4)%	(6.3)%
Contributions										
Statutory - Chapter 490	24,907	25,357	25,819	26,297	26,787	27,293	27,813	28,349	28,903	29,475
Required - Chapter 356 (MVA)	26,090	26,743	27,479	28,230	29,046	29,930	30,908	31,927	33,096	34,436
Sufficiency / (Deficiency)	(1,183)	(1,386)	(1,660)	(1,933)	(2,259)	(2,637)	(3,095)	(3,578)	(4,193)	(4,961)
Funding Ratios										
Current Assets (MVA)	310,608	321,289	331,865	342,476	353,197	364,086	375,231	386,779	398,751	411,138
Actuarial Accrued Liability (AAL)	495,684	506,287	516,536	526,554	536,389	546,080	555,681	565,318	574,972	584,608
Unfunded AAL	185,076	184,998	184,671	184,078	183,192	181,994	180,450	178,539	176,221	173,470
Funding Ratio	63%	63%	64%	65%	66%	67%	68%	68%	69%	70%
Benefit Payments	36,984	38,305	39,494	40,633	41,732	42,777	43,712	44,671	45,689	46,601
Ratio of Assets to Benefit Payments	8.40	8.39	8.40	8.43	8.46	8.51	8.58	8.66	8.73	8.82

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.

Judges Retirement Fund

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 490	37.0%	36.8%	36.6%	36.4%	36.2%	36.0%	35.9%	35.7%	35.5%	35.4%
Required - Chapter 356 (MVA)	44.2%	45.1%	46.3%	48.0%	50.2%	53.4%	58.2%	66.4%	82.8%	132.3%
Sufficiency / (Deficiency)	(7.2)%	(8.4)%	(9.8)%	(11.6)%	(14.0)%	(17.4)%	(22.4)%	(30.7)%	(47.2)%	(96.9)%
Contributions										
Statutory - Chapter 490	30,058	30,669	31,292	31,928	32,580	33,248	33,950	34,646	35,361	36,095
Required - Chapter 356 (MVA)	35,921	37,643	39,654	42,113	45,180	49,286	55,112	64,406	82,372	134,912
Sufficiency / (Deficiency)	(5,863)	(6,974)	(8,362)	(10,185)	(12,600)	(16,038)	(21,162)	(29,760)	(47,011)	(98,817)
Funding Ratios										
Current Assets (MVA)	424,098	437,790	452,346	467,925	484,670	502,701	522,157	543,220	565,926	590,386
Actuarial Accrued Liability (AAL)	594,353	604,327	614,613	625,325	636,567	648,401	660,914	674,204	688,263	703,130
Unfunded AAL	170,255	166,537	162,267	157,400	151,897	145,700	138,757	130,984	122,337	112,744
Funding Ratio	71%	72%	74%	75%	76%	78%	79%	81%	82%	84%
Benefit Payments	47,413	48,178	48,865	49,500	50,120	50,715	51,272	51,903	52,566	53,199
Ratio of Assets to Benefit Payments	8.94	9.09	9.26	9.45	9.67	9.91	10.18	10.47	10.77	11.10

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.

Judges Retirement Fund

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 490	42.5%	41.9%	41.6%	41.2%	40.9%	40.6%	40.4%	40.1%	39.8%	39.5%
Required - Chapter 356 (MVA)	42.4%	42.3%	42.6%	42.7%	43.0%	43.3%	43.8%	44.2%	44.8%	45.4%
Sufficiency / (Deficiency)	0.1%	(0.4)%	(1.1)%	(1.5)%	(2.1)%	(2.7)%	(3.4)%	(4.2)%	(5.0)%	(5.8)%
Contributions										
Statutory - Chapter 490	21,196	21,373	21,722	22,086	22,455	22,837	23,225	23,628	24,044	24,471
Required - Chapter 356 (MVA)	21,146	21,591	22,273	22,889	23,598	24,347	25,188	26,084	27,060	28,088
Sufficiency / (Deficiency)	50	(218)	(551)	(803)	(1,143)	(1,510)	(1,963)	(2,456)	(3,016)	(3,617)
Funding Ratios										
Current Assets (MVA)	201,755	210,347	218,322	225,743	232,702	239,090	244,829	249,988	254,671	258,873
Actuarial Accrued Liability (AAL)	377,925	390,806	403,395	415,625	427,567	439,106	450,165	460,828	471,194	481,250
Unfunded AAL	176,170	180,459	185,073	189,882	194,865	200,016	205,336	210,840	216,523	222,377
Funding Ratio	53%	54%	54%	54%	54%	54%	54%	54%	54%	54%
Benefit Payments	24,542	25,817	27,167	28,410	29,737	31,120	32,403	33,568	34,720	35,858
Ratio of Assets to Benefit Payments	8.22	8.15	8.04	7.95	7.83	7.68	7.56	7.45	7.33	7.22

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.

