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MISSOURI STATE EMPLOYEES' RETIREMENT SYSTEM - JUDGES

ACTUARIAL VALUATION REPORT AS OF JUNE 30, 2021

CONTRIBUTION RATE FOR FISCAL YEAR ENDING JUNE 30, 2023

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October 18, 2021

Board of Trustees
Missouri State Employees' Retirement System
907 Wildewood Drive
Jefferson City, MO 65102

Dear Members of the Board:

At your request, we performed an actuarial valuation of the Missouri State Employees' Retirement System (MOSERS) as of June 30, 2021 for the purpose of determining the employer required contribution rate for the fiscal year ending June 30, 2023. This report provides valuation results for the Missouri State Employees' Retirement System - Judges (Judges). The major findings of the valuation are contained in this report, which reflects the benefit provisions in place on June 30, 2021. There have been no changes to the plan provisions since the prior valuation. However, there were several changes to the set of actuarial assumptions and methods as a result of completion of the five-year experience study that analyzed actuarial experience between July 1, 2015 and June 30, 2020. These changes, as well as their impact on the current valuation results, are discussed further in the Executive Summary of this report.

In preparing our report, we relied, without audit, on information (some oral and some in writing) supplied by the System's staff. This information includes, but is not limited to, statutory provisions, member data and financial information. We found this information to be reasonably consistent and comparable with the information received in the prior year. The valuation results depend on the integrity of this information. If any of this information is inaccurate or incomplete, our results may be different and our calculations may need to be revised.

We further certify that all costs, liabilities, rates of interest and other factors for Judges have been determined on the basis of actuarial assumptions and methods which are individually reasonable (taking into account the experience of each Plan and reasonable expectations); and which, in combination, offer the best estimate of anticipated experience affecting Judges. Nevertheless, the emerging costs will vary from those presented in this report to the extent actual experience differs from that projected by the actuarial assumptions. The MOSERS Board has the final decision regarding the appropriateness of the assumptions and adopted them as indicated in Appendix C.

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In order to prepare the results in this report, we have utilized appropriate actuarial models that were developed for this purpose. These models use assumptions about future contingent events along with recognized actuarial approaches to develop the needed 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. Due to the limited scope of our assignment, we did not perform an analysis of the potential range of future measurements.

As we prepare this report, the world is recovering from the COVID-19 pandemic. We have considered available information, but do not believe there is sufficient data yet to warrant the modification of any of our assumptions. We will continue to monitor the situation and advise the Board in the future of any adjustment we believe would be appropriate.

The actuarial computations presented in this report are for purposes of determining the funding amounts for Judges as set out in the Missouri state statutes. The calculations in the enclosed report have been made on a basis consistent with our understanding of MOSERS' funding policy. Determinations for purposes other than meeting these requirements may be significantly different from the results contained in this report. Accordingly, additional determinations may be needed for other purposes. For example, actuarial computations for purposes of fulfilling financial accounting requirements for the System under Governmental Accounting Standards No. 67 and No. 68 will be presented in separate reports.

The consultants who worked on this assignment are pension actuaries with substantive experience valuing public retirement systems. Cavanaugh Macdonald's advice is not intended to be a substitute for qualified legal or accounting counsel.

On the basis of the foregoing, we hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices. We are members of the American Academy of Actuaries and meet the Qualification Standards to render the actuarial opinion contained herein. We are available to answer any questions on the material contained in the report or to provide explanations or further details as may be appropriate.

We respectfully submit the following report and look forward to discussing it with you.

Sincerely,

Patrice Beckham

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

Bryan K. Hoge, FSA, EA, FCA, MAAA
Consulting Actuary

This report presents the results of the June 30, 2021 actuarial valuation of the Missouri State Employees' System – Judges (Judges). The primary purposes of performing the actuarial valuation are to:

- Determine the employer contribution rate, as defined in the Missouri state statutes and set out in the Board's funding policy, for the fiscal year ending June 30, 2023;
- Disclose asset and liability measurements as well as the current funded status of Judges on the valuation date;
- Compare the actual and expected experience of Judges during the plan year ended June 30, 2021;
- Assess and disclose the key risks associated with funding the System; and
- Analyze and report on trends in Judges' contributions, assets and liabilities over the past several years.

Changes to Actuarial Assumptions and Methods

A five-year comprehensive experience study was performed in 2021, including analysis of both the economic and demographic assumptions. All of the recommended changes to the assumptions and methods were adopted by the Board at their June 17, 2021 meeting. Please see the Experience Study report, dated August 4, 2021, for more detail on the change in the assumptions and methods. Significant changes include:

- The individual salary increase assumption was changed from an age-based assumption to a flat 3%.
- The mortality assumption was changed to a generational approach using the Pub-2010 General Members Median Mortality Table and projected forward with 75% of Scale MP-2020 for years after 2020.
- The retirement assumption was adjusted to partially reflect the observed experience and is no longer unisex.
- The termination assumption was changed from a sex distinct, service-based table to a flat 2.0% for all years.
- The disability assumption was eliminated.
- Changes in the UAAL due to actuarial gains/losses or assumption changes will be amortized as a level percentage of payroll, over closed 25-year periods, applied prospectively starting with the 2021 actuarial valuation.

The net impact on the current valuation results due to the adoption of the new set of actuarial assumptions and methods is summarized in the following table.

	Prior Assumptions	Current Assumptions	Difference
Actuarial Accrued Liability ($M)	$631.2	$626.3	$(4.9)
Actuarial Value of Assets ($M)	195.0	195.0	0.0
Unfunded Actuarial Accrued Liability ($M)	**$436.2**	**$431.3**	**$(4.9)**
Funded Ratio	30.9%	31.1%	0.2%
Normal Cost Rate	20.10%	20.57%	0.47%
UAAL Amortization Rate	42.59%	42.02%	(0.57%)
Actuarial Contribution Rate	62.69%	62.59%	(0.10%)
Member Contribution Rate	(2.43%)	(2.42%)	0.01%
Employer Contribution Rate	**60.26%**	**60.17%**	**(0.09%)**
Employer Contribution Amount ($M)	**$39.9**	**$39.9**	**$0.0**

Experience Impacting the June 30, 2021 Valuation

The actuarial valuation results provide a "snapshot" view of the System's financial condition on June 30, 2021. The unfunded actuarial accrued liability (UAAL) for Judges decreased from $444.1 million last year to $431.3 million this year and the funded ratio increased from 28.9% to 31.1%. In addition, the employer actuarial contribution rate decreased from 61.94% of pay last year to 60.17% of pay in this year's valuation, a decrease of 1.77% of pay. The key factors impacting the 2021 valuation results include:

- The net rate of return on the market value of assets for fiscal year 2021 was 26.4%, as reported by MOSERS. However, due to the use of an asset smoothing method, the rate of return on the actuarial value of assets was 8.0%, which was higher than the assumed return of 6.95%. As a result, there was an actuarial gain on assets of $2 million which lowered the unfunded actuarial accrued liability. The employer contribution rate decreased by 0.21% as a result of the asset gain.

- There was a net liability gain of $7 million for fiscal year 2021, i.e., the actuarial accrued liability was lower than expected. The main sources of gain were lower salary increases than expected for continuing active members and lower COLAs than assumed. The net liability gain decreased the UAAL and decreased the employer contribution rate by 0.75%.

- Because the benefit structure is different for judges hired after January 1, 2011, including an employee contribution rate of 4%, the ongoing cost of the System declines as a larger percentage of active members are covered by the 2011 benefit structure. The number of active members covered by the 2011 Plan increased from 235 in the 2020 valuation to 252 in the 2021 valuation, and the percentage of total active members in 2011 Plan increased from 56% to 60%. The normal cost rate decreased by 0.47% and the effective member contribution rate increased by 0.17% which both served to reduce the employer contribution rate.

As discussed above, the valuation results reflect net favorable experience for the past plan year which resulted in a lower UAAL that was expected. The changes to the actuarial assumptions and methods also reduced the UAAL and employer contribution rate. As a result, the key results in the June 30, 2021 valuation reflect a higher funded status and lower employer contribution rate.

A summary of the key results from the June 30, 2021 actuarial valuation, compared to the prior valuation, is shown in the following table. Further detail on the changes and actuarial experience affecting the valuation results can be found in the following sections of this Executive Summary.

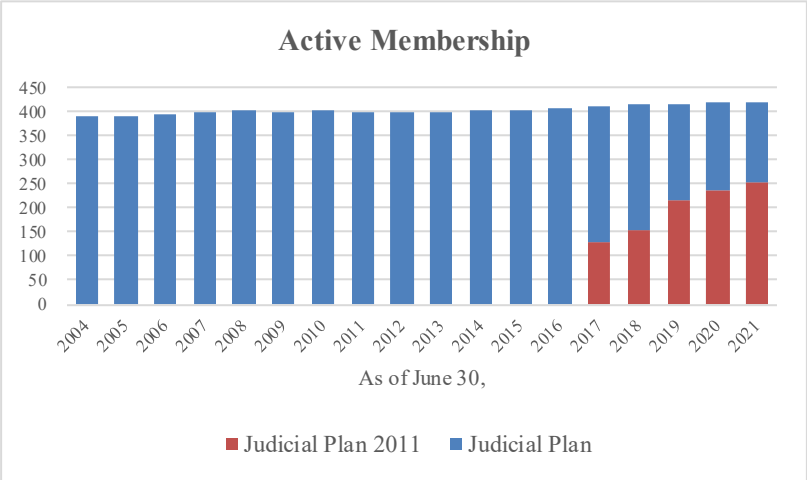
	June 30, 2021	June 30, 2020
Unfunded Actuarial Accrued Liability ($M)	$431.3	$444.1
Funded Ratio (Actuarial Assets)	31.1%	28.9%
Normal Cost Rate	20.57%	20.53%
UAAL Amortization Rate	42.02%	43.67%
Total Actuarial Required Contribution	62.59%	64.20%
Member Contribution Rate	(2.42%)	(2.26%)
Employer Contribution Rate	60.17%	61.94%

Experience for the Last Plan Year

Numerous factors contributed to the change in the Judges assets, liabilities, and actuarial required contribution rate between June 30, 2020 and June 30, 2021. The components are examined in the following discussion.

Membership

The number of active members in this valuation remains unchanged from the prior valuation (418 active members). As shown in the following graph, the active population has remained relatively steady over the past 17 years, which is typical for a statewide Judges system.



Note: Split between MSEP and MSEP 2011 is not available prior to June 30, 2017.

The percentage of active members covered by the Judicial 2011 Plan has increased over time as actives covered by the Judicial Plan leave the bench and are replaced by new judges. The number of active members covered by the Judicial 2011 Plan increased from 235 in the 2020 valuation (about 56% of the total active population) to 252 (about 60% of total active population) in the 2021 valuation. Because the benefit structure is different for the Judicial 2011 members, including an employee contribution rate of 4.0%, the ongoing cost of the System declines as a larger percentage of active members is covered by the Judicial 2011 Plan. As a result of the increase in the number of active members covered by the Judicial 2011 Plan, the effective member contribution rate increased 0.17% and the normal cost rate decreased by 0.47% (before the assumption changes). The combined impact (decline of 0.64% of covered payroll) was a significant factor in the decrease in the employer contribution rate.

As is expected in a mature retirement system, the number of members receiving benefits increased from 590 last year to 607 in the current valuation. In addition, the average benefit amount for this group increased (2.5%), which is to be expected.

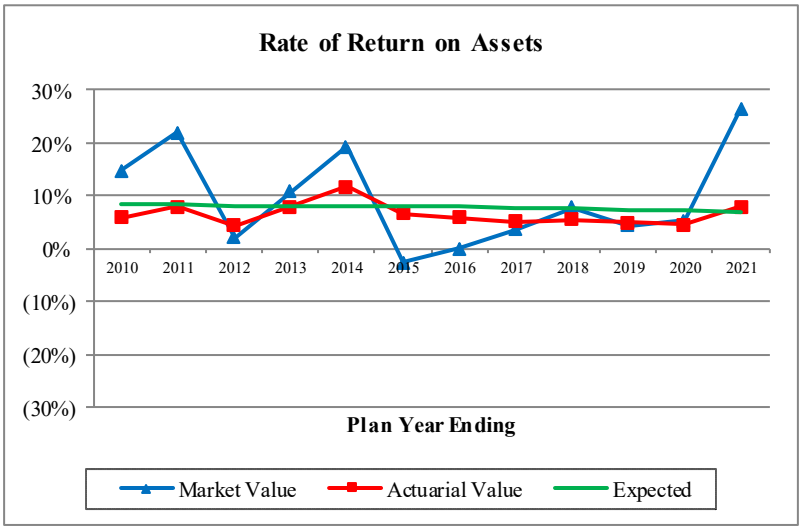
System Assets

As of June 30, 2021, Judges had net assets of $211.1 million, when measured on a market value basis, an increase of $43.8 million from the prior year value of $167.3 million. However, the market value of assets is not used directly in the calculation of the unfunded actuarial accrued liability and the employer actuarial contribution rate. An asset valuation method, which smoothes the effect of market fluctuations, is applied to determine the value of assets used in the valuation, called the actuarial value of assets. The current asset valuation method was first implemented in the June 30, 2018 actuarial valuation. Under this method, the difference between the dollar amount of the actual and assumed investment return on the market value of assets is recognized evenly over a closed five-year period. In addition, to transition from the prior to the new smoothing method, the total unrecognized investment experience as of June 30, 2017 ($11.9 million) was established on a schedule to evenly recognize the amount over a closed seven-year period beginning June 30, 2018.

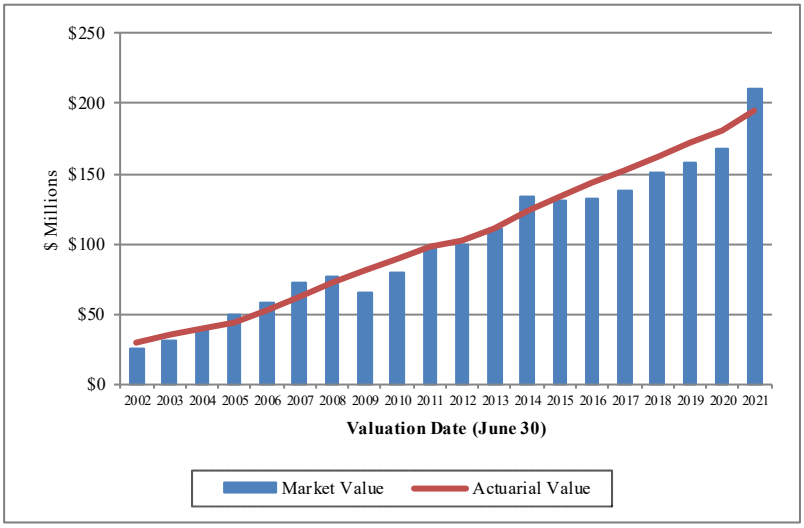
In the current valuation, the actuarial value of assets for Judges is $195.0 million, an increase of $14.3 million from the prior year. The components of change in the asset values are shown in the following table.

	Market Value ($M)		Actuarial Value ($M)	
Net Assets, June 30, 2020	$	167.29	$	180.71
- Employer and Member Contributions	+	41.44	+	41.44
- Benefit Payments	-	41.63	-	41.63
- Net Investment Income	+	44.06	+	14.55
- Administrative Expenses	-	0.08	-	0.08
Net Assets, June 30, 2021	$	211.08	$	194.99
Estimated Net Rate of Return		26.4%		8.0%

Due to the scheduled recognition of the current and prior investment experience in the asset smoothing method, the estimated rate of return on the actuarial value of assets for FY 2021 was 8.0%, which is higher than the assumed investment return of 6.95% during that period. As a result, there was an actuarial gain on the smoothed value of assets of $2.0 million. The investment return on the market value of assets for the year ending June 30, 2021 of 26.4%, as reported by MOSERS, was well above the assumed rate of return. As a result, it produced an investment income surplus for the year ended June 30, 2021 of $32.4 million. There is currently a net deferred investment gain of $16.1 million (market value of assets exceeds actuarial value). Please see Section 3 of this report for more detailed information on the market and actuarial value of assets.



The rate of return of the actuarial value of assets has been less volatile than the market value return, illustrating the benefit of using an asset smoothing method. However, during this period, the rate of return on actuarial assets has been at or below the assumed rate of return for most years, resulting in actuarial losses.



An asset smoothing method is used to mitigate the volatility in the market value of assets. By using a smoothing method, the actuarial (or smoothed) value can be, and actually should be, both above and below the pure market value.

Note the asset smoothing method changed with the 2018 valuation.

System Liabilities

The actuarial accrued liability is that portion of the present value of future benefits that will not be paid by future normal costs. The difference between this liability and the actuarial value of assets as of the valuation date is called the unfunded actuarial accrued liability. The dollar amount of the UAAL is reduced if the contributions to the System exceed the normal cost for the year plus interest on the prior year's UAAL.

Note that until 1999, the Judges Plan was funded on a pay-as-you-go basis so no advance funding occurred. Since that time the funding of the Plan has steadily increased, but the funded ratio is still very low and the amount of the UAAL is significant for a plan of this size. As the State continues to fund the Judges Plan, the funded ratio is expected to increase and eventually reach 100% if all actuarial assumptions are met in future years.

The UAAL, using both the actuarial and market value of assets, is shown as of June 30, 2021 in the following table:

	Actuarial Value of Assets	Market Value of Assets
Actuarial Accrued Liability	$626,284,219	$626,284,219
Value of Assets	194,988,153	211,081,342
Unfunded Actuarial Accrued Liability	$431,296,066	$415,202,877
Funded Ratio	31.13%	33.70%

See Section 4 of the report for the detailed development of the UAAL.

