# Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS)

## Actuarial Valuation Report

June 30, 2020

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September 15, 2020

Retirement Board
Missouri Department of Transportation
and Highway Patrol Employees' Retirement System
1913 William Street
Jefferson City, Missouri 65102-1930

Ladies and Gentlemen:

The results of the regular annual actuarial valuation as of June 30, 2020 of the Missouri Department of Transportation and Highway Patrol Employees' Retirement System, as established by Chapter 104 of the Missouri Revised Statutes, are presented in this report. Reports providing accounting and financial reporting information that are intended to comply with the Governmental Accounting Standards Board Statements No. 67 and No. 68 will be provided separately. The purposes of this valuation were:

- To measure the System's funding progress;
- To determine the employer contribution rate for Fiscal Year 2022; and
- To provide certain supplemental schedules for use in the System's CAFR.

Your attention is directed particularly to the summary of the results on pages 1-13.

This report was prepared at the request of the Board and is intended for use by the Retirement System and those designated or approved by the Board. This report may be provided to parties other than the System only in its entirety and only with the permission of the Board. This report should not be relied on for any purpose other than the purpose described. GRS is not responsible for unauthorized use of this report.

The member statistical data required for the valuation together with pertinent data on financial operations was furnished by your Executive Director and his staff. Member data was reviewed for reasonableness, but was not audited by the actuary. Financial data was received in aggregate and reviewed for reasonableness. Individual investments were not reviewed. Assets are not audited by the actuary. We are not responsible for the accuracy or completeness of the data provided by MPERS.

The cooperation of the Executive Director and the staff in furnishing materials requested for this valuation, and the complete and excellent condition of the records, is acknowledged with appreciation.

The valuation results summarized in this report involve actuarial calculations that require assumptions about future events. The assumptions are established by the Board after consulting with the actuary. We believe that the assumptions and methods used in this report are reasonable and appropriate for the purpose for which they have been used. However, other assumptions and methods could also be reasonable and could result in materially different results. In addition, because it is not possible or practical to consider every possible contingency, we may use summary information, estimates or simplifications of calculations to facilitate the modeling of future events. We may also exclude factors or data that are deemed to be immaterial.

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; and changes in plan provisions or applicable law. This report does not contain an analysis of the potential range of such future measurements.

To the best of our knowledge, this report is complete and accurate and was made in accordance with standards of practice promulgated by the Actuarial Standards Board. The actuarial assumptions used for the valuation produce results which, individually and in the aggregate, are reasonable. The actuarial assumptions used in making the valuation are shown in Section E of this report.

The employer contributions determined in this report are based on Board funding policy. This policy is discussed on page 4 of this report. We commend the Board for its aggressive monitoring and updating of the funding policy over the recent past. However, continued employer contributions at the current level do not guarantee benefit security. We therefore encourage the Board to continue to routinely monitor and update its funding policy and to continue to consider benefit security when doing so.

This report has been prepared by individuals who have substantial experience valuing public employee retirement systems. Heidi G. Barry and Jamal Adora are Members of the American Academy of Actuaries (MAAA) and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

The signing individuals are independent of the plan sponsor.

Respectfully submitted,

Heidi G. Barry, ASA, FCA, MAAA

Jamal Adora, ASA, MAAA

Kenneth G. Alberts

HGB/JA/KGA:bd

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# Summary

This report contains the results of the June 30, 2020 valuation. The table below shows a summary of the data used in the valuation as well as the unfunded actuarial accrued liability for the two experience rated groups. This data was the basis for determining valuation results and recommended employer contribution rates.

| | Non-Uniformed | | | | |
|---|---|---|---|---|---|
| | Civilian Patrol | MoDOT Employees | Non-Uniformed Total | Uniformed Patrol | Total |
| **Participants** | | | | | |
| Active Members | | | | | |
| Closed Plan | 236 | 1,283 | 1,519 | 454 | 1,973 |
| Year 2000 Plan (also closed) | 377 | 1,511 | 1,888 | 363 | 2,251 |
| Year 2011 Tier (open) | 477 | 2,267 | 2,744 | 387 | 3,131 |
| Total Active Members | 1,090 | 5,061 | 6,151 | 1,204 | 7,355 |
| *Total Active Members Prior Year* | *1,113* | *5,097* | *6,210* | *1,211* | *7,421* |
| Retiree -- Regular Pensioners | | | | | |
| Closed Plan | 493 | 3,331 | 3,824 | 1,001 | 4,825 |
| Year 2000 Plan (also closed) | 606 | 3,595 | 4,201 | 8 | 4,209 |
| Year 2011 Tier (open) | 5 | 5 | 10 | 0 | 10 |
| Total Regular Pensioners | 1,104 | 6,931 | 8,035 | 1,009 | 9,044 |
| Self Insured Disability Pensioners | 2 | 40 | 42 | 3 | 45 |
| Fully Insured Disability Pensioners | 11 | 76 | 87 | 6 | 93 |
| Terminated Vested Members | 255 | 1,662 | 1,917 | 177 | 2,094 |
| **Total** | **2,462** | **13,770** | **16,232** | **2,399** | **18,631** |
| Active Member Valuation Payroll | $49,999,727 | $226,738,711 | $ 276,738,438 | $ 84,113,107 | $ 360,851,545 |
| *Active Mem. Val. Payroll Prior Year* | *$49,980,131* | *$224,584,899* | *$ 274,565,030* | *$ 84,731,026* | *$ 359,296,056* |
| Unfunded Actuarial Accrued Liability | N/A | N/A | $1,158,661,344 | $452,107,022 | $1,610,768,366 |

The June 30, 2020 valuation results are used to determine the contribution rate for the plan year beginning July 1, 2021. A summary of valuation results and recommended contribution rates follows.

# Summary (Continued)

The **total contribution rate** for the plan year beginning July 1, 2021 is shown below:

| | FY 2022 Employer Contribution Rates Expressed as % of Active Payroll for Total Benefits | | | | |
|---|---|---|---|---|---|
| | Non-Uniformed | | | | |
| | Civilian Patrol Employees | MoDOT Employees | Total | Uniformed Patrol Total | Combined Rate (System Total) |
| Benefit Normal Cost | 8.11% | 8.11% | 8.11% | 15.32% | 9.82% |
| Expenses | 1.12% | 1.12% | 1.12% | 1.12% | 1.12% |
| Disability Insurance | 0.53% | 0.53% | 0.53% | 0.53% | 0.53% |
| Total Normal Cost | 9.76% | 9.76% | 9.76% | 16.97% | 11.47% |
| Unfunded Liability | 48.24% | 48.24% | 48.24% | 41.03% | 46.53% |
| Total | 58.00% | 58.00% | 58.00% | 58.00% | 58.00% |
| Projected $ | $30,765,932 | $139,517,317 | $170,283,249 | $51,756,645 | $222,039,894 |
| *Prior Year Projected $* | *$30,753,874* | *$138,192,029* | *$168,945,903* | *$52,136,864* | *$221,082,767* |

The projected dollar amounts are the total employer rate multiplied by the valuation payroll projected to the fiscal year the rate is effective. The projection factor is 1.0609 for Non-Uniformed and 1.0609 for Uniformed. Actual contributions will be based on the actual payroll during the 2022 Fiscal Year. The total contribution is based on a 4-year amortization period for unfunded retiree liabilities and a 19-year amortization period for other unfunded liabilities from July 1, 2021 in accordance with Board policy adopted September 17, 2009. In accordance with Board Policy adopted September 26, 2014, a minimum Employer contribution of 58% of payroll was included to establish a Contribution Stabilization Reserve Fund.

The contributions above are Employer contributions only. In addition, Employee contributions are estimated to be (on average) 1.57% for Non-Uniformed members and 1.03% for Uniformed members.

The combined contribution rate (58.00% of active payroll) is less than the actual benefit payout rate (74.16% of active payroll). The difference is intended to be made up by investment return. The ability to contribute less than the benefit payout is one of the advantages of a funded retirement plan.

Prior year projected dollars (FY 2021) are based on rates of 58.00% for Non-Uniform and 58.00% for Uniform.

# Summary (Continued)

**Benefits, Assumptions and Methods for the June 30, 2020 valuation:** There were no changes in benefits for the June 30, 2020 valuation. The assumptions and methods used were those adopted by the Board from the July 1, 2012 through June 30, 2017 Experience Study and titled Alternate 3 in that report. The Board formally adopted these new assumptions at the February 14, 2018 Board meeting. The next Experience Study is scheduled to follow the June 30, 2022 valuation. We informally review assumptions with Staff and/or the Board each summer, prior to the beginning of the valuation process with a focus on economic assumptions. This year, our review was performed in two stages. The first stage was in tandem with the Board's review of the asset allocation. Our modeling indicates that the current economic assumptions are reasonable based on the asset allocation adopted by the Board at the June 18, 2020 Board meeting. However, our modeling indicates a continued trend downward of future expectations of investment returns. Given that trend and the fact that we recommended a lower investment return assumption in the last experience study than was adopted, there is an increasing likelihood that we will be recommending lowering the investment return assumption within the next couple of years, assuming the trend on future expectations continues.

The second stage of our review focused on short term increases in payroll. During the summer of 2020, we collected projections of payroll for the next few fiscal years from MoDOT, which had announced its "Shared Work Program" which was effectively a temporary reduction in pay. Based on the payroll information we collected, the temporary nature of the program, the minimum employer contribution rate and the contribution stabilization reserve fund, we determined that any contribution loss resulting from the "Shared Work Program," by itself, would only result in a small reduction in the contribution stabilization reserve fund and therefore did not require modifications to the funding policy. The Board is, of course, always free to modify the funding policy if it deems appropriate.

**Experience:** System assets earned a (0.44)% return on a market basis, although the fund recognized a 4.9% rate of return on an actuarial basis after accounting for the smoothing of the 2018 and 2019 gains and losses (please see page C-2). In aggregate, there was an experience loss of $49 million (approximately 1.2% of beginning of year liabilities). This loss was primarily investment related. Despite this loss the funding status still increased from 59.8% to 60.6%. Pages A-11 and A-12 show the derivation of the gain/(loss) in aggregate and by division.

The table below shows a comparison of actual demographic activity versus expected activity (based on the prior year's valuation assumptions).

**Demographic Experience**

| | Non-Uniformed | | | | Uniformed | | | |
|---|---|---|---|---|---|---|---|---|
| | Number Count | | | General | Number Count | | | General |
| | Actual | Expected | A/E% | Direction | Actual | Expected | A/E% | Direction |
| Retirement | 224 | 262.8 | 85% | Gain | 39 | 31.8 | 123% | Loss |
| Death | 2 | 5.2 | 38% | Gain | 0 | 0.7 | 0% | Gain |
| Disability | 14 | 15.9 | 88% | Gain | 0 | 1.1 | 0% | Gain |
| Vested Terminations | 140 | 118.8 | 118% | Gain | 13 | 8.3 | 157% | Gain |
| Other Terminations | 308 | 231.4 | 133% | Gain | 12 | 7.6 | 158% | Gain |
| Post-Retirement Death | 289 | 261.9 | 110% | Gain | 37 | 29.9 | 124% | Gain |

Liability gains were more than offset by recognized investment losses resulting in an experience loss of $37 million (Non-Uniformed) and $11 million (Uniformed) in aggregate.

# Summary (Continued)

**Funding Policy:**
*Permanent Policy:* The total contribution will be based on normal cost plus a 15-year amortization of unfunded actuarial accrued liabilities. The amortization period is a closed 15-year period starting July 1, 2021.

*Temporary Accelerated Policy:* The total contribution is based on normal cost plus a 4-year amortization period for unfunded retiree liabilities and a 19-year amortization period for other unfunded liabilities. Both amortization periods are closed periods starting July 1, 2021.

In accordance with RSMo 105.684, an accelerated amortization schedule was prepared and presented to the Board. This temporary accelerated policy was adopted by the Retirement Board on September 17, 2009 and will remain in effect until such time as the retiree liability becomes 100% funded or the permanent policy produces a higher contribution rate.

In September 2014, the Board adopted a contribution stabilization reserve fund from experience gains in an effort to keep the employer contribution rate at or near 58%, in the near term. In February 2015, the Board established a maximum of $250 million in the contribution stabilization reserve fund. The contribution stabilization reserve fund is expected to result in the fund becoming more than 100% funded by the end of the amortization period, if experience is exactly as assumed.

**Rate Reconciliation:** The table below shows the computed rate last year and the approximate effect of the changes that occurred during the year.

| | Non-Uniform | Uniform |
|---|---|---|
| Computed employer contribution rate, prior valuation | 58.00% | 58.00% |
| Effects of: | | |
| Change in disability premiums | 0.00% | 0.00% |
| Change in plan provisions | 0.00% | 0.00% |
| Change in assumptions and methods | 0.00% | 0.00% |
| Phase-in of 2011 Tier members | (0.25)% | (0.39)% |
| 19/20 recognized investment loss/(gain) | 3.32% | 4.51% |
| 19/20 liability experience loss/(gain) | 0.17% | (1.06)% |
| Change in administrative expenses | (0.03)% | (0.03)% |
| Change due to payroll increase other than expected | 1.49% | 2.83% |
| Misc (demographic, payroll weighting, component interaction, etc.) | (0.13)% | (0.93)% |
| Change in Contribution Stabilization Reserve Fund | (4.57)% | (4.93)% |
| Computed employer contribution rate, current valuation | 58.00% | 58.00% |

# Summary (Continued)

**Funded Status of Retiree Liability:** The chart below indicates the funding status of retiree liabilities on a funding value asset basis and a market value asset basis:

| | June 30, 2020 | | | June 30, 2019 |
|---|---|---|---|---|
| **Asset Basis** | **Non-Uniformed** | **Uniformed** | **Total** | **Total** |
| Funding Value | 87.4% | 98.4% | 90.4% | 90.4% |
| Market Value | 83.1% | 93.7% | 86.0% | 90.7% |

**Total Plan Funded Status:** The plan is currently 60.64% funded on an actuarial value of assets basis or 57.71% funded on a market value of assets basis.

If not for the minimum contribution rate and the contribution stabilization reserve, the permanent funding policy would have resulted in a higher employer contribution for the Uniformed division (when compared to the temporary policy) and the temporary policy would have resulted in a higher employer contribution for the Non-Uniformed division (when compared to the permanent policy), using current valuation assumptions.

**Plan Provisions:** There were no plan provisions intentionally excluded from the valuation that were in effect on the valuation date. However, certain disability benefits are funded through third party insurance. The premiums for this insurance are included in the normal cost. The liabilities for these disability benefits are not included in the accrued liabilities of the plan, since they are liabilities of the insurance carrier.

**Look Forward:** Before recognizing any fiscal year 2021 activity, the fund is positioned to recognize an investment loss of approximately $60 million next year (see page C-2). Since this loss (by itself) will not deplete the contribution stabilization reserve fund (currently the contribution stabilization reserve is $144 million), the employer contribution rate is not expected to increase under the current funding policy. However, this loss, if not offset by other experience gains, will put downward pressure on the funded status of the plan.

**Recommendations:**

1) In accordance with changes in actuarial standards along with more recent changes in forecasts of future economic conditions, we recommend that economic assumptions continue to be reviewed annually each spring/summer before the next valuation cycle begins.

2) The contribution stabilization reserve fund is able to provide a limited buffer against losses in the short therm. However, depletion of the contribution stabilization reserve fund would likely result in considerable contribution volatility while the temporary funding policy is in effect.
While no change in the funding policy is needed at this time, we recommend the Board consider reviewing the funding policy to determine if small changes (effective for the June 30, 2021 valuation) might reduce future contribution volatility.

# Summary (Concluded)

**Conclusion:** Based upon the results of the June 30, 2020 regular annual actuarial valuation, it is our opinion that the Missouri Department of Transportation and Highway Patrol Employees' Retirement System continues to be financed in accordance with actuarial principles of level percent-of-payroll financing. This statement is based upon the fact that the employer is contributing to the System based upon actuarially determined rates and presumes a continuation of payment of actuarially determined contributions. In addition, we commend the 2009 Board in its decision to more aggressively address the unfunded retiree liability issue, the 2011 Board in its decision to reflect the near-term downsizing of MoDOT, and the 2014 Board for establishing the contribution stabilization reserve fund, which effectively accelerated the funding of the UAAL.

# Other Observations

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

Given the plan's contribution allocation procedure, if all actuarial assumptions are met (including the assumption of the plan earning 7.00% on the actuarial value of assets), it is expected that:

1) The unfunded actuarial accrued liabilities will be fully amortized after 15 years, based on the permanent funding policy;
2) The funded status of the plan will increase gradually towards a 100% funded ratio and then slightly exceed 100% (due to the contribution stabilization reserve fund); and
3) The unfunded accrued liability will follow the pattern shown on page A-5.

## Limitations of Funded Status Measurements

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

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

## Limitations of Project Scope

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

## Risks to Future Employer Contribution Requirements

There are ongoing risks to future employer contribution requirements to which the Retirement System is exposed, such as:

- Actual and Assumed Investment Rate of Return
- Actual and Assumed Mortality Rates
- Amortization Policy

## Scenario testing/Sensitivity Testing

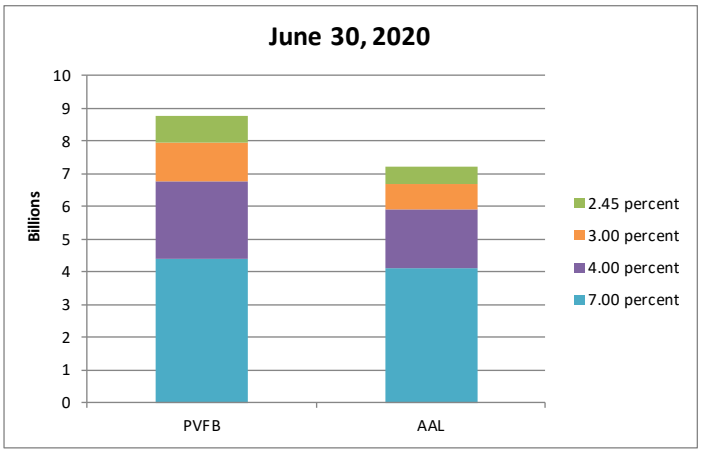
MPERS staff is provided a 10-year projection tool that allows for various scenario and sensitivity testing. If the Board would like to see additional projections, we would be happy to perform such projections.

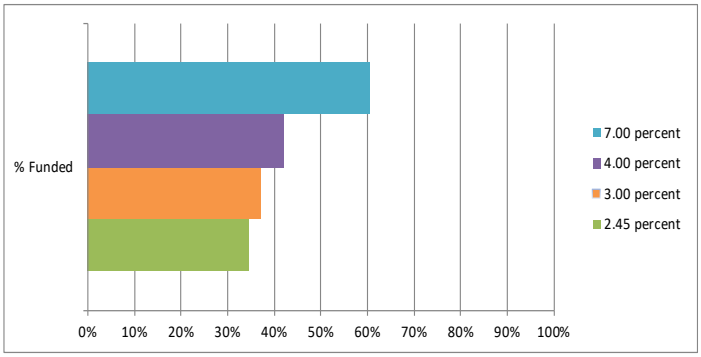
# Summary of Key Valuation Results

| Actuarial Present Value | June 30, 2020 (1) Actuarial Present Value | (2) Portion Covered By Future Normal Cost Contributions | (3) Actuarial Accrued Liabilities (1) - (2) | June 30, 2019 Actuarial Accrued Liabilities |
|---|---|---|---|---|
| **Active Members** | | | | |
| Service retirement benefits based on service rendered before and likely to be rendered after valuation date | $ 1,468,653,193 | $ 250,560,934 | $ 1,218,092,259 | $ 1,233,018,991 |
| Disability benefits likely to be paid to present active members who become totally and permanently disabled* | 29,988,713 | 18,196,279 | 11,792,434 | 11,816,523 |
| Survivor benefits likely to be paid to widows and children of present active members who die before retiring | 16,038,726 | 5,551,742 | 10,486,984 | 10,613,520 |
| Separation benefits likely to be paid to present active members | 53,689,015 | 31,099,391 | 22,589,624 | 24,685,565 |
| **Active Member Totals** | $ 1,568,369,647 | $ 305,408,346 | $ 1,262,961,301 | $ 1,280,134,599 |
| **Terminated Vested Members** | 102,753,368 | | 102,753,368 | 100,826,491 |
| **Retired Lives** | 2,726,383,228 | | 2,726,383,228 | 2,656,408,618 |
| **Total Actuarial Accrued Liability** | $ 4,397,506,243 | $ 305,408,346 | $ 4,092,097,897 | $ 4,037,369,708 |
| **Actuarial Value of Assets** | | | 2,481,329,531 | 2,415,343,431 |
| **Unfunded Actuarial Accrued Liability** | | | $ 1,610,768,366 | $ 1,622,026,277 |
| **Contribution Stabilization Reserve Fund** | | | $ 143,863,600 | $ 204,781,636 |
| **Total Amount Financed** | | | $ 1,754,631,966 | $ 1,826,807,913 |

* *The amounts presented for this category represent liabilities for retirement benefits for active members that may become participants of the long-term disability plan until they reach normal retirement eligibility. These are not liabilities for active members currently on long-term disability.*

# Summary of Key Valuations Results – (Concluded)




The first chart, above, shows the Present Value of Future Benefits (PVFB) and the Actuarial Accrued Liability (AAL) at four different interest rates. Using an interest rate of 3.0%, we obtain a value of $7.9 billion PVFB and $6.7 billion AAL. This is akin to the cost (in uninflated or 2020 dollars) of all future expected benefit payments to current members of the System (PVFB) and the portion that is allocated to the post AAL.

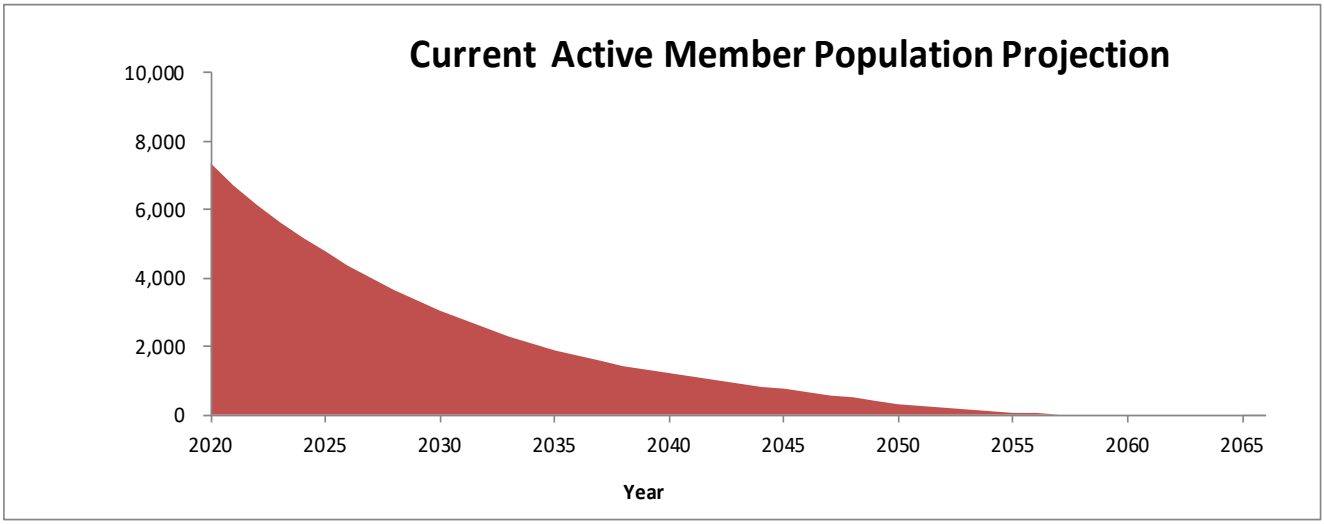
Using an interest rate of 2.45%, the PVFB is $8.8 billion and the AAL is $7.2 billion. The 2.45% interest rate is shown as an estimate of the return that might be achieved with "risk free" investments (U.S. Treasuries and their "safe" fixed income securities) in a 2.25% inflationary environment. The difference between these first two measurements is an estimate of the value of pre-funding the System with little to no investment risk. (Note: this is intended to show the Low-Default-Risk Obligation Measure that is expected to be required by actuarial standards, in the future). Also for comparison, using an interest rate of 4.00% we obtain a value of $6.7 billion PVFB and $5.9 billion AAL.

