

**MINNESOTA STATE RETIREMENT SYSTEM**  
**JUDGES RETIREMENT FUND**  
ACTUARIAL VALUATION REPORT AS OF JULY 1, 2016



December 14, 2016

Minnesota State Retirement System  
Judges Retirement Fund  
St. Paul, Minnesota

Dear Board of Directors:

The results of the July 1, 2016 annual actuarial valuation of the Judges Retirement Fund are presented in this report. This report was prepared at the request of the Board and is intended for use by the Board and staff and those designated or approved by the Board. This report may be provided to parties other than the Fund only in its entirety. GRS is not responsible for the consequences of any unauthorized use of this report by persons other than the intended users as described above.

The purpose of the valuation is to measure the Fund's funding progress and to determine the required contribution rate for the fiscal year beginning July 1, 2016. Note that we have not attempted to quantify the impact of GASB Statements No. 67 and No. 68 in this report. Please see the separate report dated December 1, 2016.

The required contribution rate shown on page one was designed to comply with Minnesota Statutes. Users of this report should be aware that contributions made at that rate do not guarantee benefit security. Given the importance of benefit security to any retirement system, we suggest that contributions to the System in excess of those presented in this report be considered.

The contribution rate in this report is determined using the actuarial assumptions and methods disclosed in the Actuarial Basis of this report. This report includes risk metrics on page five, but does not include a more robust assessment of the risks of future experience differing materially from the actuarial assumptions. Additional assessment of risks was outside the scope of this assignment. We encourage a review and assessment of investment and other significant risks that may have a material effect on the plan's financial condition.

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.

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 this report. 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. Due to the limited scope of our assignment, we did not perform an analysis of the potential range of such future measurements.

This report should not be relied on 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.

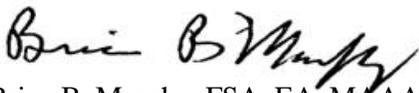
The signing actuaries are independent of the plan sponsor. We are not aware of any relationship that would impair the objectivity of our work.

Brian B. Murphy and Bonita J. Wurst 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.

We are available to answer any questions or provide further details.

Respectfully submitted,



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



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

BBM/BJW:bd

## **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 8.00% on the actuarial value of assets), it is expected that:

- (1) The unfunded actuarial accrued liabilities will be fully amortized after approximately 32 years,
- (2) The funded status of the plan will increase gradually towards a 100% funding ratio, 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 actuarial 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 market value of assets were used instead of the actuarial 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.

## **Discount Rate Assumption**

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 this valuation instead of 8.00%, we estimate that the unfunded liability would be approximately \$14 million higher than estimated herein. This estimate incorporates lower salary scale rates due to lower inflation expectations as well as a delay in the assumed payment of 2.00% and 2.50% postretirement benefit increases.

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## Summary of Valuation Results

### Contributions

The following table summarizes important contribution information as described in the Development of Costs section.

Contributions for Fiscal Year Beginning	Actuarial Valuation as of	
	July 1, 2016	July 1, 2015
Statutory Contributions - Chapter 490* (% of Payroll)	37.06%	30.84%
Required Contributions - Chapter 356 (% of Payroll)	43.34%	42.73%
Sufficiency / (Deficiency)	(6.28)%	(11.89)%

The contribution deficiency decreased from 11.89% of payroll to 6.28% of payroll. The primary reason for the decreased contribution deficiency is the new state contribution of \$3 million. The state contribution will increase to \$6 million beginning in the fiscal year beginning July 1, 2017. When this future funding is reflected, the deficiency drops to 0.04% of payroll. On a market value of assets basis, contributions are deficient by 7.30% of payroll (1.06% when the future additional state contribution is reflected).

Based on the current member and employer contribution rates and other methods and assumptions described in this report, including the actuarial value of assets, the unfunded liability will be eliminated in approximately 32 years.

The Plan Assets section provides detail on the plan assets used for the valuation including a development of the Actuarial Value of Assets (AVA). The Market Value of Assets (MVA) earned approximately -0.1% for the plan year ending June 30, 2016. The AVA earned approximately 7.8% for the plan year ending June 30, 2016 as compared to the assumed rate of 8.00%. The assumed rate is a prescribed assumption mandated by Minnesota Statutes, and is at the very upper end of the reasonable range. According to the NASRA survey, the most common assumption for statewide plans is currently 7.50%. Use of a 7.50% return assumption would produce a deficiency greater than shown above.

Participant reconciliation and statistics are detailed in the Membership Data section. The Actuarial Basis section includes a summary of plan provisions and actuarial methods and assumptions used for the calculations in this report.

Accounting and financial reporting information prepared according to GASB Statements No. 67 and No. 68 was provided to MSRS in a separate report dated December 1, 2016.

*\* Statutory contributions reflect the fact that member contributions for Judges at the maximum benefit level are directed to the Unclassified Employees Retirement Plan. If these contributions were not directed to the Unclassified Employees Retirement Plan, the statutory contribution rate would be 37.38% instead of 37.06% as of July 1, 2016 and 31.25% instead of 30.84% as of July 1, 2015.*

## Summary of Valuation Results

A summary of principal valuation results from the current valuation and the prior valuation follows. Any changes in plan provisions, actuarial assumptions or valuation methods and procedures between the two valuations are described after the summary.

	<b>Actuarial Valuation as of</b>	
	<b>July 1, 2016</b>	<b>July 1, 2015</b>
<b>Contributions</b> ( <i>% of Payroll</i> )		
Statutory - Chapter 490*	37.06%	30.84%
Required - Chapter 356	43.34%	42.73%
Sufficiency / (Deficiency)	(6.28%)	(11.89%)
<b>Funding Ratios</b> ( <i>dollars in thousands</i> )		
Assets		
- Current assets (AVA)	\$ 172,525	\$ 168,235
- Current assets (MVA)	165,905	174,580
Accrued Benefit Funding Ratio		
- Current benefit obligations	\$ 319,329	\$ 304,493
- Funding ratio (AVA)	54.03%	55.25%
- Funding ratio (MVA)	51.95%	57.33%
Accrued Liability Funding Ratio		
- Actuarial accrued liability	\$ 331,334	\$ 315,633
- Funding ratio (AVA)	52.07%	53.30%
- Funding ratio (MVA)	50.07%	55.31%
Projected Benefit Funding Ratio		
- Current and expected future assets	\$ 349,496	\$ 297,270
- Current and expected future benefit obligations	390,118	370,192
- Projected benefit funding ratio (AVA)	89.59%	80.30%
<b>Participant Data</b>		
Active Members		
- Number	311	312
- Annual valuation earnings ( <i>000s</i> )	46,876	43,384
- Projected annual earnings ( <i>000s</i> )	48,070	44,577
- Average projected annual earnings	154,566	142,875
- Average age	56.9	56.9
- Average service	9.9	9.9
Service Retirements	250	240
Survivors	80	83
Disability Retirements	20	23
Deferred Retirements	17	16
Terminated other Non-Vested	0	0
<b>Total</b>	<b>678</b>	<b>674</b>

\* Statutory contributions reflect the fact that member contributions for Judges at the maximum benefit level are directed to the Unclassified Employees Retirement Plan. If these contributions were not directed to the Unclassified Employees Retirement Plan, the statutory contribution rate would be 37.38.00% instead of 37.06% as of July 1, 2016 and 31.25% instead of 30.84% as of July 1, 2015.

## Summary of Valuation Results

### Effects of Changes

The following changes were recognized as of July 1, 2016:

- 2016 legislation provides state contributions equal to \$3,000,000 for the fiscal year ending June 30, 2017, and \$6,000,000 per year thereafter until the plan is fully funded.
- The assumed post-retirement benefit increase rate was changed from 1.75% per year for all years to 1.75% through 2034, 2.00% for 2035 through 2045, and 2.50% thereafter.

The combined impact of the above changes was to increase the accrued liability by \$1.2 million and increase the required contribution by 0.4% of pay, as follows:

	<b>Before Changes</b>	<b>Before Assumption Changes</b>	<b>Reflecting Changes</b>
Normal Cost Rate, % of Pay	18.3%	18.3%	18.6%
Amortization of UAAL*, % of Pay	24.4%	24.4%	24.5%
Expenses (% of Pay)	0.2%	0.2%	0.2%
Total Required Contribution, % of Pay	42.9%	42.9%	43.3%
Accrued Liability Funding Ratio	52.3%	52.3%	52.1%
Projected Benefit Funding Ratio	79.8%	90.2%	89.6%
UAAL* (in millions)	\$157.6	\$157.6	\$158.8

*\*Unfunded Actuarial Accrued Liability.*

Refer to the Actuarial Basis section of this report for a complete description of these changes.