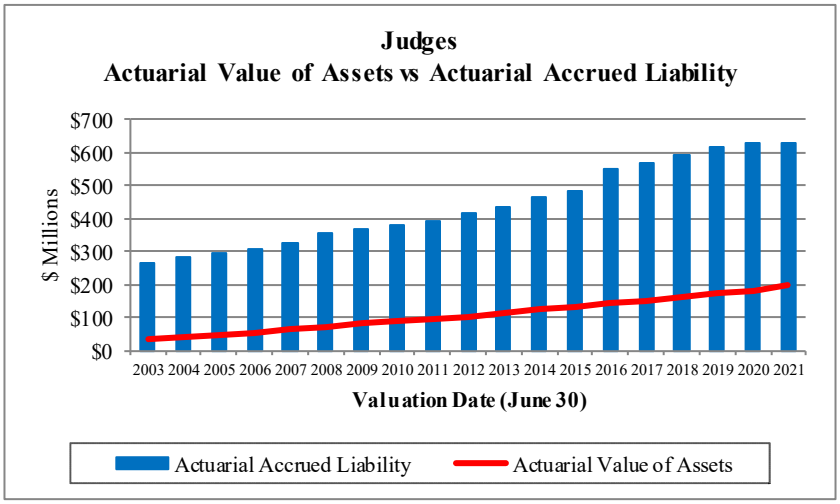
The net change in the UAAL from June 30, 2020 to June 30, 2021 was a decrease of $12.8 million. The components of this net change are shown in the following table:

	($ Millions)
Unfunded Actuarial Accrued Liability, June 30, 2020	$444.1
- Expected increase from amortization method	1.4
- Investment experience	(2.0)
- Liability experience	(6.9)
- Change to actuarial assumptions	(4.9)
- Other experience	(0.4)
Unfunded Actuarial Accrued Liability, June 30, 2021	$431.3

As shown above, various components impacted the dollar amount of the UAAL. The UAAL is amortized as a level-percent of payroll. This methodology results in dollar payment amounts that are lower in the early part of the amortization period but increase each year in the future with the assumed payroll growth assumption (currently 2.25%). Given the amortization period and the actuarial assumptions, the current amortization payment is less than the interest on the UAAL. As a result, even if all assumptions are met the dollar amount of the UAAL is expected to increase as evidenced in the first row in the table above.

Actuarial gains (losses), which result from actual experience that is more (less) favorable than anticipated based on the actuarial assumptions in place in the prior valuation, are reflected in the UAAL and are measured as the difference between the expected UAAL and the actual UAAL, taking into account any changes due to actuarial assumptions and methods, benefit provision changes or valuation programming changes. Overall, Judges experienced a net actuarial gain of $8.9 million, the combined result of an actuarial gain of $2.0 million on actuarial assets and a $6.9 million actuarial gain on System liabilities. The most significant sources of liability gain were lower cost-of-living adjustments than expected, based on the valuation assumptions, as well as lower salary increases than expected.

As the following graph of historical actuarial assets and actuarial accrued liabilities shows, due to the magnitude of the contributions to the Plan, the assets have been growing at a faster rate than the liabilities. As a result, the Plan's funded ratio has steadily improved over time.

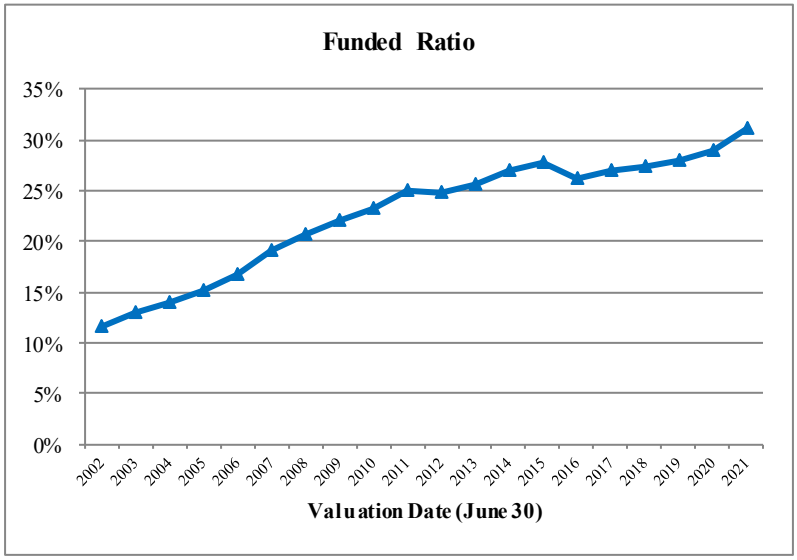


An evaluation of the UAAL on a pure dollar basis may not provide a complete analysis since only the difference between the assets and liabilities (which are both large numbers) is reflected. Another way to evaluate the UAAL and the progress made in its funding is to track the funded ratio, the ratio of the actuarial value of assets to the actuarial accrued liability. The funded status information, using both the actuarial value of assets and the market value of assets, is shown in the following table (in millions).

	6/30/2016	6/30/2017	6/30/2018	6/30/2019	6/30/2020	6/30/2021
Using Actuarial Value of Assets:						
- Funded Ratio	26.2%	26.9%	27.3%	27.9%	28.9%	31.1%
- UAAL ($M)	$404	$413	$432	$445	$444	$431
Using Market Value of Assets:						
- Funded Ratio	24.1%	24.4%	25.3%	25.6%	26.8%	33.7%
- UAAL ($M)	$416	$427	$444	$459	$458	$415

Note that the funded ratio does not indicate whether or not the System assets are sufficient to settle benefits earned to date. The funded ratio, by itself, also may not be indicative of future funding requirements. As shown in the table above, the funded ratios differ using the market value of assets.

The funded ratio over a longer period is shown in the following graph:



Typically plans that have been in existence as long as Judges (over 40 years) have a funded ratio well above the current level of 31%. However, until 1999, Judges was funded on a pay-as-you-go basis. As a result, each year's contribution was equal to the benefit payments and administrative expenses for that year only, i.e., the funded ratio was 0%. As a result of a change in funding policy that required contributions to equal the normal cost plus an amortization payment on the UAAL, the funded ratio has steadily increased over time. Assuming future experience follows the current actuarial assumptions, continued contributions under the current funding policy will allow the funded ratio to increase, until the UAAL is fully amortized in 2047, and the funded ratio reaches 100%.

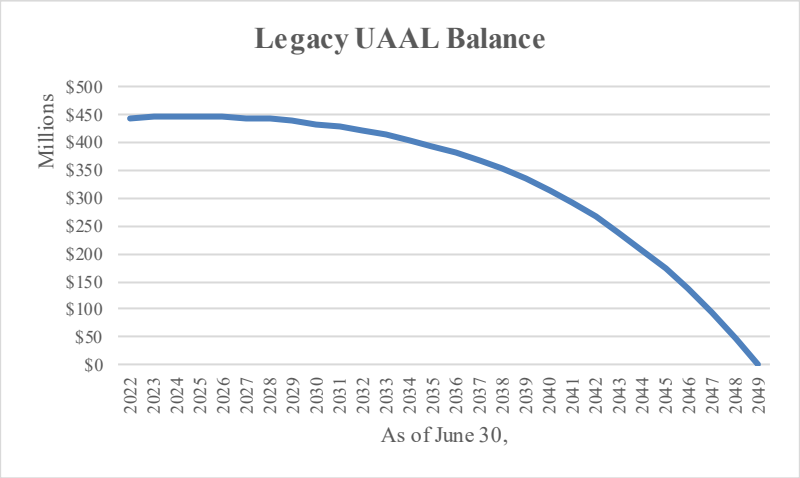
Actuarial Required Contribution Rate

The Plan is funded by contributions from employers (actuarially determined) and employees hired after December 31, 2010 (4.00% of pay). Under the Entry Age Normal cost method, the actuarial contribution rate consists of two components:

- A "normal cost" for the portion of projected liabilities allocated by the actuarial cost method to service of members during the year following the valuation date, which includes a component for administrative expenses.
- An "unfunded actuarial accrued liability contribution" for the excess of the portion of projected liabilities allocated to service to date over the actuarial value of assets.

Under the System's current funding policy, the UAAL contribution rate is determined by amortizing the UAAL using the layered amortization method. To implement this method, the projected UAAL developed in the June 30, 2018 valuation was amortized as a level-percent of payroll over a closed, 30-year period. Effective June 30, 2021, subsequent changes in the UAAL due to actuarial gains/losses or assumption changes are separately financed by establishing amortization bases and payments, as a level percentage of payroll, over closed 25-year periods. Bases established prior to June 30, 2021 will continue to be amortized on their original schedule. Any change in the System's benefit structure shall be amortized over a closed period of 20 years, as set out in state statutes. The total UAAL amortization payment is the sum of the payments for each of the amortization bases.

The level-percent of payroll methodology for UAAL payments results in dollar payment amounts that are lower than the level-dollar payment method in the early portion of the amortization period, but increase each year in the future with the assumed payroll growth assumption (currently 2.25%). Because the UAAL contribution rate is determined as a level-percent of payroll, the dollar amount of the UAAL contribution is scheduled to increase 2.25% each year in the future, even if all actuarial assumptions are met. If covered payroll increases, as expected based on the assumption, the contribution rate will remain stable. However, if actual payroll increases are lower than 2.25% the UAAL contribution rate will increase. Note that with this payment methodology the dollar amount of the legacy UAAL base is expected to hold steady for about six years before starting to decline as illustrated in the following graph:



See Section 5 of the report for the detailed development of the employer contribution rate, which is summarized in the following table:

Contribution Rates	June 30 Valuation* 2021	2020
1. Normal Cost Rate	20.57%	20.53%
2. UAAL Contribution Rate	42.02%	43.67%
3. Total Actuarial Required Contribution Rate	62.59%	64.20%
4. Member Contribution Rate	(2.42%)	(2.26%)
5. Employer Contribution Rate	60.17%	61.94%

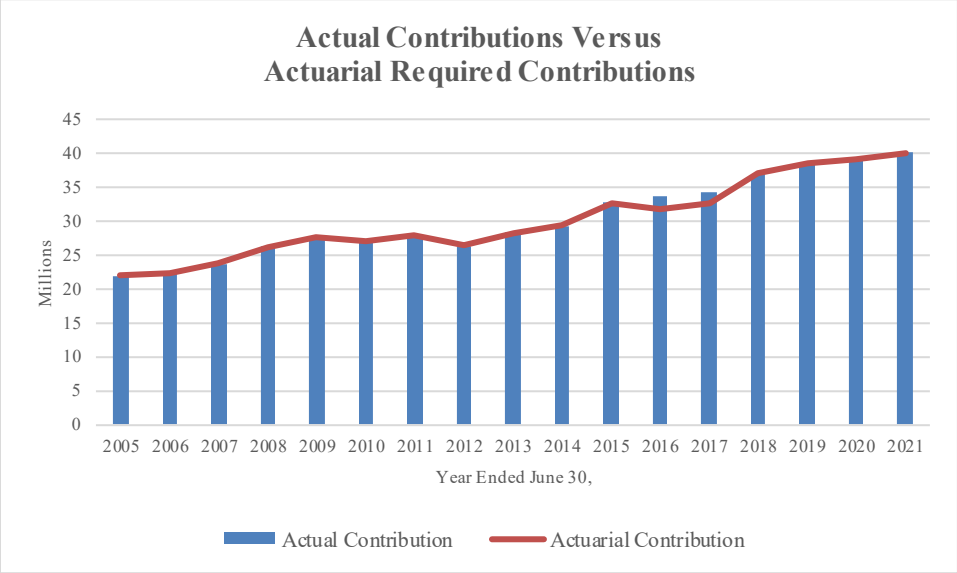
*Note different assumptions were used in the two valuation reports so results are not directly comparable.

The total actuarial required contribution rate in the June 30, 2021 valuation is 62.59%. The member contribution rate (as a percentage of total payroll) is anticipated to be 2.42%, resulting in an employer contribution rate for the fiscal year ending June 30, 2021 of 60.17%. This amount exceeds the minimum employer contribution of 58.45%, as required by the Funding Policy.

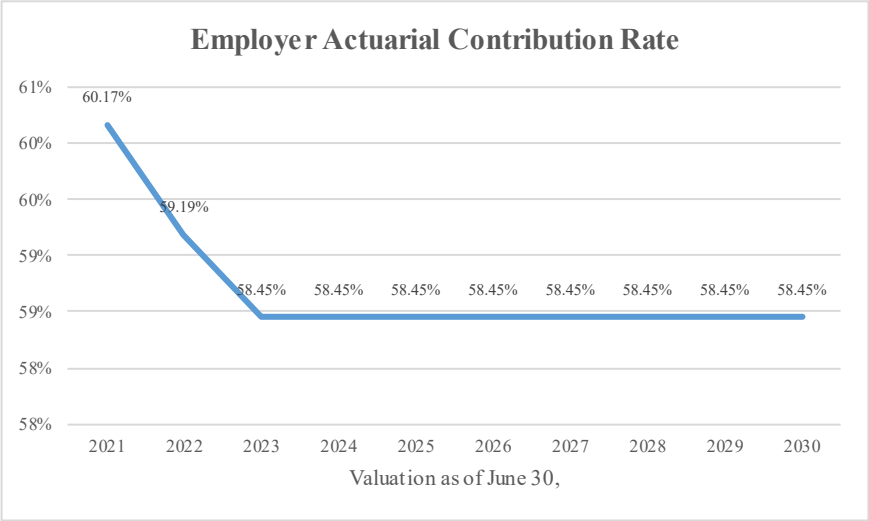
The following table shows the reconciliation of the Computed Employer Contribution Rate from June 30, 2020 to June 30, 2021 valuation:

	% of Payroll
6/30/2020 Computed Employer Contribution Rate	**61.94%**
Asset (Gain)/Loss	(0.21%)
Liability (Gain)/Loss	(0.75%)
Change to Actuarial Assumptions	(0.09%)
Projected Payroll Higher than Expected	(0.04%)
Change in Normal Cost Rate	(0.47%)
Change in Effective Member Contribution Rate	(0.17%)
Other Experience	(0.04%)
6/30/2021 Computed Employer Contribution Rate	**60.17%**

The state of Missouri has historically contributed the full actuarial contribution as shown in the graph below which compares the computed employer contribution rates and actual contribution amounts:



The computed employer contribution rate, which is determined based on the snapshot of the System taken on each valuation date, is anticipated to decrease over the short-term as the deferred investment experience is recognized through the asset smoothing method. Future experience (both investment and demographic), which is not modeled here, will also have an impact on the ultimate level of contributions for the Judges System. The following graph of the projected employer contribution rate over the next ten years reflects the impact of the recognition of the deferred investment experience ($16.1 million gain). Once the deferred investment experience is recognized, the actuarial required rate continues to decline as the normal cost rate decreases and the effective employee contribution rate increases due to more Judges 2011 members joining the System. As shown in the following graph, the minimum employer contribution rate of 58.45% is expected to impact the valuation results within the next two years, assuming all actuarial assumptions are met in the future. The minimum contribution rate will be in effect until the System reaches an 80% funded ratio.



The net deferred investment gain (difference between the market value and actuarial value of assets) is $16.1 million as of June 30, 2021. Absent unfavorable investment experience in future years, the deferred investment losses will eventually be reflected in the actuarial value of assets in future years. While the use of an asset smoothing method is a common procedure for public retirement systems, it is important to recognize the potential impact of the deferred investment experience. This is accomplished by comparing the key valuation results from the June 30, 2021 actuarial valuation using both the actuarial and market value of assets (see table below):

	Using Actuarial Value of Assets	Using Market Value of Assets
Actuarial Accrued Liability	$626,284,219	$626,284,219
Asset Value	(194,988,153)	(211,081,342)
Unfunded Actuarial Accrued Liability	$431,296,066	$415,202,877
Funded Ratio	31.1%	33.7%
Normal Cost Rate	20.57%	20.57%
UAAL Contribution Rate	42.02%	40.43%
Total Contribution Rate	62.59%	61.00%
Member Contribution Rate	(2.42%)	(2.42%)
Employer Contribution Rate	60.17%	58.58%

A typical retirement plan faces many different risks. The term "risk" is most commonly associated with an outcome with undesirable results. However, in the actuarial world risk can be translated as uncertainty. The actuarial valuation process uses many actuarial assumptions to project how future contributions and investment returns will meet the cash flow needs for future benefit payments. Of course, we know that actual experience will not unfold exactly as anticipated by the assumptions and that uncertainty, whether favorable or unfavorable, creates risk. Actuarial Standard of Practice Number 51 defines risk as the potential of actual future measurements to deviate from expected results due to actual experience that is different than the actuarial assumptions. Risk evaluation is an important part of managing a defined benefit plan. Please see Section 7 of this report for an in-depth discussion of the specific risks facing MOSERS.

As we prepare this report, the world is recovering from the COVID-19 pandemic. We have considered available information, but do not believe there is sufficient data yet to warrant the modification of any of our assumptions. We will continue to monitor the situation and advise the Board in the future of any adjustment we believe would be appropriate.

The next page contains a comprehensive summary of valuation results for the current and prior year. Detailed exhibits deriving the results are in the following sections.