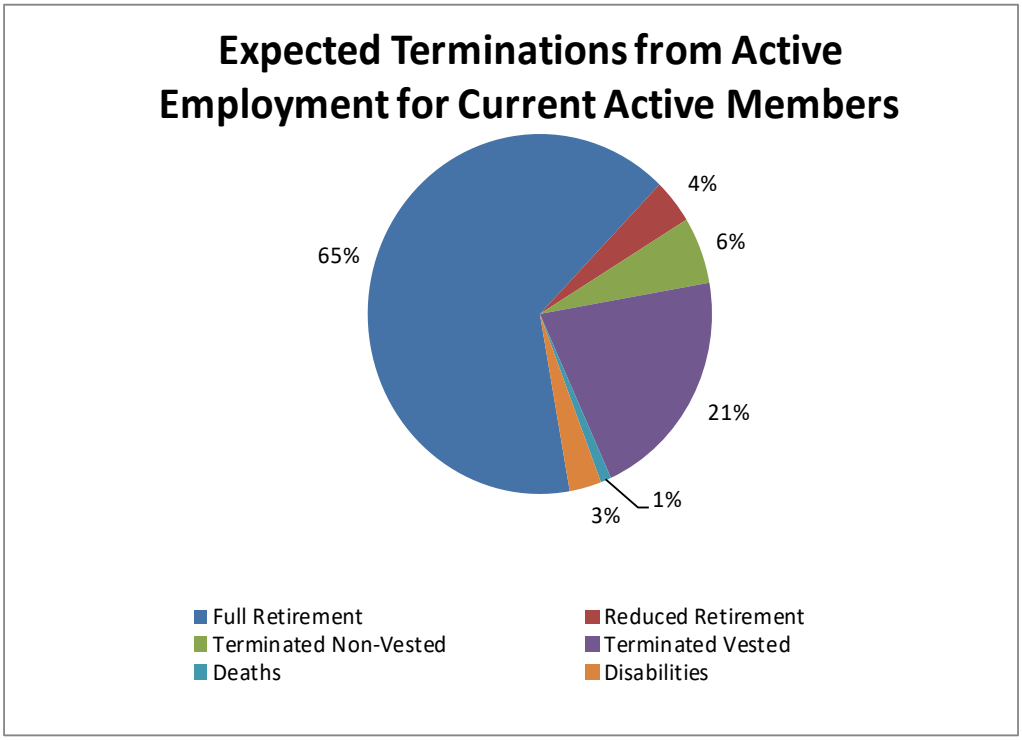
Using an investment return of 7.00% (the current valuation assumed investment return based on the current investment portfolio), the PVFB is $4.4 billion and the AAL is $4.1 billion. The difference between the 2nd and 3rd measures (2.45% interest and 7.00% interest) is the estimate of the reward the System expects to receive as a result of investing in a balanced portfolio instead of "risk free" securities.

The second chart shows the funded status (AAL/Actuarial Value of Assets) at each interest rate. This illustration was not intended to satisfy the recommended actuarial standards regarding solvency measures.

Notes: 7.00% is the current assumed rate of return; 4.00% is an estimated return of a low risk/low volatility portfolio and is intended to only change when the valuation assumption is changed for consistency of year to year measurements; 3.00% is the assumed wage inflation; 2.45% is the June 2020 AA municipal bond rate that will be used/referenced in the GASB valuations and is used herein as a proxy for a risk-free investment portfolio.

# Expected Development of Present Populations as of June 30, 2020

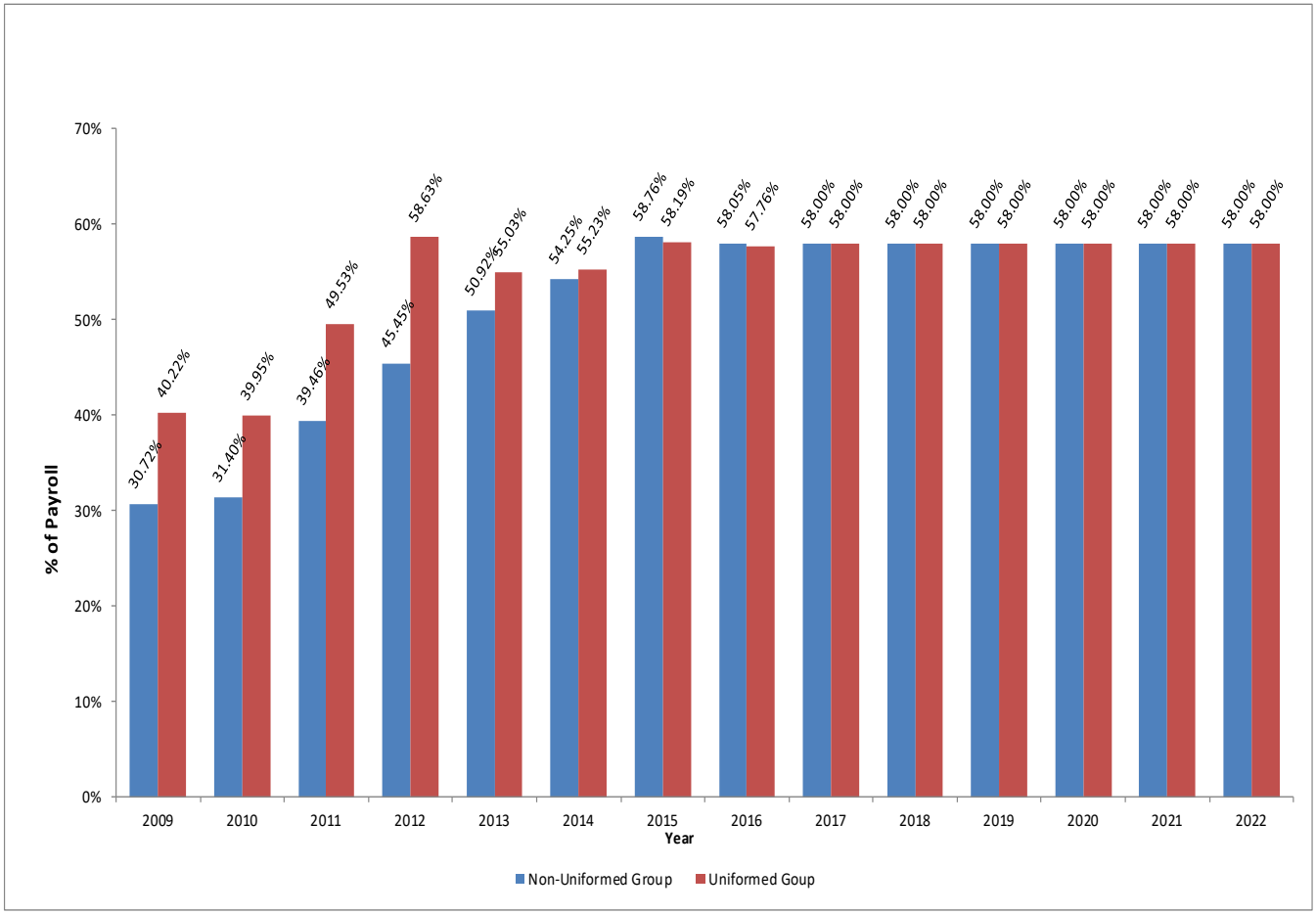


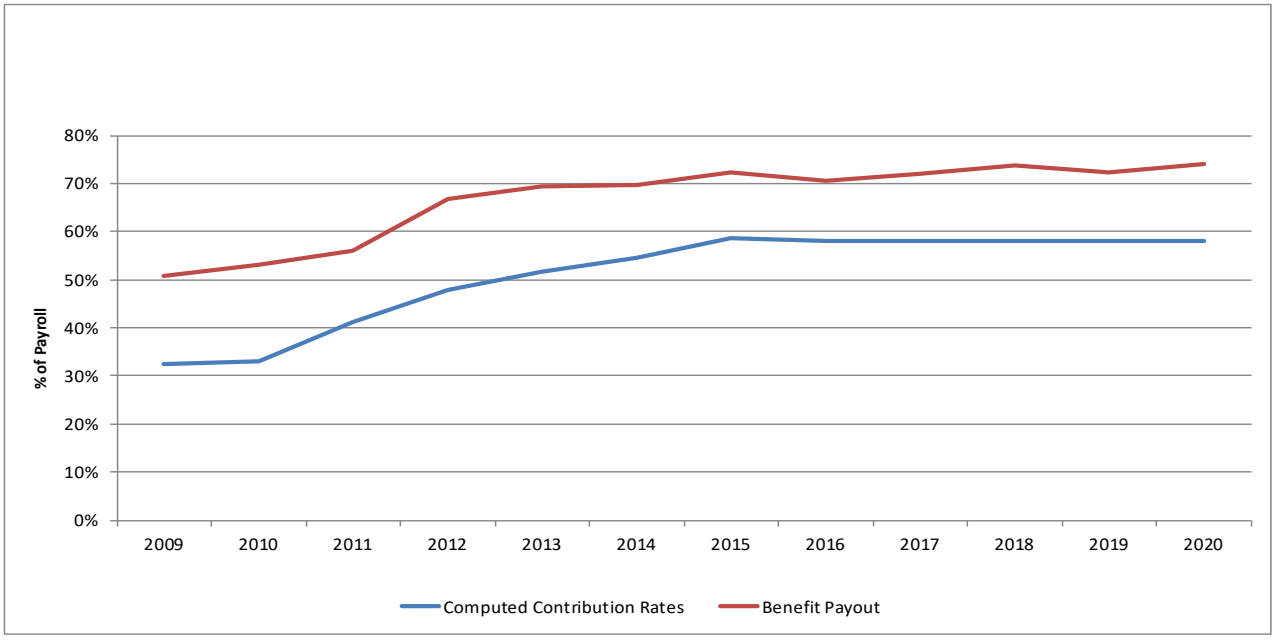

The charts above show the expected future development of the present population in simplified terms. The Retirement System presently covers 7,355 active members. Eventually, 6% of the population is expected to terminate covered employment prior to retirement and forfeit eligibility for an employer provided benefit. Of the present population, 90% is expected to receive monthly retirement benefits either by retiring directly from active service, or by separating from service with a vested benefit, and 4% of the present population is expected to become eligible for death-in-service or disability benefits. Within 10 years, over half of the covered membership is expected to consist of new hires.

# Historical Contribution Rates and Benefit Payouts

## Computed Contribution Rates

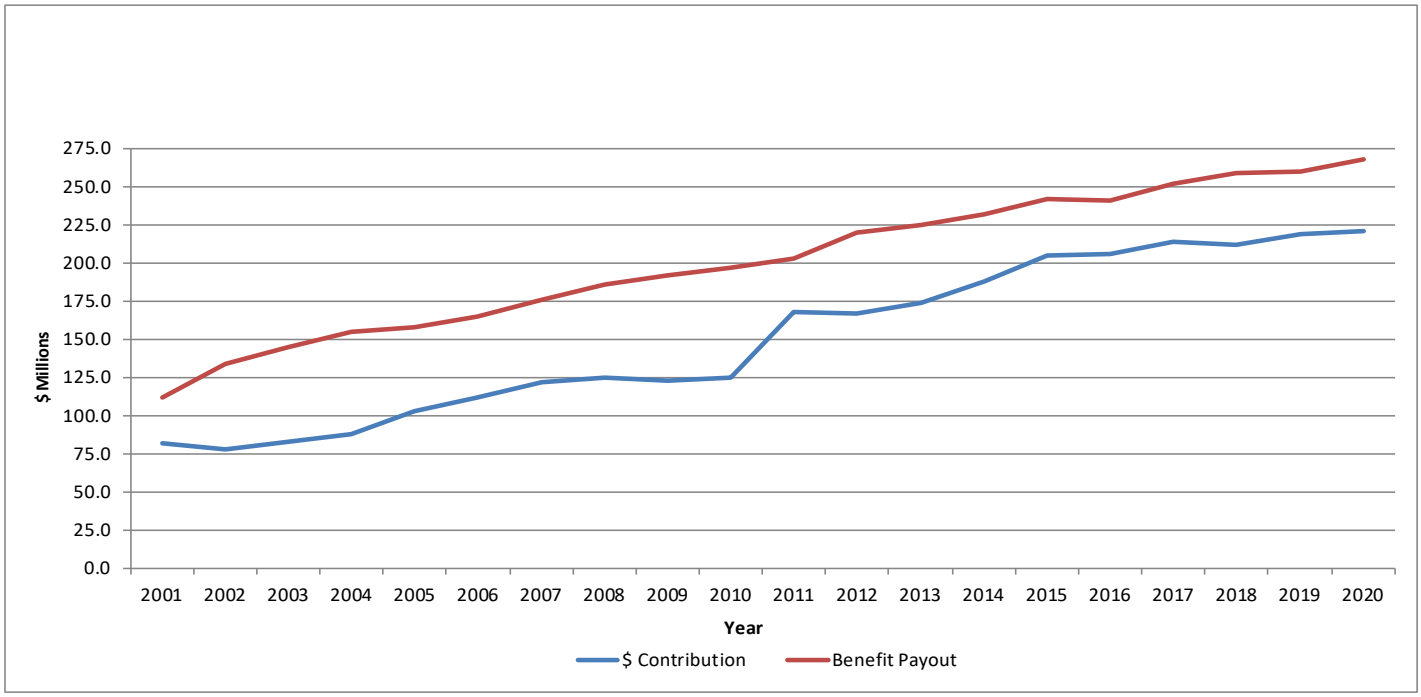



## Contribution Rates vs. Benefit Payout



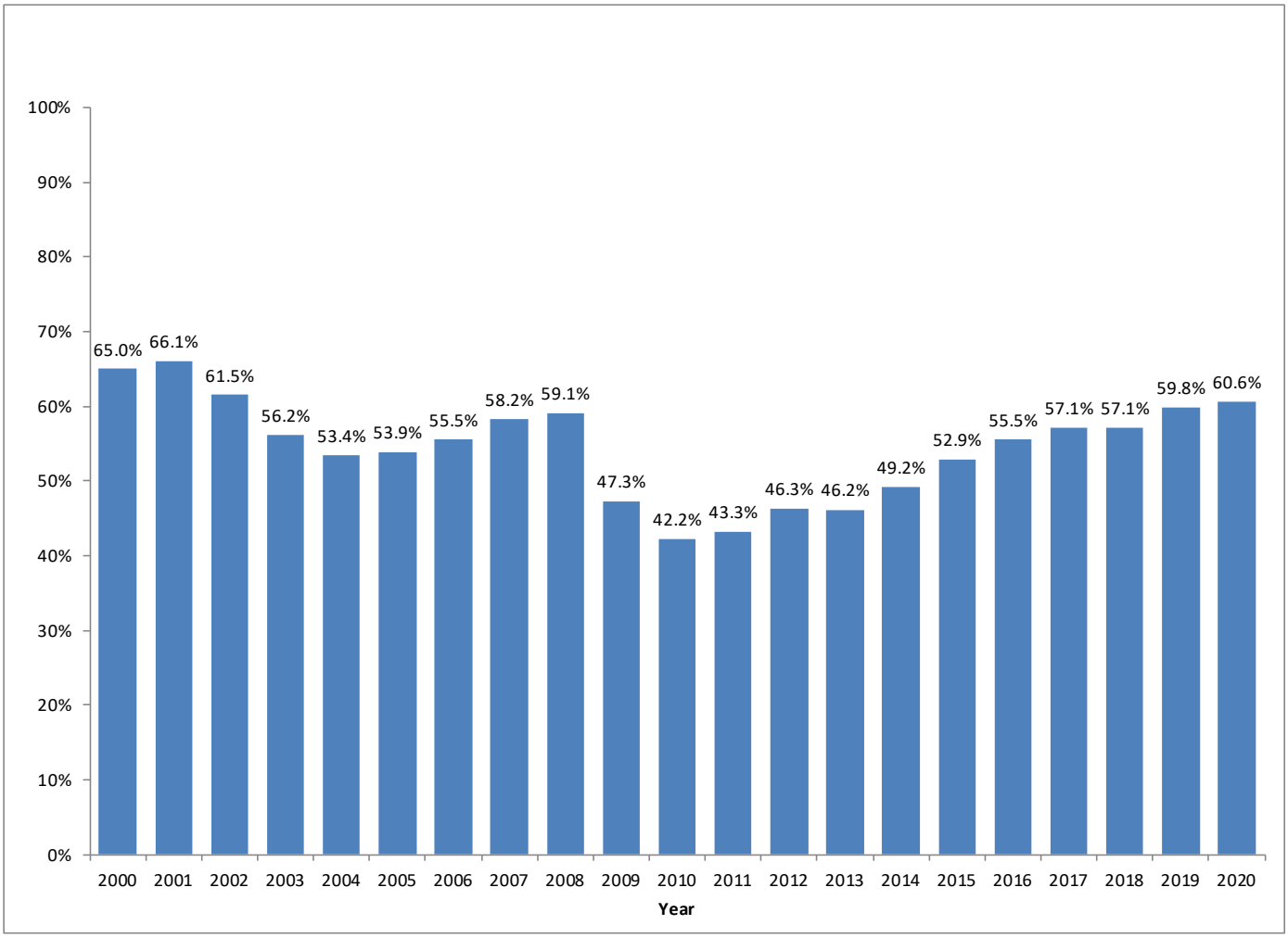
# Historical Contribution Rates and Benefit Payouts (Concluded)

## Contribution Dollars vs. Benefit Payout Dollars (in Millions)



# Historical Funded Ratios

## Actuarial Value of Assets as Percents of Accrued Liabilities (Funded Ratio)




The funded status shown herein is not appropriate to assess the sufficiency of plan assets to cover the estimated cost of settling the Plan's benefit obligations. A funded status below 100% is an indication that additional contributions will be needed in the future, if experience is exactly as assumed. However, a funded status at or above 100% (by itself) cannot be used to determine the need for future contributions.

# SECTION A

## VALUATION RESULTS

# Computed Contributions to Support Benefits for Fiscal Year 2022
# Contributions Computed as of June 30, 2020

| Contributions for | Non-Uniformed Employees | | | Uniformed Patrol | | | MPERS |
|---|---|---|---|---|---|---|---|
| | Closed & Year 2000 | 2011 Tier | Total | Closed & Year 2000 | 2011 Tier | Total | Total |
| Normal Cost | | | | | | | |
| Age & service benefits | 8.06% | 6.32% | 7.38% | 16.21% | 12.03% | 15.13% | 9.22% |
| Disability benefits # | 0.64% | 0.93% | 0.75% | 0.38% | 0.29% | 0.36% | 0.66% |
| Survivor benefits | 0.16% | 0.22% | 0.18% | 0.25% | 0.20% | 0.24% | 0.19% |
| Separation benefits | 1.45% | 1.23% | 1.37% | 0.73% | 0.30% | 0.62% | 1.19% |
| Total Normal Cost | 10.31% | 8.70% | 9.68% | 17.57% | 12.82% | 16.35% | 11.26% |
| Member Contributions | 0.00% | 4.00% | 1.57% | 0.00% | 4.00% | 1.03% | 1.44% |
| Employer Normal Cost | 10.31% | 4.70% | 8.11% | 17.57% | 8.82% | 15.32% | 9.82% |
| Unfunded Actuarial Accrued Liabilities* | | | 48.24% | | | 41.03% | 46.53% |
| Expense Provision | | | 1.12% | | | 1.12% | 1.12% |
| Subtotal | | | 57.47% | | | 57.47% | 57.47% |
| Disability Insurance | | | 0.53% | | | 0.53% | 0.53% |
| Total Contribution Rate | | | 58.00% | | | 58.00% | 58.00% |
| Projected Dollar Contribution | | | $ 170,283,249 | | | $ 51,756,645 | $ 222,039,894 |
| **Prior Year** | | | | | | | |
| Total Contribution Rate | | | 58.00% | | | 58.00% | 58.00% |
| Projected Dollar Contribution | | | $ 168,945,903 | | | $ 52,136,864 | $ 221,082,767 |

\# *Includes costs for benefits payable after conversion to normal retirement and/or benefits payable to survivors. Costs for disability benefits payable prior to conversion are shown under Disability Insurance which is outsourced.*

* *Amortized as a level-percentage of payroll over a 4-year amortization period for unfunded retiree liabilities and a 19-year amortization period for other unfunded liabilities from July 1, 2021 and then increased to achieve a 58% total employer contribution rate.*

# Development of Contribution Stabilization Reserve Fund as of June 30, 2020

| | Non-Uniformed Employees | Uniformed Patrol | Total |
|---|---|---|---|
| Beginning of Year Contribution Stabilization Reserve Fund | $ 162,660,266 | $ 42,121,370 | $ 204,781,636 |
| Growth (to maintain contribution rate) | - | - | - |
| Reduction (to match contribution rate) | (45,884,512) | (15,033,524) | (60,918,036) |
| End of Year Contribution Stabilization Reserve Fund | $ 116,775,754 | $ 27,087,846 | $ 143,863,600 |

At the September 25, 2014 Board meeting, the Board adopted the use of a contribution stabilization reserve fund that would result in an MPERS employer contribution of 58.00% of pay.

At the February 19, 2015 Board meeting, the Board adopted to cap the contribution stabilization reserve fund at $250 million. Furthermore, the Board adopted a motion that if MPERS experienced a loss, MPERS would deplete the entire reserve fund if a loss of that magnitude were to be realized.

In order to determine the current amount of the contribution stabilization reserve fund for the separate groups, we determined the amount of reduction needed to achieve a 58.00% contribution rate for each group.