## Summary of Valuation Results

### Valuation of Future Annual Post-Retirement Benefit Increases

Benefit recipients receive a future annual compounding 1.75% post-retirement benefit increase. If the accrued liability funding ratio (determined on a market value of assets basis), reaches or exceeds 70% (based on a 2.00% post-retirement benefit increase assumption) for two consecutive years, the benefit increase will revert to 2.00%. Similarly, if the accrued liability funding ratio (determined on a market value of assets basis) reaches or exceeds 90% (based on a 2.50% post-retirement benefit increase assumption) for two consecutive years, the benefit increase will revert to 2.50%.

Minnesota Statutes were revised in 2014 to establish a process for establishing a post-retirement benefit increase assumption for each valuation. If the plan has not yet reached the accrued liability funding ratio threshold required to pay a 2.00% or 2.50% benefit increase, a projection must be performed to determine the expected attainment of the threshold, and the expected change to a 2.00% or 2.50% benefit increase rate must be reflected in the liability calculations.

To determine an assumption regarding a future change in the post-retirement benefit increase, we performed a projection of liabilities and market value of assets based on the following methods and assumptions:

- Future investment returns of 8.00%;
- Open group; stable active population (new member profile based on average new members hired in recent years);
- The post-retirement benefit increase rate is assumed to be 1.75% per year until the accrued liability funding ratio threshold (determined on a market value of assets basis) required to pay a 2.00% post-retirement benefit increase is reached and is assumed to be 2.00% per year until the threshold required to pay a 2.50% post-retirement benefit increase is reached; and
- Current statutory contribution levels (i.e., not including potential contribution increases).

Based on these assumptions and methods, the projection indicates this plan is expected to attain the accrued liability funding ratio threshold to pay the 2.00% benefit increase in the year 2034 and the plan would begin paying 2.00% benefit increases on January 1, 2035. Similarly, the projection indicates this plan is expected to attain the accrued liability funding ratio threshold to pay the 2.50% benefit increase in the year 2045 and the plan would begin paying 2.50% benefit increases on January 1, 2046. This assumption is reflected in our calculations. This is only an assumption; actual timing will depend on actual experience.

## Summary of Valuation Results

### Risk Measures (*Dollars in Thousands*)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Valuation Date (July 1)	Accrued Liabilities (AAL)	Market Value of Assets	Market Value Unfunded AAL (1) - (2)	Valuation Payroll	Market Value Funded Ratio (2) / (1)	Retiree Liabilities	RetLiab/ AAL (6) / (1)	AAL/ Payroll (1) / (4)	Assets/ Payroll (2) / (4)
2010	\$240,579	\$126,201	\$114,378	\$39,291	52.5%	\$135,184	56.2%	612.3%	321.2%
2011	248,630	148,504	100,126	40,473	59.7%	141,762	57.0%	614.3%	366.9%
2012	281,576	144,086	137,490	38,644	51.2%	169,262	60.1%	728.6%	372.9%
2013	284,513	155,398	129,115	39,888	54.6%	180,641	63.5%	713.3%	389.6%
2014	298,233	175,556	122,677	41,893	58.9%	190,570	63.9%	711.9%	419.1%
2015	315,633	174,580	141,053	43,449	55.3%	205,115	65.0%	726.4%	401.8%
2016	331,334	165,905	165,429	45,418	50.1%	211,594	63.9%	729.5%	365.3%

	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Valuation Date (July 1)	Portfolio StdDev	Std Dev % of Pay (9) x (10)	Unfunded / Payroll (3) / (4)	Non-Investment Cash Flow (NICF)	NICF/ Assets (13) / (2)	SBI Market Rate of Return	SBI 5-year Average
2010			291.1%	\$(5,828)	-4.6%	15.2%	3.4%
2011			247.4%	(6,341)	-4.3%	23.3%	5.3%
2012			355.8%	(7,759)	-5.4%	2.4%	2.3%
2013			323.7%	(8,631)	-5.6%	14.2%	6.2%
2014			292.8%	(8,548)	-4.9%	18.6%	14.5%
2015	14.1%	56.7%	324.6%	(8,548)	-4.9%	4.4%	12.3%
2016	14.1%	51.5%	364.2%	(8,489)	-5.1%	-0.1%	7.7%

Notes pertaining to numbered columns:

- (5) The Funded ratio is the most widely known measure of a plan's financial strength, but the trend in the funded ratio is much more important than the absolute ratio. The funded ratio should trend to 100%. As it approaches 100%, it is important to re-evaluate the level of investment risk in the portfolio and potentially to re-evaluate the assumed rate of return.
- (6) and (7). The ratio of Retiree liabilities to total accrued liabilities gives an indication of the maturity of the system. As the ratio increases, cash flow needs increase, and the liquidity needs of the portfolio change. A ratio on the order of 50% indicates a maturing system.
- (8) and (9). The ratios of liabilities and assets to payroll gives an indication of both maturity and volatility. Many systems have ratios between 500% and 700%. Ratios significantly above that range may indicate difficulty in supporting the benefit level as a level % of payroll.
- (10) and (11). The portfolio standard deviation measures the volatility of investment return. When multiplied by the ratio of assets to payroll it gives the effect of a one standard deviation asset move as a percent of payroll. This figure helps users understand the difficulty of dealing with investment volatility and the challenges volatility brings to sustainability.
- (12) The ratio of unfunded liability to payroll gives an indication of the plan sponsor's ability to actually pay off the unfunded liability. A ratio above approximately 300% or 400% may indicate difficulty in discharging the unfunded liability within a reasonable time frame.
- (13) The ratio of non-investment cash flow to assets is an important measure of sustainability. Negative ratios are common and expected for a maturing system. In the longer term, this ratio should be on the order of approximately -4%. A ratio that is significantly more negative than that for an extended period could be a leading indicator of potential exhaustion of assets.
- (15) and (16). Investment return is probably the largest single risk that most systems face. The year by year return and the 5-year geometric average give an indicator of the realism of the systems assumed return. Of course, past performance is not a guarantee of future results. The performance data for the Combined Funds (pooled investments of major Minnesota Public Retirement Systems) is presented in these columns. The source of this data is the Minnesota State Board of Investment.

Information prior to 2012 provided by prior actuary. See prior reports for additional detail.

## Supplemental Information

The remainder of the report includes information supporting the results presented in the previous sections.

- **Plan assets** presents information about the plan's assets as reported by the Minnesota State Retirement System. The assets represent the portion of total fund liabilities that has been funded.
- **Membership data** presents and describes the membership data used in the valuation.
- **Development of costs** shows the liabilities for plan benefits and the derivation of the contribution amount.
- **Actuarial basis** describes the plan provisions, as well as the methods and assumptions used to value the plan. The valuation is based on the premise that the plan is ongoing.
- **Additional Schedules** includes a summary of funding progress and contributions over the long term.
- **Glossary** defines the terms used in this report.

## Plan Assets

### Statement of Fiduciary Net Position *(Dollars in Thousands)*

Assets	Market Value	
	June 30, 2016	June 30, 2015
Cash, equivalents, short term securities	\$ 5,048	\$ 3,911
Fixed income	40,576	40,967
Equity	120,247	129,688
Other*	23,332	17,755
<b>Total cash, investments, and other assets</b>	<b>\$ 189,203</b>	<b>\$ 192,321</b>
Amounts Receivable	174	134
<b>Total Assets</b>	<b>\$ 189,377</b>	<b>\$ 192,455</b>
Amounts Payable*	(23,472)	(17,875)
<b>Net Position Restricted for Pensions</b>	<b>\$ 165,905</b>	<b>\$ 174,580</b>

\* Includes \$23,332 in Securities Lending Collateral as of June 30, 2016 and \$17,755 as of June 30, 2015.

## Plan Assets

### Reconciliation of Plan Assets (*Dollars in Thousands*)

The following exhibit shows the revenue, expenses and resulting assets of the Fund as reported by the Minnesota State Retirement System for the prior two fiscal years.