SUMMARY OF PRINCIPAL RESULTS
($ in millions)

Valuation Date Contribution for Fiscal Year Ending	June 30, 2021 June 30, 2023	June 30, 2020 June 30, 2022	% Change
Computed Employer Contribution			
Annual Amount (Estimated)	$39.9	$40.1	(0.5%)
Percentage of Covered Payroll	60.17%	61.94%	(2.9%)
Projected Payroll for FYE 2023 and 2022	$66.4	$64.8	2.5%
Benefit Payments During Prior Year	$41.6	$39.6	5.1%
Membership			
Number of			
- Active Members	418	418	0.0%
- Retirees and Beneficiaries	607	590	2.9%
- Terminated Vested Members	27	35	(22.9%)
- Leave-of-Absence Members	0	0	0.0%
- Long Term Disability Members	0	0	0.0%
- Total	1,052	1,043	0.9%
- Reported Payroll	$63.0	$61.5	2.4%
Assets			
Market Value (MVA)	$211.1	$167.3	26.2%
Actuarial Value (AVA)	$195.0	$180.7	7.9%
Ratio - Actuarial Value to Market Value	92%	108%	
Return on Market Value*	26.4%	5.2%	
Return on Actuarial Value	8.0%	4.5%	
Actuarial Information			
Actuarial Accrued Liability (AAL)	$626.3	$624.8	0.2%
Unfunded Actuarial Accrued Liability (UAAL)	$431.3	$444.1	(2.9%)
Funded Ratio (Actuarial Value of Assets)	31.1%	28.9%	7.6%
Ratio of AVA to Reported Payroll	3.1	2.9	
Ratio of AAL to Reported Payroll	9.9	10.2	
Normal Cost Rate	20.57%	20.53%	0.2%
UAAL Contribution Rate	42.02%	43.67%	(3.8%)
Total Contribution Rate	62.59%	64.20%	(2.5%)
Member Contribution Rate	(2.42%)	(2.26%)	7.1%
Employer Contribution Rate	60.17%	61.94%	(2.9%)

* As reported by MOSERS.

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This report presents the actuarial valuation results of the Missouri State Employees' Retirement System – Judges as of June 30, 2021. This valuation was prepared at the request of the MOSERS Board.

Please pay particular attention to our actuarial certification letter, where the guidelines employed in the preparation of this report are outlined. We also comment on the sources and reliability of both the data and the actuarial assumptions upon which our findings are based. Those comments are the basis for our certification that this report is complete and accurate to the best of our knowledge and belief.

A summary of the findings which result from this valuation is presented in the previous section. Section 3 describes the assets and investment experience of the System. Sections 4 and 5 describe how the obligations of the System are to be met under the System's funding policy. Section 6 contains projections of future valuation results, assuming all actuarial assumptions are met. Section 7 discloses key maturity measurements and discusses the key risks facing the funding of the System. Section 8 includes some historical funding information that was required by the Governmental Accounting Standards Board (GASB) in the past.

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In many respects, an actuarial valuation can be thought of as an inventory process. The inventory is taken as of the actuarial valuation date, which for this valuation is June 30, 2021. On that date, the assets available for the payment of benefits are appraised. The assets are compared with the liabilities of the System, which are generally in excess of assets. The actuarial process then leads to a method of determining the contributions needed by members and the employer in the future to balance the System assets and liabilities.

Market Value of Assets

The current market value represents the "snapshot" or "cash-out" value of System assets as of the valuation date. In addition, the market value of assets provides a basis for measuring investment performance from time to time. Table 1 shows a summary of changes to both the market and the actuarial value assets for the year beginning June 30, 2020 and ending June 30, 2021.

Actuarial Value of Assets

Neither the market value of assets, representing a "cash-out" value of System assets, nor the book values of assets, representing the cost of investments, may be the best measure of the System's ongoing ability to meet its obligations.

To arrive at a suitable value of assets for the actuarial valuation, a technique for determining the actuarial value of assets is used which dampens swings in the market value while still indirectly recognizing market values.

Table 2 shows the development of the actuarial value of assets (AVA) as of the valuation date.

TABLE 1
ASSET SUMMARY

	Judges	
	Market Value	Actuarial Value
1. Assets at June 30, 2020	167,288,066	180,713,310
2. Contributions		
State Contributions	39,996,509	39,996,509
Employee Contributions	1,448,428	1,448,428
Member Purchases of Service Credit	0	0
Total	41,444,937	41,444,937
3. Investment Income, Net of Investment Expenses	44,049,707	14,531,274
4. Benefit Payments		
Monthly Benefit Payments	41,542,760	41,542,760
Inactive Vested Lump Sum Payments	82,786	82,786
Contribution Refunds	0	0
Total	41,625,546	41,625,546
5. Administrative and Misc. Expenses	75,822	75,822
6. Assets at June 30, 2021 (1) + (2) + (3) - (4) - (5)	211,081,342	194,988,153
7. Rate of Return, Net of Investment Expenses*	26.4%	8.0%

* Based on the approximation formula: (2 x I) / (A+B-I), where
I = Investment Increment
A = Beginning of year asset value
B = End of year asset value

Market value return reported by MOSERS

TABLE 2
DEVELOPMENT OF ACTUARIAL VALUE OF ASSETS

Under the current asset smoothing method, the difference between the actual and assumed investment return on the market value of assets will be recognized evenly over a closed five-year period. The method was first implemented with the June 30, 2018 valuation. Deferred asset experience as of June 30, 2017 will be recognized evenly over a closed seven-year period, beginning June 30, 2018.

Fiscal Year End June 30,	2018	2019	2020	2021
A. Market Value of Assets, Beginning of Year	$ 137,566,230	$ 150,199,575	$ 158,332,990	$ 167,288,066
B. Contributions During Year	37,794,522	39,742,769	40,489,085	41,444,937
C. Benefit Payments and Expenses During Year	35,838,843	37,665,190	39,696,718	41,701,368
D. Expected Rate of Return	7.50%	7.25%	7.10%	6.95%
E. Expected Net Investment Income	10,389,479	10,963,464	11,269,289	11,617,759
F. Expected Market Value of Assets, End of Year	149,911,388	163,240,618	170,394,646	178,649,394
G. Market Value of Assets, End of Year	150,199,575	158,332,990	167,288,066	211,081,342
H. Excess/(Shortfall) of Net Investment Income	$ 288,187	$ (4,907,628)	$ (3,106,580)	$ 32,431,948

The table below shows the development of gain/(loss) to be recognized in the current year:

Plan Year Ended	Asset Gain/(Loss)	Gain/(Loss) Recognized in Prior Years	Gain/(Loss) Recognized This Year		Gain/(Loss) Deferred to Future Years
6/30/2017	(14,193,690)	(6,083,010)	(2,027,670)	*	(6,083,010)
6/30/2018	288,187	172,911	57,637		57,639
6/30/2019	(4,907,628)	(1,963,052)	(981,526)		(1,963,050)
6/30/2020	(3,106,580)	(621,316)	(621,316)		(1,863,948)
6/30/2021	32,431,948	0	6,486,390		25,945,558
Total	10,512,237	(8,494,467)	2,913,515		16,093,189

A. Market Value of Assets as of June 30, 2021	$	211,081,342
B. Total Deferred Investment Experience	$	16,093,189
C. Actuarial Value of Assets as of June 30, 2021 (A. - B.)	$	194,988,153
D. Ratio of Actuarial Value to Market Value		92.4%

* The unrecognized investment experience as of June 30, 2017 will be recognized over a closed seven-year period.

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In the previous section, an analysis of System's current assets was given as of June 30, 2021. In this section, the discussion will focus on the commitments (future benefit payments) of the System, which are referred to as its liabilities.

Table 3 contains an analysis of the actuarial present value of all future benefits (PVFB) for contributing members, inactive members, retirees and their beneficiaries. The liabilities summarized in Table 3 include the actuarial present value of all future benefits expected to be paid with respect to each member. For an active member, this value includes measures of both benefits already earned and future benefits expected to be earned. For all members, active and retired, the value extends over benefits earnable and payable for the rest of their lives and, if an optional benefit is chosen, for the lives of their surviving spouses.

The actuarial assumptions used to determine liabilities are based on the results of the latest experience study. These assumptions are outlined in Appendix C.

The Board's funding policy amortizes the UAAL using a "layered" bases method. Under this method, the "Legacy UAAL", as determined in the June 30, 2018 valuation, is amortized over a closed 30-year period (see Table 4). Effective June 30, 2021, subsequent changes in the UAAL due to actuarial gains/losses or assumption changes are separately financed by establishing amortization bases and payments, as a level percentage of payroll, over closed 25-year periods. Bases established prior to June 30, 2021 will continue to be amortized on their original schedule. Any change in the System's benefit structure shall be amortized over a closed period of 20 years, as set out in state statutes. The total UAAL amortization payment is the sum of the payments for each of the amortization bases. Note that the use of closed amortization periods will result in the System being fully funded at the end of the amortization period, if all actuarial assumptions are met.

All liabilities reflect the benefit provisions in place as of June 30, 2021, as amended by any legislation in the 2021 Legislative Session.

Actuarial Accrued Liability

A fundamental principle in financing the liabilities of a retirement program is that the cost of its benefits should be related to the period in which benefits are earned, rather than to the period of benefit distribution. An actuarial cost method is a mathematical technique that allocates the present value of future benefits into annual costs. In order to do this allocation, it is necessary for the funding method to "breakdown" the present value of future benefits into two components:

(1) that which is attributable to the past and
(2) that which is attributable to the future.

Actuarial terminology calls the part attributable to the past the "past service liability" or the "actuarial accrued liability." The portion allocated to the future is known as the present value of future normal costs, with the specific piece of it allocated to the current year being called the "normal cost." Table 5 contains the actuarial balance sheet for the System. The Entry Age Normal actuarial cost method is used to develop the actuarial accrued liability. Table 6 shows the gain/(loss) analysis in total for the System.

TABLE 3
UNFUNDED ACTUARIAL ACCRUED LIABILITY
As of June 30, 2021

	(1) Actuarial Present Value	(2) Present Value of Future Normal Cost Contributions	(3) = (1) - (2) Actuarial Accrued Liabilities
Active Members			
Service retirement benefits based on service rendered before and likely to be rendered after valuation date	$253,705,742	$78,533,391	$175,172,351
Disability benefits likely to be paid to present active members who become totally and permanently disabled	0	0	0
Survivor benefits likely to be paid to widows and children of present active members who die before retiring	4,523,749	3,279,523	1,244,226
Separation benefits likely to be paid to present active members	15,415,657	14,397,266	1,018,391
Active Member Totals	$273,645,148	$96,210,180	$177,434,968
Members on Leave of Absence & LTD Service retirement benefits based on service rendered before the valuation date			0
Terminated Vested Members Service retirement benefits based on service rendered before the valuation date			10,311,392
Retired Lives			438,537,859
Total Actuarial Accrued Liability			$626,284,219
Actuarial Value of Assets			194,988,153
Unfunded Actuarial Accrued Liability			$431,296,066
Funded Ratio			31.1%

TABLE 4
AMORTIZATION SCHEDULE FOR LEGACY UAAL

This amortization schedule for the outstanding balance of the legacy UAAL as of June 30, 2022 reflects the underlying assumptions used in this valuation including an investment return assumption of 6.95% and the assumed payroll growth of 2.25%. Any change in these assumptions in the future, will impact the amortization schedule for the legacy UAAL.

As of June 30	Outstanding Balance (BOY)	Amortization Years Remaining	Contributions ($M)
2022	444	27	29
2023	445	26	29
2024	446	25	30
2025	446	24	31
2026	445	23	31
2027	443	22	32
2028	441	21	33
2029	438	20	34
2030	434	19	34
2031	428	18	35
2032	422	17	36
2033	414	16	37
2034	405	15	38
2035	394	14	38
2036	382	13	39
2037	368	12	40
2038	352	11	41
2039	334	10	42
2040	314	9	43
2041	291	8	44
2042	266	7	45
2043	238	6	46
2044	207	5	47
2045	173	4	48
2046	136	3	49
2047	95	2	50
2048	50	1	51
2049	0	0	0

TABLE 5
ACTUARIAL BALANCE SHEET

ASSETS			
Actuarial Value of Assets		$	194,988,153
Unfunded Actuarial Accrued Liability			431,296,066
Present Value of Future Normal Costs			96,210,180
Total Assets		$	722,494,399
LIABILITIES			
Present Value of Future Benefits			
Active members			
Retirement	$ 253,705,742		
Withdrawal	15,415,657		
Death	4,523,749		
Disability	0		
Total		$	273,645,148
Inactive members			
Currently receiving benefits	438,537,859		
Not currently receiving benefits	10,311,392		
Total		$	448,849,251
Total Liabilities		$	722,494,399

TABLE 6
ANALYSIS OF GAIN/(LOSS)

	(1) Actuarial Accrued Liabilities	(2) Valuation Assets	(3) = (1) - (2) UAAL
(1) Value at start of year	$ 624,847,011	$ 180,713,310	$ 444,133,701
(2) Total normal cost from last valuation	12,036,133	0	12,036,133
(3) Actual contributions (Employer and Member)	0	41,444,937	(41,444,937)
(4) Benefit payments	(41,625,546)	(41,625,546)	0
(5) Administrative expenses	0	(75,822)	75,822
(6) Interest on (1), (2), (3), (4) and (5) at 6.95%	42,841,186	12,550,814	30,290,372
(7) Expected value before changes	$ 638,098,784	$ 193,007,693	$ 445,091,091
(8) Change in actuarial assumptions	(4,928,456)	0	(4,928,456)
(9) Expected value after changes: (7) + (8)	$ 633,170,328	$ 193,007,693	$ 440,162,635
(10) Actual value at end of year	626,284,219	194,988,153	431,296,066
(11) Gain / (Loss)	$ 6,886,109	$ 1,980,460	$ 8,866,569
(12) Gain / (Loss) as percent of expected actuarial accrued liabilities: $638,098,784	1.1%	0.3%	1.4%

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The previous two sections were devoted to a discussion of the Judges' assets and liabilities. Table 5 indicates that current assets fall short of meeting the present value of future benefits (total liability). This is expected in all but a completely closed fund, where no further contributions are anticipated. In an active system, there will almost always be a difference between the actuarial value of assets and total liabilities. This deficiency has to be made up by future contributions and investment returns. An actuarial valuation sets out a schedule of future contributions that will fund this deficiency in an orderly fashion.

The method used to determine the incidence of the contributions in various years is called the actuarial cost method. Under an actuarial cost method, the contributions required to meet the difference between current assets and current liabilities are allocated each year between two elements: (1) the normal cost rate and (2) the unfunded actuarial accrued liability contribution rate.

The term "fully funded" is often applied to a system in which contributions at the normal cost rate are sufficient to pay for the benefits of existing employees as well as for those of new employees. More often than not, systems are not fully funded, either because of past benefit improvements that have not been completely funded or because of actuarial deficiencies that have occurred because experience has not been as favorable as anticipated by the actuarial assumptions. Under these circumstances, an unfunded actuarial accrued liability (UAAL) exists. Likewise, when the actuarial value of assets is greater than the actuarial accrued liability, a surplus exists.

Description of Contribution Rate Components

The Entry Age Normal (EAN) actuarial cost method is used for the valuation. Under that method, the normal cost for each year from entry age to assumed exit age is a constant percentage of the member's year by year projected compensation. The portion of the present value of future benefits not provided by the present value of future normal costs is the actuarial accrued liability. The unfunded actuarial accrued liability represents the difference between the actuarial accrued liability and the actuarial value of assets as of the valuation date. The unfunded actuarial accrued liability is calculated each year and reflects experience gains and losses.

In general, contributions are computed in accordance with a level percent-of-payroll funding objective. The contribution rate based on the June 30, 2021 actuarial valuation will be used to determine the actuarial employer contribution rate for the plan year ending June 30, 2023. In this context, the term "contribution rate" means the percentage, which is applied to the active member payroll to determine the actual employer contribution amount (i.e., in dollars) for the group.

Contribution Rate Summary

Table 7 shows the development of the June 30, 2022 projected UAAL. In Table 8, the amortization payment related to the UAAL is developed. Table 9 develops the computed employer contribution rate for the Plan and the estimated amount of required State contributions. Table 10 shows estimated contribution amounts if the employer contributions are paid early on July 15, September 1 or November 1. Amounts are shown for both the UAAL payment only and the total employer contribution.

The contribution rates shown in this report are based on the actuarial assumptions and cost methods described in Appendix C.

TABLE 7
PROJECTED UAAL AS OF JUNE 30, 2022

(1) Unfunded Actuarial Accrued Liability at June 30, 2021	$431,296,066
(2) Expected Contribution Rate for Year Ending June 30, 2022*	64.20%
(3) Normal Cost Rate for Year Ending June 30, 2022	20.57%
(4) Contribution Rate Applied to UAAL [(2) - (3)]	43.63%
(5) Projected Payroll for the Year After the Valuation Date	$64,922,448
(6) Expected UAAL Contribution [(4) * (5)]	$28,325,664
(7) Interest on (1) and (6) to June 30, 2022 at 6.95%	$29,007,293
(8) Projected UAAL at June 30, 2022 [(1) - (6) + (7)]	$431,977,695

*The Total Contribution Rate was the employer rate of 61.94% plus the weighted average member rate of 2.26% of payroll.

TABLE 8
UAAL CONTRIBUTION RATE

Amortization Base	Original Amount	Remaining Payments	Projected June 30, 2022 Balance	Annual Payment*
2018 Legacy UAAL	$ 435,941,756	27	$ 444,055,751	$ 28,714,715
2019 Assumption Changes	5,024,057	28	5,084,983	322,820
2019 Experience Base	3,858,637	28	3,905,430	247,936
2020 Assumption Changes	6,341,771	29	6,379,898	398,084
2020 Experience Base	(12,097,127)	29	(12,169,855)	(759,358)
2021 Assumption Changes	(4,928,456)	25	(4,928,456)	(331,895)
2021 Experience Base	$ (10,350,056)	25	(10,350,056)	(697,000)
Total			**$ 431,977,695**	**$ 27,895,302**

* Payment amount reflects mid-year timing.