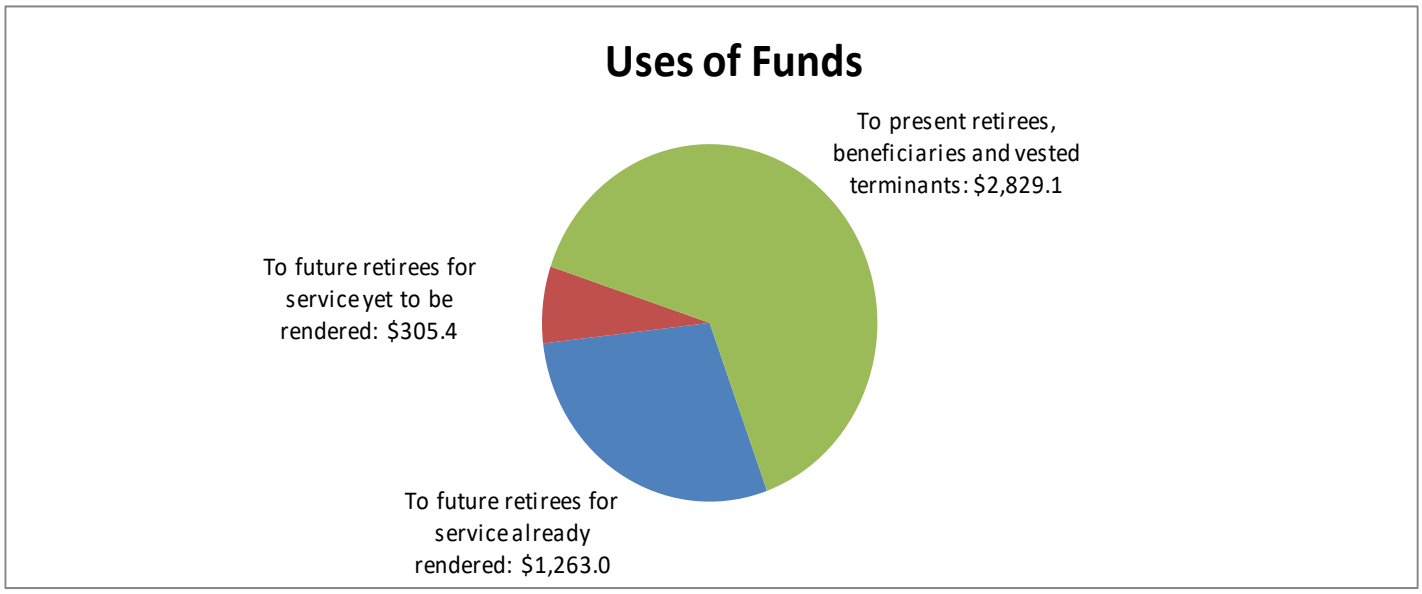
# Development of Liabilities
# as of June 30, 2020

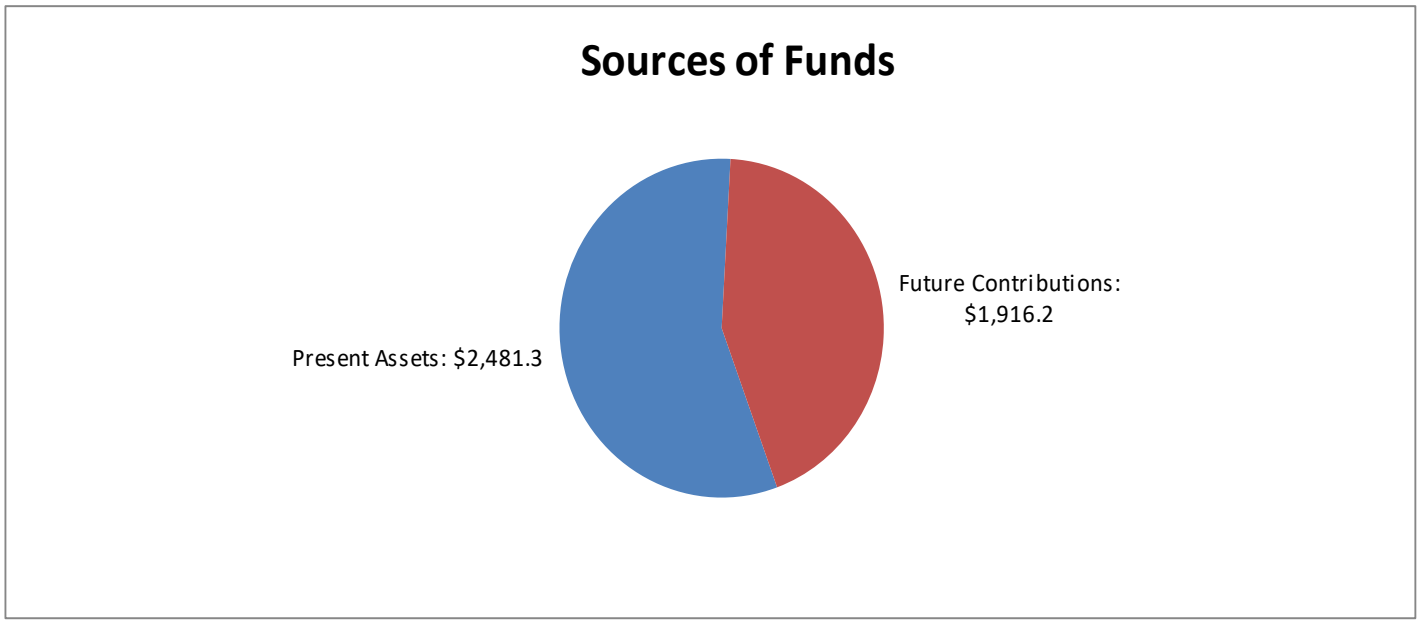
| | Non-Uniformed Employees | Uniformed Patrol | Total |
|---|---|---|---|
| **Present Value of Future Benefits - Inactives** | | | |
| Retirees and Survivors | $1,971,551,281 | $ 732,731,231 | $2,704,282,512 |
| Disability Pensioners | 18,968,646 | 3,132,070 | 22,100,716 |
| Vested Terminated Employees | 87,978,054 | 14,775,314 | 102,753,368 |
| Subtotal PVFB - Inactives | 2,078,497,981 | 750,638,615 | 2,829,136,596 |
| **Present Value of Future Benefits - Actives** | | | |
| Age & Service benefits | 932,109,057 | 536,544,136 | 1,468,653,193 |
| Normal and Work Related Disability benefits | 26,770,628 | 3,218,085 | 29,988,713 |
| Survivor benefits | 11,374,457 | 4,664,269 | 16,038,726 |
| Separation benefits | 49,408,637 | 4,280,378 | 53,689,015 |
| Subtotal PVFB - Actives | 1,019,662,779 | 548,706,868 | 1,568,369,647 |
| **Total Present Value of Future Benefits** | 3,098,160,760 | 1,299,345,483 | 4,397,506,243 |
| **Less Present Value of Future Entry Age Normal Costs** | 186,118,945 | 119,289,401 | 305,408,346 |
| **Equals Actuarial Accrued Liability** | 2,912,041,815 | 1,180,056,082 | 4,092,097,897 |
| **Less Actuarial Value of Assets** | 1,753,380,471 | 727,949,060 | 2,481,329,531 |
| **Equals Unfunded Actuarial Accrued Liability** | 1,158,661,344 | 452,107,022 | 1,610,768,366 |
| **Plus Contribution Stabilization Reserve Fund** | 116,775,754 | 27,087,846 | 143,863,600 |
| **Equals Total Amount Financed** | 1,275,437,098 | 479,194,868 | 1,754,631,966 |
| **Amortization Payment on UAAL*** | $ 141,628,688 | $ 36,613,365 | $ 178,242,053 |
| **as a % of Projected Payroll** | 48.24% | 41.03% | 46.53% |

* *Amortized as a level-percentage of payroll over a 4-year amortization period for unfunded retiree liabilities and a 19-year amortization period for other unfunded liabilities from July 1, 2021 and then increased to achieve a 58% total employer contribution rate.*

# System Resources and Obligations
# Sources and Uses of $4,397.5 Million
# as of June 30, 2020

## ($ Millions)



# Financing Unfunded Actuarial Accrued Liabilities (UAAL) Which Were Calculated Using a Wage Inflation Assumption of 3.00%* and an Investment Return Assumption of 7.00% Compounded Annually 4/19 Year Amortization*

| Fiscal Year Ending June 30 | Active Employee Payroll | Unfunded Actuarial Accrued Liability at End of Year | Annual UAAL Contributions During Fiscal Year | | UAAL at Year End as % of Payroll |
|---|---|---|---|---|---|
| | | | Dollars | % of Payroll | |
| 2020 | $ 360,851,545 | $ 1,610,768,366 | | | |
| 2021 | 371,677,091 | 1,545,903,538 | $ 171,677,648 | 46.19% | 415.9% |
| 2022 | 382,827,404 | 1,469,822,957 | 178,129,591 | 46.53% | 383.9% |
| 2023 | 394,312,226 | 1,382,887,920 | 183,473,479 | 46.53% | 350.7% |
| 2024 | 406,141,593 | 1,284,172,752 | 188,977,683 | 46.53% | 316.2% |
| 2025 | 418,325,841 | 1,172,682,002 | 194,647,014 | 46.53% | 280.3% |
| 2026 | 430,875,616 | 1,128,475,957 | 122,069,526 | 28.33% | 261.9% |
| 2027 | 443,801,884 | 1,077,386,675 | 125,731,612 | 28.33% | 242.8% |
| 2028 | 457,115,941 | 1,018,818,666 | 129,503,560 | 28.33% | 222.9% |
| 2029 | 470,829,419 | 952,131,343 | 133,388,667 | 28.33% | 202.2% |
| 2030 | 484,954,302 | 876,635,769 | 137,390,327 | 28.33% | 180.8% |
| 2031 | 499,502,931 | 791,591,162 | 141,512,037 | 28.33% | 158.5% |
| 2032 | 514,488,019 | 696,201,159 | 145,757,398 | 28.33% | 135.3% |
| 2033 | 529,922,660 | 589,609,814 | 150,130,120 | 28.33% | 111.3% |
| 2034 | 545,820,340 | 470,897,312 | 154,634,024 | 28.33% | 86.3% |
| 2035 | 562,194,950 | 339,075,380 | 159,273,044 | 28.33% | 60.3% |
| 2036 | 579,060,799 | 193,082,369 | 164,051,236 | 28.33% | 33.3% |
| 2037 | 596,432,623 | 31,777,999 | 168,972,773 | 28.33% | 5.3% |
| 2038 | 614,325,602 | -146,062,281 | 174,041,956 | 28.33% | -23.8% |
| 2039 | 632,755,370 | -250,000,000 | 90,578,846 | 14.31% | -39.5% |
| 2040 | 651,738,031 | -250,000,000 | -16,914,662 | -2.60% | -38.4% |

* *Amortized as a level-percentage of payroll over a 4-year amortization period for unfunded retiree liabilities and a 19-year amortization period for other unfunded liabilities from July 1, 2021 and then increased to achieve a 58% total employer contribution rate. Growth of the stabilization fund was capped at $250 million. Payroll was assumed to increase 3.00%.*

# Projected Employer Contributions, 30 Years

| Fiscal Year Ending June 30 | Active Employee Payroll | Annual Employer Contributions During Fiscal Year | |
|---|---|---|---|
| | | Dollars | % of Payroll |
| 2020 | $ 360,851,545 | | |
| 2021 | 371,677,091 | $ 214,309,011 | 57.66% |
| 2022 | 382,827,404 | 222,039,894 | 58.00% |
| 2023 | 394,312,226 | 228,701,091 | 58.00% |
| 2024 | 406,141,593 | 235,562,124 | 58.00% |
| 2025 | 418,325,841 | 242,628,988 | 58.00% |
| 2026 | 430,875,616 | 171,490,959 | 39.80% |
| 2027 | 443,801,884 | 176,635,688 | 39.80% |
| 2028 | 457,115,941 | 181,934,759 | 39.80% |
| 2029 | 470,829,419 | 187,392,801 | 39.80% |
| 2030 | 484,954,302 | 193,014,585 | 39.80% |
| 2031 | 499,502,931 | 198,805,023 | 39.80% |
| 2032 | 514,488,019 | 204,769,174 | 39.80% |
| 2033 | 529,922,660 | 210,912,249 | 39.80% |
| 2034 | 545,820,340 | 217,239,617 | 39.80% |
| 2035 | 562,194,950 | 223,756,805 | 39.80% |
| 2036 | 579,060,799 | 230,469,509 | 39.80% |
| 2037 | 596,432,623 | 237,383,595 | 39.80% |
| 2038 | 614,325,602 | 244,505,103 | 39.80% |
| 2039 | 632,755,370 | 163,155,887 | 25.78% |
| 2040 | 651,738,031 | 57,839,691 | 8.87% |
| 2041 | 671,290,172 | 60,082,321 | 8.95% |
| 2042 | 691,428,877 | 62,392,231 | 9.02% |
| 2043 | 712,171,743 | 64,771,437 | 9.09% |
| 2044 | 733,536,895 | 67,222,020 | 9.16% |
| 2045 | 755,543,002 | 69,746,121 | 9.23% |
| 2046 | 778,209,292 | 72,345,944 | 9.30% |
| 2047 | 801,555,571 | 75,023,762 | 9.36% |
| 2048 | 825,602,238 | 77,781,915 | 9.42% |
| 2049 | 850,370,305 | 80,622,812 | 9.48% |
| 2050 | 875,881,414 | 83,548,937 | 9.54% |

# Projected Employer Contributions and Benefit Payment, 5 Years

| Fiscal Year Ending June 30 | Projected Annual Employer Contributions During Fiscal Year Dollars | Projected Annual Benefit Payments During Fiscal Year * Dollars |
|---|---|---|
| 2020 | | |
| 2021 | $ 214,309,011 | $ 264,748,880 |
| 2022 | 222,039,894 | 271,283,872 |
| 2023 | 228,701,091 | 278,267,072 |
| 2024 | 235,562,124 | 285,107,557 |
| 2025 | 242,628,988 | 293,320,629 |

* *Projected benefit payments include assumed backdrop elections, but does not include any other optional forms of payment elections (other than straight life)*

# Historical Funding Progress
# June 30, 2020

| Year Ending June 30 | Actuarial Asset Value | Entry Age Accrued Liability | Unfunded Accrued Liability (UAAL) | Funded Ratio | Estimated Covered Payroll** | UAAL as a Percentage of Covered Payroll |
|---|---|---|---|---|---|---|
| 2011 | $ 1,427,290,718 | $ 3,297,589,869 | $ 1,870,299,151 | 43.28% | $ 362,654,376 | 515.72% |
| 2012# | 1,531,033,613 | 3,306,278,671 | 1,775,245,058 | 46.31% | 341,637,559 | 519.63% |
| 2013# | 1,657,402,393 | 3,583,975,559 | 1,926,573,166 | 46.24% | 329,481,506 | 584.73% |
| 2014 | 1,795,264,291 | 3,650,241,741 | 1,854,977,450 | 49.18% | 336,590,797 | 551.11% |
| 2015 | 1,967,001,509 | 3,715,845,651 | 1,748,844,142 | 52.94% | 342,264,593 | 510.96% |
| 2016 | 2,086,654,348 | 3,761,733,004 | 1,675,078,656 | 55.47% | 344,275,147 | 486.55% |
| 2017 | 2,172,787,144 | 3,802,443,730 | 1,629,656,586 | 57.14% | 356,142,973 | 457.58% |
| 2018# | 2,274,248,122 | 3,981,838,941 | 1,707,590,819 | 57.12% | 353,371,000 | 483.23% |
| 2019 | 2,415,343,431 | 4,037,369,708 | 1,622,026,277 | 59.82% | 362,356,771 | 447.63% |
| **2020** | **2,481,329,531** | **4,092,097,897** | **1,610,768,366** | **60.64%** | **363,572,158** | **443.04%** |

** *Values are estimated from contribution rate and amount.*

\# *New assumptions and/or methods adopted.*

# Historical Employer Contributions
# Non-Uniformed Group ##
# June 30, 2020

| Valuation Date | Fiscal Year Ending June 30, | Estimated Covered Payroll** | Actual Employer Contributions | Actual Employer Contribution % | Annually Determined Employer Contribution (ADEC) % | Annually Determined Employer Contribution (ADEC) $ | Percentage of ADEC Contributed |
|---|---|---|---|---|---|---|---|
| June 30, 2008 | 2010# | $ 310,637,016 | $ 97,540,023 | 31.40% | 31.40% | $ 97,540,023 | 100.00% |
| June 30, 2009 | 2011 | 294,637,164 | 116,263,825 | 39.46% | 39.46% | 116,263,825 | 100.00% |
| June 30, 2010 | 2012# | 268,722,565 | 122,134,406 | 45.45% | 45.45% | 122,134,406 | 100.00% |
| June 30, 2011 | 2013 | 254,928,368 | 129,809,525 | 50.92% | 50.92% | 129,809,525 | 100.00% |
| June 30, 2012 | 2014# | 259,720,022 | 140,898,112 | 54.25% | 54.25% | 140,898,112 | 100.00% |
| June 30, 2013 | 2015 | 258,737,537 | 152,034,177 | 58.76% | 58.76% | 152,034,177 | 100.00% |
| June 30, 2014 | 2016 | 260,714,141 | 151,344,559 | 58.05% | 58.05% | 151,344,559 | 100.00% |
| June 30, 2015 | 2017 | 269,522,202 | 156,322,877 | 58.00% | 58.00% | 156,322,877 | 100.00% |
| June 30, 2016 | 2018# | 269,229,112 | 156,152,885 | 58.00% | 58.00% | 156,152,885 | 100.00% |
| June 30, 2017 | 2019 | 276,575,119 | 160,413,569 | 58.00% | 58.00% | 160,413,569 | 100.00% |
| **June 30, 2018** | **2020** | **278,280,036** | **161,402,421** | **58.00%** | **58.00%** | **161,402,421** | **100.00%** |

** *Values are estimated from contribution rate and amount.*

\# *New assumptions and/or methods adopted.*

## *Includes non-uniformed employees of MoDOT, Patrol, and MPERS.*

This information is presented in draft form for review by the System's auditor. Please let us know if there are any items that the auditor changes so that we may maintain consistency with the System's financial statements.

# Historical Employer Contributions
# Uniformed Patrol Group
# June 30, 2020

| Valuation Date | Fiscal Year Ending June 30, | Estimated Covered Payroll** | Actual Employer Contributions | Actual Employer Contribution % | Annually Determined Employer Contribution (ADEC) % | Annually Determined Employer Contribution (ADEC) $ | Percentage of ADEC Contributed |
|---|---|---|---|---|---|---|---|
| June 30, 2008 | 2010# | $ 67,425,990 | $ 26,936,683 | 39.95% | 39.95% | $ 26,936,683 | 100.00% |
| June 30, 2009 | 2011 | 68,017,212 | 33,688,925 | 49.53% | 49.53% | 33,688,925 | 100.00% |
| June 30, 2010 | 2012# | 72,914,994 | 42,750,061 | 58.63% | 58.63% | 42,750,061 | 100.00% |
| June 30, 2011 | 2013 | 74,553,138 | 41,026,592 | 55.03% | 55.03% | 41,026,592 | 100.00% |
| June 30, 2012 | 2014# | 76,870,775 | 42,455,729 | 55.23% | 55.23% | 42,455,729 | 100.00% |
| June 30, 2013 | 2015 | 83,527,056 | 48,604,394 | 58.19% | 58.19% | 48,604,394 | 100.00% |
| June 30, 2014 | 2016 | 83,561,006 | 48,264,837 | 57.76% | 57.76% | 48,264,837 | 100.00% |
| June 30, 2015 | 2017 | 86,620,771 | 50,240,047 | 58.00% | 58.00% | 50,240,047 | 100.00% |
| June 30, 2016 | 2018# | 84,141,888 | 48,802,295 | 58.00% | 58.00% | 48,802,295 | 100.00% |
| June 30, 2017 | 2019 | 85,781,652 | 49,753,358 | 58.00% | 58.00% | 49,753,358 | 100.00% |
| **June 30, 2018** | **2020** | **85,292,122** | **49,469,431** | **58.00%** | **58.00%** | **49,469,431** | **100.00%** |

** *Values are estimated from contribution rate and amount.*

\# *New assumptions and/or methods adopted.*

This information is presented in draft form for review by the System's auditor. Please let us know if there are any items that the auditor changes so that we may maintain consistency with the System's financial statements.

# Development of Gain/(Loss)
# July 1, 2019 to June 30, 2020

| | UAAL = | AAL - | Assets |
|---|---|---|---|
| Beginning of Year Values (at July 1) | $ 1,622,026,277 | $ 4,037,369,708 | $ 2,415,343,431 |
| Normal Cost | 48,303,944 | 48,303,944 | 0 |
| Transfer In and Service Purchase - Liability | 5,046,936 | 5,046,936 | 0 |
| Contributions | (220,902,777) | 0 | 220,902,777 |
| Disbursements | 0 | (271,896,861) | (271,896,861) |
| Interest | 107,677,522 | 274,966,770 | 167,289,248 |
| Expected Value Before Any Changes | 1,562,151,902 | 4,093,790,497 | 2,531,638,595 |
| Effect of Benefit Changes | 0 | 0 | 0 |
| Effect of Changes in Assumptions & Methods | 0 | 0 | 0 |
| Effect of Adjustment | 0 | 0 | 0 |
| Expected Value After Changes | 1,562,151,902 | 4,093,790,497 | 2,531,638,595 |
| End of Year Values (at June 30) | 1,610,768,366 | 4,092,097,897 | 2,481,329,531 |
| Gain/(Loss) for Year | $ (48,616,464) | $ 1,692,600 | $ (50,309,064) |

# Development of Gain/(Loss)
# July 1, 2019 to June 30, 2020

| | Total | Non-Uniformed | Uniformed |
|---|---|---|---|
| Beginning of Year UAAL (at July 1) | $ 1,622,026,277 | $ 1,176,812,729 | $ 445,213,548 |
| Normal Cost | 48,303,944 | 32,324,266 | 15,979,678 |
| Transfer In and Service Purchase - Liability | 5,046,936 | 3,958,421 | 1,088,515 |
| Contributions | (220,902,777) | (169,515,565) | (51,387,212) |
| Interest | 107,677,522 | 77,713,740 | 29,963,782 |
| Net Change in LTD Assets | 0 | 0 | 0 |
| Expected Value Before Any Changes | 1,562,151,902 | 1,121,293,591 | 440,858,311 |
| Effect of Benefit Changes | 0 | 0 | 0 |
| Effect of Changes in Assumptions & Methods | 0 | 0 | 0 |
| Effect of Adjustment | 0 | 0 | 0 |
| Expected Value After Changes | 1,562,151,902 | 1,121,293,591 | 440,858,311 |
| End of Year UAAL (at June 30) | 1,610,768,366 | 1,158,661,344 | 452,107,022 |

| | | | |
|---|---|---|---|
| Aggregate Gain/(Loss) for Year | $ (48,616,464) | $ (37,367,753) | $ (11,248,711) |
| Gain/(Loss) as a % of Beginning of Year Liabilities | (1.20)% | (1.30)% | (0.98)% |

| | | | |
|---|---|---|---|
| Asset Gain/(Loss) for Year | $ (50,309,064) | $ (35,588,748) | $ (14,720,316) |
| Liability Gain/(Loss) for Year | 1,692,600 | (1,779,005) | 3,471,605 |
| Aggregate Gain/(Loss) for Year | $ (48,616,464) | $ (37,367,753) | $ (11,248,711) |

# Risk Measures

**Plan Maturity Measures:** Risks facing a pension plan evolve over time. A young plan with virtually no investments and paying few benefits may experience little investment risk. An older plan with a large number of members in pay status and a significant trust may be much more exposed to investment risk. Generally accepted plan maturity measures include the following:

| | 2020 | 2019 |
|---|---|---|
| Ratio of the market value of assets to total payroll | 6.54 | 6.74 |
| Ratio of actives to retirees and beneficiaries | 1.25 | 1.22 |
| Duration of the actuarial liability | 11.36 | 11.52 |

**Ratio of Market Value of Assets to Payroll:** The relationship between assets and payroll is a useful indicator of the potential volatility of contributions. For example, if the market value of assets is 2.0 times the payroll, a return on assets 5% different than assumed would equal 10% of payroll. A higher (lower) or increasing (decreasing) level of this maturity measure generally indicates a higher (lower) or increasing (decreasing) volatility in plan sponsor contributions as a percentage of payroll.

**Ratio of Actives to Retirees and Beneficiaries:** A young plan with many active members and few retirees will have a high ratio of active to retirees. A mature open plan may have close to the same number of actives to retirees resulting in a ratio near 1.0. A super-mature or closed plan may have significantly more retirees than actives resulting in a ratio below 1.0.

**Duration of Actuarial Liability:** The duration of the actuarial liability may be used to approximate the sensitivity to a 1% change in the assumed rate of return. For example, a duration of 10 indicates that the liability would increase approximately 10% if the assumed rate of return were lowered 1%.

**Additional Risk Assessment:** Additional risk assessment is outside the scope of the annual actuarial valuation. Additional assessment may include scenario tests, sensitivity tests, stochastic modeling, stress tests, and a comparison of the present value of accrued benefits at low-risk discount rates with the actuarial accrued liability.

A table of additional historical risk measures is shown on the next page.