Change in Assets Year Ending	Market Value	
	June 30, 2016	June 30, 2015
<b>1. Fund balance at market value at beginning of year</b>	<b>\$ 174,580</b>	<b>\$ 175,556</b>
2. Contributions		
a. Member	3,763	3,629
b. Employer	10,219	9,776
c. Other sources	0	0
d. Total contributions	<u>\$ 13,982</u>	<u>\$ 13,405</u>
3. Investment income		
a. Investment income/(loss)	36	7,816
b. Investment expenses	(222)	(244)
c. Net investment income/(loss)	<u>(186)</u>	<u>7,572</u>
4. Other	0	0
<b>5. Total income: (2.d.) + (3.c.) + (4.)</b>	<b>\$ 13,796</b>	<b>\$ 20,977</b>
6. Benefits Paid		
a. Annuity benefits	(22,378)	(21,893)
b. Refunds	0	0
c. Total benefits paid	<u>(22,378)</u>	<u>(21,893)</u>
7. Expenses		
a. Other	0	0
b. Administrative	(93)	(60)
c. Total expenses	<u>(93)</u>	<u>(60)</u>
<b>8. Total disbursements: (6.c.) + (7.c.)</b>	<b>(22,471)</b>	<b>(21,953)</b>
<b>9. Fund balance at market value at end of year: (1.) + (5.) + (8.)</b>	<b>\$ 165,905</b>	<b>\$ 174,580</b>
10. State Board of Investment calculated return on investments	-0.1%	4.4%

## Plan Assets

### Actuarial Asset Value (Dollars in Thousands)

	<u>June 30, 2016</u>	<u>June 30, 2015</u>			
<b>1. Market value of assets available for benefits</b>	<b>\$ 165,905</b>	<b>\$ 174,580</b>			
2. Determination of average balance					
a. Total assets available at beginning of year	174,580	175,556			
b. Total assets available at end of year	165,905	174,580			
c. Net investment income for fiscal year	(186)	7,572			
d. Average balance $[a. + b. - c.] / 2$	170,336	171,282			
3. Expected return $[8.0\% \times 2.d.]$	13,627	13,703			
4. Actual return	(186)	7,572			
5. Current year asset gain/(loss) $[4. - 3.]$	(13,813)	(6,131)			
6. Unrecognized asset returns					
	<u>Original</u>	<u>Unrecognized Amount</u>	<u>Unrecognized Amount</u>		
	<u>Amount</u>	<u>%</u>	<u>Dollar</u>	<u>%</u>	<u>Dollar</u>
a. Year ended June 30, 2016	\$ (13,813)	80%	\$ (11,050)	N/A	N/A
b. Year ended June 30, 2015	(6,131)	60%	(3,679)	80%	\$ (4,905)
c. Year ended June 30, 2014	15,893	40%	6,357	60%	9,536
d. Year ended June 30, 2013	8,761	20%	1,752	40%	3,504
e. Year ended June 30, 2012	(8,952)		N/A	20%	(1,790)
<b>f. Unrecognized return adjustment</b>			<b>\$ (6,620)</b>		<b>\$ 6,345</b>
7. Actuarial value at end of year $(1. - 6.f.)$			<b>\$ 172,525</b>		<b>\$ 168,235</b>
8. Approximate return on actuarial value of assets during fiscal year			7.8%		12.6%
9. Ratio of actuarial value of assets to market value of assets			1.04		0.96

## Membership Data

### Distribution of Active Members (Total)\*

Age	Years of Service as of June 30, 2016									Total
	<3**	3 - 4**	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35+	
< 25										
Avg. Earnings										
25 - 29										
Avg. Earnings										
30 - 34										
Avg. Earnings										
35 - 39	3									3
Avg. Earnings	149,605									149,605
40 - 44	10	2	5							17
Avg. Earnings	149,605	149,605	153,511							150,754
45 - 49	16	11	10	1						38
Avg. Earnings	149,605	149,605	149,605	149,605						149,605
50 - 54	12	9	16	12						49
Avg. Earnings	150,419	149,605	150,215	151,832						150,549
55 - 59	14	8	22	21	9	3				77
Avg. Earnings	148,532	151,215	149,958	152,605	152,574	149,605				150,843
60 - 64	1	10	15	14	20	12	5			77
Avg. Earnings	149,605	151,558	149,624	151,455	152,408	150,291	151,558			151,161
65 - 69	1	1	11	14	12	4	3	3		49
Avg. Earnings	149,605	149,605	150,519	151,733	152,432	145,669	152,860	149,605		150,989
70+						1				1
Avg. Earnings						149,605				149,605
<b>Total</b>	<b>57</b>	<b>41</b>	<b>79</b>	<b>62</b>	<b>41</b>	<b>20</b>	<b>8</b>	<b>3</b>		<b>311</b>
<b>Avg. Earnings</b>	<b>149,513</b>	<b>150,396</b>	<b>150,205</b>	<b>151,950</b>	<b>152,452</b>	<b>149,229</b>	<b>152,046</b>	<b>149,605</b>		<b>150,726</b>

\* Includes 11 Tier 1 Judges who have reached the maximum benefit formula (member contributions are directed to the Unclassified Employees Retirement Plan).

\*\* This exhibit does not reflect service earned in other MSRS or Combined Service Annuity benefits. It should not be relied upon as an indicator of non-vested status.

In each cell, the top number is the count of active participants for the age/service combination and the bottom number is average valuation earnings for the fiscal year ending on the valuation date.

## Membership Data

### Distribution of Active Members (Tier 1)\*

Age	Years of Service as of June 30, 2016									Total
	<3**	3 - 4**	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35+	
< 25										
Avg. Earnings										
25 - 29										
Avg. Earnings										
30 - 34										
Avg. Earnings										
35 - 39										
Avg. Earnings										
40 - 44		2	5							7
Avg. Earnings		149,605	153,511							152,395
45 - 49		11	10	1						22
Avg. Earnings		149,605	149,605	149,605						149,605
50 - 54		9	16	12						37
Avg. Earnings		149,605	150,215	151,832						150,591
55 - 59		8	22	21	9	3				63
Avg. Earnings		151,215	149,958	152,605	152,574	149,605				151,357
60 - 64		10	15	14	20	12	5			76
Avg. Earnings		151,558	149,624	151,455	152,408	150,291	151,558			151,181
65 - 69		1	11	14	12	4	3	3		48
Avg. Earnings		149,605	150,519	151,733	152,432	145,669	152,860	149,605		151,017
70+						1				1
Avg. Earnings						149,605				149,605
<b>Total</b>		<b>41</b>	<b>79</b>	<b>62</b>	<b>41</b>	<b>20</b>	<b>8</b>	<b>3</b>		<b>254</b>
<b>Avg. Earnings</b>		<b>150,396</b>	<b>150,205</b>	<b>151,950</b>	<b>152,452</b>	<b>149,229</b>	<b>152,046</b>	<b>149,605</b>		<b>150,999</b>

\* Includes 11 Tier 1 Judges who have reached the maximum benefit formula (member contributions are directed to the Unclassified Employees Retirement Plan).

\*\* This exhibit does not reflect service earned in other MSRS or Combined Service Annuity benefits. It should not be relied upon as an indicator of non-vested status.

In each cell, the top number is the count of active participants for the age/service combination and the bottom number is average valuation earnings for the fiscal year ending on the valuation date.

## Membership Data

### Distribution of Active Members (Tier 2)

Age	Years of Service as of June 30, 2016								Total	
	<3*	3 - 4*	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34		35+
< 25										
Avg. Earnings										
25 - 29										
Avg. Earnings										
30 - 34										
Avg. Earnings										
35 - 39		3								3
Avg. Earnings	149,605									149,605
40 - 44		10								10
Avg. Earnings	149,605									149,605
45 - 49		16								16
Avg. Earnings	149,605									149,605
50 - 54		12								12
Avg. Earnings	150,419									150,419
55 - 59		14								14
Avg. Earnings	148,532									148,532
60 - 64		1								1
Avg. Earnings	149,605									149,605
65 - 69		1								1
Avg. Earnings	149,605									149,605
70+										
Avg. Earnings										
<b>Total</b>		<b>57</b>								<b>57</b>
<b>Avg. Earnings</b>	<b>149,513</b>									<b>149,513</b>

\* This exhibit does not reflect service earned in other MSRS or Combined Service Annuity benefits. It should not be relied upon as an indicator of non-vested status.

In each cell, the top number is the count of active participants for the age/service combination and the bottom number is average valuation earnings for the fiscal year ending on the valuation date.

## Membership Data

### Distribution of Service Retirements

Age	Years Retired as of June 30, 2016							Total
	<1	1 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25+	
<50								
Avg. Benefit								
50 - 54								
Avg. Benefit								
55 - 59								
Avg. Benefit								
60 - 64	2	2	1					5
Avg. Benefit	54,606	57,151	20,727					48,848
65 - 69	8	44	7					59
Avg. Benefit	72,880	68,123	56,598					67,400
70 - 74	6	36	32	3				77
Avg. Benefit	68,295	62,919	72,755	55,217				67,125
75 - 79		2	24	17	4			47
Avg. Benefit		61,926	68,482	64,839	53,399			65,602
80 - 84				12	13	1		26
Avg. Benefit				63,535	74,032	35,091		67,689
85 - 89				1	10	11	2	24
Avg. Benefit				94,800	61,930	91,281	74,301	77,783
90+					1	5	6	12
Avg. Benefit					22,420	86,649	76,088	76,016
<b>Total</b>	<b>16</b>	<b>84</b>	<b>64</b>	<b>33</b>	<b>28</b>	<b>17</b>	<b>8</b>	<b>250</b>
<b>Avg. Benefit</b>	<b>68,877</b>	<b>65,484</b>	<b>68,572</b>	<b>64,398</b>	<b>64,919</b>	<b>86,613</b>	<b>75,641</b>	<b>68,047</b>

In each cell, the top number is the count of retired participants for the age/years retired combination and the bottom number is the average annual benefit amount.