1. Total UAAL Amortization Payments	$	27,895,302
2. Expected Payroll for FYE 2023	$	66,383,203
3. UAAL Amortization Payment Rate (1) / (2)		42.02%

TABLE 9
COMPUTED EMPLOYER CONTRIBUTION RATE FOR THE FISCAL YEAR ENDING JUNE 30, 2023

ACTUARIAL VALUATION RESULTS AS OF JUNE 30, 2021

	Percent of Payroll		
	Pre 1/1/2011 Hires	Post 1/1/2011 Hires	Weighted Average
A. Normal Cost			
(1) Service retirement benefits	16.64 %	17.30 %	17.04 %
(2) Termination benefits	3.34	2.33	2.73
(3) Survivor benefits	0.62	0.72	0.68
(4) Disability benefits	0.00	0.00	0.00
(5) Administrative expenses	0.12	0.12	0.12
(6) Total	20.72	20.47	20.57
B. Less Member Contributions	0.00	4.00	2.42
C. Employer Normal Cost [A(6) - B]	20.72	16.47	18.15
D. Unfunded Actuarial Accrued Liabilities (UAAL) (level percent-of-payroll amortization with layered bases)			42.02
E. TOTAL COMPUTED EMPLOYER CONTRIBUTION RATE [C. + D.]			**60.17 %**
F. POLICY MINIMUM EMPLOYER CONTRIBUTION RATE			**58.45 %**
G. ESTIMATED EMPLOYER CONTRIBUTION ($Millions) #			**$39.9**

At the September 18, 2014 meeting, the Board adopted a policy minimum contribution rate so that the employer contribution rate shall not fall below the fiscal 2015 rate (58.45% of payroll) until the plan is 80% funded.

Illustrative only. Estimated employer contribution amounts (shown in millions) are based on the greater of the Total Computed Employer Contribution Rate and the Policy Minimum Contribution Rate shown and the valuation payroll projected two years to the applicable fiscal year using the valuation assumption of 2.25% per year.

TABLE 10
EARLY PAYMENT AMOUNTS FOR FISCAL YEAR 2023

Section 104.436, RSMo. describes the certified contribution rate the employer shall pay in accordance with its ordinary course payrolls during each fiscal year. Per a Board Rule adopted during 2020, the employer may elect to pre-pay the amount for the unfunded actuarial accrued liability (UAAL) only or the total contribution which also includes the normal cost rate, on July 15, September 1, or November 1. At the end of the fiscal year, actual payroll will be compared to assumed payroll and an adjustment will be made to the total contributions paid, in either an additional amount paid by the employer or a credit to reduce future payments.

This exhibit is for informational purposes only and all payment amounts should be confirmed with MOSERS. Payment amounts are adjusted to payment dates using the assumed rate of return (6.95%) used in the actuarial funding valuation and assuming all scheduled payments are made prior to the one-time payment date.

	Expected Payroll for FY 2023	Total FY 2023 Payments	FY 2023 Contribution Rate	One-Time Payment, Adjusted for Expected Payroll Contributions to Date: July 15*	September 1**	November 1***	Additional Payroll Contributions
UAAL Payment Only	66,383,203	27,895,302	42.02%	27,049,332	22,731,228	18,389,772	18.15%
Full Employer Contribution	66,383,203	39,942,773	60.17%	38,731,444	32,548,429	26,331,978	0.00%

* One-time payment is for fiscal year payments and assumes no other contributions during the fiscal year have been made.
** Fiscal year payments are assumed to be made for all of July and August, in addition to the one-time payment.
*** Fiscal year payments are assumed to be made for all of July, August, September, and October, in addition to the one-time payment.

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The June 30, 2021 valuation results present the System's financial status at a single point in time and contribution requirements for a single fiscal year. Historical valuation results allow analysis of past trends, but no insight into future trends. A projection model provides insight into the longer term trend of (1) the projected Employer contributions; (2) the projected System funded status (ratio of actuarial assets over liabilities); (3) net cash flow patterns; and (4) the unfunded actuarial accrued liability (actuarial accrued liability minus actuarial assets). Projections can also be used to demonstrate how sensitive the valuation results are to the key variables being modeled. Such sensitivity analysis can be found in Section 7 of this report.

For Judges, projections are particularly important and insightful due to the multiple-tiered benefit structure. The current valuation produces a normal cost and actuarial accrued liability based on the composition of active members on the valuation date, June 30, 2021. Without a tiered structure, systems can assume that the normal cost, as a percentage of payroll, will remain relatively level. However, since all new employees are covered under a less costly benefit structure, until all new employees are covered under the post-2010 benefit structure, the normal cost percentage will continue to decrease. In addition, members hired after 2010 are the only group making employee contributions so projections allow for the projected payroll to be segregated by tier so that total future contributions reflect an estimate of the amounts to be contributed by employees.

The member data (active and in-pay status) is projected for each year in the future using current assumptions. After the first year, a new-member profile is used to estimate the demographics of new employees replacing members who are projected to terminate, retire, die or become disabled in future years. ***For this modeling, the number of active members is assumed to remain level over the projection period.***

These projections in this section assume that all actuarial assumptions are met in all future years, including the investment return assumption, and that the Employer makes contributions equal to the full amount of the actuarially determined contribution, as calculated by the valuation, based on the Board's Funding Policy. The projections are based on the current plan provisions and assume that all new members joining after June 30, 2021 will make employee contributions and participate in the post-2010 benefit structure.

The projections do not predict the System's financial condition or its ability to pay benefits in the future and do not provide any guarantee of future financial soundness of the System nor do they, on their own, indicate future funding requirements. Over time, a defined benefit plan's total cost will depend on a number of factors, including the amount of benefits paid, the number of people paid benefits, plan expenses and the amount of earnings on assets invested to pay benefits. These amounts, and other variables, are uncertain and unknowable at the time the projections were prepared. Because not all of the assumptions will unfold exactly as expected, actual results will differ from the projections shown.

TABLE 11
PROJECTION OF FUTURE ACTUARIAL VALUATION RESULTS
AS OF JUNE 30, 2021

Projection Based on Assumptions Outlined in Appendix D
(Amounts in thousands)

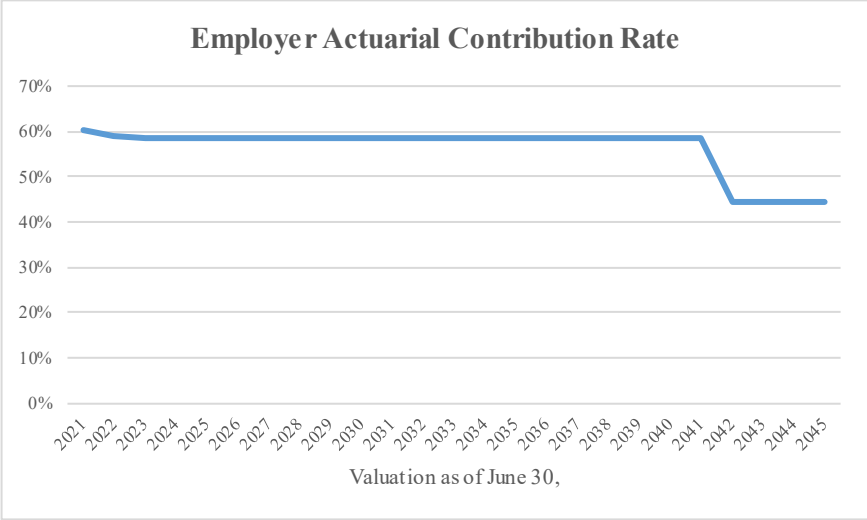
Valuation as of June 30, (1)	Covered Payroll at Valuation (2)	Actuarial Accrued Liability (AAL) (3)	Actuarial Value of Assets (AVA) (4)	Unfunded AAL (5)	Funded Ratio Using AVA (6)	Normal Cost Rate (7)	UAAL Amortization Payment Rate (8)	Actuarial Contribution Rate (9)	Member Contribution Rate (10)	Employer Actuarial Contribution Rate* (11)	Estimated Dollar Amount of Employer Contribution** (12)
2021	$64,922	$626,284	$194,988	$431,296	31.1%	20.57%	42.02%	62.59%	2.42%	60.17%	$40,042
2022	66,548	638,498	210,871	427,627	33.0%	20.36%	41.44%	61.80%	2.61%	59.19%	40,349
2023	68,169	649,788	225,739	424,049	34.7%	20.22%	40.91%	61.13%	2.80%	58.45%	40,761
2024	69,737	659,740	240,723	419,017	36.5%	20.17%	40.35%	60.52%	2.96%	58.45%	41,802
2025	71,517	669,675	258,536	411,139	38.6%	20.10%	39.43%	59.53%	3.10%	58.45%	42,841
2026	73,295	678,964	270,364	408,600	39.8%	20.03%	39.14%	59.17%	3.22%	58.45%	43,921
2027	75,143	687,937	282,968	404,969	41.1%	19.79%	38.79%	58.58%	3.32%	58.45%	44,973
2028	76,943	695,855	296,094	399,762	42.6%	19.76%	38.44%	58.20%	3.42%	58.45%	46,080
2029	78,837	703,767	310,258	393,509	44.1%	19.58%	38.04%	57.62%	3.50%	58.45%	47,206
2030	80,763	711,082	325,424	385,657	45.8%	19.53%	37.60%	57.13%	3.58%	58.45%	48,339
2031	82,701	718,105	341,815	376,290	47.6%	19.37%	37.13%	56.50%	3.64%	58.45%	49,444
2032	84,591	724,359	359,259	365,101	49.6%	19.29%	36.66%	55.95%	3.69%	58.45%	50,623
2033	86,608	730,584	378,276	352,308	51.8%	19.34%	36.13%	55.47%	3.75%	58.45%	51,822
2034	88,660	736,852	399,151	337,702	54.2%	19.32%	35.57%	54.89%	3.80%	58.45%	53,074
2035	90,803	743,113	422,104	321,010	56.8%	19.34%	34.94%	54.28%	3.84%	58.45%	54,397
2036	93,066	749,873	447,634	302,240	59.7%	19.34%	34.25%	53.59%	3.87%	58.45%	55,706
2037	95,305	757,030	475,938	281,093	62.9%	19.37%	33.54%	52.91%	3.91%	58.45%	57,075
2038	97,647	764,634	507,139	257,495	66.3%	19.39%	32.76%	52.15%	3.94%	58.45%	58,482
2039	100,055	772,705	541,538	231,167	70.1%	19.43%	31.94%	51.37%	3.96%	58.45%	59,871
2040	102,431	780,933	579,143	201,790	74.2%	19.44%	31.08%	50.52%	3.97%	58.45%	61,311
2041	104,895	789,707	620,373	169,334	78.6%	19.45%	30.15%	49.60%	3.98%	58.45%	62,820
2042	107,476	799,132	665,567	133,564	83.3%	19.45%	29.15%	48.60%	3.99%	44.61%	49,161
2043	110,203	809,557	715,327	94,230	88.4%	19.48%	29.01%	48.49%	3.99%	44.50%	50,239
2044	112,896	820,540	753,955	66,585	91.9%	19.49%	28.89%	48.38%	4.00%	44.38%	51,340
2045	115,682	832,425	796,050	36,374	95.6%	19.51%	28.77%	48.28%	4.00%	44.28%	52,500

* Reflects Policy Minimum Contribution Rate, if applicable.
** Amounts shown are contributions in the fiscal year ending two years after the valuation date.

Note: Projections also assume the active population remains constant over the projection period and all actuarial assumptions are met in the future.

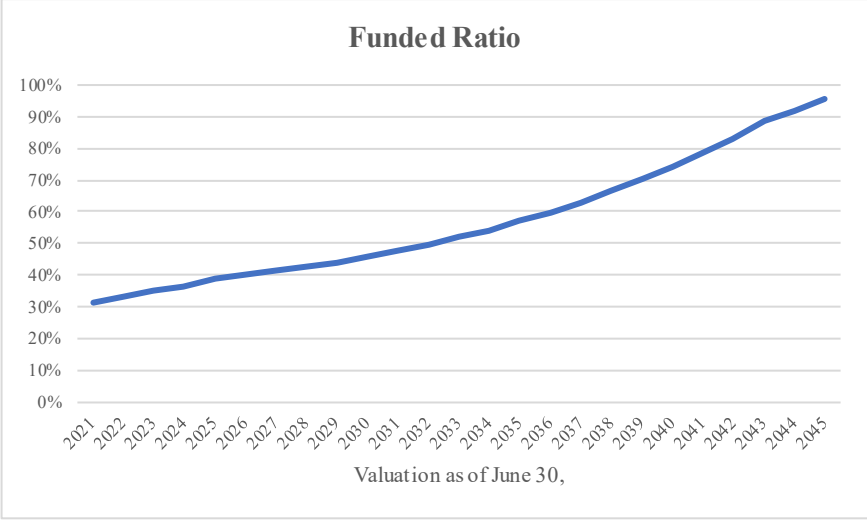
TABLE 11
PROJECTION OF FUTURE ACTUARIAL VALUATION RESULTS
AS OF JUNE 30, 2021

(continued)



Note: Reflects Policy Minimum Contribution Rate, if applicable.

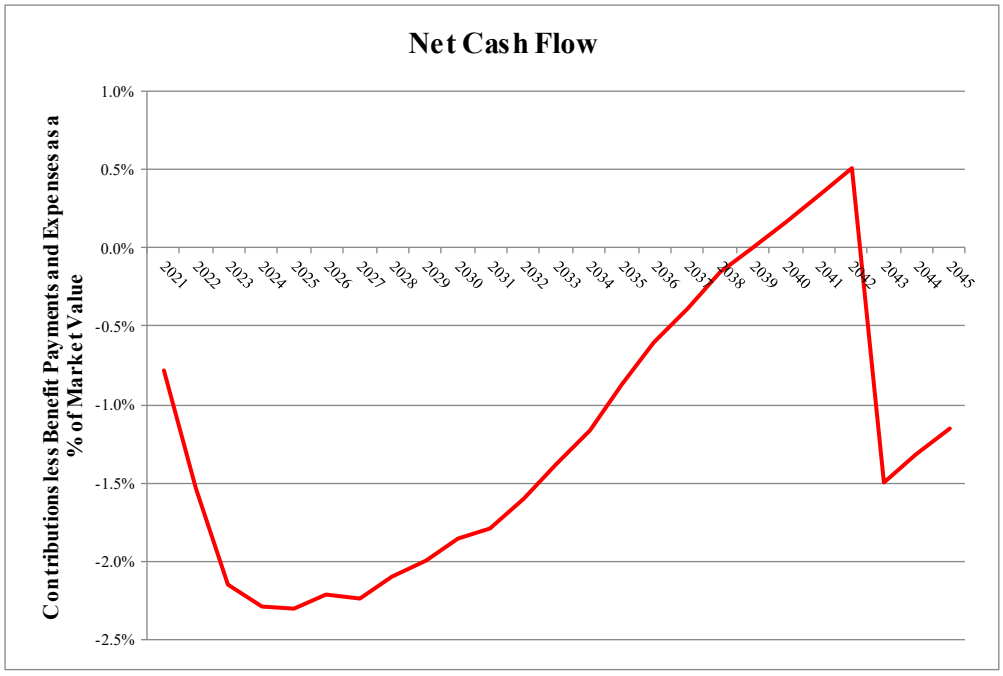
The employer contribution rate trends downward over time as a greater percentage of active members are covered by Judges 2011 Plan which has a lower normal cost rate and employee contributions of 4.0% of pay. The Policy Minimum Contribution Rate applies beginning in 2023.



In the early stages of funding a retirement system (Judges was funded on a "pay as you go" basis until 1999), the contributions are an important part of accumulating assets and improving the funded ratio. If assumptions are met in the future, the funded ratio is expected to steadily improve.

TABLE 12
PROJECTION OF FUTURE NET CASH FLOWS
AS OF JUNE 30, 2021

Projection Based on Assumptions Outlined in Appendix D Amounts in thousands						
Valuation as of June 30, (1)	Total Contributions (2)	Benefit Payments (3)	Administrative Expenses (4)	Net Cash Flows (5)	Market Value of Assets (MVA) (6)	Net Cash Flow as a % of MVA (7)
2021	$41,680	$43,247	$78	($1,644)	$211,081	(0.78%)
2022	41,652	45,015	79	(3,442)	224,051	(1.54%)
2023	42,129	47,134	81	(5,086)	236,063	(2.15%)
2024	42,714	48,293	83	(5,662)	247,210	(2.29%)
2025	43,919	49,771	85	(5,937)	258,536	(2.30%)
2026	45,113	51,009	87	(5,982)	270,364	(2.21%)
2027	46,341	52,576	89	(6,324)	282,968	(2.23%)
2028	47,527	53,639	91	(6,202)	296,094	(2.09%)
2029	48,776	54,869	93	(6,185)	310,258	(1.99%)
2030	50,033	55,958	95	(6,021)	325,424	(1.85%)
2031	51,299	57,307	97	(6,104)	341,815	(1.79%)
2032	52,523	58,178	99	(5,754)	359,259	(1.60%)
2033	53,818	58,954	101	(5,237)	378,276	(1.38%)
2034	55,147	59,673	104	(4,630)	399,151	(1.16%)
2035	56,525	60,099	106	(3,681)	422,104	(0.87%)
2036	57,971	60,576	108	(2,714)	447,634	(0.61%)
2037	59,394	61,098	111	(1,815)	475,938	(0.38%)
2038	60,893	61,598	113	(819)	507,139	(0.16%)
2039	62,424	62,340	116	(31)	541,538	(0.01%)
2040	63,927	62,862	118	947	579,143	0.16%
2041	65,476	63,345	121	2,010	620,373	0.32%
2042	67,097	63,587	124	3,386	665,567	0.51%
2043	53,559	64,152	126	(10,720)	715,327	(1.50%)
2044	54,743	64,578	129	(9,964)	753,955	(1.32%)
2045	55,967	65,005	132	(9,170)	796,050	(1.15%)



RISK MEASURES

Actuarial Standards of Practice are issued by the Actuarial Standards Board and are binding on credentialed actuaries practicing in the United States. These standards generally identify what the actuary should consider, document and disclose when performing an actuarial assignment. In September 2017, Actuarial Standard of Practice Number 51, *Assessment and Disclosure of Risk in Measuring Pension Obligations*, (ASOP 51) was issued as final with application to measurement dates on or after November 1, 2018. This ASOP, which applies to funding valuations, actuarial projections, and actuarial cost studies of proposed plan changes, was first applicable for the June 30, 2019 actuarial valuation for the Missouri State Employees' Retirement System – Judges (Judges or System).