# Risk Measures

## ($ Thousands)

| Valuation Date June 30 | (1) Accrued Liabilities (AAL) | (2) Market Value of Assets | (3) Unfunded AAL (1)-(2) | (4) Valuation Payroll | (5) Funded Ratio (2)/(1) | (6) Liability/ Payroll (1)/(4) | (7) Assets/ Payroll (2)/(4) | (8) Unfunded/ Payroll (3)/(4) | (9) Portfolio Rate of Return | (10) 10-Year Trailing Average | (11) Non-Investment Net Cash Flow | (12) Non-Investment Net Cash Flow Percent of Beginning of Year Assets (11)/(2[Prior Year]) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | $ 3,761,733 | $ 1,992,074 | $ 1,769,659 | $ 339,799 | 53.0% | 1,107.0% | 586.2% | 520.8% | 1.1% | N/A | $ (38,725) | (1.9)% |
| 2017 | 3,802,444 | 2,169,775 | 1,632,669 | 348,979 | 57.1% | 1,089.6% | 621.8% | 467.8% | 11.2% | N/A | (42,601) | (2.1)% |
| 2018 | 3,981,839 | 2,314,530 | 1,667,309 | 351,497 | 58.1% | 1,132.8% | 658.5% | 474.3% | 9.2% | N/A | (51,928) | (2.4)% |
| 2019 | 4,037,370 | 2,423,262 | 1,614,108 | 359,296 | 60.0% | 1,123.7% | 674.5% | 449.2% | 6.7% | N/A | (45,595) | (2.0)% |
| 2020 | 4,092,098 | 2,361,600 | 1,730,498 | 360,852 | 57.7% | 1,134.0% | 654.4% | 479.6% | -0.4% | N/A | (50,994) | (2.1)% |

(5) The funded ratio is the most widely known measure of a plan's financial strength, but the trend in the funded ratio is much more important than the absolute ratio. The funded ratio should trend to 100%. As it approaches 100%, it is important to re-evaluate the level of investment risk in the portfolio and potentially to re-evaluate the assumed rate of return.

(6) and (7) the ratio of liabilities and assets to payroll gives an indication of both maturity and volatility. Many systems have values between 500% and 700%. Values significantly above that range may indicate difficulty in supporting the benefit level as a level % of payroll.

(8) The ratio of unfunded liability to payroll gives an indication of the plan's sensitivity to differences between assumed and actual experience related to the employer contributions. A value above approximately 300% or 400% may indicate high volatility relative to small gains and losses.

(9) and (10) Investment return is probably the largest single risk that most systems face. The year-by-year return and the 10-year geometric average give an indicator of the realism of the System's assumed return.

(11 and 12) Non-Divestment Net Cash Flow is a measure of both risk and maturity. For a mature plan the absolute value of (12) should be in the order of the assumed real rate of return over wage inflation (currently assumed to be 4.00%). A more negative number indicates a plan that is more at risk of fund depletion and more sensitive to annual gains and losses.

# SECTION B

## SUMMARY OF BENEFITS

# Missouri Department of Transportation and Highway Patrol Employees' Retirement System
# Summary of Benefit Provisions Evaluated as of June 30, 2020

| Closed Plan | Year 2000 Plan | 2011 Tier |
|---|---|---|

### Participation

Participants include:

All MPERS active members, vested terminated members, disability recipients, retirees and survivors who first became members prior to July 1, 2000 and who do not elect to transfer to the Year 2000 Plan at retirement.

### Participation

Participants include:

1. All active employees who first became members on or after July 1, 2000 but prior to January 1, 2011.
2. Closed Plan active members and vested former members who elect to transfer to the Year 2000 Plan at retirement.
3. Closed Plan retirees who elected to transfer to the Year 2000 Plan during the election window from July 1, 2000 through July 1, 2001, and their survivors.
4. Closed Plan members who left state employment prior to becoming vested (not eligible for a future retirement benefit) and return to work in a benefit eligible position on or after July 1, 2000.

### Participation

Participants include:

1. All employees who first become members on or after January 1, 2011.

| Closed Plan | Year 2000 Plan | 2011 Tier |
|---|---|---|
| **Normal Retirement Eligibility (unreduced benefit)** | **Normal Retirement Eligibility (unreduced benefit)** | **Normal Retirement Eligibility (unreduced benefit)** |
| ***Non-Uniformed Employees:*** The earlier of attaining:<br>1. Age 65 with at least 4 years of creditable service.<br>2. Age 60 with at least 15 years of creditable service.<br>3. Age 48 with age plus creditable service equal to 80 or more.<br>4. Age 65 with at least 5 years of service (deferred).* | ***Non-Uniformed Employees:*** The earlier of attaining:<br>1. Age 62 with at least 5 years of creditable service.<br>2. Age 48 with age plus creditable service equal to 80 or more. | ***Non-Uniformed Employees:*** The earlier of attaining:<br>1. Age 67 with at least 5 years of creditable service.<br>2. Age 55 with age plus creditable service equal to 90 or more. |
| ***Uniformed Patrol Employees Only:*** The earlier of attaining:<br>1. Age 55 with at least 4 years of creditable service.<br>2. Mandatory retirement at age 60.<br>3. Age 48 with age plus creditable service equal to 80 or more. | ***Uniformed Patrol Employees Only:*** The earlier of attaining:<br>1. Mandatory retirement at age 60.<br>2. Age 48 with age plus creditable service equal to 80 or more. | ***Uniformed Patrol Employees Only:*** The earlier of attaining:<br>1. Age 55 with at least 5 years of creditable service.<br>2. Mandatory retirement at age 60. |
| **Final Average Pay Used for Benefit Determination** | **Final Average Pay Used for Benefit Determination** | **Final Average Pay Used for Benefit Determination** |
| Final Average Pay is the average annual pay of a member for the three consecutive years of service during which pay was highest (overtime pay is included for purposes of determining average pay). Employees terminating after reaching retirement eligibility will receive 1/12 of a year of creditable service for every 168 hours of unused sick leave (usable only for benefit computation, not eligibility). | Final Average Pay is the average annual pay of a member for the three consecutive years of service during which pay was highest (overtime pay is included for purposes of determining average pay). All vested members will receive 1/12 of a year of creditable service for every 168 hours of unused sick leave (usable only for benefit computation, not eligibility). | Final Average Pay is the average annual pay of a member for the three consecutive years of service during which pay was highest (overtime pay is included for purposes of determining average pay). Employees terminating after reaching retirement eligibility will receive 1/12 of a year of creditable service for every 168 hours of unused sick leave (usable only for benefit computation, not eligibility). |

**See Chapter 104.010.1(32) RSMo*

| Closed Plan | Year 2000 Plan | 2011 Tier |
|---|---|---|
| **Normal Retirement Benefit Amount** | **Normal Retirement Benefit Amount** | **Normal Retirement Benefit Amount** |
| ***Non-Uniformed Employees:***<br>Life Benefit: 1.6% of final average pay times years of creditable service.<br>***Uniformed Patrol Employees:***<br>Life Benefit: 2.1333% of final average pay times years of creditable service.<br>Special Benefit: $90 per month payable until age 65. Offset by any amount earned from gainful employment. This benefit does not apply to uniformed members hired on or after January 1, 1995. | ***All Employees:***<br>Life Benefit: 1.7% of final average pay times years of creditable service.<br>Temporary Benefit:<br>If member retires between ages 48 and 62 with age plus creditable service equal to 80 or more, a temporary benefit is payable in the amount of 0.8% of final average pay times years of creditable service until attainment of age 62 or death, whichever occurs first. All Uniformed Patrol members are eligible for the temporary benefit until age 62. | ***All Employees:***<br>Life Benefit: 1.7% of final average pay times years of creditable service.<br>Temporary Benefit:<br>If member retires between ages 55 and 62 with age plus creditable service equal to 90 or more, a temporary benefit is payable in the amount of 0.8% of final average pay times years of creditable service until attainment of age 62 or death, whichever occurs first. All Uniformed Patrol members are eligible for the temporary benefit until age 62. |
| **Early Retirement (reduced benefit)** | **Early Retirement (reduced benefit)** | **Early Retirement (reduced benefit)** |
| ***Eligibility: Non-Uniformed Employees***<br>Age 55 with at least 10 years of creditable service.<br>***Amount:***<br>Normal retirement amount reduced by 0.6% for each month that retirement precedes eligibility for normal retirement.<br>***Uniformed Patrol*** members are not eligible for early retirement. | ***Eligibility: All Employees***<br>Age 57 with at least 5 years of creditable service.<br>***Amount:***<br>Normal retirement amount reduced by 0.5% for each month that retirement precedes eligibility for normal retirement. | ***Eligibility: All Active Non-Uniformed Employees***<br>Age 62 with at least 5 years of creditable service.<br>***Amount:***<br>Normal retirement amount reduced by 0.5% for each month that retirement precedes eligibility for normal retirement.<br>***Uniformed Patrol*** members are not eligible for early retirement. |

| Closed Plan | Year 2000 Plan | 2011 Tier |
|---|---|---|
| **Vested Deferred Benefits** | **Vested Deferred Benefits** | **Vested Deferred Benefits** |
| ***Eligibility: All Employees***<br>Fully vested in accrued pension with 5 years of creditable service. The benefit will commence at the age the individual is eligible for early or normal retirement, considering years of creditable service. | ***Eligibility: All Employees***<br>Fully vested in accrued pension with 5 years of creditable service. The benefit will commence at the age the individual is eligible for early or normal retirement considering years of creditable service. Normal retirement eligibility begins at age 62. | ***Eligibility: All Employees***<br>Fully vested in accrued pension with 5 years of creditable service. The benefit will commence at the age the individual is eligible for normal retirement considering years of creditable service. Normal retirement eligibility begins at age 67. |
| **Minimum Base Benefit** | **Minimum Base Benefit** | **Minimum Base Benefit** |
| Receive a monthly base benefit of no less than $15 for each full year of creditable service. Must be eligible to receive a normal or early retirement benefit the first of the month immediately following the date you leave state employment. Not required to immediately start drawing a benefit. | Same. | Same. |
| **Death Prior to Retirement** | **Death Prior to Retirement** | **Death Prior to Retirement** |
| The spouse of the member who dies after accruing 5 years of creditable service may elect to receive an annuity as if the employee had retired on the date of death and elected a joint and 100% survivor annuity.<br><br>If no eligible spouse survives or upon the death of the spouse, 80% of the member's accrued annuity will be paid to eligible children until age 21.<br><br>If the member has 3 or more, but less than 5 years of creditable service, the surviving spouse may elect to receive an annuity equal to 25% of the accrued benefit.<br><br>If the death is duty-related, there is no service requirement and the minimum annuity is 50% of the final average pay (FAP) to the surviving spouse or eligible children. | The spouse of the member who dies after accruing 5 years of creditable service may elect to receive an annuity as if the employee had retired on the date of death and elected a joint and 100% survivor annuity.<br><br>If no eligible spouse survives or upon the death of the spouse, 80% of the member's accrued annuity will be paid to eligible children until age 21.<br><br>If the death is duty related, there is no service requirement and the minimum annuity is 50% of the final average pay (FAP) to the surviving spouse or eligible children. | **Actives:** The spouse of the member who dies after accruing 5 years of creditable service may elect to receive an annuity as if the employee had retired on the date of death and elected a joint and 100% survivor annuity. **Deferred:** The spouse of a vested former member who dies after accruing 5 years of creditable service may elect to receive an annuity on the date the member would have attained normal retirement eligibility based on a joint and 100% survivor annuity election.<br><br>If no eligible spouse survives or upon the death of the spouse, 80% of the member's accrued annuity will be paid to eligible children until age 21.<br><br>If the death is duty related, there is no service requirement and the minimum annuity is 50% of the final average pay (FAP) to the surviving spouse or eligible children. |

| Closed Plan | Year 2000 Plan | 2011 Tier |
|---|---|---|
| **Death After Retirement** | **Death After Retirement** | **Death After Retirement** |
| The benefit payable is 50% of the benefit the retired member was receiving on the date of death (the normal form of payment), or the benefit payable under the joint and survivor or period certain form of payment, if the member elected an optional form of payment at time of retirement.<br><br>A member who is not married at retirement but marries thereafter may designate a spouse as beneficiary. Additionally, a member may designate a new spouse as beneficiary in the event of the death of the spouse the member was married to at the date of retirement. The election must be completed within one year of the date of marriage.<br><br>For period certain annuities, beneficiaries may be changed at any time. | The benefit payable under the joint and survivor or period certain form of payment, if the member elected an optional form of payment at time of retirement.<br><br>A member who is not married at retirement but marries thereafter may designate a spouse as beneficiary. Additionally, a member may designate a new spouse as beneficiary in the event of the death of the spouse the member was married to at the date of retirement. The election must be completed within one year of the date of marriage.<br><br>For period certain annuities, beneficiaries may be changed at any time. | The benefit payable under the joint and survivor or period certain form of payment, if the member elected an optional form of payment at time of retirement.<br><br>A member who is not married at retirement but marries thereafter may designate a spouse as beneficiary. Additionally, a member may designate a new spouse as beneficiary in the event of the death of the spouse the member was married to at the date of retirement. The election must be completed within one year of the date of marriage.<br><br>For period certain annuities, beneficiaries may be changed at any time. |
| **Pop-Up Provision** | **Pop-Up Provision** | **Pop-Up Provision** |
| Benefits to members who choose a reduced survivor form of payment and whose spouse precedes the member in death, will “pop-up” or revert to the amount the member would have received had he/she not elected a reduced survivor option. | Same. | Same. |

| Closed Plan | Year 2000 Plan | 2011 Tier |
|---|---|---|
| **$5,000 Death Benefit**<br>MPERS provides a $5,000 death benefit for a designated beneficiary(ies) of members who retire from service or were approved for normal or work-related disability benefits after September 28, 1985. Members who die while on terminated vested status or long-term disability status do not qualify for this benefit. Long-term disability recipients who retire on or after September 28, 1985 are eligible to receive this benefit. | **$5,000 Death Benefit**<br>MPERS provides a $5,000 death benefit for a designated beneficiary(ies) of members who retire from service or were approved for work-related disability benefits. Members who die while on terminated vested status or long-term disability status do not qualify for this benefit. Long-term disability recipients who retire are eligible to receive this benefit. | **$5,000 Death Benefit**<br>MPERS provides a $5,000 death benefit for a designated beneficiary(ies) of members who retire from service or were approved for work-related disability benefits. Members who die while on terminated vested status or long-term disability status do not qualify for this benefit. Long-term disability recipients who retire are eligible to receive this benefit. |
| **Purchase of Service**<br>**Military:** Prior to retirement, qualifying members may purchase up to a maximum of 4 years military service that includes active service, and/or active and inactive duty training from which they were honorably discharged. All months the member is eligible for must be purchased. This service credit ***can*** be used to satisfy the vesting requirement. Periods of military service cannot coincide with employment in a state agency. | **Purchase of Service**<br>**Military:** Prior to retirement, qualifying members may purchase up to a maximum of 4 years military service that includes active service from which they were honorably discharged. All months the member is eligible for must be purchased. This service credit ***cannot*** be used to satisfy the vesting requirement. Periods of military service cannot coincide with employment in a state agency. | **Purchase of Service**<br>**Military:** Not available. |
| **Police Service:** Prior to retirement, uniformed patrol members only, may purchase up to a maximum of 4 years police service. Members must purchase all months of service they are eligible for. | **Police Service:** Not available. | **Police Service:** Not available. |

| Closed Plan | Year 2000 Plan | 2011 Tier |
|---|---|---|
| **Portability:** Section 105.691 allows vested members to acquire (purchase/transfer) service credit for any non-federal, full-time public sector employment within Missouri.<br><br>Service may be purchased/transferred by using the member's own money and/or using the value of the retirement benefit in the prior retirement plan if that plan has an agreement with MPERS. Any non-federal public employment **not covered** by a retirement plan must be purchased. | **Portability:** Same as Closed Plan Section 105.691. | **Portability:** Same as Closed Plan Section 105.691. |
| **Public Employment Prior Service (Subsidized Purchase)** | **Public Employment Prior Service (Subsidized Purchase)** | **Public Employment Prior Service (Subsidized Purchase)** |
| Section 104.040.6 allows, prior to retirement, members may purchase up to a maximum of 4 years full-time "public employment." Public employment refers to employment with a city, county, municipality, public school, or other political subdivision. Federal and out-of-state employment is not eligible. Members must purchase all months of service they are eligible for up to 4 years. | Not available. | Not available. |
| **Disability** | **Disability** | **Disability** |
| Benefits that may be payable during the period of disability (whether Normal, Work-related, or LTD) are administered through a separate program and were not considered for purposes of the valuation.<br><br>Normal retirement benefits become payable at the time a disabled member becomes eligible for normal retirement, and are computed based on: i) the service that would have accrued to the member if active employment had continued; and ii) the member's rate of pay at the time of disability. | Benefits that may be payable during the period of disability (whether Normal, Work-related, or LTD) are administered through a separate program and were not considered for purposes of the valuation.<br><br>Normal retirement benefits become payable at the time a disabled member becomes eligible for normal retirement, and are computed based on: i) the service that would have accrued to the member if active employment had continued; and ii) the member's rate of pay at the time of disability increased by 80% of CPI to the retirement date. | Benefits that may be payable during the period of disability (whether Normal, Work-related, or LTD) are administered through a separate program and were not considered for purposes of the valuation.<br><br>Normal retirement benefits become payable at the time a disabled member becomes eligible for normal retirement, and are computed based on: i) the service that would have accrued to the member if active employment had continued; and ii) the member's rate of pay at the time of disability increased by 80% of CPI to the retirement date. |

| Closed Plan | Year 2000 Plan | 2011 Tier |
|---|---|---|
| **Post-Retirement Benefit Adjustments**<br>For active and inactive employees hired prior to August 28, 1997 and current retirees, the benefits of pensioners and their beneficiaries are increased annually by 80% of the increase in the Consumer Price Index (subject to a maximum increase of 5% and a minimum of 4%). These increases are made until the total of the increases reaches 65% of initial benefit at which time the increases will have the minimum removed.<br><br>For employees hired on or after August 28, 1997 the annual percentage increase is equal to the lesser of:<br>i) 80% of the CPI-U increase, or<br>ii) 5%. | **Post-Retirement Benefit Adjustments**<br>Benefits are increased to retired members (including survivors) annually in accordance with the following:<br><br>Annual benefit percentage increase equal to the lesser of:<br>i) 80% of the CPI-U increase, or<br>ii) 5%. | **Post-Retirement Benefit Adjustments**<br>Benefits are increased to retired members (including survivors) annually* in accordance with the following:<br><br>Annual benefit percentage increase equal to the lesser of:<br>i) 80% of the CPI-U increase, or<br>ii) 5%.<br><br>** Vested former members and their survivor benefits are increased beginning on the second anniversary of retirement.* |
| **Member Contributions**<br>None. | **Member Contributions**<br>None. | **Member Contributions**<br>4% contributions with interest credited annually at a rate equal to the investment rate published by the US Department of Treasury for 52-week treasury bill, nearest the preceding July 1st. The state of Missouri employer shall pick up and pay the contributions. A deduction shall be made from each member's compensation equal to the amount of the member's contributions picked up by the employer. |

# The Closed Plan and Year 2000 Plan
# BackDROP Option

Legislation effective January 1, 2002 provides a Deferred Retirement Option Provision (BackDROP) to members of MPERS. It is available in both the Closed Plan and the Year 2000 Plan.

To be eligible to participate in the BackDROP, a member must have been eligible to retire under normal age and/or service conditions for at least two years. A retroactive starting date is established for BackDROP purposes which is the later of: 1) the member's normal retirement date; or 2) five years prior to the annuity starting date under the retirement plan selected by the member.

The BackDROP period for the accumulation of the BackDROP amount is from the retroactive starting date to the annuity starting date. This results in a BackDROP period of one to five years depending upon the individual situation.

A theoretical BackDROP account is accumulated that includes 90% of the value of the benefit payments that would have been paid during the BackDROP period had the member retired at the retroactive starting date. These payments include applicable post-retirement benefit increases. These payments do not include any reduction for spouse options during the BackDROP period. The member may choose the BackDROP period in 12-month increments or their maximum period, not to exceed 60 months.

The member is paid the resulting lump sum value of the BackDROP account as of the annuity starting date or as three equal annual installments beginning at the annuity starting date.

The annuity benefit payable from the actual retirement date is computed with years of service and final average pay as of the retroactive starting date for the BackDROP. Post-retirement benefit increases that occurred during the BackDROP period are applied in the calculation of the monthly annuity.