Judges Retirement Fund

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 490	39.3%	39.0%	38.8%	38.5%	38.3%	38.0%	37.8%	37.6%	37.4%	37.2%
Required - Chapter 356 (MVA)	46.0%	46.7%	47.7%	48.6%	49.9%	51.5%	53.3%	55.3%	57.8%	60.7%
Sufficiency / (Deficiency)	(6.7)%	(7.7)%	(8.9)%	(10.1)%	(11.7)%	(13.4)%	(15.5)%	(17.7)%	(20.4)%	(23.6)%
Contributions										
Statutory - Chapter 490	24,907	25,357	25,819	26,297	26,787	27,293	27,813	28,349	28,903	29,475
Required - Chapter 356 (MVA)	29,176	30,382	31,745	33,211	34,960	36,930	39,182	41,709	44,672	48,177
Sufficiency / (Deficiency)	(4,269)	(5,025)	(5,926)	(6,914)	(8,173)	(9,637)	(11,369)	(13,360)	(15,769)	(18,702)
Funding Ratios										
Current Assets (MVA)	262,594	265,826	268,353	270,281	271,642	272,458	272,766	272,667	272,128	271,083
Actuarial Accrued Liability (AAL)	490,977	500,351	509,139	517,437	526,057	534,411	542,549	550,586	558,497	566,236
Unfunded AAL	228,383	234,525	240,786	247,156	254,415	261,953	269,783	277,919	286,369	295,153
Funding Ratio	53%	53%	53%	52%	52%	51%	50%	50%	49%	48%
Benefit Payments	36,984	38,305	39,494	40,633	41,732	42,777	43,712	44,671	45,689	46,601
Ratio of Assets to Benefit Payments	7.10	6.94	6.79	6.65	6.51	6.37	6.24	6.10	5.96	5.82

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.

Judges Retirement Fund

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 490	37.0%	36.8%	36.6%	36.4%	36.2%	36.0%	35.9%	35.7%	35.5%	35.4%
Required - Chapter 356 (MVA)	64.3%	68.7%	74.2%	81.4%	91.0%	104.5%	124.7%	158.6%	226.6%	430.6%
Sufficiency / (Deficiency)	(27.4)%	(32.0)%	(37.7)%	(45.0)%	(54.8)%	(68.5)%	(88.9)%	(122.9)%	(191.0)%	(395.2)%
Contributions										
Statutory - Chapter 490	30,058	30,669	31,292	31,928	32,580	33,248	33,950	34,646	35,361	36,095
Required - Chapter 356 (MVA)	52,312	57,330	63,527	71,446	81,890	96,441	118,090	153,973	225,453	439,246
Sufficiency / (Deficiency)	(22,254)	(26,661)	(32,235)	(39,518)	(49,310)	(63,193)	(84,140)	(119,327)	(190,092)	(403,151)
Funding Ratios										
Current Assets (MVA)	269,684	268,077	266,322	264,504	262,683	260,889	259,170	257,608	256,134	254,747
Actuarial Accrued Liability (AAL)	573,975	581,880	590,027	598,527	607,474	616,923	626,958	637,675	649,062	661,157
Unfunded AAL	304,291	313,803	323,705	334,023	344,791	356,034	367,788	380,067	392,928	406,410
Funding Ratio	47%	46%	45%	44%	43%	42%	41%	40%	39%	39%
Benefit Payments	47,223	47,880	48,460	48,990	49,507	49,994	50,440	50,957	51,499	52,006
Ratio of Assets to Benefit Payments	5.71	5.60	5.50	5.40	5.31	5.22	5.14	5.06	4.97	4.90

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.