A typical retirement plan faces many different risks, but the greatest risk is the inability to make benefit payments when due. If plan assets are depleted, benefits may not be paid which could create legal and litigation risk or the plan could become "pay as you go". This risk is why consistent funding of the full actuarial contribution rate, based on reasonable assumptions and methods, is so critical to the successful funding of a retirement system.

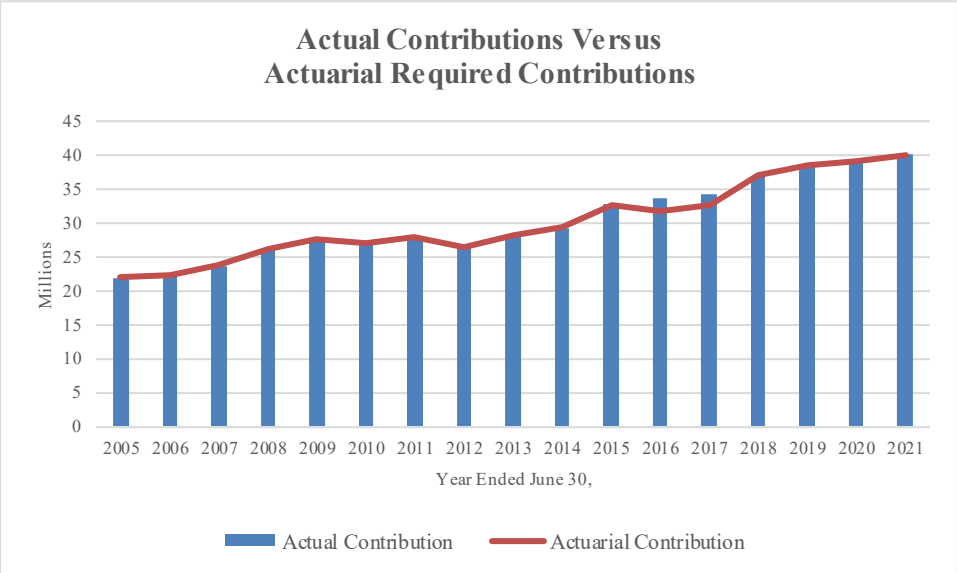
The term "risk" is most commonly associated with an outcome with undesirable results. However, in the actuarial world, risk can be translated as uncertainty. The actuarial valuation process uses many actuarial assumptions to project how future contributions and investment returns will meet the cash flow needs for future benefit payments. Of course, we know that actual experience will not unfold exactly as anticipated by the assumptions and that uncertainty, whether favorable or unfavorable, creates risk. ASOP 51 defines risk as the potential of actual future measurements to deviate from expected results due to actual experience that is different than the actuarial assumptions.

The various risk factors for a given plan can have a significant impact – positive or negative – on the actuarial projection of liability and contribution rates.

There are a number of risks inherent in the funding of a defined benefit plan. These include:

- economic risks, such as investment return and price inflation;
- demographic risks such as mortality, payroll growth, aging population, declining active membership and retirement ages;
- external risks such as the regulatory and political environment.

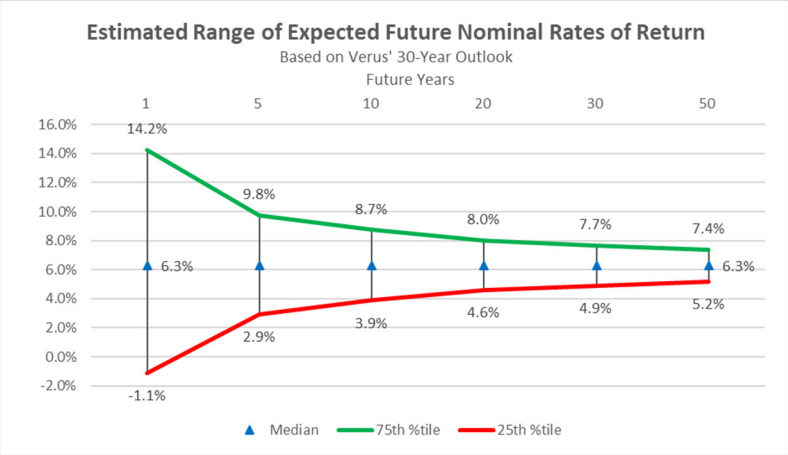
There is typically a direct correlation between healthy, well-funded retirement plans and consistent contributions equal to the full actuarial contribution rate each year. Historically, the state of Missouri has contributed the full actuarial contribution rate. At their September 18, 2014 meeting, the Board adopted a policy minimum contribution rate so that the employer contribution rate will not fall below the fiscal 2015 rate (58.45% of payroll) until the plan is 80% funded. As a result, the System's contributions were slightly above the actuarial rate during FY 2016 and FY 2017. The following graph displays the System's historical contribution levels over the past 17 years.



One of the most positive factors regarding the System's funding is the State's commitment to make contributions that are at least equal to the actuarial required contribution. This disciplined approach to funding has been illustrated by consistently contributing the full actuarial required contribution amount even with the increases that have occurred in the recent past. Despite the fact the full actuarial contribution rate has been contributed, the Judges Plan is only 31% funded. This is because the Plan was funded using a "pay-as-you-go" method prior to 1999, which means that there was no cash reserve to invest and pay benefits from and the System's funded ratio was zero. In addition, the actuarial assumptions have been changed eight times in the last ten years, including a reduction in the investment return assumption from 8.50% in the 2011 valuation to 6.95% in the 2020 valuation. In addition, actual investment experience over this period has lagged the assumptions. However, to the extent the State continues to fund the full actuarial contribution rate in the future, we would expect the funded ratio to steadily improve if the actuarial assumptions are met.

The most significant risk factor for most systems is investment return because of the volatility of returns and the size of plan assets compared to payroll (see Table 15). Given the underlying capital market assumptions provided by MOSERS' investment consultant, Verus, in 2021 when the experience study was performed and the System's asset allocation, the distribution of returns over time is illustrated in the graph on the next page.

As the following graph illustrates, in any single year the rate of return is expected to fall between -1% and 14% about 50% of the time. This volatility in the investment return from year to year creates significant risk to funding a retirement plan because of the corresponding volatility it creates in the employer contribution rate. As Table 13 explains, if the actual return is 10% different than the expected return, it would result in an increase in the actuarial contribution rate of 2.26% once the experience is fully recognized in the asset smoothing method (five years). As the System continues to build its asset reserve and approach 100% funding, unfavorable investment experience will have a more and more significant impact on the contribution rate. This is a typical characteristic of well-funded, mature plans.



A key demographic risk for all retirement systems, including Judges, is improvements in mortality (longevity) greater than anticipated. While the actuarial assumptions reflect small, continuous improvements in mortality experience over time and these assumptions are refined every experience study, the risk arises because there is a possibility of some sudden shift, perhaps from a significant medical breakthrough that could quickly increase liabilities. Likewise, there is some possibility of a significant public health crisis that could result in a significant number of additional deaths in a short time period, as experienced with the COVID-19 pandemic. This type of event is also significant, although more easily absorbed. While either of these events could happen, it represents a small probability and thus represents much less risk than the volatility associated with investment returns.

Many of the public retirement systems were created shortly after World War II. In general, the aging of the population, including the retirement of the baby boomers, along with earlier retirement eligibility has created a shift in the demographics of most systems. This change is not unexpected and has, in fact, been anticipated in the funding of the retirement system. Even though it was anticipated, the demographic shift and maturing of the plans have increased the risk associated with funding the system. The following exhibits summarize certain historical information that indicates how certain key risk metrics have changed over time due to the maturing of the retirement system.

TABLE 13
HISTORICAL ASSET VOLATILITY RATIOS

As a retirement system matures, the size of the market value of assets is expected to increase relative to the covered payroll of active members, on which the System is funded. The size of the plan assets relative to covered payroll, sometimes referred to as the asset volatility ratio, is an important indicator of the contribution risk for the System. The higher this ratio, the more sensitive a plan's contribution rate is to investment return volatility. In other words, it will be harder to recover from investment losses with increased contribution rates.

Valuation Date	Market Value of Assets	Covered Payroll	Asset Volatility Ratio	Change in ACR with a Return 10% Different than Assumed*
6/30/2004	39,705,632	39,878,499	1.00	0.67%
6/30/2005	48,534,166	40,016,098	1.21	0.81%
6/30/2006	57,728,934	40,270,535	1.43	0.96%
6/30/2007	72,180,820	40,846,581	1.77	1.19%
6/30/2008	77,341,103	44,542,530	1.74	1.17%
6/30/2009	65,919,546	45,505,512	1.45	0.98%
6/30/2010	78,553,877	46,112,730	1.70	1.14%
6/30/2011	98,208,033	45,888,020	2.14	1.44%
6/30/2012	99,837,257	45,835,501	2.18	1.47%
6/30/2013	111,203,538	48,697,726	2.28	1.54%
6/30/2014	132,645,657	49,587,936	2.67	1.80%
6/30/2015	130,851,263	55,656,457	2.35	1.58%
6/30/2016	132,056,351	57,421,016	2.30	1.55%
6/30/2017	137,634,941	58,150,935	2.37	1.60%
6/30/2018	150,199,575	59,551,874	2.52	1.70%
6/30/2019	158,332,990	60,380,734	2.62	1.76%
6/30/2020	167,288,066	61,450,808	2.72	1.83%
6/30/2021	211,081,342	63,031,506	3.35	2.26%

* The impact of asset smoothing is not reflected in the impact on the Actuarial Contribution Rate (ACR). Current year assumptions are used for all years shown.

The assets at June 30, 2021 are about 3.3 times the amount of covered payroll. Consequently, underperforming the investment return assumption by 10.00% (i.e., earn -3.05% for one year) is equivalent to about 33% of payroll. While the actual impact of this experience in the first year is mitigated by the asset smoothing method and amortization of the UAAL, this table illustrates the risk associated with volatile investment returns. Such an event in one year would be expected to increase the actuarial contribution rate by 2.26% of payroll once it is fully recognized in the asset smoothing method.

TABLE 13
HISTORICAL ASSET VOLATILITY RATIOS

(continued)

The following graph shows a comparison of Judges' historical asset volatility ratios and the historical median asset volatility ratio for a group of large public plans that are tracked in the Public Plan Database. The pattern of the change in the asset volatility ratio for Judges over time is similar to that observed in the Public Plan Database. When asset values drop significantly (like in 2009), the ratio drops as well. Most of the plans that participate in the NASRA Public Fund Survey have been accumulating assets for fifty or more years. Consequently, it is not surprising that the Judges System has a lower asset volatility ratio in comparison.

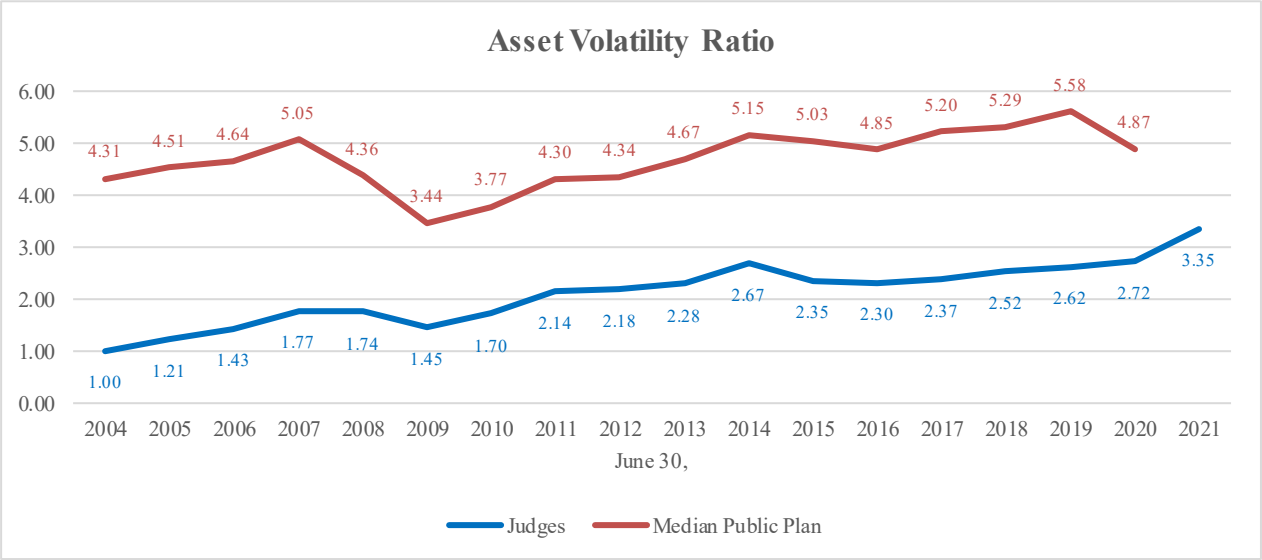


TABLE 14
LIABILITY MATURITY MEASUREMENTS

Most public sector retirement systems have been in operation for many years. As a result, they have aging plan populations, and in some cases declining active populations, resulting in an increasing ratio of retirees to active members and a growing percentage of retiree liability. The retirement of the remaining baby boomers over the next decade is expected to further exacerbate the aging of the retirement system population. With more of the total liability residing with retirees, investment volatility has a greater impact on the funding of the system since it is more difficult to restore the system financially after losses occur when there is comparatively less payroll over which to spread costs.

Projections provide the most effective way of analyzing the impact of these changes on future funding measures, but studying several key metrics from the valuation can also provide some valuable insight.

Fiscal Year End	Retiree Liability (a)	Total Actuarial Accrued Liability (b)	Retiree Percentage (a) / (b)	Covered Payroll (c)	Ratio (b) / (c)
6/30/10	236,113,077	382,012,773	61.81%	46,112,730	8.28
6/30/11	251,532,354	393,484,589	63.92%	45,888,020	8.57
6/30/12	258,642,149	413,332,538	62.57%	45,835,501	9.02
6/30/13	274,911,416	435,378,358	63.14%	48,697,726	8.94
6/30/14	285,124,436	462,336,255	61.67%	49,587,936	9.32
6/30/15	316,042,514	482,969,311	65.44%	55,656,457	8.68
6/30/16	354,715,048	547,621,617	64.77%	57,421,016	9.54
6/30/17	377,099,534	564,417,925	66.81%	58,150,935	9.71
6/30/18	401,725,610	593,788,592	67.65%	59,551,874	9.97
6/30/19	434,204,353	617,482,705	70.32%	60,380,734	10.23
6/30/20	436,014,583	624,847,011	69.78%	61,450,808	10.17
6/30/21	438,537,859	626,284,219	70.02%	63,031,506	9.94

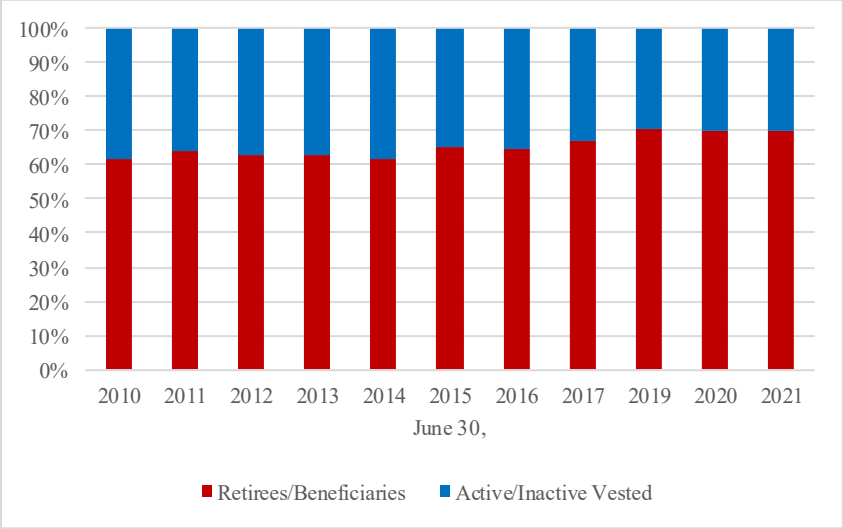
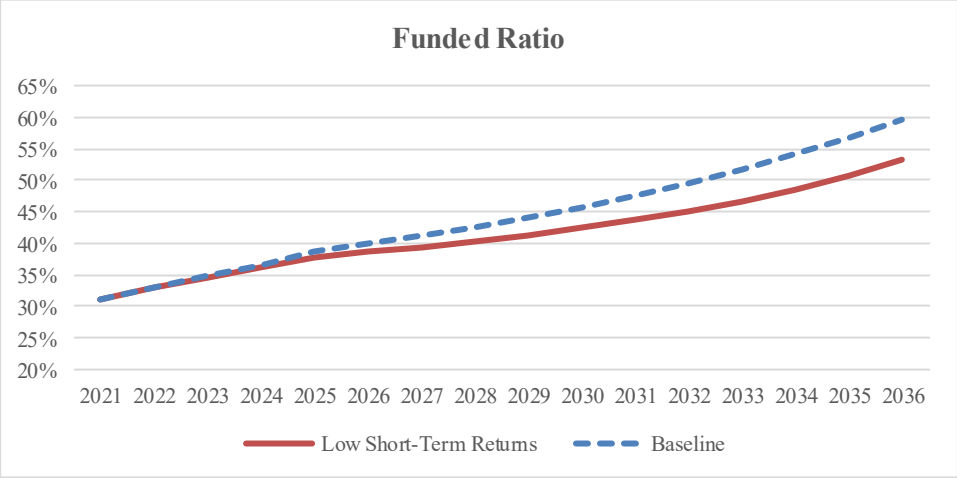


TABLE 15
SCENARIO TESTING

As mentioned earlier, the most significant risk factor for most systems is investment return. There are many different tools that can be useful when assessing investment risk. One of these tools is to perform scenario testing using a projection model. Scenario testing is choosing one set of specific criteria to compare against another set of specific criteria, also known as a "what if" scenario.