# Sample Benefit Computation for Closed Plan Members
# Retiring July 1, 2020
# Non-Uniformed Employee

| | Data | Description |
|---|---|---|
| A. | $40,000 | Final Average Pay |
| B. | 20 | Years of Creditable Service |
| C. | 60 | Age of Retiree |
| D. | 50% | Automatic percentage to continue to spouse after retirant's death |

**Sample Computation Steps**

| | | |
|---|---|---|
| E. | Retirement Benefit Formula: | 0.016 x 20 x $40,000 = $12,800 |

**Benefit payable to:**

| | | |
|---|---|---|
| F. | Retiree while spouse is alive (E) | $ 12,800 |
| G. | Spouse after retiree's death (D x E) | $ 6,400 |
| H. | Retiree after spouse's death | $ 12,800 |

| Year Ended June 30 | Annual Amount Payable if Price Inflation is 2.25% and Post-Retirement Increases are 1.8% |
|---|---|
| 2020 | $12,800 |
| 2021 | 13,030 |
| 2022 | 13,265 |
| 2023 | 13,504 |
| 2024 | 13,747 |
| 2025 | 13,994 |
| 2026 | 14,246 |
| 2027 | 14,503 |
| 2028 | 14,764 |
| 2029 | 15,029 |

# Sample Benefit Computation for Closed Plan Members
# Retiring July 1, 2020
# Uniformed Patrol

| | Data | Description |
|---|---|---|
| A. | $40,000 | Final Average Pay |
| B. | 20 | Years of Creditable Service |
| C. | 60 | Age of Retiree |
| D. | 50% | Automatic percentage to continue to spouse after retirant's death |

**Sample Computation Steps**

E. Retirement Benefit Formula: 0.021333 x 20 x $40,000 = $17,066

**Benefit payable to:**

| | | |
|---|---|---|
| F. | Retiree while spouse is alive (E) | $ 17,066 |
| G. | Spouse after retiree's death (D x E) | $ 8,533 |
| H. | Retiree after spouse's death | $ 17,066 |

Amounts shown below do not include the $1,080 annual supplementary benefit payable to age 65.

| Year Ended June 30 | Annual Amount Payable if Price Inflation is 2.25% and Post-Retirement Increases are 1.8% |
|---|---|
| 2020 | $17,066 |
| 2021 | 17,373 |
| 2022 | 17,686 |
| 2023 | 18,004 |
| 2024 | 18,328 |
| 2025 | 18,658 |
| 2026 | 18,994 |
| 2027 | 19,336 |
| 2028 | 19,684 |
| 2029 | 20,038 |

# Sample Benefit Computation for Year 2000 Plan Members Retiring July 1, 2020

| | Data | Description |
|---|---|---|
| A. | $40,000 | Final Average Pay |
| B. | 20 | Years of Creditable Service |
| C. | 60 (67 for 2011 Tier) | Age of Retiree |
| D. | 0% | Automatic percentage to continue to spouse after retirant's death |

| | | |
|---|---|---|
| E1. | Retirement Benefit Formula: | 0.017 x 20 x $40,000 = $13,600 |
| E2. | Supplemental Benefit Formula: | .008 x 20 x $40,000 = $6,400 |

**Benefit payable to:**

| | | |
|---|---|---|
| F1. | Retiree prior to age 62 (E1+E2) | $ 20,000 |
| F2. | Retiree after age 62 (E1) | $ 13,600 |
| G. | Spouse after retiree's death (D x E) | $ 0 |

| Year Ended June 30 | Annual Amount Payable if Price Inflation is 2.25% and Post-Retirement Increases are 1.8% |
|---|---|
| 2020 | $20,000 |
| 2021 | 20,360 |
| 2022 | 14,094 |
| 2023 | 14,348 |
| 2024 | 14,606 |
| 2025 | 14,869 |
| 2026 | 15,137 |
| 2027 | 15,409 |
| 2028 | 15,686 |
| 2029 | 15,969 |

# SECTION C

## FINANCIAL INFORMATION

# Summary of Fund Operations

| | 2020 | 2019 |
|---|---|---|
| Market Value of Fund Beginning of Fiscal Year | $2,423,261,830 | $2,314,530,148 |
| Post Valuation Audit Adjustment | 0 | 0 |
| Contributions | | |
| Employer | 210,871,852 | 210,166,927 |
| Employee | 4,983,989 | 4,449,428 |
| Transfer from MOSERS | 3,483,574 | 2,460,905 |
| Service Purchase (Employee) | 1,563,362 | 1,518,381 |
| Total Contributions | $ 220,902,777 | $ 218,595,641 |
| Investment Return | | |
| Interest | $ 27,545,526 | $ 31,016,755 |
| Dividends | 11,185,634 | 10,150,262 |
| Real Estate | 23,258,476 | 33,464,850 |
| Realized Capital Gains | 896,353,383 | 355,939,616 |
| Realized Capital Losses | (795,666,529) | (260,796,855) |
| Miscellaneous Income | 0 | 0 |
| Securities Lending Income | 193,392 | 166,774 |
| Other | 0 | 0 |
| Total Investment Return | $ 162,869,882 | $ 169,941,402 |
| Other Income (Rental Income and Misc) | 5,412 | 307 |
| Increase (Decrease) in Unrealized Appreciation | (151,844,475) | 19,036,291 |
| Benefit Payments | | |
| Retirement Payments | $ 246,007,290 | $ 239,029,540 |
| Retirement Payments - BackDROP | 15,787,033 | 15,424,880 |
| Death Benefits | 890,000 | 820,000 |
| Long-Term Disability Payments | 26,488 | 35,987 |
| Insured Disability Program | 1,640,971 | 1,615,860 |
| Employee Contribution Refunds | 796,107 | 780,538 |
| Service Transfer Payments - Employer | 2,457,945 | 2,111,007 |
| Total Benefit Payments | $ 267,605,833 | $ 259,817,811 |
| Expenses | | |
| Investment | $ 21,698,677 | $ 34,651,182 |
| Other | 4,291,028 | 4,372,966 |
| Total Expenses | $ 25,989,705 | $ 39,024,148 |
| Market Value of Fund End of Fiscal Year | $2,361,599,888 | $2,423,261,830 |

# Missouri MPERS
# Development of Actuarial Value of Assets

**MISSOURI HTEHPRS**
**DEVELOPMENT OF ACTUARIAL VALUE OF ASSETS**

| Valuation Date of June 30 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|
| **A. Actuarial value at beginning of year** | $1,967,001,509 | $2,086,654,348 | $2,172,787,144 | $2,274,248,122 | **$2,415,343,431** | | |
| **B. Market value at end of year** | 1,992,073,946 | 2,169,775,040 | 2,314,530,148 | 2,423,261,830 | **2,361,599,888** | | |
| **C. Market value at beginning of year** | 2,009,367,134 | 1,992,073,946 | 2,169,775,040 | 2,314,530,148 | **2,423,261,830** | | |
| **D. Cash flow** | | | | | | | |
| D1. Contributions | 205,821,588 | 213,198,963 | 211,824,043 | 218,595,641 | **220,902,777** | | |
| D2. Benefit Payments | (240,176,011) | (251,284,152) | (259,058,863) | (259,817,811) | **(267,605,833)** | | |
| D3. Administrative Expenses | (4,370,860) | (4,515,458) | (4,693,492) | (4,372,966) | **(4,291,028)** | | |
| D4. Non-Investment Net Cash Flow | (38,725,283) | (42,600,647) | (51,928,312) | (45,595,136) | **(50,994,084)** | | |
| **E. Investment income** | | | | | | | |
| E1. Market total (B - C - D4) | 21,432,095 | 220,301,741 | 196,683,420 | 154,326,818 | **(10,667,858)** | | |
| E2. Assumed Rate of Return | 7.75% | 7.75% | 7.75% | 7.00% | **7.00%** | | |
| E3. Amount for Immediate Recognition (A+.5xD4)xE2 | 150,942,012 | 160,064,937 | 166,378,782 | 157,601,539 | **167,289,247** | | |
| E4. Amount for Phased-In Recognition | (129,509,917) | 60,236,804 | 30,304,638 | (3,274,721) | **(177,957,105)** | | |
| **F. Phased in recognition of investment income** | | | | | | | |
| F1. Current Year (33 1/3% of E4) | (43,169,972) | 20,078,935 | 10,101,546 | (1,091,574) | **(59,319,035)** | | |
| F2. First Prior Year | (8,240,457) | (43,169,972) | 20,078,935 | 10,101,546 | (1,091,574) | $ (59,319,035) | |
| F3. Second Prior Year | 58,846,539 | (8,240,457) | (43,169,973) | 20,078,934 | 10,101,546 | (1,091,573) | $(59,319,035) |
| F4. Total Recognized Investment Gain (F1 + F2 + F3) | 7,436,110 | (31,331,494) | (12,989,492) | 29,088,906 | **(50,309,063)** | (60,410,608) | (59,319,035) |
| **G. Actuarial value at end of year (A + D4 + E3 + F4)** | 2,086,654,348 | 2,172,787,144 | 2,274,248,122 | 2,415,343,431 | **2,481,329,531** | | |
| **Less LTD Assets** | 0 | 0 | 0 | 0 | **0** | | |
| **H. Preliminary Plan AVA** | 2,086,654,348 | 2,172,787,144 | 2,274,248,122 | 2,415,343,431 | **2,481,329,531** | | |
| **I. Corridor (Maximum of 120% of Market Value)** | 2,390,488,735 | 2,603,730,048 | 2,777,436,178 | 2,907,914,196 | **2,833,919,866** | | |
| **J. Corridor Minimum of 80% of Market Value)** | 1,593,659,157 | 1,735,820,032 | 1,851,624,118 | 1,938,609,464 | **1,889,279,910** | | |
| **K. Additional Investment Gain/(Loss) recognized due to corridor** | 0 | 0 | 0 | 0 | 0 | | |
| **L. Final Plan AVA after corridor adjustment, if any** | 2,086,654,348 | 2,172,787,144 | 2,274,248,122 | 2,415,343,431 | **2,481,329,531** | | |
| **Difference between market and actuarial values** | (94,580,402) | (3,012,104) | 40,282,026 | 7,918,399 | **(119,729,643)** | | |
| **Market Rate of Return** | 1.08% | 11.18% | 9.17% | 6.73% | **(0.44)%** | | |
| **Ratio of Funding Value to Market Value** | 104.75% | 100.14% | 98.26% | 99.67% | **105.07%** | | |
| **Recognized actuarial rate of return** | 8.13% | 6.23% | 7.14% | 8.29% | **4.89%** | | |

# Allocation of Assets between Groups

The allocation of the funding value of assets between the Uniformed Patrol and Non-Uniformed Employee groups is in proportion to their market value of assets, as shown below:

| Allocation of Funding Value of Assets | June 30 2020 | June 30 2019 |
|---|---|---|
| 1. Funding Value of Assets | $2,481,329,531 | $2,415,343,431 |
| 2. Reported Market Value of Assets | | |
| a) Uniformed Patrol | 692,823,906 | 709,697,821 |
| b) Non-Uniformed Employees | 1,668,775,982 | 1,713,564,009 |
| c) Total | 2,361,599,888 | 2,423,261,830 |
| 3. Funding Value of Assets Split | | |
| a) Uniformed Patrol (2a) / (2c) x (1) | 727,949,060 | 707,378,769 |
| b) Non-Uniformed Employees (2b) / (2c) x (1) | 1,753,380,471 | 1,707,964,662 |
| 4. Total Assets Allocated | 2,481,329,531 | 2,415,343,431 |

# SECTION D

## SUMMARY OF MEMBER DATA

# Civilian Patrol Closed Active Members
# as of June 30, 2020
# by Attained Age and Years of Service

| Attained Age | Count by Complete Years of Service to Valuation Date | | | | | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-4 | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30+ | No. | Valuation Payroll |
| Under 20 | | | | | | | | | |
| 20-24 | | | | | | | | | |
| 25-29 | | | | | | | | | |
| 30-34 | | | | | | | | | |
| 35-39 | | | | | | | | | |
| 40-44 | | | | 1 | 18 | 2 | | 21 | $ 1,074,528 |
| 45-49 | | 1 | | | 31 | 14 | | 46 | 2,337,487 |
| 50-54 | | 2 | 2 | 1 | 28 | 26 | 16 | 75 | 4,201,105 |
| 55-59 | | 1 | 2 | 3 | 18 | 20 | 17 | 61 | 3,275,215 |
| 60 | | | | | 4 | 2 | 3 | 9 | 402,335 |
| 61 | | | 1 | | 2 | 1 | 3 | 7 | 361,554 |
| 62 | | | | | 4 | 1 | | 5 | 188,567 |
| 63 | | | | | | 1 | 1 | 2 | 96,666 |
| 64 | | | | | 1 | 2 | | 3 | 148,826 |
| 65 | | | | | 1 | 1 | 2 | 4 | 263,625 |
| 66 | | | | | 1 | | | 1 | 60,068 |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | |
| Over 70 | | | | | 1 | | 1 | 2 | 68,355 |
| **Totals** | | **4** | **5** | **5** | **109** | **70** | **43** | **236** | **$12,478,331** |

Average Age: 53.1 years
Average Service: 25.3 years
Average Pay: $52,874

# Civilian Patrol Year 2000 Active Members as of June 30, 2020 by Attained Age and Years of Service

| Attained Age | Count by Complete Years of Service to Valuation Date | | | | | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-4 | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30+ | No. | Valuation Payroll |
| Under 20 | | | | | | | | | |
| 20-24 | | | | | | | | | |
| 25-29 | | | | | | | | | |
| 30-34 | | 5 | 16 | | | | | 21 | $ 1,030,570 |
| 35-39 | | 8 | 43 | 20 | | | | 71 | 3,578,147 |
| 40-44 | 3 | 7 | 30 | 42 | | | | 82 | 4,378,073 |
| 45-49 | 1 | 1 | 21 | 24 | 1 | | | 48 | 2,313,012 |
| 50-54 | 3 | 7 | 24 | 25 | 3 | | | 62 | 2,897,619 |
| 55-59 | 1 | 3 | 18 | 21 | 5 | | | 48 | 2,166,715 |
| 60 | | 1 | 5 | 5 | | | | 11 | 534,835 |
| 61 | | 1 | 3 | 2 | 1 | 1 | | 8 | 357,769 |
| 62 | | | 2 | 5 | | | | 7 | 317,361 |
| 63 | | | 2 | | | | | 2 | 74,598 |
| 64 | | | 2 | | 1 | | | 3 | 111,837 |
| 65 | | 1 | 3 | | | | | 4 | 156,466 |
| 66 | 1 | | | 1 | | | | 2 | 81,430 |
| 67 | | 2 | 1 | 1 | | | | 4 | 132,505 |
| 68 | | | | 1 | | | | 1 | 35,480 |
| 69 | | | 1 | | | | | 1 | 38,853 |
| 70 | | | | | | | | | |
| Over 70 | | | 2 | | | | | 2 | 46,088 |
| **Totals** | **9** | **36** | **173** | **147** | **11** | **1** | | **377** | **$18,251,358** |

Average Age: 47.2 years
Average Service: 14.0 years
Average Pay: $48,412

# Civilian Patrol 2011 Tier Active Members as of June 30, 2020 by Attained Age and Years of Service

| Attained Age | Count by Complete Years of Service to Valuation Date | | | | | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-4 | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30+ | No. | Valuation Payroll |
| Under 20 | | | | | | | | | |
| 20-24 | 26 | | | | | | | 26 | $ 951,578 |
| 25-29 | 91 | 16 | | | | | | 107 | 4,630,702 |
| 30-34 | 47 | 45 | | | | | | 92 | 3,947,188 |
| 35-39 | 28 | 25 | | | | | | 53 | 2,286,185 |
| 40-44 | 23 | 20 | | | | | | 43 | 1,694,590 |
| 45-49 | 27 | 17 | | | | | | 44 | 1,680,056 |
| 50-54 | 22 | 22 | | | | | | 44 | 1,708,442 |
| 55-59 | 23 | 12 | | | | | | 35 | 1,217,570 |
| 60 | 6 | 3 | | | | | | 9 | 316,901 |
| 61 | | 2 | | | | | | 2 | 71,424 |
| 62 | 2 | 4 | | | | | | 6 | 193,441 |
| 63 | 3 | 4 | | | | | | 7 | 261,779 |
| 64 | 1 | 2 | | | | | | 3 | 99,980 |
| 65 | 1 | 1 | | | | | | 2 | 73,759 |
| 66 | 1 | 1 | | | | | | 2 | 58,631 |
| 67 | | 1 | | | | | | 1 | 33,701 |
| 68 | | | | | | | | | |
| 69 | | 1 | | | | | | 1 | 44,110 |
| 70 | | | | | | | | | |
| Over 70 | | | | | | | | | |
| **Totals** | **301** | **176** | | | | | | **477** | **$19,270,037** |

Average Age: 39.0 years
Average Service: 4.2 years
Average Pay: $40,398

# MoDOT Closed Active Members
# as of June 30, 2020
# by Attained Age and Years of Service

| Attained Age | Count by Complete Years of Service to Valuation Date | | | | | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-4 | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30+ | No. | Valuation Payroll |
| Under 20 | | | | | | | | | |
| 20-24 | | | | | | | | | |
| 25-29 | | | | | | | | | |
| 30-34 | | | | | | | | | |
| 35-39 | | | | 1 | 1 | | | 2 | $ 121,655 |
| 40-44 | | 1 | 2 | 5 | 120 | 1 | | 129 | 6,485,741 |
| 45-49 | | | 1 | 2 | 189 | 101 | 1 | 294 | 16,556,060 |
| 50-54 | | 2 | 1 | 7 | 152 | 198 | 47 | 407 | 22,666,166 |
| 55-59 | | 2 | 2 | 2 | 113 | 81 | 79 | 279 | 15,064,626 |
| 60 | | | | 1 | 21 | 13 | 13 | 48 | 2,471,310 |
| 61 | | | | | 16 | 10 | 7 | 33 | 1,715,548 |
| 62 | | 1 | | | 9 | 10 | 7 | 27 | 1,356,436 |
| 63 | | | | | 6 | 7 | 4 | 17 | 858,094 |
| 64 | | | | | 6 | 7 | | 13 | 667,032 |
| 65 | | | | | 7 | 4 | 5 | 16 | 780,315 |
| 66 | | | | | 3 | 3 | 3 | 9 | 496,631 |
| 67 | | | | | 1 | 1 | | 2 | 122,703 |
| 68 | | | | | | 2 | 1 | 3 | 178,222 |
| 69 | | | | | | | 1 | 1 | 48,125 |
| 70 | | | | | | | | | |
| Over 70 | | | | | | | 3 | 3 | 312,844 |
| **Totals** | | **6** | **6** | **18** | **644** | **438** | **171** | **1,283** | **$69,901,508** |

Average Age: 52.4 years
Average Service: 25.3 years
Average Pay: $54,483

# MoDOT Year 2000 Active Members
# as of June 30, 2020
# by Attained Age and Years of Service

| Attained Age | Count by Complete Years of Service to Valuation Date | | | | | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-4 | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30+ | No. | Valuation Payroll |
| Under 20 | | | | | | | | | |
| 20-24 | | | | | | | | | |
| 25-29 | | | | | | | | | |
| 30-34 | 4 | 8 | 62 | | | | | 74 | $ 3,307,343 |
| 35-39 | 4 | 12 | 134 | 81 | | | | 231 | 11,007,745 |
| 40-44 | 4 | 20 | 104 | 183 | 2 | | | 313 | 15,217,826 |
| 45-49 | 9 | 16 | 86 | 133 | 5 | | | 249 | 11,617,230 |
| 50-54 | 6 | 12 | 83 | 118 | 6 | | | 225 | 9,979,209 |
| 55-59 | 8 | 11 | 81 | 121 | 9 | | 1 | 231 | 9,864,869 |
| 60 | | 2 | 12 | 24 | 2 | 1 | | 41 | 1,865,616 |
| 61 | | 2 | 11 | 23 | 1 | | | 37 | 1,585,070 |
| 62 | | 3 | 13 | 11 | | | | 27 | 1,111,758 |
| 63 | | 1 | 12 | 15 | 1 | | | 29 | 1,181,253 |
| 64 | | 1 | 6 | 7 | | | | 14 | 623,974 |
| 65 | 1 | 1 | 7 | 8 | | | | 17 | 782,035 |
| 66 | | 1 | 3 | 4 | | | | 8 | 372,400 |
| 67 | | | 4 | 3 | | | 1 | 8 | 380,305 |
| 68 | | | | 3 | | | | 3 | 140,451 |
| 69 | 1 | | | | | | | 1 | 31,516 |
| 70 | | | | | | | | | |
| Over 70 | | | 1 | 2 | | | | 3 | 136,815 |
| **Totals** | **37** | **90** | **619** | **736** | **26** | **1** | **2** | **1,511** | **$69,205,415** |

Average Age: 48.0 years
Average Service: 14.7 years
Average Pay: $45,801

# MoDOT 2011 Tier Active Members
# as of June 30, 2020
# by Attained Age and Years of Service

| Attained Age | Count by Complete Years of Service to Valuation Date | | | | | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-4 | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30+ | No. | Valuation Payroll |
| Under 20 | 10 | | | | | | | 10 | $ 327,430 |
| 20-24 | 206 | 2 | | | | | | 208 | 7,305,573 |
| 25-29 | 390 | 76 | | | | | | 466 | 18,687,711 |
| 30-34 | 275 | 128 | | | | | | 403 | 15,997,741 |
| 35-39 | 200 | 90 | | | | | | 290 | 11,003,145 |
| 40-44 | 181 | 71 | | | | | | 252 | 9,820,682 |
| 45-49 | 139 | 55 | | | | | | 194 | 7,446,648 |
| 50-54 | 124 | 62 | | | | | | 186 | 7,273,927 |
| 55-59 | 93 | 60 | | 1 | | | | 154 | 5,784,889 |
| 60 | 15 | 11 | | | | | | 26 | 963,931 |
| 61 | 12 | 16 | | | | | | 28 | 1,063,998 |
| 62 | 10 | 4 | | | | | | 14 | 502,031 |
| 63 | 3 | 4 | | | | | | 7 | 288,356 |
| 64 | 2 | 5 | | | | | | 7 | 300,239 |
| 65 | 8 | 2 | | | | | | 10 | 352,133 |
| 66 | | 3 | | | | | | 3 | 155,819 |
| 67 | 1 | | | | | | | 1 | 32,044 |
| 68 | 2 | 1 | | | | | | 3 | 106,394 |
| 69 | 1 | 2 | | | | | | 3 | 144,935 |
| 70 | 1 | | | | | | | 1 | 37,534 |
| Over 70 | 1 | | | | | | | 1 | 36,629 |
| **Totals** | **1,674** | **592** | | **1** | | | | **2,267** | **$87,631,789** |

Average Age: 37.7 years
Average Service: 3.3 years
Average Pay: $38,655

# Uniformed Patrol Closed Active Members as of June 30, 2020 by Attained Age and Years of Service

| Attained Age | Count by Complete Years of Service to Valuation Date | | | | | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-4 | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30+ | No. | Valuation Payroll |
| Under 20 | | | | | | | | | |
| 20-24 | | | | | | | | | |
| 25-29 | | | | | | | | | |
| 30-34 | | | | | | | | | |
| 35-39 | | 1 | | | | | | 1 | $ 53,138 |
| 40-44 | | | | | 26 | | | 26 | 2,106,266 |
| 45-49 | | | | 2 | 108 | 51 | | 161 | 13,133,847 |
| 50-54 | 1 | | | | 59 | 117 | 36 | 213 | 17,799,590 |
| 55-59 | | | | | 10 | 14 | 28 | 52 | 4,324,795 |
| 60 | | | | | | | 1 | 1 | 85,555 |
| 61 | | | | | | | | | |
| 62 | | | | | | | | | |
| 63 | | | | | | | | | |
| 64 | | | | | | | | | |
| 65 | | | | | | | | | |
| 66 | | | | | | | | | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | |
| Over 70 | | | | | | | | | |
| **Totals** | **1** | **1** | | **2** | **203** | **182** | **65** | **454** | **$37,503,191** |

Average Age: 50.3 years
Average Service: 25.5 years
Average Pay: $82,606

# Uniformed Patrol Year 2000 Active Members as of June 30, 2020 by Attained Age and Years of Service

| Attained Age | Count by Complete Years of Service to Valuation Date | | | | | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-4 | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30+ | No. | Valuation Payroll |
| Under 20 | | | | | | | | | |
| 20-24 | | | | | | | | | |
| 25-29 | | | | | | | | | |
| 30-34 | | 6 | 44 | | | | | 50 | $ 3,111,385 |
| 35-39 | | 1 | 87 | 25 | | | | 113 | 7,669,354 |
| 40-44 | | 2 | 21 | 97 | 2 | | | 122 | 9,240,968 |
| 45-49 | | 1 | 19 | 38 | 1 | | | 59 | 4,132,085 |
| 50-54 | | | 4 | 11 | | | | 15 | 1,054,088 |
| 55-59 | | | 1 | 3 | | | | 4 | 274,085 |
| 60 | | | | | | | | | |
| 61 | | | | | | | | | |
| 62 | | | | | | | | | |
| 63 | | | | | | | | | |
| 64 | | | | | | | | | |
| 65 | | | | | | | | | |
| 66 | | | | | | | | | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | |
| Over 70 | | | | | | | | | |
| **Totals** | | **10** | **176** | **174** | **3** | | | **363** | **$25,481,965** |

Average Age: 40.3 years
Average Service: 14.7 years
Average Pay: $70,198

# Uniformed Patrol 2011 Tier Active Members as of June 30, 2020 by Attained Age and Years of Service

| Attained Age | Count by Complete Years of Service to Valuation Date | | | | | | | Totals | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-4 | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30+ | No. | Valuation Payroll |
| Under 20 | | | | | | | | | |
| 20-24 | 58 | | | | | | | 58 | $ 3,063,581 |
| 25-29 | 103 | 42 | | | | | | 145 | 7,687,147 |
| 30-34 | 33 | 96 | | | | | | 129 | 7,242,431 |
| 35-39 | 4 | 28 | | | | | | 32 | 1,827,557 |
| 40-44 | 4 | 14 | | | | | | 18 | 1,022,735 |
| 45-49 | | 2 | | | | | | 2 | 119,320 |
| 50-54 | 1 | 2 | | | | | | 3 | 165,180 |
| 55-59 | | | | | | | | | |
| 60 | | | | | | | | | |
| 61 | | | | | | | | | |
| 62 | | | | | | | | | |
| 63 | | | | | | | | | |
| 64 | | | | | | | | | |
| 65 | | | | | | | | | |
| 66 | | | | | | | | | |
| 67 | | | | | | | | | |
| 68 | | | | | | | | | |
| 69 | | | | | | | | | |
| 70 | | | | | | | | | |
| Over 70 | | | | | | | | | |
| **Totals** | **203** | **184** | | | | | | **387** | **$21,127,951** |