## Membership Data

### Distribution of Survivors

Age	Years Since Death as of June 30, 2016							Total
	<1	1 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25+	
<45								
Avg. Benefit								
45 - 49								
Avg. Benefit								
50 - 54								
Avg. Benefit								
55 - 59								
Avg. Benefit								
60 - 64			2	1	1	1		5
Avg. Benefit			47,168	45,148	30,938	55,816		45,247
65 - 69	1	1	5	1	2		1	11
Avg. Benefit	49,564	38,248	49,333	19,391	32,104		58,945	43,366
70 - 74	2		3	2	1		2	10
Avg. Benefit	33,295		47,405	56,809	78,663		71,869	54,482
75 - 79		4	4		2		2	12
Avg. Benefit		46,040	46,432		54,539		50,865	48,391
80 - 84		3	6		3	1		13
Avg. Benefit		45,119	60,248		42,846	69,944		53,487
85 - 89	1	2	2	5	2	3	2	17
Avg. Benefit	87,951	52,172	40,483	37,764	81,236	49,090	42,377	50,387
90+		2	2	4	2	1	1	12
Avg. Benefit		30,093	81,704	45,607	28,404	41,998	66,666	47,625
<b>Total</b>	<b>4</b>	<b>12</b>	<b>24</b>	<b>13</b>	<b>13</b>	<b>6</b>	<b>8</b>	<b>80</b>
<b>Avg. Benefit</b>	<b>51,026</b>	<b>43,525</b>	<b>53,117</b>	<b>42,262</b>	<b>48,516</b>	<b>52,505</b>	<b>56,979</b>	<b>49,402</b>

In each cell, the top number is the count of survivors for the age/years since death combination and the bottom number is the average annual benefit amount.

## Membership Data

### Distribution of Disability Retirements

Age	Years Disabled as of June 30, 2016							Total
	<1	1 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25+	
< 45								
Avg. Benefit								
45 - 49								
Avg. Benefit								
50 - 54								
Avg. Benefit								
55 - 59								
Avg. Benefit								
60 - 64				1				1
Avg. Benefit				54,987				54,987
65 - 69			2	3				5
Avg. Benefit			50,759	60,176				56,409
70 - 74			1	3				4
Avg. Benefit			66,191	70,790				69,640
75+				4	4	1	1	10
Avg. Benefit				68,163	75,708	115,064	107,664	79,821
<b>Total</b>			<b>3</b>	<b>11</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>20</b>
<b>Avg. Benefit</b>			<b>55,903</b>	<b>65,503</b>	<b>75,708</b>	<b>115,064</b>	<b>107,664</b>	<b>70,690</b>

In each cell, the top number is the count of disabled participants for the age/years since disability combination and the bottom number is the average annual benefit amount.

## Membership Data

### Reconciliation of Members

	Terminated			Recipients			Total
	Actives*	Deferred Retirement	Other Non-Vested	Service Retirement	Disability Retirement	Survivor	
<b>Members on 7/1/2015</b>	<b>312</b>	<b>16</b>	<b>0</b>	<b>240</b>	<b>23</b>	<b>83</b>	<b>674</b>
New members	16	0	0	0	0	0	16
Return to active	0	0	0	0	0	0	0
Terminated non-vested	0	0	0	0	0	0	0
Service retirements	(14)	(2)	0	16	0	0	0
Terminated deferred	(3)	3	0	0	0	0	0
Terminated refund/transfer	0	0	0	0	0	0	0
Deaths	0	0	0	(6)	(3)	(7)	(16)
New beneficiary	0	0	0	0	0	4	4
Disabled	0	0	0	0	0	0	0
Unexpected status changes	0	0	0	0	0	0	0
Net change	(1)	1	0	10	(3)	(3)	4
<b>Members on 6/30/2016</b>	<b>311</b>	<b>17</b>	<b>0</b>	<b>250</b>	<b>20</b>	<b>80</b>	<b>678</b>

Terminated Member Statistics	Deferred Retirement	Other Non-Vested	Total
Number	17	0	17
Average age	58.6	N/A	58.6
Average service	9.9	N/A	9.9
Average annual benefit at Normal Retirement Date	\$ 38,873	N/A	\$ 38,873
Average refund value	\$159,768	N/A	\$159,768

\* Includes active Judges who have reached the maximum benefit formula (employee contributions are directed to the Unclassified Employees Retirement Plan).

## Development of Costs

### Actuarial Valuation Balance Sheet (*Dollars in Thousands*)

The actuarial balance sheet is based on the principle that the long-term projected benefit obligations of the plan should be ideally equal to the long-term resources available to fund those obligations. **A Projected Benefit Funding Ratio less than 100% indicates that contributions are insufficient.** The resources available to meet projected obligations for current members consist of current fund assets plus the present value of anticipated future contributions intended to fund benefits for current members. In the exhibit below, B.2 is the estimated present value of contributions to fund the normal cost rate for current members until their respective termination dates. Item B.1 is the present value of the total 37.06% statutory contribution net of normal cost and anticipated plan expenses during the period from the valuation date to the statutory unfunded amortization date.

The contributions made in excess of amounts required for current benefit payments are accumulated as a reserve to help meet benefit payments in later years. It is this reserve system which permits the establishment of a level rate of contribution each year.

	<u>June 30, 2016</u>		
A. Actuarial Value of Assets			\$ 172,525
B. Expected Future Assets			
1. Present value of expected future statutory supplemental contributions*			\$ 118,187
2. Present value of future normal cost contributions			58,784
3. Total expected future assets: (1.) + (2.)			\$ 176,971
C. Total Current and Expected Future Assets			\$ 349,496
D. Current Benefit Obligations**			
1. Benefit recipients	<b>Non-Vested</b>	<b>Vested</b>	<b>Total</b>
a. Service retirements	\$ 0	\$ 166,768	\$ 166,768
b. Disability retirements	0	13,696	13,696
c. Survivors	0	31,130	31,130
2. Deferred retirements with augmentation	0	4,609	4,609
3. Former members without vested rights***	0	0	0
4. Active members	4,085	99,041	103,126
5. Total Current Benefit Obligations	\$ 4,085	\$ 315,244	\$ 319,329
E. Expected Future Benefit Obligations			\$ 70,789
F. Total Current and Expected Future Benefit Obligations****			\$ 390,118
G. Unfunded Current Benefit Obligations: (D.5.) - (A.)			\$ 146,804
H. Unfunded Current and Future Benefit Obligations: (F.) - (C.)			\$ 40,622
I. Accrued Benefit Funding Ratio: (A.)/(D.5.)			54.03%
J. Projected Benefit Funding Ratio: (C.)/(F.)			89.59%

\* Per the LCPR Standards for Actuarial Work, calculated assuming the current contribution toward the unfunded liability continues for the entire amortization period. Based on a blended Tier 1 and Tier 2 member contribution rate and normal cost.

\*\* Present value of credited projected benefits (projected compensation, current service).

\*\*\* Former members who have not satisfied vesting requirements and have not collected a refund of member contributions as of the valuation date.

\*\*\*\* Present value of projected benefits (projected compensation, projected service).

## Development of Costs

### Determination of Unfunded Actuarial Accrued Liability and Supplemental Contribution Rate *(Dollars in Thousands)*

	Actuarial Present Value of Projected Benefits	Actuarial Present Value of Future Normal Costs	Actuarial Accrued Liability
A. Determination of Actuarial Accrued Liability (AAL)			
1. Active members			
a. Retirement annuities	\$ 165,326	\$ 53,618	\$ 111,708
b. Disability benefits	3,989	2,466	1,523
c. Survivor's benefits	4,345	2,581	1,764
d. Deferred retirements	0	0	0
e. Refunds*	<u>255</u>	<u>119</u>	<u>136</u>
f. Total	\$ 173,915	\$ 58,784	\$ 115,131
2. Deferred retirements with future augmentation	4,609	0	4,609
3. Former members without vested rights	0	0	0
4. Benefit recipients	<u>211,594</u>	<u>0</u>	<u>211,594</u>
5. Total	\$ 390,118	\$ 58,784	\$ 331,334
B. Determination of Unfunded Actuarial Accrued Liability (UAAL)			
1. Actuarial accrued liability			\$ 331,334
2. Current assets (AVA)			<u>172,525</u>
3. Unfunded actuarial accrued liability			\$ 158,809
C. Determination of Supplemental Contribution Rate**			
1. Present value of future payrolls through the amortization date of June 30, 2039			\$ 646,890
2. Supplemental contribution rate: (B.3.) / (C.1.)			24.55% ***

\* Includes non-vested refunds and non-married survivor benefits only.