Many investment consultants are projecting lower returns over the next ten years compared to the longer term (30+ years). The scenario test below shows results if actual investment returns are 1.0% less than assumed (5.95%) over the next 15 years ("Low Short-Term Returns") compared to if all assumptions are met ("Baseline").



In both scenarios, the funded ratio gradually increases over the next 15 years, even in the low short-term returns scenario. The most significant factor in the early stages of building an asset reserve is the contributions, rather than investment income. However, that is not to say that investment returns have no impact on the System's funding. By the end of this period, the funded ratio is about 6% lower under the low short-term returns scenario.

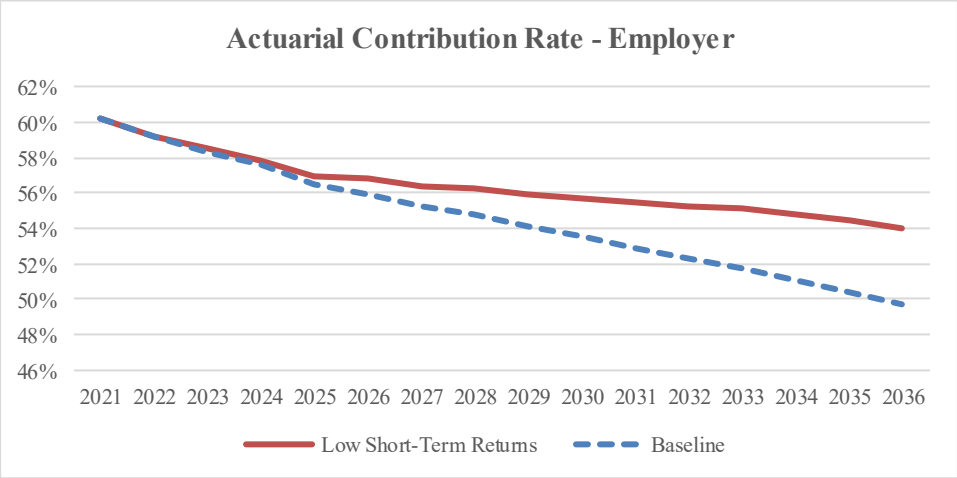
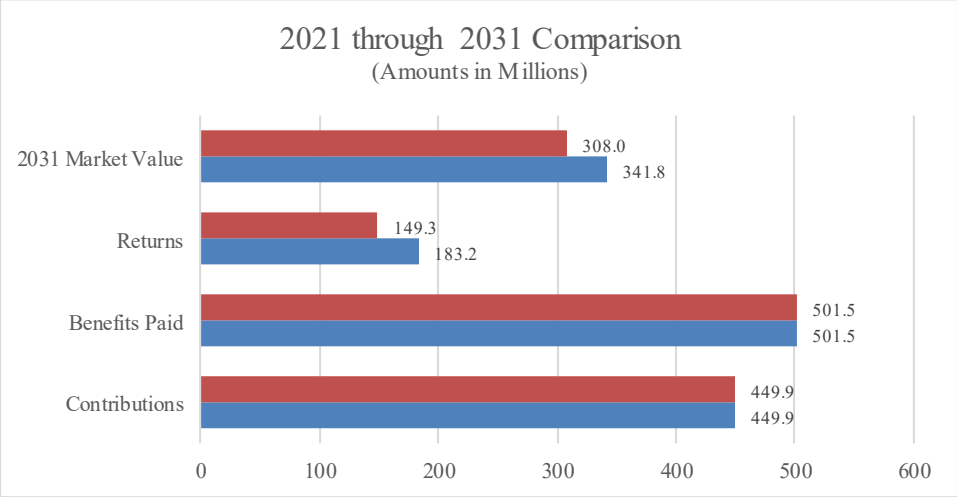


TABLE 15
SCENARIO TESTING

(continued)

Under both scenarios, the employer portion of the actuarial contribution rate decreases from about 60% to about 58% over the next four years due to the recognition of deferred asset gains. Under the baseline scenario, the employer portion of the actuarial contribution rate drops to just under 50% after 15 years, which is about 4% lower than the low short-term returns scenario. Note that while the employer portion of the actuarial contribution rate falls to below 58%, the Policy Minimum Employer Contribution does not allow the employer to contribute less than 58.45% until the System is 80% funded, which is not projected to happen in the next 15 years. The steadily decreasing employer contribution rate is largely due to a decline in the normal cost rate as more members are covered by the Judges 2011 benefit structure over time, as well as increases in the effective employee contribution rate.

While it is helpful to see the funded ratio and employer contribution rate trend lines when scenario testing, it can sometimes be difficult to grasp the full impact without analyzing the impact in dollar amounts. The graph below compares the projected 2031 market value of assets under the baseline (blue bars) and the low short-term return scenario (red bars). In addition, the sum over a ten-year period of actual investment returns, benefits paid and contribution to the System are compared.



Under the low short-term return scenario, the 2031 market value of assets is about $34 million lower when compared with the baseline. If asset returns are 1.0% lower than assumed for the next ten years, actual investment returns would be $34 million less than assumed. Also note that contributions are only slightly higher under the low short-term return scenario over the ten-year period. This is because the recognition of deferred investment gains.

TABLE 16
COMPARISON OF VALUATION RESULTS UNDER ALTERNATE INVESTMENT RETURN ASSUMPTIONS

($ in millions)

This exhibit compares the key June 30, 2021 valuation results under five (5) different investment return assumptions to illustrate the impact of different assumptions on the funding of the System. Note that only the investment return assumption is changed, as identified in the heading below. All other assumptions are unchanged for purposes of this analysis.

Investment Return Assumption	**5.95%**	**6.45%**	**6.95%**	**7.45%**	**7.95%**
Contributions					
Total Normal Cost	25.03%	22.67%	20.57%	18.68%	17.00%
Member Contributions	(2.42%)	(2.42%)	(2.42%)	(2.42%)	(2.42%)
Employer Normal Cost	22.61%	20.25%	18.15%	16.26%	14.58%
Unfunded Actuarial Accrued Liability	43.84%	42.94%	42.02%	41.09%	40.14%
Total Employer Contribution Rate	66.45%	63.19%	60.17%	57.35%	54.72%
Total Employer Contribution Amount	$44.1	$41.9	$39.9	$38.1	$36.3
Actuarial Accrued Liability	$688.9	$656.3	$626.3	$598.5	$572.7
Actuarial Value of Assets	$195.0	$195.0	$195.0	$195.0	$195.0
Unfunded Actuarial Accrued Liability	$493.9	$461.3	$431.3	$403.5	$377.7
Funded Ratio	28.3%	29.7%	31.1%	32.6%	34.0%

Note: All other assumptions are unchanged for purposes of this sensitivity analysis.
Numbers may not add due to rounding.

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HISTORICAL FUNDING AND OTHER INFORMATION

This section of the report provides a historical perspective on the System's funding and contribution practices, along with other information that may be of interest.

The information required for financial reporting by the System and participating employers is established by the Governmental Accounting Standards Board (GASB). GASB 67 separates accounting and financial reporting from funding requirements by creating disclosure and reporting requirements that are independent of the basis used for funding the System. A separate report that contains all of the information and exhibits of an actuarial nature that are necessary for the System's financial reporting under GASB 67 will be issued in the future.

GASB Statement No. 68 establishes standards for the measurement, recognition, and display of pension expense and related liabilities. Annual pension cost is measured and disclosed on the accrual basis of accounting. A separate report containing all of the pertinent information under GASB 68 reporting will also be prepared in the future.

TABLE 17
SCHEDULE OF FUNDING PROGRESS

($ in millions)

Actuarial Valuation Date	Actuarial Value of Assets (a)	Actuarial Accrued Liability (AAL) (b)	Unfunded Actuarial Accrued Liability (UAAL) (b - a)	Funded Ratio (a / b)	Covered Payroll (c)	UAAL as a % of Covered Payroll [(b - a) / c]
June 30, 2004	$39	$280	$241	14.0%	$39.9	604.0%
June 30, 2005	44	292	248	15.1%	40.0	620.0%
June 30, 2006	52	309	257	16.7%	40.3	637.7%
June 30, 2007	62	327	265	18.9%	40.8	649.5%
June 30, 2008	73	355	282	20.6%	44.5	633.7%
June 30, 2009	81	369	288	22.0%	45.5	633.0%
June 30, 2010	89	382	293	23.3%	46.1	635.6%
June 30, 2011	98	393	295	25.0%	45.9	642.7%
June 30, 2012	102	413	311	24.8%	45.8	679.0%
June 30, 2013	111	435	324	25.5%	48.7	665.3%
June 30, 2014	124	462	338	28.0%	49.6	681.5%
June 30, 2015	134	483	349	27.8%	55.7	626.6%
June 30, 2016	143	548	404	26.2%	57.4	703.8%
June 30, 2017	152	564	413	26.9%	58.2	708.9%
June 30, 2018	162	594	432	27.3%	59.6	724.8%
June 30, 2019	172	617	445	27.9%	60.4	737.4%
June 30, 2020	181	625	444	28.9%	61.5	722.7%
June 30, 2021	195	626	431	31.1%	63.0	684.3%

Note: Information before 2017 was produced by the prior actuary. Numbers may not add due to rounding.

TABLE 18
SHORT-TERM SOLVENCY TEST

Fiscal Year End	Member Contributions (1)	Current Retirees and Beneficiaries (2)	Active and Inactive Members, Employer Financed Portion (3)	Actuarial Value of Assets Available for Benefits	Percentage of Actuarial Liabilities Covered by Actuarial Value of Assets Available for (1)	(2)	(3)
2010	$ 0	$ 236,113,077	$ 145,899,696	$ 88,976,738	100.0	37.7	0.0
2011	59,958	251,532,354	141,892,277	98,398,628	100.0	39.1	0.0
2012	209,817	258,642,149	154,450,572	102,266,706	100.0	39.5	0.0
2013	421,753	274,911,416	160,045,189	111,140,339	100.0	40.3	0.0
2014	716,564	285,124,436	176,469,255	124,269,105	100.0	43.3	0.0
2015	1,204,757	316,042,514	165,722,040	134,349,908	100.0	42.1	0.0
2016	1,855,955	354,715,048	191,050,614	143,468,860	100.0	39.9	0.0
2017	2,232,405	377,099,534	185,085,986	151,828,631	100.0	39.7	0.0
2018	3,124,482	401,725,610	188,938,500	162,135,045	100.0	39.6	0.0
2019	4,421,019	434,204,353	178,857,333	172,224,529	100.0	38.6	0.0
2020	5,991,360	436,014,583	182,841,068	180,713,310	100.0	40.1	0.0
2021	7,294,197	438,537,859	180,452,163	194,988,153	100.0	42.8	0.0

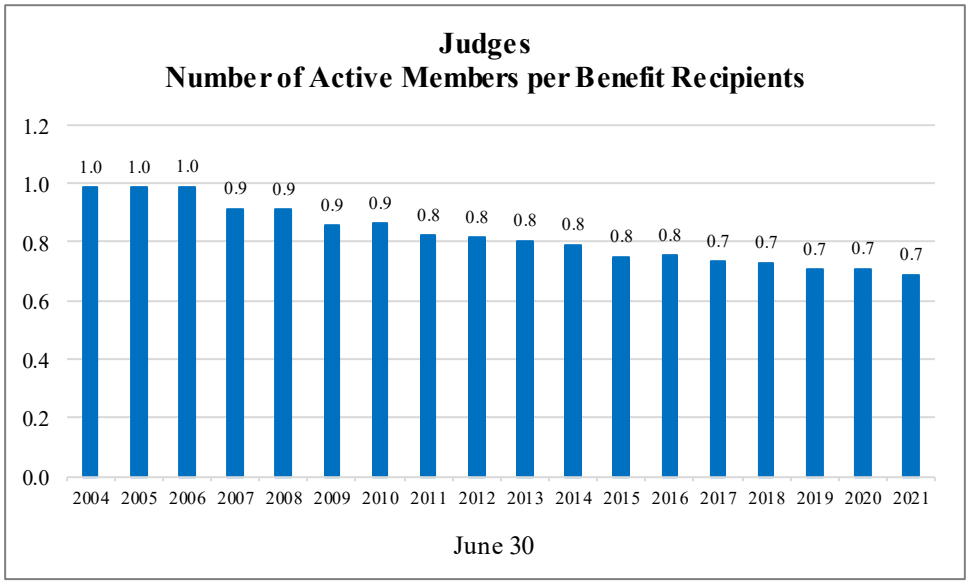
TABLE 19
HISTORICAL EMPLOYER CONTRIBUTIONS

($ in millions)

Fiscal Year Ending	Actuarially Determined Employer Contribution	Actual Dollar Amount	Percent Contributed
June 30, 2005	$21.9	$21.9	100.0%
June 30, 2006	22.4	22.4	100.0%
June 30, 2007	23.7	23.7	100.0%
June 30, 2008	26.2	26.2	100.0%
June 30, 2009	27.7	27.7	100.0%
June 30, 2010	27.0	27.0	100.0%
June 30, 2011	27.8	27.8	100.0%
June 30, 2012	26.3	26.3	100.0%
June 30, 2013	28.3	28.3	100.0%
June 30, 2014	29.3	29.3	100.0%
June 30, 2015	32.7	32.7	100.0%
June 30, 2016	31.6	33.6	106.3%
June 30, 2017	32.7	34.2	104.6%
June 30, 2018	36.9	36.9	100.0%
June 30, 2019	38.6	38.6	100.0%
June 30, 2020	39.2	39.2	100.0%
June 30, 2021	40.0	40.0	100.0%

TABLE 20
HISTORICAL MEMBER STATISTICS

Valuation Date June 30	Active Members				Retired Members			
	Number	Payroll $ Millions	Average Salary $	% Incr.	Number	Active/ Retired	Annual Benefits $ Millions	% Incr.
2004	391	$40	$101,911		397	1.0	$18.0	
2005	392	40	102,082	0.2	397	1.0	18.8	4.4
2006	394	40	102,209	0.1	398	1.0	19.4	3.2
2007	400	41	102,116	(0.1)	437	0.9	21.7	11.9
2008	401	45	111,079	8.8	440	0.9	22.5	3.7
2009	397	46	114,623	3.2	463	0.9	24.0	6.7
2010	402	46	114,708	0.1	465	0.9	24.5	2.1
2011	399	46	115,008	0.3	486	0.8	26.5	8.2
2012	398	46	115,165	0.1	488	0.8	27.0	1.9
2013	400	49	121,744	5.7	497	0.8	28.4	5.2
2014	405	50	122,439	0.6	511	0.8	29.8	4.9
2015	405	56	137,423	12.2	539	0.8	32.4	8.7
2016	408	57	140,738	2.4	540	0.8	33.2	2.5
2017	410	58	141,832	0.8	559	0.7	34.6	4.2
2018	415	60	143,498	1.2	569	0.7	36.3	4.9
2019	414	60	145,847	1.6	585	0.7	38.6	6.3
2020	418	61	147,012	0.8	590	0.7	40.1	3.9
2021	418	63	150,793	2.6	607	0.7	42.3	5.5



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MEMBER DATA RECONCILIATION

	Active Members	Inactive Vested	Leave of Absence	Retirees	Beneficiaries	Total
As of June 30, 2020	418	35	0	436	154	1,043
Changes in status:						
a) Retirement	(19)	(7)	0	26	0	0
b) Death	(2)	0	0	(11)	(7)	(20)
c) Leave of absence	0	0	0	0	0	0
d) Vested termination	0	0	0	0	0	0
e) Contribution refund	0	0	0	0	0	0
f) Beneficiary in receipt	0	0	0	0	10	10
g) Disability retirement	0	0	0	0	0	0
h) Return to active service	1	(1)	0	0	0	0
i) Expired benefit	0	0	0	0	0	0
j) Data adjustment	(1)	0	0	(1)	0	(2)
Total changes in status	(21)	(8)	0	14	3	(12)
New entrants	21	0	0	0	0	21
Net Change	0	(8)	0	14	3	9
As of June 30, 2021	418	27	0	450	157	1,052