Average Age: 29.7 years
Average Service: 4.7 years
Average Pay: $54,594

# Growth of Active Member Payroll

| Actuarial Valuation for June 30, | Number | Covered Payroll | Average Pay | % Change in Average Pay from Prior Year |
|---|---|---|---|---|
| 1989 | 8,181 | $194,452,400 | $23,769 | (0.5)% |
| 1990 | 8,256 | 211,414,753 | 25,607 | 7.7 % |
| 1991 | 8,308 | 220,856,988 | 26,584 | 3.8 % |
| 1992 | 8,591 | 228,503,592 | 26,598 | 0.1 % |
| 1993 | 8,658 | 236,236,082 | 27,285 | 2.6 % |
| 1994 | 8,849 | 242,864,780 | 27,445 | 0.6 % |
| 1995 | 8,904 | 250,529,253 | 28,137 | 2.5 % |
| 1996 | 9,023 | 264,196,115 | 29,280 | 4.1 % |
| 1997 | 8,997 | 280,209,116 | 31,145 | 6.4 % |
| 1998 | 8,871 | 284,889,796 | 32,115 | 3.1 % |
| 1999 | 9,140 | 298,673,247 | 32,678 | 1.8 % |
| 2000 | 9,171 | 312,532,009 | 34,078 | 4.3 % |
| 2001 | 9,087 | 327,049,257 | 35,991 | 5.6 % |
| 2002 | 8,695 | 312,747,492 | 35,969 | (0.1)% |
| 2003 | 8,892 | 318,744,192 | 35,846 | (0.3)% |
| 2004 | 9,002 | 328,210,887 | 36,460 | 1.7 % |
| 2005 | 9,193 | 345,695,867 | 37,604 | 3.1 % |
| 2006 | 9,033 | 348,614,699 | 38,593 | 2.6 % |
| 2007 | 8,640 | 360,842,421 | 41,764 | 8.2 % |
| 2008 | 8,599 | 369,424,653 | 42,961 | 2.9 % |
| 2009 | 8,784 | 377,652,245 | 42,993 | 0.1 % |
| 2010 | 8,457 | 369,911,252 | 43,740 | 1.7 % |
| 2011 | 8,231 | 361,639,001 | 43,936 | 0.4 % |
| 2012 | 7,458 | 329,293,168 | 44,153 | 0.5 % |
| 2013 | 7,319 | 323,205,767 | 44,160 | 0.0 % |
| 2014 | 7,390 | 332,085,689 | 44,937 | 1.8 % |
| 2015 | 7,358 | 334,400,980 | 45,447 | 1.1 % |
| 2016 | 7,441 | 339,799,379 | 45,666 | 0.5 % |
| 2017 | 7,456 | 348,979,212 | 46,805 | 2.5 % |
| 2018 | 7,391 | 351,496,555 | 47,557 | 1.6 % |
| 2019 | 7,421 | 359,296,056 | 48,416 | 1.8 % |
| 2020 | 7,355 | 360,851,545 | 49,062 | 1.3 % |
| | | | **Ten-Year Average:** | 1.2 % |

# Count and Total Monthly Benefits
# Civilian Patrol Closed Retired (Non-Disabled)
# Members and Survivors
# as of June 30, 2020
# by Attained Age

| Age | Number | Monthly Benefit Amount |
|---|---|---|
| Less than 20 | | |
| 20-24 | | |
| 25-29 | | |
| 30-34 | | |
| 35-39 | | |
| 40-44 | | |
| 45-49 | | |
| 50-54 | 3 | $ 5,308 |
| 55-59 | 29 | 59,814 |
| 60-64 | 55 | 99,961 |
| 65-69 | 88 | 153,302 |
| 70-74 | 72 | 110,688 |
| 75-79 | 66 | 109,214 |
| 80-84 | 79 | 155,414 |
| 85-89 | 67 | 131,087 |
| 90-94 | 33 | 49,833 |
| 95-99 | 1 | 329 |
| 100-104 | | |
| 105 & Over | | |
| **TOTAL** | **493** | **$ 874,950** |

# Count and Total Monthly Benefits of Civilian Patrol Year 2000 Retired (Non-Disabled) Members and Survivors as of June 30, 2020 by Attained Age

| Age | Number | Monthly Benefit Amount |
|---|---|---|
| Less than 20 | | |
| 20-24 | | |
| 25-29 | | |
| 30-34 | | |
| 35-39 | | |
| 40-44 | | |
| 45-49 | | |
| 50-54 | 10 | $ 26,138 |
| 55-59 | 46 | 110,395 |
| 60-64 | 141 | 247,162 |
| 65-69 | 164 | 230,105 |
| 70-74 | 142 | 202,793 |
| 75-79 | 92 | 140,580 |
| 80-84 | 9 | 4,283 |
| 85-89 | 1 | 2,309 |
| 90-94 | | |
| 95-99 | 1 | 1,055 |
| 100-104 | | |
| 105 & Over | | |
| **TOTAL** | **606** | **$ 964,820** |

# Count and Total Monthly Benefits of Civilian Patrol 2011 Tier Retired (Non-Disabled) Members and Survivors as of June 30, 2020 by Attained Age

| Age | Number | Monthly Benefit Amount |
|---|---|---|
| Less than 20 | | |
| 20-24 | | |
| 25-29 | | |
| 30-34 | | |
| 35-39 | | |
| 40-44 | | |
| 45-49 | | |
| 50-54 | | |
| 55-59 | | |
| 60-64 | | |
| 65-69 | 5 | $ 1,234 |
| 70-74 | | |
| 75-79 | | |
| 80-84 | | |
| 85-89 | | |
| 90-94 | | |
| 95-99 | | |
| 100-104 | | |
| 105 & Over | | |
| **TOTAL** | **5** | **$ 1,234** |

# Count and Total Monthly Benefits of MoDOT Closed Retired (Non-Disabled) Members and Survivors as of June 30, 2020 by Attained Age

| Age | Number | Monthly Benefit Amount |
|---|---|---|
| Less than 20 | 1 | $ 465 |
| 20-24 | 2 | 628 |
| 25-29 | | |
| 30-34 | 1 | 194 |
| 35-39 | | |
| 40-44 | 2 | 1,232 |
| 45-49 | 12 | 8,819 |
| 50-54 | 40 | 60,763 |
| 55-59 | 157 | 261,547 |
| 60-64 | 341 | 555,760 |
| 65-69 | 379 | 628,911 |
| 70-74 | 398 | 645,010 |
| 75-79 | 486 | 1,028,506 |
| 80-84 | 724 | 1,904,904 |
| 85-89 | 501 | 1,186,351 |
| 90-94 | 233 | 493,169 |
| 95-99 | 48 | 84,163 |
| 100-104 | 5 | 5,416 |
| 105 & Over | 1 | 201 |
| **TOTAL** | **3,331** | **$ 6,866,039** |

# Count and Total Monthly Benefits of MoDOT Year 2000 Retired (Non-Disabled) Members and Survivors as of June 30, 2020 by Attained Age

| Age | Number | Monthly Benefit Amount |
|---|---|---|
| Less than 20 | 9 | $ 2,097 |
| 20-24 | | |
| 25-29 | 1 | 238 |
| 30-34 | 1 | 306 |
| 35-39 | 3 | 1,479 |
| 40-44 | 5 | 4,249 |
| 45-49 | 6 | 3,870 |
| 50-54 | 104 | 341,994 |
| 55-59 | 472 | 1,325,987 |
| 60-64 | 874 | 1,734,603 |
| 65-69 | 861 | 1,262,759 |
| 70-74 | 777 | 1,360,857 |
| 75-79 | 402 | 774,077 |
| 80-84 | 54 | 76,491 |
| 85-89 | 11 | 17,082 |
| 90-94 | 10 | 21,503 |
| 95-99 | 5 | 6,982 |
| 100-104 | | |
| 105 & Over | | |
| **TOTAL** | **3,595** | **$ 6,934,574** |

# Count and Total Monthly Benefits of MoDOT Year 2011 Tier Retired (Non-Disabled) Members and Survivors as of June 30, 2020 by Attained Age

| Age | Number | Monthly Benefit Amount |
|---|---|---|
| Less than 20 | | |
| 20-24 | | |
| 25-29 | | |
| 30-34 | | |
| 35-39 | | |
| 40-44 | | |
| 45-49 | | |
| 50-54 | | |
| 55-59 | | |
| 60-64 | | |
| 65-69 | 2 | $ 535 |
| 70-74 | 3 | 830 |
| 75-79 | | |
| 80-84 | | |
| 85-89 | | |
| 90-94 | | |
| 95-99 | | |
| 100-104 | | |
| 105 & Over | | |
| **TOTAL** | **5** | **$ 1,365** |

# Count and Total Monthly Benefits of Uniformed Patrol Closed Retired (Non-Disabled) Members and Survivors as of June 30, 2020 by Attained Age

| Age | Number | Monthly Benefit Amount |
|---|---|---|
| Less than 20 | 2 | $ 1,055 |
| 20-24 | 1 | 3,197 |
| 25-29 | | |
| 30-34 | | |
| 35-39 | 1 | 1,463 |
| 40-44 | 1 | 1,923 |
| 45-49 | 10 | 26,235 |
| 50-54 | 29 | 126,068 |
| 55-59 | 153 | 655,653 |
| 60-64 | 150 | 784,985 |
| 65-69 | 158 | 831,174 |
| 70-74 | 162 | 798,550 |
| 75-79 | 140 | 738,834 |
| 80-84 | 107 | 518,513 |
| 85-89 | 48 | 225,681 |
| 90-94 | 30 | 139,410 |
| 95-99 | 9 | 24,323 |
| 100-104 | | |
| 105 & Over | | |
| **TOTAL** | **1,001** | **$ 4,877,064** |

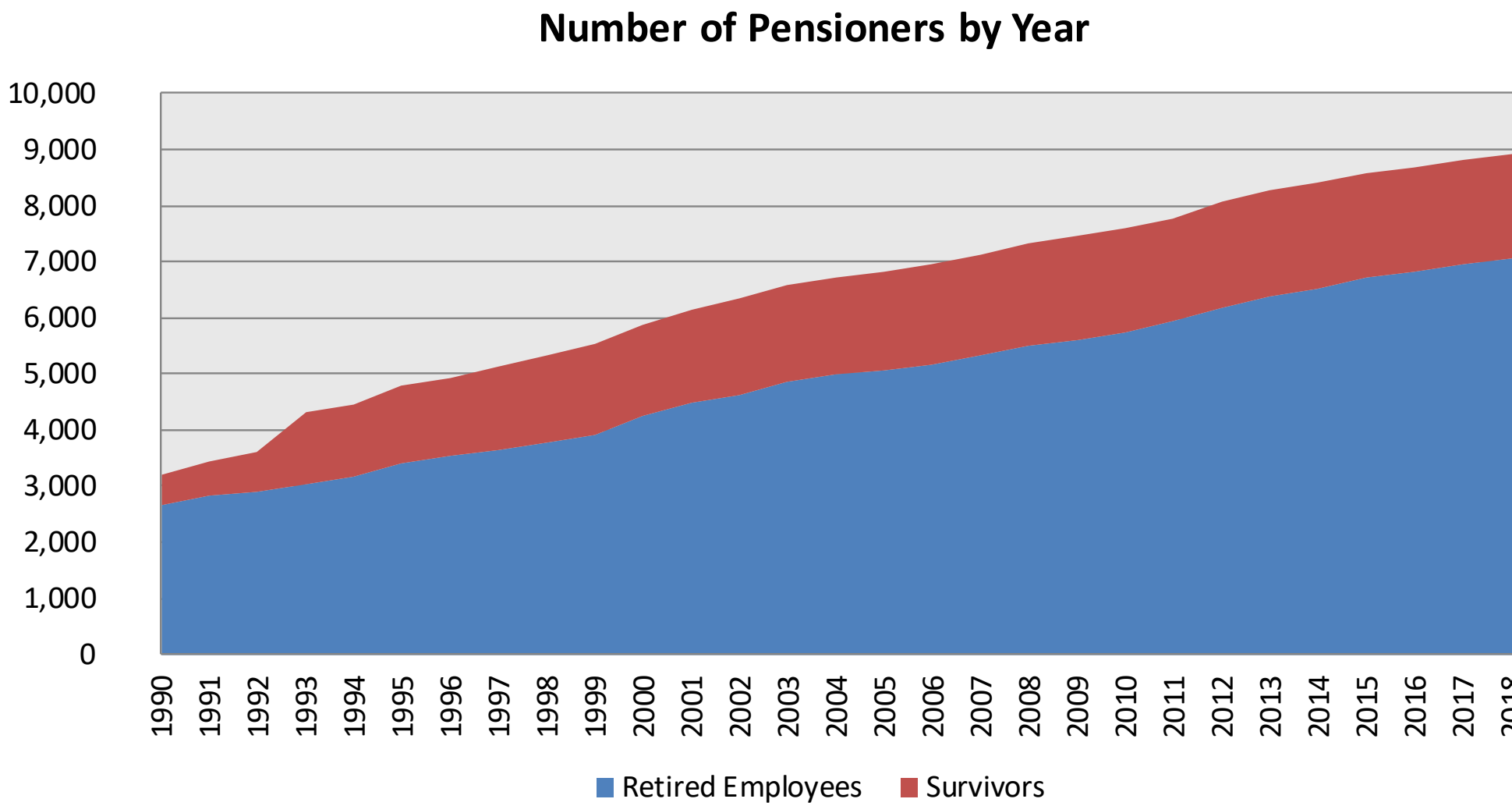
# Count and Total Monthly Benefits of Uniformed Patrol Year 2000 Retired (Non-Disabled) Members and Survivors as of June 30, 2020 by Attained Age

| Age | Number | Monthly Benefit Amount |
|---|---|---|
| Less than 20 | 2 | $ 417 |
| 20-24 | | |
| 25-29 | | |
| 30-34 | | |
| 35-39 | 1 | 1,697 |
| 40-44 | 1 | 1,742 |
| 45-49 | 1 | 923 |
| 50-54 | | |
| 55-59 | 1 | 4,620 |
| 60-64 | 1 | 3,352 |
| 65-69 | 1 | 934 |
| 70-74 | | |
| 75-79 | | |
| 80-84 | | |
| 85-89 | | |
| 90-94 | | |
| 95-99 | | |
| 100-104 | | |
| 105 & Over | | |
| **TOTAL** | **8** | **$ 13,685** |

# Growth of Pension Population by Year

| Year | Retired Employees | Survivors | Total | % Increase | Annual Benefits | Active Payroll | Benefits as a % of Payroll |
|---|---|---|---|---|---|---|---|
| 1990 | 2,669 | 543 | 3,212 | 5.3% | | | |
| 1991 | 2,814 | 632 | 3,446 | 7.3% | | | |
| 1992 | 2,908 | 699 | 3,607 | 4.7% | | | |
| 1993 | 3,047 | 1,269 | 4,316 | 19.7% | | | |
| 1994 | 3,156 | 1,307 | 4,463 | 3.4% | | | |
| 1995 | 3,419 | 1,365 | 4,784 | 7.2% | | | |
| 1996 | 3,536 | 1,405 | 4,941 | 3.3% | | | |
| 1997 | 3,646 | 1,486 | 5,132 | 3.9% | | | |
| 1998 | 3,781 | 1,549 | 5,330 | 3.9% | $ 80,686,152 | $284,889,796 | 28.3% |
| 1999 | 3,924 | 1,600 | 5,524 | 3.6% | 91,512,311 | 298,673,247 | 30.6% |
| 2000 | 4,236 | 1,621 | 5,857 | 6.0% | 100,794,676 | 312,532,009 | 32.3% |
| 2001 | 4,482 | 1,663 | 6,145 | 4.9% | 115,998,915 | 327,049,257 | 35.5% |
| 2002 | 4,623 | 1,716 | 6,339 | 3.2% | 125,623,460 | 312,747,492 | 40.2% |
| 2003 | 4,845 | 1,751 | 6,596 | 4.1% | 136,320,125 | 318,744,192 | 42.8% |
| 2004 | 4,996 | 1,735 | 6,731 | 2.0% | 142,359,307 | 328,210,887 | 43.4% |
| 2005 | 5,068 | 1,761 | 6,829 | 1.5% | 148,340,170 | 345,695,867 | 42.9% |
| 2006 | 5,164 | 1,790 | 6,954 | 1.8% | 155,230,301 | 348,614,699 | 44.5% |
| 2007 | 5,336 | 1,805 | 7,141 | 2.7% | 164,048,455 | 360,842,421 | 45.5% |
| 2008 | 5,496 | 1,829 | 7,325 | 2.6% | 172,112,941 | 369,424,653 | 46.6% |
| 2009 | 5,604 | 1,866 | 7,470 | 2.0% | 179,850,466 | 377,652,245 | 47.6% |
| 2010 | 5,739 | 1,867 | 7,606 | 1.8% | 187,267,535 | 369,911,252 | 50.6% |
| 2011 | 5,926 | 1,849 | 7,775 | 2.2% | 191,892,660 | 361,639,001 | 53.1% |
| 2012 | 6,172 | 1,883 | 8,055 | 3.6% | 201,906,768 | 329,293,168 | 61.3% |
| 2013 | 6,382 | 1,908 | 8,290 | 2.9% | 210,904,464 | 323,205,767 | 65.3% |
| 2014 | 6,507 | 1,894 | 8,401 | 1.3% | 217,149,528 | 332,085,689 | 65.4% |
| 2015 | 6,720 | 1,868 | 8,588 | 2.2% | 223,021,512 | 334,400,980 | 66.7% |
| 2016 | 6,814 | 1,870 | 8,684 | 1.1% | 227,218,908 | 339,799,379 | 66.9% |
| 2017 | 6,969 | 1,862 | 8,831 | 1.7% | 231,168,516 | 348,979,212 | 66.2% |
| 2018 | 7,064 | 1,852 | 8,916 | 1.0% | 235,395,456 | 351,496,555 | 67.0% |
| 2019 | 7,180 | 1,855 | 9,035 | 1.3% | 241,935,168 | 359,296,056 | 67.3% |
| 2020 | 7,318 | 1,864 | 9,182 | 1.6% | 249,197,664 | 360,851,545 | 69.1% |

## Growth of Pension Population by Year



# Self-Insured Disabled Retired Members as of June 30, 2020

| Age | Number | Monthly Benefit Amount |
|---|---|---|
| Less than 20 | | |
| 20-24 | | |
| 25-29 | | |
| 30-34 | | |
| 35-39 | | |
| 40-44 | | |
| 45-49 | 2 | $ 6,652 |
| 50-54 | 4 | 4,267 |
| 55-59 | 7 | 7,428 |
| 60-64 | 8 | 17,820 |
| 65-69 | 10 | 15,372 |
| 70-74 | 9 | 12,545 |
| 75-79 | 3 | 3,673 |
| 80-84 | 1 | 2,423 |
| 85-89 | 1 | 115 |
| 90-94 | | |
| 95-99 | | |
| 100-104 | | |
| 105 & Over | | |
| **TOTAL** | **45** | **$ 70,295** |

These members became disabled prior to outsourcing disability claims. Liabilities for these members include benefits payable during and after the period of disability.

# Fully Insured Disabled Retired Members as of June 30, 2020

| Age | Number | Monthly Benefit Amount |
|---|---|---|
| Less than 20 | | |
| 20-24 | | |
| 25-29 | 1 | $ 2,348 |
| 30-34 | 2 | 5,945 |
| 35-39 | 3 | 5,035 |
| 40-44 | 9 | 23,137 |
| 45-49 | 14 | 30,844 |
| 50-54 | 20 | 36,465 |
| 55-59 | 30 | 46,083 |
| 60-64 | 13 | 11,874 |
| 65-69 | 1 | 715 |
| 70-74 | | |
| 75-79 | | |
| 80-84 | | |
| 85-89 | | |
| 90-94 | | |
| 95-99 | | |
| 100-104 | | |
| 105 & Over | | |
| **TOTAL** | **93** | **$ 162,446** |

These members became disabled after disability claims became outsourced. Liabilities for these members during the period of disability are an obligation of the insurance company and not included in this valuation. Liabilities for these members after the period of disability are included in the valuation.

# Data Reconciliation
# as of June 30, 2020

| Non-Uniformed | Active Members | Vested Terminated Members | Retired * |
|---|---|---|---|
| Number at Start of Year | 6,210 | 1,866 | 8,046 |
| Increase (Decrease) From | | | |
| New Entrants/Rehires | 629 | (5) | (2) |
| Service Retirement | (224) | (57) | 283 |
| Vested Terminations | (140) | 141 | (1) |
| Deaths/Removals | (2) | (26) | (178) |
| Disability Retirement | (14) | (2) | 16 |
| Non-Vested Terminations | (308) | | |
| **Number at End of Year** | **6,151** | **1,917** | **8,164** |

| Uniformed | Active Members | Vested Terminated Members | Retired * |
|---|---|---|---|
| Number at Start of Year | 1,211 | 176 | 989 |
| Increase (Decrease) From | | | |
| New Entrants/Rehires | 57 | (3) | |
| Service Retirement | (39) | (7) | 46 |
| Vested Terminations | (13) | 14 | (1) |
| Deaths/Removals | 0 | (2) | (17) |
| Disability Retirement | 0 | (1) | 1 |
| Non-Vested Terminations | (12) | | |
| **Number at End of Year** | **1,204** | **177** | **1,018** |

* *Including disability participants.*

# SECTION E

## ASSUMPTIONS USED IN THE VALUATION AND GLOSSARY

# Summary of Valuation Method and Assumptions
# June 30, 2020

***The actuarial assumptions used*** in the valuation are shown in this Section of the report unless stated otherwise. The assumptions were established for the June 30, 2018 actuarial valuation, following a five-year actuarial investigation covering the period July 1, 2012 through June 30, 2017. They were adopted by the Board.

An actuarial valuation is based upon an actuarial cost method, an asset valuation method, and actuarial assumptions. These methods and assumptions are chosen by the Board of Trustees after consultation with the Actuary and other advisors.

The actuarial cost method is called the Entry Age Actuarial Cost Method. This method is consistent with the Board's level percent-of-payroll funding objective. With this method, the level percent-of-payroll is determined that will fund a member's retirement benefit over the member's entire working lifetime, from date of hire (Entry Age) to date of exit from the active member population. Differences in the past between assumed and actual experience become part of unfunded actuarial accrued liabilities and are amortized with level percent-of-payroll contributions. This cost method was first used in the ***June 30, 1999*** valuation.

The asset valuation method is a three-year smoothed market value method in which assumed investment return is recognized immediately each year and differences between actual and assumed investment return are phased-in over a closed three-year period. This asset valuation method is intended to give recognition to the long term accuracy of market values while filtering out and dampening short term market swings. This method was first used in the ***June 30, 1999*** valuation.

## Economic Assumptions

***The assumed investment return rate*** used in making the valuations was 7.00% per year, compounded annually (net after investment expenses). The ***wage inflation rate*** was assumed to be 3.00%. The real rate of return over wage growth is defined to be the portion of total investment return, which is more than the rate of wage inflation. The 7.00% investment return rate and 3.00% wage inflation rate translates to an assumed real rate of return over wage growth net of expenses of 4.00%. Based upon other assumptions, the net real rate of return over price inflation is 4.75%.

***Pay increase assumptions for merit and seniority*** for individual active members are shown on page E-6. Part of the total assumed pay increase at each age is for merit and/or seniority, and the other 3.00% recognizes wage inflation. ***The active member payroll*** for all members is assumed to increase 3.00% annually for all years.

***The price inflation rate*** is assumed to be 2.25% annually. This is the inflation rate upon which the post-retirement increases are based. The difference between wage and price inflation of 0.75% is attributable to overall productivity increases and macroeconomic factors.

***The total number of active members*** is assumed to continue at the present total number.

# Summary of Valuation Method and Assumptions
# June 30, 2020 (Continued)

## Reviewing the Investment Return Assumption

The analysis of the investment return assumption in this report is based on forward-looking measures of expected investment return outcomes for the asset classes in the System's current investment policy. For purposes of this analysis, we have analyzed the System's investment policy with the capital market assumptions from thirteen nationally recognized investment advisors.