\*\* The amortization of the Unfunded Actuarial Accrued Liability (UAAL) using the current amortization method results in initial payments less than the "interest only" payment on the UAAL. Payments less than the interest only amount will result in the UAAL increasing for an initial period of time.

\*\*\* The amortization factor as of July 1, 2016 is 13.45726.

## Development of Costs

### Changes in Unfunded Actuarial Accrued Liability (UAAL) (Dollars in Thousands)

	Year Ending June 30, 2016		
	Actuarial Accrued Liability	Current Assets	Unfunded Actuarial Accrued Liability
A. At beginning of year	\$ 315,633	\$ 168,235	\$ 147,398
B. Changes due to interest requirements and current rate of funding			
1. Normal cost and expenses	\$ 8,367	\$ 0	\$ 8,367
2. Benefit payments	(22,378)	(22,378)	0
3. Contributions	0	13,982	(13,982)
4. Interest on A., B.1., B.2., and B.3.	24,690	13,123	11,567
5. Total (B.1. + B.2. + B.3. + B.4.)	10,679	4,727	5,952
C. Expected unfunded actuarial accrued liability at end of year (A. + B.5.)	\$ 326,312	\$ 172,962	\$ 153,350
D. Increase (decrease) due to actuarial losses (gains) because of experience deviations from expected			
1. Age and Service Retirements			\$ 430
2. Disability Retirements			(140)
3. Death-in-Service Benefits			(105)
4. Withdrawals			(967)
5. Salary increases			4,455
6. Investment income			437
7. Mortality of annuitants			(253)
8. Other items			430
9. Total			\$ 4,287
E. Unfunded actuarial accrued liability at end of year before plan amendments and changes in actuarial assumptions (C. + D.9.)			\$ 157,637
F. Change in unfunded actuarial accrued liability due to changes in plan provisions			\$ 0
G. Change in unfunded actuarial accrued liability due to changes in actuarial assumptions			\$ 1,172
H. Change in unfunded actuarial accrued liability due to changes in methodology			\$ 0
I. Unfunded actuarial accrued liability at end of year (E. + F. + G. + H.)*			\$ 158,809

\* The unfunded actuarial accrued liability on a market value of assets basis is \$165,429.

## Development of Costs

### Determination of Contribution Sufficiency/(Deficiency) (*Dollars in Thousands*)

The required contribution is defined in Minnesota Statutes as the sum of normal cost, a supplemental contribution to amortize the UAAL, and an allowance for expenses. The dollar amounts shown are for illustrative purposes and equal percent of payroll multiplied by projected annual payroll.

	<u>Percent of Payroll</u>	<u>Dollar Amount</u>
A. Statutory contributions - Chapter 490		
1. Employee contributions*	8.32%	\$ 3,999
2. Employer contributions	22.50%	10,816
3. State contributions*****	6.24%	3,000
3. Total	<u>37.06%</u>	<u>\$ 17,815</u>
B. Required contributions - Chapter 356		
1. Normal cost		
a. Retirement benefits	16.95%	\$ 8,148
b. Disability benefits	0.76%	365
c. Survivors	0.83%	399
d. Deferred retirement benefits	0.00%	0
e. Refunds**	0.04%	19
f. Total	<u>18.58%</u>	<u>\$ 8,931</u>
2. Supplemental contribution amortization of Unfunded Actuarial Accrued Liability by June 30, 2039	24.55%	\$ 11,801
3. Allowance for expenses	<u>0.21%</u>	<u>\$ 101</u>
4. Total	43.34% ***	\$ 20,833
C. Contribution Sufficiency/(Deficiency) (A.3. - B.4.)	(6.28)%	\$ (3,018)

Note: Projected annual payroll for fiscal year beginning on the valuation date: \$48,070.

\* For Tier 1 Judges who have reached the maximum benefit amount, member contributions equal to 9% of pay are directed to the Unclassified Employees Retirement Plan. The member contribution amount of \$3,999 shown above is equal to 9% of a Tier 1 payroll amount of \$37,697 (which excludes the payroll for Tier 1 Judges at the maximum level) and 7.00% of a Tier 2 payroll amount of \$8,662 for Tier 2 Judges.

\*\* Includes non-vested refunds and non-married survivor benefits only.

\*\*\* The required contribution on a market value of assets basis is 44.36% of payroll.

\*\*\*\*\* \$3,000,000 for the year ending June 30, 2017, and \$6,000,000 per year thereafter until the plan is fully funded.

## **Actuarial Basis**

### **Actuarial Methods**

All actuarial methods are prescribed by Minnesota Statutes, the Legislative Commission on Pensions and Retirement, or the MSRS Board of Directors. Different methodologies may also be reasonable and results based on other methodologies would be different.

### **Actuarial Cost Method**

Actuarial Accrued Liability and required contributions in this report are computed using the Entry Age Normal Cost Method. This method is prescribed by Minnesota Statute. An actuarial cost method is a set of techniques used by the actuary to develop contribution levels under a retirement plan. The actuarial cost method used in this valuation for all purposes is the Entry Age Actuarial Cost Method. Under this method, a normal cost is developed by amortizing the actuarial value of benefits expected to be received by each active participant (as a level percentage of pay) over the total working lifetime of that participant, from hire to termination. Age as of the valuation date was calculated based on the dates of birth provided by the Fund. Entry age for valuation purposes was calculated as the age on the valuation date minus the provided years of service on the valuation date.

To the extent that current assets and future normal costs do not support participants' expected future benefits, an Unfunded Actuarial Accrued Liability ("UAAL") develops. The UAAL is amortized over the statutory amortization period using level percent of payroll assuming payroll increases. The total contribution developed under this method is the sum of normal cost, expenses, and the payment toward the UAAL.

### **Valuation of Future Post-Retirement Benefit Increases**

If the plan has reached the accrued liability funding ratio threshold (determined on a market value of assets basis) required to pay a 2.00% or 2.50% benefit increase, Minnesota Statutes require the 2.00% or 2.50% benefit increase rate to be reflected in the liability calculations. If the plan has not yet reached the accrued liability funding ratio threshold required to pay a 2.00% or 2.50% benefit increase, Minnesota Statutes require a projection to be performed to determine the expected attainment of the accrued liability funding ratio thresholds, and the expected payment of 2.00% or 2.50% benefit increases must be reflected in the liability calculations.

### **Funding Objective**

The fundamental financing objective of the fund is to establish contribution rates which, when expressed as a percentage of active member payroll, will remain approximately level from generation to generation and meet the required deadline for full funding.

## **Actuarial Basis**

### **Actuarial Methods (Concluded)**

#### **Asset Valuation Method**

The assets are valued based on a five-year moving average of expected and market values (five-year average actuarial value) determined as follows:

- At the end of each plan year, an average asset value is calculated as the average of the market asset value at the beginning and end of the fiscal year net of investment income for the fiscal year;
- The investment gain or (loss) is taken as the excess of actual investment income over the expected investment income based on the average asset value as calculated above;
- The investment gain or (loss) so determined is recognized over five years at 20% per year; and
- The asset value is the sum of the market asset value plus the scheduled recognition of investment gains or (losses) during the current and the preceding four fiscal years.

#### **Payment on the Unfunded Actuarial Accrued Liability**

Payment equals a level percentage of payroll each year to the statutory amortization date of June 30, 2039 assuming payroll increases of 2.75% per annum. If there is a negative Unfunded Actuarial Accrued Liability, the surplus amount is amortized over 30 years as a level percentage of payroll. If the unfunded liability increases due to changes in benefits, assumptions, or methods, the statutory amortization date will be re-determined. Projected payroll is multiplied by 0.959 in the determination of the present value of future payroll to account for timing differences (as required by the Standards for Actuarial Work).

#### **Changes in Methods since Prior Valuation**

There have been no changes in actuarial methods since the prior valuation.

## Actuarial Basis

### Summary of Actuarial Assumptions

The following assumptions were used in valuing the liabilities and benefits under the plan. All actuarial assumptions are prescribed by Minnesota Statutes, the Legislative Commission on Pensions and Retirement (LCPR), or the MSRS Board of Directors. These parties are responsible for selecting the assumptions used for this valuation. The assumptions prescribed are based on the last experience study, dated February 2012, prepared by a former actuary, and a review of inflation and investment return assumptions dated September 11, 2014. An experience study for the 2011-2015 period was issued on July 26, 2016. This report recommended many changes to demographic assumptions, expected to be effective at a future date.