Judges Retirement Fund

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 490	42.5%	41.9%	41.6%	41.2%	40.9%	40.6%	40.4%	40.1%	39.8%	39.5%
Required - Chapter 356 (MVA)	42.4%	41.7%	41.3%	40.7%	40.2%	39.6%	39.1%	38.5%	37.9%	37.1%
Sufficiency / (Deficiency)	0.1%	0.2%	0.2%	0.5%	0.8%	1.0%	1.3%	1.6%	1.9%	2.4%
Contributions										
Statutory - Chapter 490	21,196	21,373	21,722	22,086	22,455	22,837	23,225	23,628	24,044	24,471
Required - Chapter 356 (MVA)	21,146	21,275	21,598	21,802	22,042	22,255	22,485	22,685	22,866	22,984
Sufficiency / (Deficiency)	50	98	124	284	413	582	740	943	1,178	1,487
Funding Ratios										
Current Assets (MVA)	201,755	216,348	231,107	246,145	261,616	277,478	293,719	310,484	327,960	346,238
Actuarial Accrued Liability (AAL)	377,925	391,388	404,719	417,882	430,976	443,921	456,676	469,364	482,125	494,992
Unfunded AAL	176,170	175,040	173,612	171,737	169,360	166,443	162,957	158,880	154,165	148,754
Funding Ratio	53%	55%	57%	59%	61%	63%	64%	66%	68%	70%
Benefit Payments	24,542	25,817	27,167	28,410	29,737	31,120	32,403	33,568	34,720	35,858
Ratio of Assets to Benefit Payments	8.22	8.38	8.51	8.66	8.80	8.92	9.06	9.25	9.45	9.66

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Judges Retirement Fund

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 490	39.3%	39.0%	38.8%	38.5%	38.3%	38.0%	37.8%	37.6%	37.4%	37.2%
Required - Chapter 356 (MVA)	36.3%	35.4%	34.6%	33.5%	31.6%	30.0%	28.1%	25.9%	23.4%	20.5%
Sufficiency / (Deficiency)	3.0%	3.6%	4.2%	5.0%	6.7%	8.1%	9.7%	11.6%	13.9%	16.6%
Contributions										
Statutory - Chapter 490	24,907	25,357	25,819	26,297	26,787	27,293	27,813	28,349	28,903	29,475
Required - Chapter 356 (MVA)	23,028	23,038	23,024	22,890	22,117	21,507	20,700	19,570	18,130	16,271
Sufficiency / (Deficiency)	1,879	2,319	2,795	3,407	4,670	5,786	7,113	8,779	10,773	13,204
Funding Ratios										
Current Assets (MVA)	365,415	385,547	406,485	428,449	451,598	476,092	502,124	529,962	559,759	591,539
Actuarial Accrued Liability (AAL)	507,996	521,118	534,121	547,126	555,079	566,045	576,913	587,806	598,706	609,466
Unfunded AAL	142,581	135,571	127,636	118,677	103,481	89,953	74,789	57,844	38,947	17,927
Funding Ratio	72%	74%	76%	78%	81%	84%	87%	90%	93%	97%
Benefit Payments	36,984	38,441	39,723	40,955	42,150	43,292	44,324	45,380	46,600	47,762
Ratio of Assets to Benefit Payments	9.88	10.03	10.23	10.46	10.71	11.00	11.33	11.68	12.01	12.39

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Judges Retirement Fund

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 490	37.0%	29.6%	29.6%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%
Required - Chapter 356 (MVA)	17.4%	15.4%	13.7%	12.0%	10.2%	8.3%	6.3%	4.1%	1.8%	0.0%
Sufficiency / (Deficiency)	19.6%	14.2%	15.8%	17.5%	19.3%	21.2%	23.3%	25.4%	27.7%	29.5%
Contributions										
Statutory - Chapter 490	30,058	24,669	25,292	25,928	26,580	27,248	27,950	28,646	29,361	30,095
Required - Chapter 356 (MVA)	14,128	12,833	11,759	10,563	9,182	7,663	5,926	3,979	1,814	-
Sufficiency / (Deficiency)	15,930	11,836	13,533	15,365	17,398	19,585	22,024	24,667	27,547	30,095
Funding Ratios										
Current Assets (MVA)	625,560	662,196	695,493	731,522	770,603	813,053	859,231	909,564	964,358	1,024,017
Actuarial Accrued Liability (AAL)	620,156	630,941	641,898	653,139	664,764	676,832	689,438	702,684	716,569	731,137
Unfunded AAL	(5,404)	(31,255)	(53,595)	(78,383)	(105,839)	(136,221)	(169,793)	(206,880)	(247,789)	(292,880)
Funding Ratio	101%	105%	108%	112%	116%	120%	125%	129%	135%	140%
Benefit Payments	48,770	49,728	50,602	51,417	52,209	52,962	53,662	54,421	55,197	55,927
Ratio of Assets to Benefit Payments	12.83	13.32	13.74	14.23	14.76	15.35	16.01	16.71	17.47	18.31

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 7.5%.