Our analysis is based on the GRS Capital Market Assumption Modeler (CMAM). Because GRS is a benefits consulting firm and does not develop or maintain our own capital market expectations, we request and monitor forward-looking expectations developed by several major investment advisory firms. We update our CMAM on an annual basis. The capital market assumptions in the 2020 CMAM are from the following investment advisors (in alphabetical order): Aon Hewitt, Blackrock, BNY Mellon, Callan, Cambridge, JPMorgan, Meketa, Mercer, NEPC, RVK, Verus, Voya and Wilshire. We believe that the benefit of performing this analysis using multiple investment advisory firms is to recognize the uncertain nature of the items affecting the selection of the investment return assumption. While there may be differences in asset classes, investment horizons, inflation assumptions, treatment of investment expenses, excess manager performance (i.e., alpha), etc., we have attempted to align the various assumption sets from the different investment advisors to be as consistent as possible.

To the best of our ability, we have adapted the System's investment policy to fit with the advisors' assumptions adjusting for these known differences in assumptions and methodology. In the following charts, to the extent possible all returns are net of passive investment expenses and have no assumption for excess manager performance (alpha) in excess of active management fees.

For purposes of this analysis, we have been provided with the following asset allocation from System staff:

| Asset Classes | Current Policy |
|---|---|
| Cash | 0.00% |
| US Stock - Large Cap | 20.88% |
| US Stock - Small Cap | 2.32% |
| Int'l Equity | 12.00% |
| Emerging Mkts Eq | 4.80% |
| US Corporate Bonds | 9.00% |
| Government Bonds | 13.50% |
| TIPS | 0.00% |
| High Yield | 7.50% |
| Int'l Debt | 0.00% |
| Real Estate | 20.00% |
| Private Equity | 10.00% |
| Hedge Funds | 0.00% |
| Other Alternatives | 0.00% |
| **Total** | **100.00%** |

# Summary of Valuation Method and Assumptions
# June 30, 2020 (Continued)

| Investment Consultant | Investment Consultant Expected Nominal Return | Investment Consultant Inflation Assumption | Expected Real Return (2)–(3) | Actuary Inflation Assumption | Expected Nominal Return (4)+(5) | Investment Expenses | Expected Nominal Return Net of Expenses (6)-(7) |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 1 | 4.74% | 2.20% | 2.54% | 2.25% | 4.79% | 0.00% | 4.79% |
| 2 | 6.21% | 2.21% | 4.00% | 2.25% | 6.25% | 0.00% | 6.25% |
| 3 | 6.02% | 2.25% | 3.77% | 2.25% | 6.02% | 0.00% | 6.02% |
| 4 | 5.95% | 2.10% | 3.85% | 2.25% | 6.10% | 0.00% | 6.10% |
| 5 | 6.53% | 2.30% | 4.23% | 2.25% | 6.48% | 0.00% | 6.48% |
| 6 | 6.52% | 2.20% | 4.31% | 2.25% | 6.56% | 0.00% | 6.56% |
| 7 | 6.30% | 1.80% | 4.50% | 2.25% | 6.75% | 0.00% | 6.75% |
| 8 | 6.97% | 2.26% | 4.71% | 2.25% | 6.96% | 0.00% | 6.96% |
| 9 | 6.48% | 1.75% | 4.73% | 2.25% | 6.98% | 0.00% | 6.98% |
| 10 | 6.47% | 1.90% | 4.57% | 2.25% | 6.82% | 0.00% | 6.82% |
| 11 | 6.56% | 2.01% | 4.55% | 2.25% | 6.80% | 0.00% | 6.80% |
| 12 | 7.12% | 2.18% | 4.94% | 2.25% | 7.19% | 0.00% | 7.19% |
| 13 | 7.08% | 2.00% | 5.08% | 2.25% | 7.33% | 0.00% | 7.33% |
| **Average** | **6.38%** | **2.09%** | **4.29%** | **2.25%** | **6.54%** | **0.00%** | **6.54%** |

| Investment Consultant | Distribution of 20-Year Average Geometric Net Nominal Return | | | Probability of Exceeding 7.00% | Probability of Exceeding 6.75% | Probability of Exceeding 6.50% |
|---|---|---|---|---|---|---|
| | 40th | 50th | 60th | | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1 | 3.45% | 4.12% | 4.79% | 14.17% | 16.33% | 18.71% |
| 2 | 4.92% | 5.59% | 6.26% | 29.78% | 33.09% | 36.54% |
| 3 | 5.05% | 5.59% | 6.13% | 25.59% | 29.44% | 33.55% |
| 4 | 5.24% | 5.73% | 6.23% | 26.12% | 30.37% | 34.91% |
| 5 | 5.12% | 5.80% | 6.48% | 32.80% | 36.19% | 39.70% |
| 6 | 5.34% | 5.97% | 6.61% | 34.10% | 37.82% | 41.66% |
| 7 | 5.62% | 6.22% | 6.82% | 37.12% | 41.15% | 45.28% |
| 8 | 5.58% | 6.27% | 6.96% | 39.37% | 42.93% | 46.56% |
| 9 | 5.58% | 6.27% | 6.97% | 39.55% | 43.08% | 46.67% |
| 10 | 5.69% | 6.29% | 6.89% | 38.31% | 42.36% | 46.50% |
| 11 | 5.80% | 6.35% | 6.91% | 38.42% | 42.83% | 47.34% |
| 12 | 5.91% | 6.56% | 7.22% | 43.31% | 47.14% | 51.00% |
| 13 | 6.01% | 6.68% | 7.35% | 45.15% | 48.90% | 52.67% |
| **Average** | **5.33%** | **5.96%** | **6.59%** | **34.14%** | **37.82%** | **41.62%** |

Based on the current asset allocation policy as well as the current price inflation assumption, the investment return assumption is reasonable. Both the price inflation assumption and the investment return assumption were reviewed in the Plan's most recent experience study. While we have stated that the assumptions are reasonable for this valuation, that may not continue in the future if recent trends in forward looking expectations continue.

**Investment Return**

**With Policy Allocation**

| CMAM Year | Mean | Median |
|---|---|---|
| 2015 | 6.73% | 6.15% |
| 2016 | 7.13% | 6.55% |
| 2017 | 6.59% | 6.03% |
| 2018 | 6.53% | 5.94% |
| 2019 | 7.02% | 6.44% |
| 2020 | 6.54% | 5.96% |

Generally, we recommend an investment return assumption between the arithmetic mean and the geometric median of our most recent capital market assumption modeler. Because the results of the most recent CMAMs are not trending in a single direction, we would broaden our range slightly for a recommendation

# Summary of Valuation Method and Assumptions
# June 30, 2020 (Concluded)

## Non-Economic Assumptions

***Post-Retirement Healthy Mortality Rates*** are used to measure the probabilities of members dying after retirement. The rates currently in use are from the RP-2014 Healthy Annuitant Mortality Tables projected to 2022 using projection scale MP-2017, shown on page E-7.

***Post-Retirement Disabled Mortality Rates.*** The rates currently in use for disabled lives are from the RP-2014 Disabled Retiree Annuitant Mortality Tables projected to 2022 using projection scale MP-2017, shown on page E-8.

***Pre-Retirement Mortality Rates.*** The rates currently in use for active lives are the RP-2014 Employee Mortality Table projected to 2022 using projection scale MP-2017 and multiplied by a factor of 65%, shown on page E-9.

***The probabilities of age and service retirement*** are shown on page E-11. Upon retirement, members are assumed to pick the BackDROP period that when combined with the remaining annuity produces the highest liability.

***The probabilities of disability*** are shown on page E-12.

***The probabilities of withdrawal from service*** are shown on page E-13.

***Employer contributions*** were assumed to be ***paid in equal installments*** throughout the employer fiscal year.

***Present assets (cash & investments)*** were used with a market value adjustment. Assets may be used in the valuation prior to the final audit. The exact method is shown on page C-2.

***The data about persons now covered and about present assets*** were furnished by the System's administrative staff. Although examined for general reasonableness, the data was not audited by the Actuary. Data was furnished as of May 31 and assumed to be statistically equivalent to June 30.

The actuarial valuation computations were made by or under the supervision of a Member of the American Academy of Actuaries (MAAA) who has experience performing public plan valuations.

# Service Based Salary Scale

| % Merit Increases in Salaries Next Year | | |
|---|---|---|
| **Service Index** | **Uniformed Members** | **Non-Uniformed Members** |
| 1 | 9.45% | 6.80% |
| 2 | 5.00% | 4.50% |
| 3 | 2.75% | 2.80% |
| 4 | 2.50% | 1.50% |
| 5 | 2.00% | 1.00% |
| 6 | 1.50% | 0.80% |
| 7 | 1.25% | 0.00% |
| 8 | 1.25% | 0.00% |
| 9 | 1.00% | 0.00% |
| 10 | 0.75% | 0.00% |
| 11 | 0.75% | 0.00% |
| 12 | 0.75% | 0.00% |
| 13 | 0.50% | 0.00% |
| 14 | 0.50% | 0.00% |
| 15 | 0.25% | 0.00% |
| 16 | 0.25% | 0.00% |
| 17 | 0.25% | 0.00% |
| 18 | 0.25% | 0.00% |
| 19 | 0.25% | 0.00% |
| 20 | 0.25% | 0.00% |
| 21 | 0.00% | 0.00% |
| 22 | 0.00% | 0.00% |
| 23 | 0.00% | 0.00% |
| 24 | 0.00% | 0.00% |
| 25 | 0.00% | 0.00% |

# Post-Retirement Mortality

## Retired Lives Mortality Rates

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 20 | 0.0369% | 0.0174% |
| 21 | 0.0408% | 0.0195% |
| 22 | 0.0449% | 0.0223% |
| 23 | 0.0492% | 0.0256% |
| 24 | 0.0538% | 0.0295% |
| 25 | 0.0588% | 0.0340% |
| 26 | 0.0641% | 0.0388% |
| 27 | 0.0700% | 0.0441% |
| 28 | 0.0764% | 0.0499% |
| 29 | 0.0836% | 0.0567% |
| 30 | 0.0916% | 0.0644% |
| 31 | 0.1004% | 0.0731% |
| 32 | 0.1098% | 0.0828% |
| 33 | 0.1201% | 0.0933% |
| 34 | 0.1300% | 0.1047% |
| 35 | 0.1405% | 0.1166% |
| 36 | 0.1519% | 0.1291% |
| 37 | 0.1638% | 0.1413% |
| 38 | 0.1766% | 0.1532% |
| 39 | 0.1899% | 0.1644% |
| 40 | 0.2035% | 0.1750% |
| 41 | 0.2169% | 0.1838% |
| 42 | 0.2307% | 0.1918% |
| 43 | 0.2453% | 0.1994% |
| 44 | 0.2609% | 0.2070% |
| 45 | 0.2779% | 0.2146% |
| 46 | 0.2964% | 0.2231% |
| 47 | 0.3167% | 0.2325% |
| 48 | 0.3394% | 0.2424% |
| 49 | 0.3644% | 0.2533% |
| 50 | 0.3922% | 0.2660% |
| 51 | 0.4231% | 0.2806% |
| 52 | 0.4563% | 0.2986% |
| 53 | 0.4885% | 0.3200% |
| 54 | 0.5223% | 0.3449% |
| 55 | 0.5582% | 0.3734% |
| 56 | 0.5971% | 0.4054% |
| 57 | 0.6398% | 0.4409% |
| 58 | 0.6865% | 0.4797% |
| 59 | 0.7377% | 0.5218% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 60 | 0.7938% | 0.5667% |
| 61 | 0.8547% | 0.6147% |
| 62 | 0.9205% | 0.6657% |
| 63 | 0.9918% | 0.7196% |
| 64 | 1.0684% | 0.7773% |
| 65 | 1.1511% | 0.8398% |
| 66 | 1.2408% | 0.9085% |
| 67 | 1.3387% | 0.9850% |
| 68 | 1.4472% | 1.0710% |
| 69 | 1.5680% | 1.1678% |
| 70 | 1.7034% | 1.2770% |
| 71 | 1.8549% | 1.4005% |
| 72 | 2.0259% | 1.5392% |
| 73 | 2.2187% | 1.6965% |
| 74 | 2.4366% | 1.8727% |
| 75 | 2.6823% | 2.0723% |
| 76 | 2.9606% | 2.2975% |
| 77 | 3.2770% | 2.5540% |
| 78 | 3.6348% | 2.8455% |
| 79 | 4.0410% | 3.1769% |
| 80 | 4.5024% | 3.5553% |
| 81 | 5.0252% | 3.9869% |
| 82 | 5.6159% | 4.4782% |
| 83 | 6.2866% | 5.0381% |
| 84 | 7.0474% | 5.6722% |
| 85 | 7.9002% | 6.3897% |
| 86 | 8.8634% | 7.1988% |
| 87 | 9.9417% | 8.1051% |
| 88 | 11.1427% | 9.1109% |
| 89 | 12.4767% | 10.2194% |
| 90 | 13.9500% | 11.4522% |
| 91 | 15.4968% | 12.7799% |
| 92 | 17.0856% | 14.1857% |
| 93 | 18.6789% | 15.6544% |
| 94 | 20.2575% | 17.1685% |
| 95 | 21.8007% | 18.7264% |
| 96 | 23.6045% | 20.4458% |
| 97 | 25.4442% | 22.2335% |
| 98 | 27.3578% | 24.1013% |
| 99 | 29.3232% | 26.0345% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 100 | 31.3381% | 28.0166% |
| 101 | 33.3774% | 30.0266% |
| 102 | 35.3995% | 32.0621% |
| 103 | 37.3951% | 34.0941% |
| 104 | 39.3487% | 36.0900% |
| 105 | 41.2343% | 38.0614% |
| 106 | 43.0470% | 39.9941% |
| 107 | 44.7813% | 41.8213% |
| 108 | 46.4200% | 43.5827% |
| 109 | 47.9720% | 45.2475% |
| 110 | 49.4044% | 46.8213% |
| 111 | 49.9809% | 48.2854% |
| 112 | 49.9755% | 49.6513% |
| 113 | 49.9953% | 50.2110% |
| 114 | 49.9851% | 50.0952% |
| 115 | 50.0000% | 50.0000% |
| 116 | 50.0000% | 50.0000% |
| 117 | 50.0000% | 50.0000% |
| 118 | 50.0000% | 50.0000% |
| 119 | 50.0000% | 50.0000% |
| 120 | 100.0000% | 100.0000% |

# Post-Retirement Mortality (Disability)

## Disabled Retired Lives Mortality Rates

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 20 | 0.0438% | 0.0203% |
| 21 | 0.0612% | 0.0284% |
| 22 | 0.0856% | 0.0397% |
| 23 | 0.1168% | 0.0547% |
| 24 | 0.1553% | 0.0728% |
| 25 | 0.2005% | 0.0940% |
| 26 | 0.2533% | 0.1174% |
| 27 | 0.3130% | 0.1436% |
| 28 | 0.3801% | 0.1725% |
| 29 | 0.4543% | 0.2051% |
| 30 | 0.5358% | 0.2419% |
| 31 | 0.6235% | 0.2828% |
| 32 | 0.7158% | 0.3281% |
| 33 | 0.8114% | 0.3776% |
| 34 | 0.9026% | 0.4306% |
| 35 | 0.9943% | 0.4864% |
| 36 | 1.0858% | 0.5436% |
| 37 | 1.1751% | 0.6006% |
| 38 | 1.2617% | 0.6557% |
| 39 | 1.3443% | 0.7078% |
| 40 | 1.4204% | 0.7560% |
| 41 | 1.4852% | 0.7965% |
| 42 | 1.5449% | 0.8333% |
| 43 | 1.6000% | 0.8677% |
| 44 | 1.6518% | 0.9006% |
| 45 | 1.7022% | 0.9338% |
| 46 | 1.7528% | 0.9691% |
| 47 | 1.8036% | 1.0081% |
| 48 | 1.8561% | 1.0486% |
| 49 | 1.9108% | 1.0931% |
| 50 | 1.9679% | 1.1445% |
| 51 | 2.0285% | 1.2025% |
| 52 | 2.0949% | 1.2677% |
| 53 | 2.1519% | 1.3387% |
| 54 | 2.2110% | 1.4144% |
| 55 | 2.2745% | 1.4929% |
| 56 | 2.3451% | 1.5721% |
| 57 | 2.4253% | 1.6494% |
| 58 | 2.5146% | 1.7227% |
| 59 | 2.6124% | 1.7921% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 60 | 2.7176% | 1.8560% |
| 61 | 2.8283% | 1.9166% |
| 62 | 2.9435% | 1.9759% |
| 63 | 3.0631% | 2.0367% |
| 64 | 3.1849% | 2.1023% |
| 65 | 3.3118% | 2.1768% |
| 66 | 3.4447% | 2.2633% |
| 67 | 3.5855% | 2.3662% |
| 68 | 3.7399% | 2.4882% |
| 69 | 3.9098% | 2.6317% |
| 70 | 4.0984% | 2.7988% |
| 71 | 4.3081% | 2.9925% |
| 72 | 4.5436% | 3.2128% |
| 73 | 4.8065% | 3.4648% |
| 74 | 5.1008% | 3.7463% |
| 75 | 5.4281% | 4.0624% |
| 76 | 5.7929% | 4.4139% |
| 77 | 6.2011% | 4.8052% |
| 78 | 6.6529% | 5.2368% |
| 79 | 7.1550% | 5.7097% |
| 80 | 7.7133% | 6.2278% |
| 81 | 8.3320% | 6.7925% |
| 82 | 9.0153% | 7.4046% |
| 83 | 9.7759% | 8.0682% |
| 84 | 10.6221% | 8.7816% |
| 85 | 11.5504% | 9.5490% |
| 86 | 12.5809% | 10.3728% |
| 87 | 13.7130% | 11.2504% |
| 88 | 14.9503% | 12.1767% |
| 89 | 16.2983% | 13.1470% |
| 90 | 17.7578% | 14.1809% |
| 91 | 19.1980% | 15.3068% |
| 92 | 20.6246% | 16.5148% |
| 93 | 22.0177% | 17.7919% |
| 94 | 23.3675% | 19.1177% |
| 95 | 24.6544% | 20.4885% |
| 96 | 26.2066% | 22.0265% |
| 97 | 27.7603% | 23.6241% |
| 98 | 29.3541% | 25.2910% |
| 99 | 30.9669% | 27.0120% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 100 | 32.6085% | 28.7749% |
| 101 | 34.2769% | 30.5690% |
| 102 | 35.9695% | 32.4095% |
| 103 | 37.6945% | 34.2784% |
| 104 | 39.4530% | 36.1549% |
| 105 | 41.2343% | 38.0614% |
| 106 | 43.0470% | 39.9941% |
| 107 | 44.7813% | 41.8213% |
| 108 | 46.4200% | 43.5827% |
| 109 | 47.9720% | 45.2475% |
| 110 | 49.4044% | 46.8213% |
| 111 | 49.9809% | 48.2854% |
| 112 | 49.9755% | 49.6513% |
| 113 | 49.9953% | 50.2110% |
| 114 | 49.9851% | 50.0952% |
| 115 | 50.0000% | 50.0000% |
| 116 | 50.0000% | 50.0000% |
| 117 | 50.0000% | 50.0000% |
| 118 | 50.0000% | 50.0000% |
| 119 | 50.0000% | 50.0000% |
| 120 | 100.0000% | 100.0000% |

# Pre-Retirement Mortality

## Death-in-Service Mortality Rates

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 20 | 0.0239% | 0.0106% |
| 21 | 0.0268% | 0.0108% |
| 22 | 0.0295% | 0.0109% |
| 23 | 0.0313% | 0.0112% |
| 24 | 0.0324% | 0.0116% |
| 25 | 0.0309% | 0.0119% |
| 26 | 0.0302% | 0.0122% |
| 27 | 0.0300% | 0.0127% |
| 28 | 0.0303% | 0.0133% |
| 29 | 0.0311% | 0.0140% |
| 30 | 0.0322% | 0.0150% |
| 31 | 0.0337% | 0.0161% |
| 32 | 0.0352% | 0.0174% |
| 33 | 0.0368% | 0.0187% |
| 34 | 0.0382% | 0.0200% |
| 35 | 0.0393% | 0.0214% |
| 36 | 0.0402% | 0.0227% |
| 37 | 0.0412% | 0.0242% |
| 38 | 0.0423% | 0.0258% |
| 39 | 0.0437% | 0.0276% |
| 40 | 0.0456% | 0.0296% |
| 41 | 0.0478% | 0.0317% |
| 42 | 0.0506% | 0.0340% |
| 43 | 0.0543% | 0.0367% |
| 44 | 0.0588% | 0.0398% |
| 45 | 0.0640% | 0.0434% |
| 46 | 0.0705% | 0.0474% |
| 47 | 0.0777% | 0.0521% |
| 48 | 0.0860% | 0.0571% |
| 49 | 0.0954% | 0.0626% |
| 50 | 0.1058% | 0.0688% |
| 51 | 0.1174% | 0.0757% |
| 52 | 0.1305% | 0.0835% |
| 53 | 0.1442% | 0.0922% |
| 54 | 0.1594% | 0.1017% |
| 55 | 0.1764% | 0.1121% |
| 56 | 0.1960% | 0.1233% |
| 57 | 0.2187% | 0.1351% |
| 58 | 0.2452% | 0.1474% |
| 59 | 0.2759% | 0.1602% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 60 | 0.3113% | 0.1733% |
| 61 | 0.3515% | 0.1870% |
| 62 | 0.3965% | 0.2013% |
| 63 | 0.4467% | 0.2166% |
| 64 | 0.5019% | 0.2329% |
| 65 | 0.5624% | 0.2506% |
| 66 | 0.6210% | 0.2753% |
| 67 | 0.6844% | 0.3028% |
| 68 | 0.7539% | 0.3335% |
| 69 | 0.8303% | 0.3680% |
| 70 | 0.9147% | 0.4070% |
| 71 | 1.0083% | 0.4510% |
| 72 | 1.1130% | 0.5006% |
| 73 | 1.2299% | 0.5572% |
| 74 | 1.3608% | 0.6207% |
| 75 | 1.5071% | 0.6928% |
| 76 | 1.6706% | 0.7741% |
| 77 | 1.8540% | 0.8664% |
| 78 | 2.0582% | 0.9704% |
| 79 | 2.2859% | 1.0874% |
| 80 | 2.5398% | 1.2190% |
| 81 | 2.8770% | 1.4450% |
| 82 | 3.2941% | 1.7633% |
| 83 | 3.7903% | 2.1715% |
| 84 | 4.3640% | 2.6658% |
| 85 | 5.0073% | 3.2435% |
| 86 | 5.7229% | 3.9007% |
| 87 | 6.5034% | 4.6310% |
| 88 | 7.3429% | 5.4253% |
| 89 | 8.2360% | 6.2734% |
| 90 | 9.1736% | 7.1761% |
| 91 | 10.1429% | 8.1223% |
| 92 | 11.1417% | 9.1047% |
| 93 | 12.1542% | 10.1144% |
| 94 | 13.1696% | 11.1381% |
| 95 | 14.1705% | 12.1722% |
| 96 | 15.3429% | 13.2898% |
| 97 | 16.5387% | 14.4518% |
| 98 | 17.7826% | 15.6658% |
| 99 | 19.0601% | 16.9224% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 100 | 20.3698% | 18.2108% |
| 101 | 21.6953% | 19.5173% |
| 102 | 23.0097% | 20.8404% |
| 103 | 24.3068% | 22.1612% |
| 104 | 25.5767% | 23.4585% |
| 105 | 26.8023% | 24.7399% |
| 106 | 27.9806% | 25.9962% |
| 107 | 29.1078% | 27.1838% |
| 108 | 30.1730% | 28.3288% |
| 109 | 31.1818% | 29.4109% |
| 110 | 32.1129% | 30.4338% |
| 111 | 32.4876% | 31.3855% |
| 112 | 32.4841% | 32.2733% |
| 113 | 32.4969% | 32.6372% |
| 114 | 32.4903% | 32.5619% |
| 115 | 32.5000% | 32.5000% |
| 116 | 32.5000% | 32.5000% |
| 117 | 32.5000% | 32.5000% |
| 118 | 32.5000% | 32.5000% |
| 119 | 32.5000% | 32.5000% |
| 120 | 100.0000% | 100.0000% |

# Joint Life Retirement Values
# (7.00% Interest)

| Sample Attained Ages | Single Life Retirement Values | | | | | |
|---|---|---|---|---|---|---|
| | Present Value of $1 Monthly for Life | | Percent Dying Next Year | | Future Life Expectancy (years) | |
| | Men | Women | Men | Women | Men | Women |
| 50 | $149.37 | $153.84 | 0.3922% | 0.2660% | 32.36 | 34.85 |
| 55 | 142.00 | 147.02 | 0.5582% | 0.3734% | 28.05 | 30.34 |
| 60 | 132.97 | 138.52 | 0.7938% | 0.5667% | 23.89 | 25.97 |
| 65 | 122.06 | 128.13 | 1.1511% | 0.8398% | 19.90 | 21.76 |
| 70 | 109.01 | 115.45 | 1.7034% | 1.2770% | 16.11 | 17.74 |
| 75 | 93.80 | 100.44 | 2.6823% | 2.0723% | 12.58 | 13.97 |
| 80 | 76.99 | 83.55 | 4.5024% | 3.5553% | 9.41 | 10.56 |

The present values shown above are for illustrative purposes only and include a 50% survivor benefit but do not include the value of future post-retirement increases. Males are assumed to be 3 years older than their spouses.