Investment return	8.00% per annum.
Benefit increases after retirement	1.75% per annum through 2034, 2.00% per annum from 2035 to 2045, and 2.50% per annum thereafter.
Salary increases	2.75% per year.
Payroll growth	2.75% per year.
Inflation	2.75% per year.
Mortality rates	
Healthy pre-retirement	RP-2000 employee generational mortality table projected using mortality improvement scale AA, white collar adjustment.
Healthy post-retirement	RP-2000 annuitant generational mortality table projected with mortality improvement scale AA, white collar adjustment, set back one year for males and set back two years for females.
	The RP-2000 employee mortality table as published by the Society of Actuaries (SOA) contains mortality rates for ages 15 to 70 and the annuitant mortality table contains mortality rates for ages 50 to 95. We have applied the annuitant mortality table for active members beyond age 70 until the assumed retirement age and the employee mortality table for annuitants younger than age 50.
Disabled	RP-2000 annuitant generational mortality table projected with mortality improvement scale AA, white collar adjustment, set back one year for males and set back two years for females.
Retirement	Members retiring from active status are assumed to retire according to the age related rates shown in the rate table. Members who have attained the highest assumed retirement age are assumed to retire in one year.
Withdrawal	None.
Disability	Age-related rates based on experience; see table of sample rates.
Administrative expenses	Prior year administrative expenses expressed as percentage of prior year projected payroll.
Refund of contributions	Account balances for deferred members accumulate interest until normal retirement date and are discounted back to the valuation date.
Commencement of deferred benefits	Members receiving deferred annuities (including current terminated deferred members) are assumed to begin receiving benefits at age 65.

## Actuarial Basis

### Summary of Actuarial Assumptions (Continued)

Percentage married	Marital status as indicated by data.
Age of spouse	Females are assumed to be three years younger than their male spouses.
Form of payment	Members are assumed to elect a life annuity.
Eligibility testing	Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur.
Decrement operation	Withdrawal decrements do not operate during retirement eligibility. Decrements are assumed to occur mid-fiscal year.
Service credit accruals	It is assumed that members accrue one year of service credit per year.
Pay increases	Pay increases are assumed to happen at the beginning of the fiscal year. This is equivalent to assuming that reported earnings are pensionable earnings for the year ending on the valuation date.
Unknown data for certain members	To prepare this report, GRS has used and relied on participant data supplied by the Fund. Although GRS has reviewed the data in accordance with Actuarial Standards of Practice No. 23, GRS has not verified or audited any of the data or information provided.

In cases where submitted data was missing or incomplete, the following assumptions were applied:

Data for active members:

There were 11 members who have reached the 24-year service cap. Based on the salary reported under the Unclassified Employees Retirement Plan, we assumed these members earned \$149,605 (9 members) or \$159,370 (2 members) for the July 1, 2015 to June 30, 2016 plan year.

There were no members reported with missing service.

There were no members reported with missing or invalid birth dates. There were no members reported with an invalid gender.

Data for terminated members:

There was 1 member reported without a benefit. We calculated the benefit for this member using the reported Average Salary, Credited Service and Termination Date provided.

## Actuarial Basis

### Summary of Actuarial Assumptions (Continued)

Unknown data for certain members	<p><u>Data for members receiving benefits:</u></p> <p>There were no members reported without a benefit.</p> <p>There were no members reported with missing or invalid birth dates.</p> <p>There was 1 member reported with a missing gender. We assumed male gender.</p> <p>There were retired members reported with a survivor option and an invalid or missing survivor gender (50 members) and/or survivor date of birth (38 members). We used the valuation assumptions if the survivor gender or date of birth was missing or invalid.</p> <p>There were 2 retirees reported with a bounce-back survivor option and a survivor date of death. We assumed no benefit was payable to the survivor, and the member benefit already reflected the increase to the life annuity value (i.e., “bounce back”), if applicable.</p> <p>There was 1 retiree reported with a bounce back annuity but was not reported with a reasonable reduction factor. A factor of 0.80, 0.85 and 0.90 was assumed for the 100%, 75% and 50% joint and survivor annuity, respectively.</p> <p>There were no survivors reported on the data file with an expired benefit.</p>
Changes in actuarial assumptions	<p>The assumed post-retirement benefit increase rate was changed from 1.75% per year for all years to 1.75% through 2034, 2.00% for 2035 through 2045, and 2.50% thereafter.</p>

## Actuarial Basis

### Summary of Actuarial Assumptions (Concluded)

Age	Percentage of Members Dying each Year*					
	Healthy Post-Retirement Mortality**		Healthy Pre-Retirement Mortality**		Disability Mortality**	
	Male	Female	Male	Female	Male	Female
20	0.03%	0.02%	0.03%	0.02%	0.03%	0.02%
25	0.04	0.02	0.04	0.02	0.04	0.02
30	0.04	0.02	0.04	0.03	0.04	0.02
35	0.05	0.04	0.06	0.05	0.05	0.04
40	0.08	0.06	0.09	0.06	0.08	0.06
45	0.12	0.08	0.13	0.10	0.12	0.08
50	0.18	0.13	0.20	0.16	0.18	0.13
55	0.56	0.29	0.27	0.24	0.56	0.29
60	0.61	0.47	0.43	0.38	0.61	0.47
65	1.04	0.74	0.67	0.59	1.04	0.74
70	1.74	1.24	0.98	0.88	1.74	1.24

\* Generally, mortality rates are expected to increase as age increases. These standard mortality rates have been adjusted slightly to prevent decreasing mortality rates. If the rates were not adjusted as described, we would not expect the valuation results to be materially different.

\*\* These rates were adjusted for mortality improvements using projection scale AA.

Percentage of Eligible Members Retiring each Year						
Age	Disability Retirement		Age	Retirement		
	Male	Female				
20	0.00%	0.00%	60	0%		
25	0.00	0.00	61	0		
30	0.00	0.00	62	8		
35	0.01	0.00	63	5		
40	0.01	0.01	64	8		
45	0.02	0.03	65	25		
50	0.07	0.05	66	20		
55	0.17	0.12	67	10		
60	0.38	0.31	68	30		
65	0.00	0.00	69	10		

## Actuarial Basis

### Summary of Plan Provisions

Following is a summary of the major plan provisions used in the valuation of this report. MSRS is solely responsible for the validity, accuracy and comprehensiveness of this information. If any of the plan provisions shown below are not accurate and complete, the valuation results may differ significantly from those shown in this report and may require a revision of this report.

<b>Plan year</b>	July 1 through June 30.
<b>Eligibility</b>	A judge or justice of any court. If the member was active prior to January 1, 1974, benefits may be computed according to provisions of the prior plan.
<b>Tier 1 / Tier 2 Member</b>	Tier 1 includes judges or justices first appointed or elected before July 1, 2013, and Tier 2 includes judges or justices first appointed or elected after June 30, 2013. A judge or justice with less than five years of service as of December 30, 2013, may make a one-time irrevocable election into Tier 2. For the purpose of this valuation, we have assumed no Tier 1 members elected Tier 2 benefits as of the valuation date.
<b>Contributions</b>	
Member	9.00% of salary for Tier 1 members, 7.00% of salary for Tier 2 members. Tier 1 member contributions after maximum benefit is reached are redirected to the Unclassified Employees Retirement Plan.
Employer	22.50% of salary.
	Member contributions are "picked up" according to the provisions of Internal Revenue Code 414(h).
<b>State Contributions</b>	\$3,000,000 for the year ending June 30, 2017, and \$6,000,000 per year thereafter until the plan is fully funded.
<b>Allowable service</b>	Service as a judge. Credit may also be earned for uncredited judicial service if the appropriate employee contributions, with interest, are made.
<b>Salary</b>	Salary set by law.
<b>Average salary</b>	Average of the five highest years of salary of the last 10 years prior to termination of judicial service.

## Actuarial Basis

### Summary of Plan Provisions (Continued)

#### Retirement

##### Normal retirement benefit

Age/Service requirement	<p>First appointed as a judge before July 1, 2013 (Tier 1):</p> <p>(a.) Age 65 and five years of Allowable Service</p> <p>(b.) Age 70 (mandatory retirement age)</p> <p>First appointed as a judge after June 30, 2013 (Tier 2):</p> <p>(a.) Age 66 and five years of Allowable Service</p> <p>(b.) Age 70 (mandatory retirement age)</p> <p>Judges appointed before July 1, 2013, with less than five years of allowable service on or before December 31, 2013, may make a one-time election for the Tier 2 benefit package.</p>
Amount	<p>First appointed as a judge before July 1, 2013 (Tier 1): 2.70% of Average Salary for each year of Allowable Service prior to July 1, 1980, and 3.20% of Average Salary for each year of Allowable Service after June 30, 1980. Maximum benefit equal to 76.80% of Average Salary.</p> <p>First appointed as a judge after June 30, 2013 (Tier 2): 2.50% of Average Salary for each year of Allowable Service.</p> <p>Tier 1 who elected into Tier 2: 3.20% of Average Salary for each year of Allowable Service prior to January 1, 2014, plus 2.50% of Average Salary for each year of Allowable Service after December 31, 2013.</p>

##### Early retirement

Age/Service requirement	Age 60 and five years of Allowable Service.
Amount	Normal Retirement Benefit based on Allowable Service and Average Salary at retirement date with reduction of 0.50% for each month the member is under Normal Retirement Age at time of retirement.