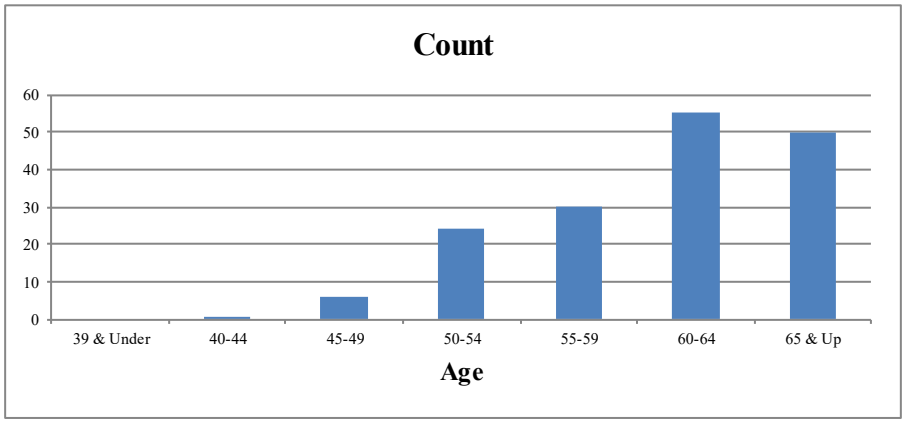
SUMMARY OF MEMBERSHIP DATA

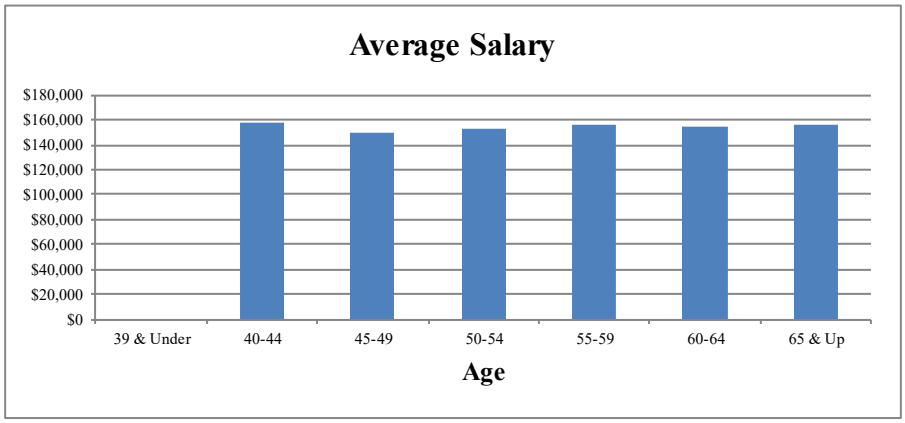
A. ACTIVE MEMBERS	June 30, 2021	June 30, 2020	% Change
1. Number of Active Members			
(a) Judicial Plan	166	183	(9.3)
(b) Judicial Plan 2011	252	235	7.2
(c) Total	418	418	0.0
2. Annualized Reported Salary			
(a) Judicial Plan	$ 25,683,827	$ 27,644,728	(7.1)
(b) Judicial Plan 2011	37,347,679	33,806,080	10.5
(c) Total	$ 63,031,506	$ 61,450,808	2.6
3. Accumulated Member Contributions	$ 7,040,934	$ 5,721,491	23.1
4. Active Member Averages			
(a) Age	55.5	55.7	(0.4)
(b) Service	10.8	10.8	0.0
(c) Compensation	$ 150,793	$ 147,012	2.6
B. INACTIVE MEMBERS			
1. Number of Inactive Vested Members	27	35	(22.9)
2. Inactive Vested Member Averages			
(a) Age	54.0	54.1	(0.2)
(b) Monthly benefit	$ 2,629	2,996	(12.2)
C. RETIREES, DISABLEDS, AND BENEFICIARIES			
1. Number of Members			
(a) Retirees	450	436	3.2
(b) Beneficiaries	157	154	1.9
(c) Total	607	590	2.9
2. Total Monthly Benefits			
(a) Retired	$ 3,011,453	$ 2,839,083	6.1
(b) Beneficiaries	514,059	503,586	2.1
(c) Total	$ 3,525,512	$ 3,342,669	5.5
3. Average Age			
(a) Retired	75.3	75.0	0.4
(b) Beneficiaries	81.2	81.1	0.1
(c) Total	76.8	76.6	0.3

ACTIVE MEMBERS
AS OF JUNE 30, 2021

HIRED BEFORE JANUARY 1, 2011

	Count of Members			Reported Annualized Earnings for Current Members		
Age	Male	Female	Total	Male	Female	Total
39 & Under	0	0	0	$ 0	$ 0	$ 0
40-44	1	0	1	157,637	0	157,637
45-49	2	4	6	290,052	606,301	896,353
50-54	16	8	24	2,445,962	1,235,072	3,681,034
55-59	24	6	30	3,774,109	906,038	4,680,147
60-64	37	18	55	5,637,604	2,840,096	8,477,700
65 & Up	38	12	50	5,913,508	1,877,448	7,790,956
Total	118	48	166	$ 18,218,872	$ 7,464,955	$ 25,683,827

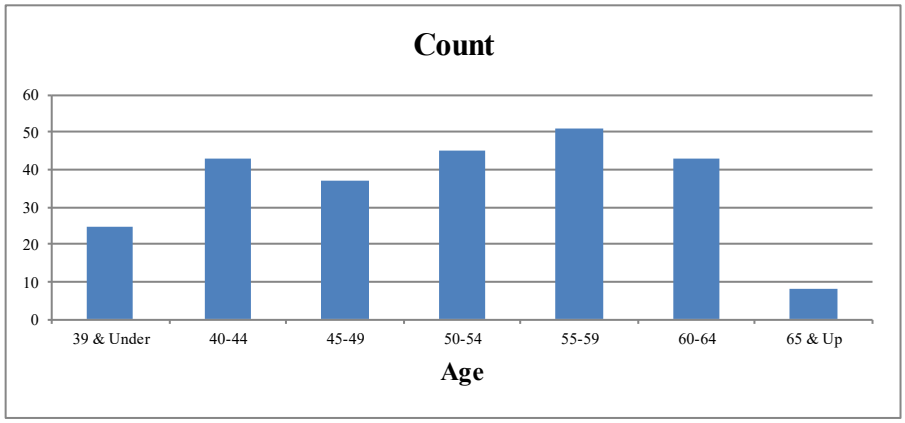


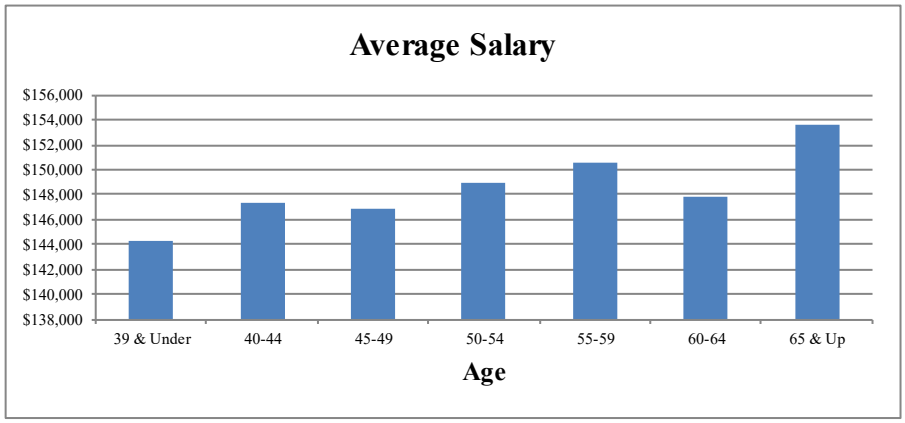


ACTIVE MEMBERS
AS OF JUNE 30, 2021

HIRED ON OR AFTER JANUARY 1, 2011

	Count of Members			Reported Annualized Earnings for Current Members		
Age	Male	Female	Total	Male	Female	Total
39 & Under	15	10	25	$ 2,194,236	$ 1,415,279	$ 3,609,515
40-44	22	21	43	3,283,351	3,052,604	6,335,955
45-49	24	13	37	3,527,552	1,904,320	5,431,872
50-54	32	13	45	4,762,497	1,941,430	6,703,927
55-59	39	12	51	5,899,680	1,778,145	7,677,825
60-64	29	14	43	4,341,740	2,018,252	6,359,992
65 & Up	7	1	8	1,070,956	157,637	1,228,593
Total	168	84	252	$ 25,080,012	$ 12,267,667	$ 37,347,679

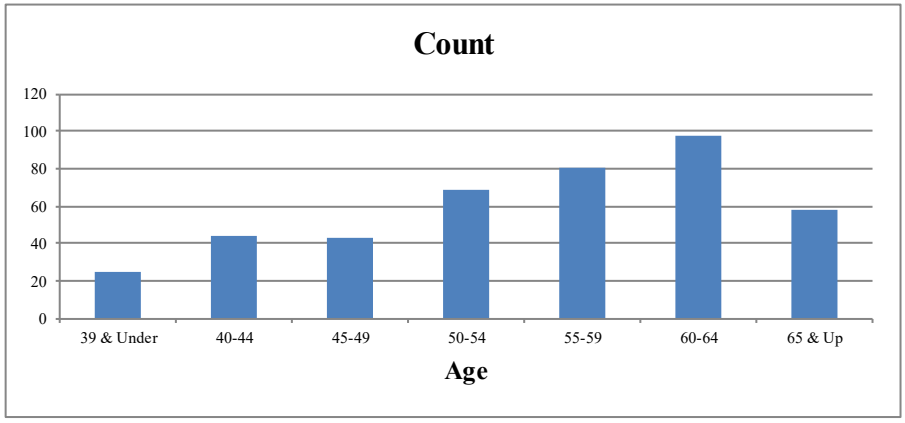


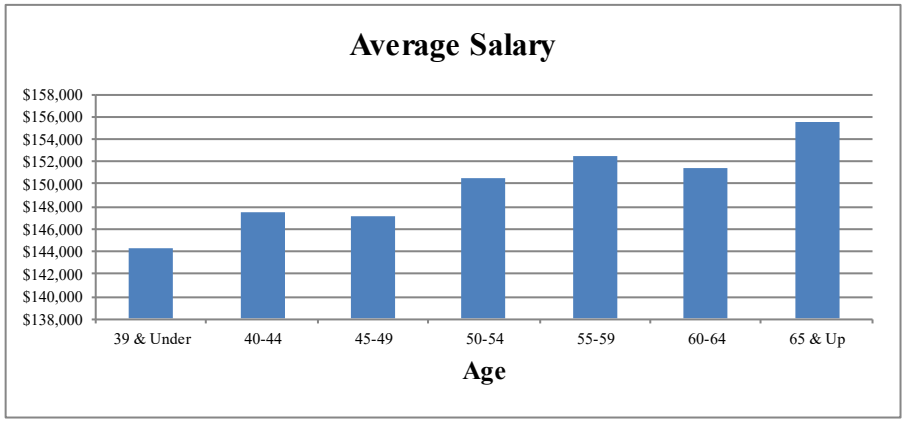


ACTIVE MEMBERS
AS OF JUNE 30, 2021

TOTAL

	Count of Members			Reported Annualized Earnings for Current Members		
Age	Male	Female	Total	Male	Female	Total
39 & Under	15	10	25	$ 2,194,236	$ 1,415,279	$ 3,609,515
40-44	23	21	44	3,440,988	3,052,604	6,493,592
45-49	26	17	43	3,817,604	2,510,621	6,328,225
50-54	48	21	69	7,208,459	3,176,502	10,384,961
55-59	63	18	81	9,673,789	2,684,183	12,357,972
60-64	66	32	98	9,979,344	4,858,348	14,837,692
65 & Up	45	13	58	6,984,464	2,035,085	9,019,549
Total	286	132	418	$ 43,298,884	$ 19,732,622	$ 63,031,506



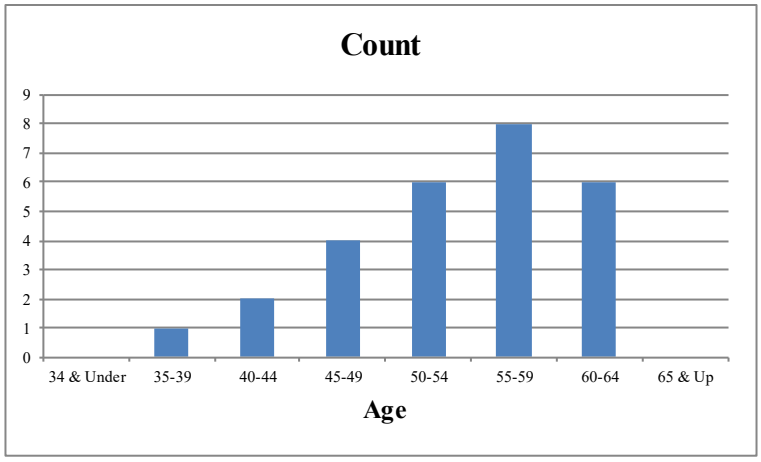


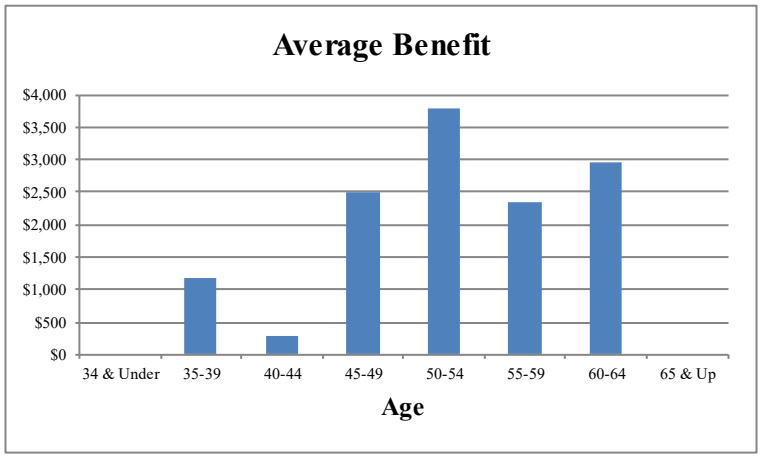
AGE AND SERVICE DISTRIBUTION
AS OF JUNE 30, 2021

Age		0-4	5-9	10-14	15-19	20-24	25-29	Over 29	Total
39 & Under	Number	22	3	0	0	0	0	0	25
	Total Salary	$ 3,161,495	$ 448,020	$ 0	$ 0	$ 0	$ 0	$ 0	$ 3,609,515
	Average Sal.	$ 143,704	$ 149,340	$ 0	$ 0	$ 0	$ 0	$ 0	$ 144,381
40-44	Number	28	12	4	0	0	0	0	44
	Total Salary	$ 4,102,209	$ 1,786,057	$ 605,326	$ 0	$ 0	$ 0	$ 0	$ 6,493,592
	Average Sal.	$ 146,507	$ 148,838	$ 151,332	$ 0	$ 0	$ 0	$ 0	$ 147,582
45-49	Number	22	13	8	0	0	0	0	43
	Total Salary	$ 3,229,764	$ 1,906,790	$ 1,191,671	$ 0	$ 0	$ 0	$ 0	$ 6,328,225
	Average Sal.	$ 146,807	$ 146,676	$ 148,959	$ 0	$ 0	$ 0	$ 0	$ 147,168
50-54	Number	25	14	16	12	2	0	0	69
	Total Salary	$ 3,692,974	$ 2,115,575	$ 2,456,090	$ 1,830,270	$ 290,052	$ 0	$ 0	$ 10,384,961
	Average Sal.	$ 147,719	$ 151,113	$ 153,506	$ 152,523	$ 145,026	$ 0	$ 0	$ 150,507
55-59	Number	20	23	19	9	8	2	0	81
	Total Salary	$ 3,054,447	$ 3,421,122	$ 2,938,546	$ 1,406,122	$ 1,254,964	$ 282,771	$ 0	$ 12,357,972
	Average Sal.	$ 152,722	$ 148,744	$ 154,660	$ 156,236	$ 156,871	$ 141,386	$ 0	$ 152,568
60-64	Number	11	25	24	6	19	12	1	98
	Total Salary	$ 1,618,879	$ 3,725,950	$ 3,636,484	$ 942,756	$ 2,873,521	$ 1,895,076	$ 145,026	$ 14,837,692
	Average Sal.	$ 147,171	$ 149,038	$ 151,520	$ 157,126	$ 151,238	$ 157,923	$ 145,026	$ 151,405
65 & Up	Number	1	4	15	4	11	11	12	58
	Total Salary	$ 157,637	$ 610,656	$ 2,310,860	$ 614,871	$ 1,693,108	$ 1,724,730	$ 1,907,687	$ 9,019,549
	Average Sal.	$ 157,637	$ 152,664	$ 154,057	$ 153,718	$ 153,919	$ 156,794	$ 158,974	$ 155,509
Total	Number	129	94	86	31	40	25	13	418
	Total Salary	$ 19,017,405	$ 14,014,170	$ 13,138,977	$ 4,794,019	$ 6,111,645	$ 3,902,577	$ 2,052,713	$ 63,031,506
	Average Sal.	$ 147,422	$ 149,087	$ 152,779	$ 154,646	$ 152,791	$ 156,103	$ 157,901	$ 150,793

INACTIVE VESTED MEMBERS
AS OF JUNE 30, 2021

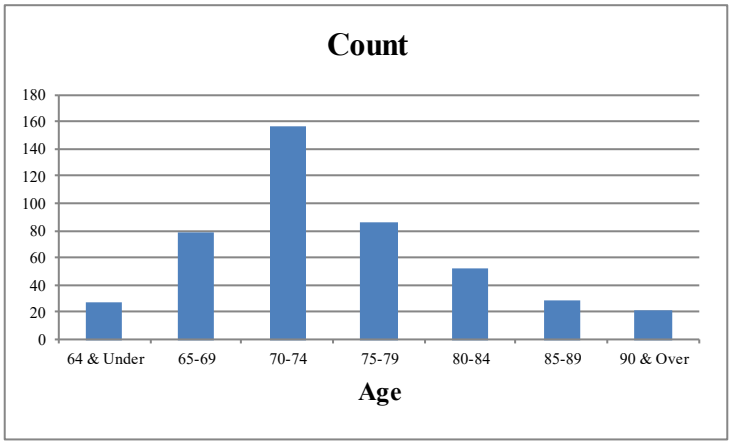
	Count of Members			Monthly Deferred Benefits		
Age	Male	Female	Total	Male	Female	Total
34 & Under	0	0	0	$ 0	$ 0	$ 0
35-39	1	0	1	1,164	0	1,164
40-44	1	1	2	213	369	582
45-49	1	3	4	5,821	4,198	10,019
50-54	5	1	6	19,207	3,476	22,683
55-59	4	4	8	13,059	5,771	18,830
60-64	6	0	6	17,707	0	17,707
65 & Up	0	0	0	0	0	0
Total	18	9	27	$ 57,171	$ 13,814	$ 70,985