##### Form of payment

Life annuity. Actuarially equivalent options are:
(a.) 50%, 75% or 100% joint and survivor with no bounce back feature
(b.) 50%, 75% or 100% with bounce back feature
(c.) 15-year certain and life thereafter

##### Benefit increases

Since January 1, 2014, benefit recipients receive annual 1.75% benefit increases. If the accrued liability funding ratio reaches or exceeds 70% for two consecutive years (on a Market Value of Assets basis), the benefit increase will revert to 2.00%. If the accrued liability funding ratio reaches or exceeds 90% for two consecutive years (on a Market Value of Assets basis), the benefit increase will revert to 2.50%.

A benefit recipient who has been receiving a benefit for at least 12 full months as of the June 30 of the calendar year immediately before the adjustment will receive a full increase. Members receiving benefits for at least one month but less than 12 full months as of the June 30 of the calendar year immediately before the adjustment will receive a pro rata increase.

## Actuarial Basis

### Summary of Plan Provisions (Continued)

#### Disability

##### Disability benefit

Age/Service requirement	Permanent inability to perform the function of judge.
Amount	No benefit is paid by the Fund. Instead salary is continued for one year but not beyond age 70. Employee contributions continue and Allowable Service is earned. If disability continues after the first year (or at age 70 if earlier), the larger of 25.00% of Average Salary or the Normal Retirement Benefit, without reduction.

##### Retirement after disability

Age/Service requirement	Member is still disabled after salary payments cease after one year or at age 70, if earlier.
Amount	No change in disability benefit amount from pre-retirement computed benefit amount.

##### Form of payment

Same as for retirement.

##### Benefit increases

Same as for retirement.

#### Death

##### Survivor's benefit

Age/service requirement	Active or disabled member dies before retirement or a former member eligible for a deferred annuity dies.
Amount	Larger of 25% of Average Salary or 60% of Normal Retirement Benefit earned at date of death. If member dies after age 60 with five or more years of service, spouse may receive the 100% joint and survivor benefit the member had earned as of date of death.  Benefit paid to spouse for life. If no spouse, benefit is paid to surviving dependent children until child marries, dies, or attains age 18 (age 22 if full-time student).
Benefit increases	Same as for retirement.

##### Refund of contributions

Age/service requirement	Member dies prior to retirement or former member eligible for a deferred annuity dies and survivors' benefits are not payable.
Amount	Member contributions with 6.00% annual interest compounded daily until June 30, 2011, and 4.00% thereafter.

## Actuarial Basis

### Summary of Plan Provisions (Concluded)

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<b>Termination</b>	
<u>Refund of contributions</u>	
Age/Service requirement	Termination of service as a judge.
Amount	Member contributions with 6.00% annual interest compounded daily until June 30, 2011, and 4.00% thereafter. If a member is vested, a deferred annuity may be elected in lieu of a refund.
 <u>Deferred benefit</u>	
Age/service requirement	Five years of Allowable Service.
Amount	Benefit computed under law in effect at termination. Amount is payable at normal or early retirement.
	If a member terminated employment prior to July 1, 1997 but was not eligible to commence their pension before July 1, 1997, an actuarial increase shall be made for the change in the post-retirement interest rates from 5.00% to 6.00%.
Form of payment	Same as for retirement.
<hr/>	
<b>Optional form conversion factors</b>	Actuarially equivalent factors based on RP-2000 for healthy annuitants, white collar adjustment, projected to 2022 using scale AA, set back one year for males and set back two years for females, blended 80% males, and 6.50% interest.
<hr/>	
<b>Combined service annuity</b>	Members are eligible for combined service benefits if they: <ul style="list-style-type: none"> <li>(a.) Have sufficient allowable service in total that equals or exceeds the applicable service credit vesting requirement of the retirement plan with the longest applicable service credit vesting requirement;</li> <li>(b.) Have at least six months of allowable service credit in each plan worked under; and</li> <li>(c.) Are not in receipt of a benefit from another plan, or have applied for benefits with an effective date within one year.</li> </ul> <p>Members who meet the above requirements must have their benefit based on the following:</p> <ul style="list-style-type: none"> <li>(a.) Allowable service in all covered plans are combined in order to determine eligibility for early retirement; and</li> <li>(b.) Average salary is based on the high five consecutive years during their entire service in all covered plans.</li> </ul>
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<b>Changes in plan provisions</b>	2016 legislation provides state contributions equal to \$3,000,000 for the fiscal year ending June 30, 2017, and \$6,000,000 per year thereafter until the plan is fully funded.
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## Additional Schedules

### Schedule of Funding Progress<sup>1</sup> (Dollars in Thousands)

Actuarial Valuation Date	Actuarial Value of Assets (a)	Actuarial Accrued Liability (AAL) (b)	Unfunded (Overfunded) AAL (UAAL) (b) - (a)	Funded Ratio (a)/(b)	Actual Covered Payroll (Previous FY) (c)	UAAL as a Percentage of Covered Payroll [(b)-(a)]/(c)
7-1-1991	\$ 33,559	\$ 78,429	\$ 44,870	42.79%	\$ 18,410	243.73 %
7-1-1992	37,768	83,969	46,201	44.98	22,765	202.95
7-1-1993	44,156	90,509	46,353	48.79	22,084	209.89
7-1-1994	50,428	98,313	47,885	51.29	22,264	215.08
7-1-1995	56,813	102,238	45,425	55.57	22,877	198.56
7-1-1996	64,851	108,150	43,299	59.96	22,421	193.12
7-1-1997	74,681	117,714	43,033	63.44	22,909	187.84
7-1-1998	86,578	130,727	44,149	66.23	24,965	176.84
7-1-1999	97,692	139,649	41,957	69.96	32,940	127.37
7-1-2000	111,113	153,660	42,547	72.31	26,315	161.68
7-1-2001	123,589	165,244	41,655	74.79	28,246	147.47
7-1-2002	131,379	171,921	40,542	76.42	31,078	130.45
7-1-2003	134,142	176,291	42,149	76.09	33,771	124.81
7-1-2004	138,948	190,338	51,390	73.00	34,683	148.17
7-1-2005	144,465	191,414	46,949	75.47	35,941	130.63
7-1-2006	151,850	202,301	50,451	75.06	36,529	138.11
7-1-2007	153,562	214,297	60,735	71.66	36,195	167.80
7-1-2008	147,542	231,623	84,081	63.70	38,296	219.56
7-1-2009	147,120	241,815	94,695	60.84	39,444	240.07
7-1-2010	144,728	240,579	95,851	60.16	39,291	243.95
7-1-2011	145,996	248,630	102,634	58.72	40,473	253.59
7-1-2012	144,898	281,576	136,678	51.46	38,644 <sup>2</sup>	353.69
7-1-2013	144,918	284,513	139,595	50.94	39,888 <sup>2</sup>	349.97
7-1-2014	157,528	298,233	140,705	52.82	41,893 <sup>3</sup>	335.86
7-1-2015	168,235	315,633	147,398	53.30	43,449 <sup>3</sup>	339.24
7-1-2016	172,525	331,334	158,809	52.07	45,418 <sup>3</sup>	349.66

<sup>1</sup> Information prior to 2012 provided by prior actuaries. See prior reports for additional detail.

<sup>2</sup> Assumed equal to actual employer contribution divided by 20.50%.

<sup>3</sup> Assumed equal to actual employer contribution divided by 22.50%.