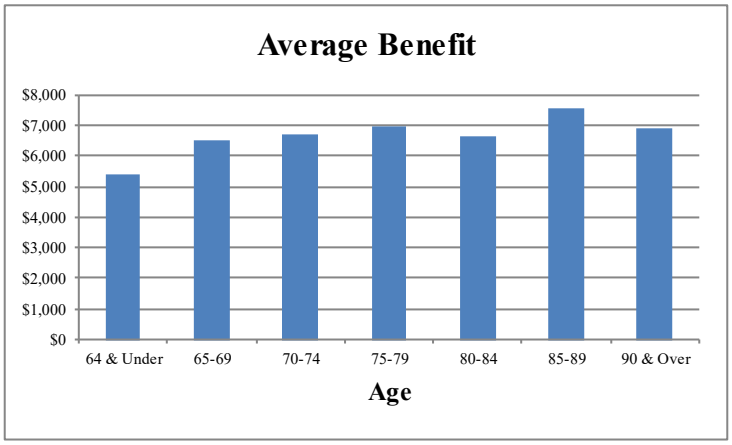




RETIRED MEMBERS
AS OF JUNE 30, 2021

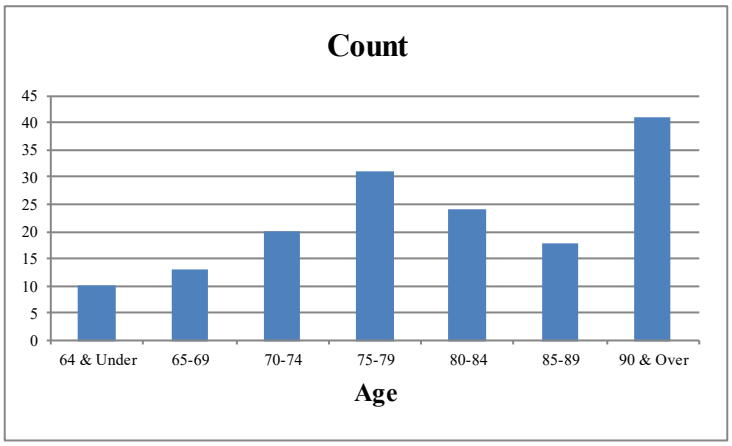
	Count of Members			Monthly Benefits		
Age	Male	Female	Total	Male	Female	Total
64 & Under	21	6	27	$ 112,417	$ 33,628	$ 146,045
65-69	63	15	78	421,227	83,484	504,711
70-74	131	26	157	873,300	181,486	1,054,786
75-79	72	14	86	495,930	100,573	596,503
80-84	46	6	52	309,240	36,381	345,621
85-89	29	0	29	218,477	0	218,477
90 & Over	21	0	21	145,310	0	145,310
Total	383	67	450	$ 2,575,901	$ 435,552	$ 3,011,453

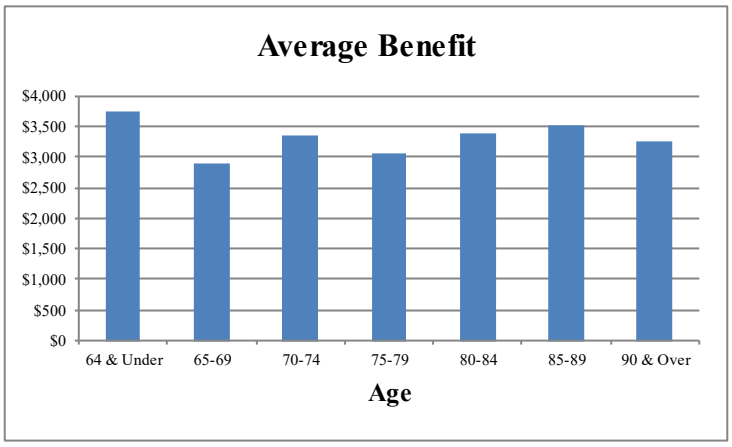




BENEFICIARIES RECEIVING BENEFITS
AS OF JUNE 30, 2021

	Count of Members			Monthly Benefits		
Age	Male	Female	Total	Male	Female	Total
64 & Under	2	8	10	$ 8,444	$ 28,864	$ 37,308
65-69	0	13	13	0	37,721	37,721
70-74	2	18	20	5,789	61,478	67,267
75-79	1	30	31	3,542	90,782	94,324
80-84	0	24	24	0	81,409	81,409
85-89	0	18	18	0	63,251	63,251
90 & Over	1	40	41	2,334	130,445	132,779
Total	6	151	157	$ 20,109	$ 493,950	$ 514,059





RETIRED LIVES BENEFITS PAYABLE
TABULATED BY OPTION AND TYPE OF BENEFIT
AS OF JUNE 30, 2021

Judges Hired Before January 1, 2011

Type of Benefit	No.	Total Monthly Benefits
Service Retirement		
Life Annuity	3	$ 21,211
50% Joint and Survivor	439	2,964,952
100% Joint and Survivor	0	0
15-Year Certain and Life	0	0
Survivor Beneficiary	122	408,985
Total	564	3,395,148
Death-in-Service	34	103,119
Total	**598**	**$ 3,498,267**

Judges Hired On or After January 1, 2011

Type of Benefit	No.	Total Monthly Benefits
Service Retirement		
Life Annuity	2	$ 7,073
50% Joint and Survivor	2	7,881
100% Joint and Survivor	3	5,128
15-Year Certain and Life	1	5,208
Survivor Beneficiary	0	0
Total	8	25,290
Death-in-Service	1	1,955
Total	**9**	**$ 27,245**

Age and Service Retirement

Eligibility for Unreduced Benefit (for Members Hired Before 1/1/2011)

The earliest of attaining:

(1) At least 62 with 12 years of creditable service.
(2) At least 60 with 15 years of creditable service.
(3) At least 55 with 20 years of creditable service.

Eligibility for Unreduced Benefit (for Members Hired On or After 1/1/2011)

The earliest of attaining:

(1) At least 67 with 12 years of creditable service.
(2) At least 62 with 20 years of creditable service.

Benefit Amount

50% of compensation

Early Retirement

Eligibility for Reduced Benefit (for Members Hired Before 1/1/2011)

Age 60

Benefit Amount

(1) If between 60 and 62, years of service divided by 15 multiplied by 50% of compensation.
(2) If at least 62, years of service divided by 12 and multiplied by 50% of compensation.

Eligibility for Reduced Benefit (for Members Hired On or After 1/1/2011)

Age 62

Benefit Amount

(1) If between 60 and 67, years of service divided by 20 multiplied by 50% of compensation.
(2) If at least 67, years of service divided by 12 and multiplied by 50% of compensation.

Compensation used for Benefit Determination

The annual salary at date of termination of the highest position held.

Vested Deferred Benefits

Benefits for employees who terminate prior to eligibility for an immediate benefit are considered to be vested. Benefits commence once the individual qualifies for normal or early retirement based on age and service.

Death Benefits

Death Prior to Retirement

50% of the benefit the member would have been eligible to receive based on service to age 70 is payable to an eligible spouse or minor children.

Death After Retirement

50% of the benefit the retired member was receiving at the date of death to an eligible surviving spouse for members hired before January 1, 2011.

Disability Benefits

Disability benefits become payable at the time the member is eligible for normal retirement (50% of salary for remainder of term) and are computed based on the service that would have accrued if active employment had continued until normal retirement age, and member's compensation while an active employee.

Post-Retirement Benefit Adjustments

Benefits are increased to benefit recipients (including survivors) annually in accordance with the following formulas:

Increase in CPI	Formula 1 Benefit Increase	Formula 2 Benefit Increase
5.00% or less	4.00%	80% of CPI increase
5.01% - 6.24%	80% of CPI increase	80% of CPI increase
6.25% or more	5.00%	5.00%

Members first hired prior to August 28, 1997 receive COLAs based on Formula 1 until an aggregate increase of 65% is reached. At that point, subsequent COLAs based on Formula 2 are granted.

Members first hired on or after August 28, 1997 receive COLAs based solely on Formula 2.

Members hired prior to January 1, 2011 who work beyond the later of age 60 or the date when first eligible for age and service retirement will have their monthly benefit increased upon retirement. The percentage increase is equal to all COLAs for the years between (i) the later of age 60 or the date when first eligible for age and service retirement and (ii) date of actual retirement, not to exceed 65%.

Member Contributions

For members hired prior to 1/1/2011:	None
For members hired on or after 1/1/2011:	4.00% of salary, with interest credited at 4.00%.

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ACTUARIAL METHODS

1. **Calculation of Normal Cost and Actuarial Accrued Liability:** The funding method used to determine the normal cost and actuarial accrued liability was the Entry Age Actuarial Cost Method described below.

   Entry Age Actuarial Cost Method

   Under the entry age normal cost method, the actuarial present value of each member's projected benefit is allocated on a level basis over the member's compensation between the entry age of the member and their assumed exit age. The portion of the actuarial present value allocated to the valuation year is called the normal cost. The actuarial present value of benefits allocated to prior years of service is called the actuarial accrued liability. The unfunded actuarial accrued liability represents the difference between the actuarial accrued liability and the actuarial value of assets as of the valuation date. The unfunded actuarial accrued liability is calculated each year and reflects experience gains/losses.

2. **Calculation of the Actuarial Value of Assets:** Calculation of the Actuarial Value of Assets (AVA): The current asset smoothing method was first effective with the June 30, 2018 valuation. Under this method, the difference between the actual and assumed investment return on the market value of assets is recognized evenly over a five-year period. No corridor is used with the new method. In addition, the total unrecognized investment experience as of June 30, 2017 will be recognized evenly over a seven-year period beginning June 30, 2018.

3. **Amortization of the Unfunded Actuarial Accrued Liability (UAAL):** Beginning with the June 30, 2018 valuation, the UAAL is amortized using a "layered" approach. Under this method, the "Legacy UAAL", as determined in the June 30, 2018 valuation, is amortized over a closed 30-year period. Effective June 30, 2021, subsequent changes in the UAAL due to actuarial gains/losses or assumption changes are separately financed by establishing amortization bases and payments, as a level percentage of payroll, over closed 25-year periods. Bases established prior to June 30, 2021 will continue to be amortized on their original schedule. Any change in the System's benefit structure shall be amortized over a closed period of 20 years, as set out in state statutes. The total UAAL amortization payment is the sum of the payments for each of the amortization bases.

Changes in Methods and Assumptions since the Prior Year

An experience study which analyzed the System's economic and demographic assumptions was performed in 2021 and the results were presented to the Board. Below is a summary of the changes to methods and assumptions since the prior year:

- Effective June 30, 2021, subsequent changes in the UAAL due to actuarial gains/losses or assumption changes are amortized as a level percentage of payroll, over closed 25-year periods.
- The salary increase assumption was changed from an age-based table to a flat 3.0% assumption.
- The mortality assumption was changed to reflect the Pub-2010 General Members Median Mortality Table. Future generational mortality improvement is reflected by using 100% of Scale MP-2020 through 2020 and 75% of Scale MP-2020 for years after 2020.
- The retirement assumption was adjusted to partially reflect observed experience. Rates are now unisex.
- The termination assumption was changed from a sex distinct, service-based table to a flat 2.0% for all years.
- The disability assumption was eliminated.
- The percentage of members who are assumed to be married was increased from 80% to 90%.

ACTUARIAL ASSUMPTIONS

An experience study which analyzed the System's economic and demographic assumptions was performed in 2021 and the results were presented to the Board. The assumptions listed below are a result of that experience study. The next experience study is scheduled for 2026.

Economic Assumptions

1. Investment Return	6.95%, compounded annually, net of investment expenses.
2. Inflation	2.25% per year
3. Salary Increases	3.00% per year (2.25% Inflation + 0.25% Productivity + 0.50% Merit)
4. Payroll Growth	2.25% per year
5. Cost-of-Living Adjustment (COLA)	4.00% on a compounded basis when a minimum COLA of 4.00% is in effect. 1.80% on a compounded basis when no minimum COLA is in effect.
6. Administrative Expenses	Actual prior year expenses, included in normal cost rate.

Demographic Assumptions

1. Mortality	The mortality assumption includes an appropriate level of conservatism that reflects expected future mortality improvement.
a. Post-retirement (Retirees)	Pub-2010 General Members Median Healthy Retiree mortality table. Mortality projected generationally from 2010 to 2020 using Scale MP-2020 and 75% of Scale MP-2020 for years after 2020.
b. Post-retirement (Beneficiaries)	Pub-2010 General Members Median Contingent Survivor mortality table. Mortality projected generationally from 2010 to 2020 using Scale MP-2020 and 75% of Scale MP-2020 for years after 2020.
c. Pre-retirement	Pub-2010 General Members Median Employee mortality table. Mortality projected generationally from 2010 to 2020 using Scale MP-2020 and 75% of Scale MP-2020 for years after 2020.

2. Retirement

Members Hired Before January 1, 2011

Early Retirement	
Age	Rate
62-69	5%
70	100

Unreduced Retirement	
Age	Rate
55	10.0%
56-63	3.0
64-66	10.0
67	17.5
68	25.0
69	35.0
70	100.0

Members Hired On or After January 1, 2011

Unreduced Retirement	
Age	Rate
62	10%
63-66	3
67	25
68-69	20
70	100

3. Termination: 2.0% per year

4. Disability: None

Other Assumptions

1. Form of Payment	Hired before 1/1/2011 – 50% joint and survivor Hired on or after 1/1/2011 – Straight life annuity
2. Marital Status	
a. Percent married	90% married
b. Spouse's age	Females assumed to be four years younger than males.
3. Pay Increase Timing	Beginning of the fiscal year.
4. Decrement Timing	Decrements of all types are assumed to occur mid-year.
5. 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.
6. Benefit Service	Exact fractional service is used to determine the amount of the benefit payable.
7. Decrement Relativity	Decrement rates are used directly from the experience study, without adjustment for multiple decrement table effects.
8. Decrement Operation	Withdrawal does not operate during normal retirement eligibility.
9. Other Liability Adjustments	None
10. Incidence of Contributions	Contributions are assumed to be received continuously throughout the year based upon the computed percent of payroll shown in this report, and the actual payroll payable at the time contributions are made. New entrant normal cost contributions are applied to the funding of new entrant benefits.
11. Forfeitures	For members hired on or after January 1, 2011 only: Value the greater of the refund amount or the present value of the deferred benefit.
12. Salary and Benefit Limits	For purposes of the valuation, no limits were applied to member compensation or benefits.
13. Commencement age for deferred vested benefit	Normal retirement age

Data Adjustments

Active and retired member data was reported as of May 31, 2021. It was brought forward to June 30, 2021 by adding one month of service for all active members, one month of contributions and interest for Judicial Plan 2011 members, and the June COLA for certain retired members. Financial information continues to be reported as of June 30. This procedure was instituted to provide sufficient time for the Board of Trustees to certify the appropriate contribution rate prior to the October 1 statutory deadline.

Active members reported with no annualized salary were assumed to receive the average active member pay.

TECHNICAL VALUATION PROCEDURES

Other Valuation Procedures

Salary increases are assumed to apply to annual amounts.

Decrements are assumed to occur mid-year, except that immediate retirement is assumed for those who are at or above the age at which retirement rates are 100%. Standard adjustments are made for multiple decrements.

No actuarial liability is included for participants who terminated without being vested prior to the valuation date, except those due a refund of contributions.

Actuarial Accrued Liability	The difference between the actuarial present value of system benefits and the actuarial value of future normal costs. Also referred to as "accrued liability" or "actuarial liability".
Actuarial Assumptions	Estimates of future experience with respect to rates of mortality, disability, turnover, retirement, rate or rates of investment income and salary increases. Decrement assumptions (rates of mortality, disability, turnover and retirement) are generally based on past experience, often modified for projected changes in conditions. Economic assumptions (salary increases and investment income) consist of an underlying rate in an inflation-free environment plus a provision for a long-term average rate of inflation.
Accrued Service	Service credited under the system which was rendered before the date of the actuarial valuation.
Actuarial Equivalent	A single amount or series of amounts of equal actuarial value to another single amount or series of amounts, computed on the basis of appropriate assumptions.
Actuarial Cost Method	A mathematical budgeting procedure for allocating the dollar amount of the actuarial present value of retirement system benefit between future normal cost and actuarial accrued liability. Sometimes referred to as the "actuarial funding method".
Experience Gain (Loss)	The difference between actual experience and actuarial assumptions anticipated experience during the period between two actuarial valuation dates.
Actuarial Present Value	The amount of funds currently required to provide a payment or series of payments in the future. It is determined by discounting future payments at predetermined rates of interest and by probabilities of payment.
Amortization	Paying off an interest-discounted amount with periodic payments of interest and principal, as opposed to paying off with lump sum payment.
Normal Cost	The actuarial present value of retirement system benefits allocated to the current year by the actuarial cost method.
Unfunded Actuarial Accrued Liability	The difference between actuarial accrued liability and the valuation assets. Sometimes referred to as "unfunded actuarial liability" or "unfunded accrued liability". Most retirement systems have unfunded actuarial accrued liability. They arise each time new benefits are added and each time an actuarial loss is realized.