## Additional Schedules

### Schedule of Contributions from the Employer and Other Contributing Entities<sup>1</sup> (Dollars in Thousands)

Plan Year Ended June 30	Actuarially Required Contribution Rate (a)	Actual Covered Payroll (b)	Actual Member Contributions (c)	Annual Required Contributions [(a)x(b)] - (c) = (d)	Actual Employer Contributions <sup>2</sup> (e)	Percentage Contributed (e)/(d)
1991	23.59%	\$ 18,410	\$ 799	\$ 3,544	\$ 0	0.00 %
1992	25.10	22,765	988	4,726	4,722	99.92
1993	26.59	22,084	1,409	4,463	4,845	108.56
1994	26.29	22,264	1,416	4,437	4,912	110.71
1995	28.27	22,877	1,455	5,012	5,162	102.99
1996	27.32	22,421	1,426	4,699	4,972	105.81
1997	27.01	22,909	1,457	4,731	6,632	140.18
1998	27.60	24,965	1,570	5,320	7,129	134.00
1999	27.32	32,940	2,069	6,930	7,051	101.75
2000	26.75	26,315	2,107	4,932	7,298	147.97
2001	24.58	28,246	2,162	4,781	7,793	163.00
2002	26.72	31,078	2,345	5,959	8,369	140.44
2003	26.82	33,771	2,574	6,483	6,923	106.79
2004	26.73	34,683	2,643	6,628	7,110	107.27
2005	29.42	35,941	2,662	7,912	7,225	91.32
2006	29.14	36,529	2,866	7,779	7,336	94.30
2007	30.73	36,195	2,792	8,331	7,572	90.88
2008	33.70	38,296	2,861	10,045	7,936	79.00
2009	30.33	39,444	2,978	8,985	8,219	91.47
2010	31.53	39,291	2,988	9,400	8,283 <sup>3</sup>	88.12
2011	31.66	40,473	3,010	9,804	8,297	84.63 <sup>3</sup>
2012	33.15	38,644 <sup>4</sup>	2,931	9,879	7,922	80.19
2013	41.52	39,888 <sup>4</sup>	3,037	13,524	8,177	60.46
2014	42.42	41,893 <sup>5</sup>	3,578	14,193	9,426	66.41
2015	41.26	43,449 <sup>5</sup>	3,629	14,298	9,776	68.37
2016	42.73	45,418 <sup>5</sup>	3,763	15,644	10,219	65.32
2017	43.34	N/A	N/A	N/A	N/A	N/A

<sup>1</sup> Information prior to 2012 provided by prior actuary. See prior reports for additional detail.

<sup>2</sup> Includes contributions from other sources (if applicable).

<sup>3</sup> Provided by MSRS instead of prior actuary.

<sup>4</sup> Assumed equal to actual employer contribution divided by 20.50%.

<sup>5</sup> Assumed equal to actual employer contribution divided by 22.50%.

## Glossary of Terms

<b><i>Accrued Benefit Funding Ratio</i></b>	The ratio of assets to Current Benefit Obligations.
<b><i>Accrued Liability Funding Ratio</i></b>	The ratio of assets to Actuarial Accrued Liability.
<b><i>Actuarial Accrued Liability (AAL)</i></b>	The difference between the Actuarial Present Value of Future Benefits, and the Actuarial Present Value of Future Normal Costs.
<b><i>Actuarial Assumptions</i></b>	Assumptions about future plan experience that affect costs or liabilities, such as: mortality, withdrawal, disablement, and retirement; future increases in salary; future rates of investment earnings; future investment and administrative expenses; characteristics of members not specified in the data, such as marital status; characteristics of future members; future elections made by members; and other items.
<b><i>Actuarial Cost Method</i></b>	A procedure for allocating the Actuarial Present Value of Future Benefits between the Actuarial Present Value of future Normal Costs and the Actuarial Accrued Liability.
<b><i>Actuarial Equivalent</i></b>	Of equal Actuarial Present Value, determined as of a given date and based on a given set of Actuarial Assumptions.
<b><i>Actuarial Present Value (APV)</i></b>	The amount of funds required to provide a payment or series of payments in the future. It is determined by discounting the future payments with an assumed interest rate and with the assumed probability each payment will be made.
<b><i>Actuarial Present Value of Projected Benefits</i></b>	The Actuarial Present Value of amounts which are expected to be paid at various future times to active members, retired members, beneficiaries receiving benefits, and inactive, non-retired members entitled to either a refund or a future retirement benefit. Expressed another way, it is the value that would have to be invested on the valuation date so that the amount invested plus investment earnings would provide sufficient assets to pay all projected benefits and expenses when due.
<b><i>Actuarial Valuation</i></b>	The determination, as of a valuation date, of the Normal Cost, Actuarial Accrued Liability, Actuarial Value of Assets, and related Actuarial Present Values for a plan. An Actuarial Valuation for a governmental retirement system typically also includes calculations of items needed for developing and monitoring a retirement system's funding policy, such as the Funded Ratio and the Annual Required Contribution (ARC).
<b><i>Actuarial Value of Assets</i></b>	The value of the assets as of a given date, used by the actuary for valuation purposes. This may be the market or fair value of plan assets or a smoothed value in order to reduce the year-to-year volatility of calculated results, such as the funded ratio and the actuarially required contribution (ARC).

## Glossary of Terms (Continued)

<i>Amortization Method</i>	A method for determining the Amortization Payment. Under the Level Percentage of Pay method, the Amortization payment is one of a stream of increasing payments, whose Actuarial Present Value is equal to the UAAL. The stream of payments increases at the rate at which total covered payroll of all active members is assumed to increase.
<i>Amortization Payment</i>	That portion of the plan contribution or ARC which is designed to pay interest on and to amortize the Unfunded Actuarial Accrued Liability.
<i>Amortization Period</i>	The period used in calculating the Amortization Payment.
<i>Annual Required Contribution (ARC)</i>	The employer's periodic required contributions, expressed as a dollar amount or a percentage of covered plan compensation. The ARC consists of the Employer Normal Cost and Amortization Payment.
<i>Augmentation</i>	Annual increases to deferred benefits.
<i>Closed Amortization Period</i>	A specific number of years that is reduced by one each year, and declines to zero with the passage of time. For example if the amortization period is initially set at 30 years, it is 29 years at the end of one year, 28 years at the end of two years, etc.
<i>Current Benefit Obligations</i>	The present value of benefits earned to the valuation date, based on current service and including future salary increases to retirement.
<i>Employer Normal Cost</i>	The portion of the Normal Cost to be paid by the employer. This is equal to the Normal Cost less expected member contributions.
<i>Expected Assets</i>	The present value of anticipated future contributions intended to fund benefits for current members.
<i>Experience Gain/Loss</i>	A measure of the difference between actual experience and that expected based upon a set of Actuarial Assumptions, during the period between two actuarial valuations. To the extent that actual experience differs from that assumed, Unfunded Actuarial Accrued Liabilities emerge which may be larger or smaller than projected. Gains are due to favorable experience, e.g., the assets earn more than projected, salaries do not increase as fast as assumed, members retire later than assumed, etc. Favorable experience means actual results produce actuarial liabilities not as large as projected by the actuarial assumptions. On the other hand, losses are the result of unfavorable experience, i.e., actual results that produce Unfunded Actuarial Accrued Liabilities which are larger than projected.

## Glossary of Terms (Concluded)

<b><i>GASB</i></b>	Governmental Accounting Standards Board.
<b><i>GASB Statements No. 25 and No. 27</i></b>	These are the governmental accounting standards that set the accounting and financial reporting rules for public retirement systems and the employers that sponsor or contribute to them. Statement No. 27 sets the accounting and financial reporting rules for the employers that sponsor or contribute to public retirement systems, while Statement No. 25 sets the rules for the systems themselves. These statements remain in effect only for pension plans that are not administered as trusts or equivalent arrangements. Please refer to the definition of GASB Statements No. 67 and No. 68 below.
<b><i>GASB Statement No. 50</i></b>	The accounting standard governing a state or local governmental employer's accounting for pensions. This statement remains in effect only for pension plans that are not administered as trusts. Please refer to the definition of GASB Statements No. 67 and No. 68.
<b><i>GASB Statements No. 67 and No. 68</i></b>	Statements No. 67 and No. 68, issued in June 2012, replace the requirements of Statements No. 25, No. 27 and No. 50, respectively, for pension plans administered as trusts. Statement No. 68, effective for the fiscal year beginning July 1, 2014, sets the accounting and financial reporting rules for the employers that sponsor or contribute to public retirement systems, while Statement No. 67, effective for the fiscal year beginning July 1, 2013, sets the rules for the systems themselves. Accounting and financial reporting information prepared according to Statements No. 67 and No. 68 is provided in a separate report beginning with the June 30, 2014 actuarial valuation.
<b><i>GASB Statement No. 82</i></b>	Statement No. 82, issued in March 2016, is an amendment to Statements No. 67, No. 68, and No. 73, and is intended to improve consistency in the application of the accounting statements.
<b><i>Normal Cost</i></b>	The annual cost assigned, under the Actuarial Cost Method, to the current plan year.
<b><i>Projected Benefit Funding Ratio</i></b>	The ratio of the sum of Actuarial Value of Assets and Expected Assets to the Actuarial Present Value of Projected Benefits. A Ratio less than 100% indicates that contributions are insufficient.
<b><i>Unfunded Actuarial Accrued Liability</i></b>	The difference between the Actuarial Accrued Liability and Actuarial Value of Assets.
<b><i>Valuation Date</i></b>	The date as of which the Actuarial Present Value of Future Benefits are determined. The benefits expected to be paid in the future are discounted to this date.