# Rates of Retirement

| | % of Active Participants Retiring | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Closed and Year 2000 Plans | | | | | 2011 Tier | | | |
| | Non-Uniformed Members | | | | | Non-Uniformed | | | |
| | Male | | Female | | Uniformed | Normal | | | Uniformed |
| Age | Normal | Early | Normal | Early | Normal | Age & Service | Rule of 90 | Early | Normal |
| 50 | 40% | | 25% | | 45% | | | | |
| 51 | 30% | | 20% | | 15% | | | | |
| 52 | 26% | | 20% | | 15% | | | | |
| 53 | 26% | | 20% | | 16% | | | | |
| 54 | 24% | | 24% | | 16% | | | | |
| 55 | 27% | 3% | 32% | 3% | 25% | | 30% | | 30% |
| 56 | 25% | 3% | 35% | 3% | 30% | | 30% | | 30% |
| 57 | 26% | 4% | 29% | 4% | 20% | | 30% | | 30% |
| 58 | 22% | 2% | 25% | 4% | 30% | | 30% | | 30% |
| 59 | 25% | 4% | 30% | 5% | 40% | | 30% | | 30% |
| 60 | 19% | 5% | 22% | 5% | 100% | | 30% | | 100% |
| 61 | 18% | 5% | 22% | 5% | 100% | | 30% | | 100% |
| 62 | 40% | 40% | 36% | 30% | 100% | | 30% | 10% | 100% |
| 63 | 35% | 35% | 22% | 30% | 100% | | 30% | 10% | 100% |
| 64 | 25% | 30% | 20% | 25% | 100% | | 30% | 10% | 100% |
| 65 | 35% | | 35% | | 100% | | 30% | 10% | 100% |
| 66 | 40% | | 45% | | 100% | | 30% | 10% | 100% |
| 67 | 45% | | 40% | | 100% | 50% | 30% | | 100% |
| 68 | 30% | | 40% | | 100% | 50% | 30% | | 100% |
| 69 | 30% | | 40% | | 100% | 50% | 30% | | 100% |
| 70 | 40% | | 50% | | 100% | 100% | 100% | | 100% |
| 71 | 50% | | 50% | | 100% | 100% | 100% | | 100% |
| 72 | 50% | | 100% | | 100% | 100% | 100% | | 100% |
| 73 | 50% | | 100% | | 100% | 100% | 100% | | 100% |
| 74 | 100% | | 100% | | 100% | 100% | 100% | | 100% |

# Rates of Disability

## All Plan Participants

| Age | % of Active Participants Becoming Disabled | | | |
|---|---|---|---|---|
| | Uniformed Members | | Non-Uniformed Members | |
| | Male | Female | Male | Female |
| 20 | 0.10% | 0.10% | 0.06% | 0.06% |
| 21 | 0.10% | 0.10% | 0.06% | 0.06% |
| 22 | 0.10% | 0.10% | 0.07% | 0.07% |
| 23 | 0.10% | 0.10% | 0.07% | 0.07% |
| 24 | 0.10% | 0.10% | 0.07% | 0.07% |
| 25 | 0.10% | 0.10% | 0.08% | 0.08% |
| 26 | 0.10% | 0.10% | 0.08% | 0.08% |
| 27 | 0.10% | 0.10% | 0.09% | 0.09% |
| 28 | 0.10% | 0.10% | 0.09% | 0.09% |
| 29 | 0.10% | 0.10% | 0.09% | 0.09% |
| 30 | 0.10% | 0.10% | 0.10% | 0.10% |
| 31 | 0.10% | 0.10% | 0.10% | 0.10% |
| 32 | 0.10% | 0.10% | 0.11% | 0.11% |
| 33 | 0.10% | 0.10% | 0.11% | 0.11% |
| 34 | 0.10% | 0.10% | 0.12% | 0.12% |
| 35 | 0.10% | 0.10% | 0.13% | 0.13% |
| 36 | 0.10% | 0.10% | 0.13% | 0.13% |
| 37 | 0.10% | 0.10% | 0.14% | 0.14% |
| 38 | 0.10% | 0.10% | 0.14% | 0.14% |
| 39 | 0.10% | 0.10% | 0.15% | 0.15% |
| 40 | 0.10% | 0.10% | 0.17% | 0.17% |
| 41 | 0.10% | 0.10% | 0.19% | 0.19% |
| 42 | 0.10% | 0.10% | 0.21% | 0.21% |
| 43 | 0.10% | 0.10% | 0.23% | 0.23% |
| 44 | 0.10% | 0.10% | 0.24% | 0.24% |
| 45 | 0.10% | 0.10% | 0.27% | 0.27% |
| 46 | 0.10% | 0.10% | 0.30% | 0.30% |
| 47 | 0.10% | 0.10% | 0.32% | 0.32% |
| 48 | 0.10% | 0.10% | 0.36% | 0.36% |
| 49 | 0.10% | 0.10% | 0.41% | 0.41% |
| 50 | 0.10% | 0.10% | 0.46% | 0.46% |
| 51 | 0.10% | 0.10% | 0.52% | 0.52% |
| 52 | 0.10% | 0.10% | 0.59% | 0.59% |
| 53 | 0.10% | 0.10% | 0.68% | 0.68% |
| 54 | 0.10% | 0.10% | 0.77% | 0.77% |
| 55 | 0.10% | 0.10% | 0.86% | 0.86% |
| 56 | 0.10% | 0.10% | 0.97% | 0.97% |
| 57 | 0.10% | 0.10% | 1.09% | 1.09% |
| 58 | 0.10% | 0.10% | 1.22% | 1.22% |
| 59 | 0.10% | 0.10% | 1.35% | 1.35% |
| 60 | 0.10% | 0.10% | 1.49% | 1.49% |
| 61 | 0.10% | 0.10% | 1.64% | 1.64% |
| 62 | 0.10% | 0.10% | 1.80% | 1.80% |
| 63 | 0.10% | 0.10% | 1.97% | 1.97% |
| 64 | 0.10% | 0.10% | 2.15% | 2.15% |
| 65 | 0.10% | 0.10% | 0.00% | 0.00% |
| 66 | 0.10% | 0.10% | 0.00% | 0.00% |
| 67 | 0.10% | 0.10% | 0.00% | 0.00% |
| 68 | 0.10% | 0.10% | 0.00% | 0.00% |
| 69 | 0.10% | 0.10% | 0.00% | 0.00% |
| 70 | 0.10% | 0.10% | 0.00% | 0.00% |
| 71 | 0.10% | 0.10% | 0.00% | 0.00% |
| 72 | 0.10% | 0.10% | 0.00% | 0.00% |

# Rates of Separation from Active Employment

## All Plan Participants

| Age | Service | % of Active Participants Withdrawing | | | |
|---|---|---|---|---|---|
| | | Uniformed Members | | Non-Uniformed Members | |
| | | Male | Female | Male | Female |
| | 0-1 | 12.00% | 12.00% | 30.00% | 20.00% |
| | 1-2 | 6.00% | 6.00% | 16.00% | 14.00% |
| | 2-3 | 2.50% | 2.50% | 9.00% | 11.00% |
| | 3-4 | 2.50% | 2.50% | 7.00% | 9.00% |
| | 4-5 | 2.50% | 2.50% | 5.50% | 6.00% |
| 25 | 5 & Up | 1.89% | 1.89% | 5.60% | 6.00% |
| 26 | | 1.89% | 1.89% | 5.60% | 6.00% |
| 27 | | 1.89% | 1.89% | 5.60% | 6.00% |
| 28 | | 1.89% | 1.89% | 5.60% | 6.00% |
| 29 | | 1.89% | 1.89% | 5.60% | 6.00% |
| 30 | | 1.89% | 1.89% | 5.60% | 6.00% |
| 31 | | 1.89% | 1.89% | 5.53% | 6.00% |
| 32 | | 1.83% | 1.83% | 5.46% | 6.00% |
| 33 | | 1.65% | 1.65% | 5.39% | 6.00% |
| 34 | | 1.49% | 1.49% | 5.32% | 6.00% |
| 35 | | 1.34% | 1.34% | 5.25% | 6.00% |
| 36 | | 1.19% | 1.19% | 5.18% | 6.00% |
| 37 | | 1.06% | 1.06% | 5.11% | 6.00% |
| 38 | | 0.95% | 0.95% | 5.04% | 6.00% |
| 39 | | 0.86% | 0.86% | 4.97% | 5.78% |
| 40 | | 0.79% | 0.79% | 4.90% | 5.54% |
| 41 | | 0.74% | 0.74% | 4.48% | 5.29% |
| 42 | | 0.69% | 0.69% | 4.06% | 5.05% |
| 43 | | 0.64% | 0.64% | 3.64% | 4.81% |
| 44 | | 0.60% | 0.60% | 3.22% | 4.56% |
| 45 | | 0.55% | 0.55% | 2.80% | 4.32% |
| 46 | | 0.50% | 0.50% | 2.66% | 4.12% |
| 47 | | 0.46% | 0.46% | 2.52% | 3.92% |
| 48 | | 0.41% | 0.41% | 2.38% | 3.72% |
| 49 | | 0.36% | 0.36% | 2.24% | 3.36% |
| 50 | | 0.32% | 0.32% | 2.10% | 3.00% |
| 51 | | 0.27% | 0.27% | 1.96% | 3.00% |
| 52 | | 0.23% | 0.23% | 1.82% | 3.00% |
| 53 | | 0.21% | 0.21% | 1.68% | 3.00% |
| 54 | | 0.19% | 0.19% | 1.54% | 3.00% |
| 55 | | 0.16% | 0.16% | 1.40% | 3.00% |
| 56 | | 0.17% | 0.17% | 1.40% | 3.00% |
| 57 | | 0.13% | 0.13% | 1.40% | 3.00% |
| 58 | | 0.13% | 0.13% | 1.40% | 3.00% |
| 59 | | 0.13% | 0.13% | 1.40% | 3.00% |
| 60 | | 0.12% | 0.12% | 1.40% | 3.00% |

# Miscellaneous and Technical Assumptions

| | |
|---|---|
| **Administrative Expenses:** | 1.15% of payroll, based upon actual results from previous year. |
| **Disability Expenses:** | 0.53% of payroll included in contribution. Retirement system pays premium directly to an outside insurance company or TPA. |
| **Marriage Assumption:** | 90% of participants are assumed to be married for purposes of death-in-service benefits. Applies to disabled members entitled to future retirement benefits also. Male spouses are assumed to be 3 years older than females if beneficiary information is not available. For purposes of valuing the 50% death after retirement benefit, 100% of closed active members are assumed to be married. |
| **Pay Increase Timing:** | Beginning of (Fiscal) year. This is equivalent to assuming that reported pays represent amounts paid to members during the year ended on the valuation date. |
| **Decrement Timing:** | Decrements of all types are assumed to occur mid-year. |
| **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. |
| **Benefit Service:** | Exact fractional service is used to determine the amount of benefit payable. |
| **Decrement Relativity:** | Decrement rates are used directly from the experience study, without adjustment for multiple decrement table effects. |
| **Normal Form of Benefit:** | The assumed normal form of benefit is a 50% joint & survivor benefit for married members in the Closed Plan and a straight life benefit for all other members. |
| **Optional Benefit Factors:** | Optional Benefit Factors are in accordance with tables adopted by the Board. We believe these factors are reasonably close to actuarial equivalence based on valuation assumptions. The reduction for the Y2K and 2011 Tier benefits was calculated in accordance with 104.1027 RSMo. |
| **Deferred Joint and Survivor:** | It was assumed that all deferred members eligible for the Closed plan would choose Closed plan benefits at retirement. |
| **Other:** | Turnover decrements do not operate during retirement eligibility. |
| **Miscellaneous Adjustments:** | The calculated normal and early retirement benefits for the Closed and Year 2000 plans were increased by 3.75% for Uniformed and 2.6% for Non-Uniformed to account for the inclusion of unused sick leave in the calculation of Average Pay. The calculated normal and early retirement benefits for the 2011 Tier plan were increased by 1.5% for Uniformed and 1.0% for Non-Uniformed to account for the inclusion of unused sick leave in the calculation of Average Pay. Post disability benefit liabilities were increased by 50% for all future disabilities to account for potential survivor benefits payable by the retirement system during the period of disability. Current self-insured disability retirant liabilities are increased by 12% to account for future survivor benefits. |

# Miscellaneous and Technical Assumptions

## Contribution Stabilization

| | |
|---|---|
| **Miscellaneous Adjustments:** | Liabilities for future deferred members were increased by 2% to account for potential survivor benefits payable if the member dies during the deferred period. We have otherwise not modeled this benefit for future deferred members. |
| **Reserve Fund:** | The contribution stabilization reserve fund affects the total amount of UAAL financed and is assumed to grow at the investment return rate. |
| **Death Prior to Retirement:** | 100% of deaths in service are assumed to be non-duty. |
| **Gainful Employment Offset:** | 30% of the $90 per month special benefit is assumed to be offset by gainful employment. |
| **Minimum Benefit Eligibility:** | Death prior to retirement benefits are assumed to be eligible for the minimum base benefit along with normal and early retirement benefits. |
| **Active Plan Choice:** | It was assumed that active members eligible for the Closed plan would choose the Closed plan benefits at retirement. |
| **Member Contribution Interest:** | Member contributions are assumed to be credited with 3.0% interest. |

# Data

Active and retired member data was reported as of May 31. It was brought forward to June 30 by adding one month of service for all active members and otherwise making no other adjustments. It was assumed that the population as of May 31 was statistically equivalent to the population as of June 30. Financial information is reported as of June 30.

**Salary Adjustments:** Salary from data as provided in prior valuations was used for two active members on leave. Salary for new hires was annualized.

**Disabled Member Data:** Y2K and 2011 Tier data as provided are increased by 80% of CPI from date of disability to the valuation date and projected increases from the valuation date to the retirement date at 2.0% annually. For purposes of valuing these benefits, the 2.0% projected annual increases are backed out and replaced with 1.8% (80% of the current 2.25% CPI assumption) projected annual increases.

**Deferred Member Data:** Two Terminated Vested members were indicated to have a refund request in progress. As a result, we removed them from the Terminated Vested data file. Additionally, one member was in the Terminated Vested file last year and in the Active file this year. In this year's Active data file, they were indicated to have been termed with an effective date prior to May 30, 2020. As such, we have valued this member as a Terminated Vested member by using the Terminated Vested data from last year's valuation.

**Reconciliation and Review:** Reported data was reconciled to data reported for the prior year and reviewed for completeness and reasonableness. Any questions arising from this review were discussed with System staff. Upon completion of the review control totals (see page 1), were shared with the Executive Director and discussed to ensure MPERS also agreed that the data was reasonable.

# Method of Financing Future Benefits for Present Active Members

The valuation was prepared in accordance with Section 104.1066 of the Missouri Revised Statutes, which requires the use of the entry-age normal actuarial cost method for determining normal cost and level percent-of-payroll financing of unfunded actuarial accrued liabilities. Details of the application of these methods are described below.

***Normal cost*** and the allocation of present values between service rendered before and after the valuation date were determined using an individual entry-age actuarial cost method having the following characteristics:

(i) the annual normal cost for each individual active member, payable from the date of employment to the date of retirement, is sufficient to accumulate the value of the member's benefit at the time of retirement; and

(ii) each annual normal cost is a constant percentage of the member's year by year projected covered pay.

The ***Value of Future Benefits*** was calculated using the benefits assumed to be payable in the future to current active, terminated vested and retired members. It was assumed that current active and retired Uniformed Patrol members hired prior to July 1, 2000 would elect to retain the benefits under the current plan. Computed costs were increased in accordance with the adjustments described on page E-14.

The ***Present Value of Future Normal Costs*** was defined as the average normal cost rate multiplied by the present value of future payroll for the group.

The ***Actuarial Accrued Liabilities*** were defined as the difference between the present value of future benefits and the present value of future normal costs.

The ***Contribution Stabilization Reserve Fund (CSR)*** is set by the Board based on deferred recognition of gains in an effort to stabilize employer contributions from year to year. The fund is capped at $250,000,000.

Actuarial Accrued Liabilities, less pension assets as of June 30, 2020, resulted in ***Unfunded Actuarial Accrued Liabilities (UAAL).*** The UAAL plus the CSR was amortized using the following funding policy.

*Permanent Policy:* The total contribution will be based on normal cost plus a 15-year amortization of unfunded actuarial accrued liabilities. The amortization period is a closed 15-year period starting July 1, 2021.

*Temporary Accelerated Policy:* The total contribution is based on normal cost plus a 5-year amortization period for unfunded retiree liabilities and a 20-year amortization period for other unfunded liabilities. Both amortization periods are closed periods starting July 1, 2021.

This temporary accelerated policy was adopted by the Retirement Board on September 17, 2009 and will remain in effect until such time as the retiree liability becomes 100% funded or the permanent policy produces a higher contribution rate.

***Post-Valuation Date Activity:*** No other adjustments were made to the valuation results to reflect other post-valuation date activity.

# June 30, 2020 Actuarial Valuation
# Glossary

***Actuarial Accrued Liability.*** The difference between (i) the actuarial present value of future plan benefits, and (ii) the actuarial present value of future normal cost. Sometimes referred to as "accrued liability" or "past service liability."

***Accrued Service.*** The service credited under the plan which was rendered before the date of the actuarial valuation.

***Actuarial Assumptions.*** Estimates of future plan 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.

***Actuarial Cost Method.*** A mathematical budgeting procedure for allocating the dollar amount of the "actuarial present value of future plan benefits" between the actuarial present value of future normal cost and the actuarial accrued liability. Sometimes referred to as the "actuarial funding method."

***Actuarial Equivalent.*** A series of payments is called an actuarial equivalent of another series of payments if the two series have the same actuarial present value.

***Actuarial Present Value.*** The amount of funds presently required to provide a payment or series of payments in the future. It is determined by discounting the future payments at a predetermined rate of interest, taking into account the probability of payment.

***Actuarial value of Assets.*** Also referred to as funding value of assets, smoothed market value of assets, or valuation assets.

Valuation assets recognize assumed investment return fully each year. Differences between actual and assumed investment return are phased-in over a closed 3-year period. This treatment helps remove the timing of investment activities from the valuation process. During periods when investment performance exceeds the assumed rate, valuation assets will tend to be less than market value. During periods when investment performance is less than the assumed rate, valuation assets will tend to be greater than market value. If assumed rates are exactly realized for 3 consecutive years, valuation assets will become equal to market value.

***Actuary.*** A person who is trained in the applications of probability and compound interest to problems in business and finance that involve payment of money in the future, contingent upon the occurrence of future events. Most actuaries in the United States are Members of the American Academy of Actuaries. The Society of Actuaries is an international research, education and membership organization for actuaries in the life and health insurance, employee benefits, and pension fields. It administers a series of examinations leading initially to Associateship and the designation ASA and ultimately to Fellowship with the designation FSA.

# June 30, 2020 Actuarial Valuation
# Glossary (Concluded)

***Amortization.*** Paying off an interest-bearing liability by means of periodic payments of interest and principal, as opposed to paying it off with a lump sum payment.

***Experience Gain (Loss).*** A measure of the difference between actual experience and that expected based upon a set of actuarial assumptions during the period between two actuarial valuation dates, in accordance with the actuarial cost method being used.

***Normal Cost.*** The annual cost assigned, under the actuarial funding method, to current and subsequent plan years. Sometimes referred to as "current service cost." Any payment toward the unfunded actuarial accrued liability is not part of the normal cost.

***Plan Termination Liability.*** The actuarial present value of future plan benefits based on the assumption that there will be no further accruals for future service and salary. The termination liability will generally be less than the liabilities computed on a "going concern" basis and is not normally determined in a routine actuarial valuation.

***Reserve Account.*** An account used to indicate that funds have been set aside for a specific purpose and are not generally available for other uses.

***Unfunded Actuarial Accrued Liability.*** The difference between the actuarial accrued liability and actuarial value of assets. Sometimes referred to as "unfunded accrued liability."

The existence of unfunded actuarial accrued liabilities is not in itself bad, any more than a mortgage on a house is bad. Unfunded actuarial accrued liabilities do not represent a debt that is payable today. What is important is the ability to amortize the unfunded actuarial accrued liabilities and the trend in their amount (after due allowance for devaluation of the dollar).

***Valuation Payroll.*** Active member payroll that is intended to reflect the annual salary considered as covered compensation for Retirement System benefits.

# SECTION F

## FINANCIAL PRINCIPLES AND OPERATIONAL TECHNIQUES

# Financial Principles and Operational Techniques of the Retirement System

***Promises Made, and To Be Paid For.*** As each year is completed, the Retirement System in effect hands an "IOU" to each member then acquiring a year of service credit -- the "IOU" says: "The Missouri Department of Transportation and Highway Patrol Employees' Retirement System owes you one year's worth of retirement benefits, payments in cash commencing when you qualify for retirement."

The principal related financial question is: When shall the money required to cover the "IOU" be contributed? This year, when the benefit of the member's service is received? Or, some future year when the "IOU" becomes a cash demand?

***The objective of level percent-of-payroll financing is that this year's taxpayers contribute the money to cover the IOUs being handed out this year.*** By following this objective, ***the employer contribution rate will remain approximately level from year to year*** --- and will not have to be increased for future generations of taxpayers. However, "Level percent-of-payroll" does NOT mean "Fixed percent-of-payroll." The level percent-of-payroll is an estimate that may change from one year to the next.

(There are systems which have a design for deferring contributions to future taxpayers, lured by a lower contribution rate now and putting aside the consequence that the contribution rate must then relentlessly grow much greater over decades of time.)

An inevitable by-product of the level-cost design is the accumulation of reserve assets, for decades, and the income produced when the assets are invested. ***Invested assets are a by-product and not the objective.*** Investment income becomes the 3rd contributor for benefits to employees, and is interlocked with the contribution amounts required from employees and employer.

# Financial Principles and Operational Techniques of the Retirement System (Concluded)

Translated to actuarial terminology, this level-cost objective means that the contribution rates must total at least the following:

***Normal Cost*** (the value assigned to service being rendered this year)

. . . plus . . .

***Interest on Unfunded Actuarial Accrued Liabilities*** (the difference between liabilities for service already rendered and the accrued assets of the Retirement System).

***Computing Contributions to Support System Benefits.*** From a given schedule of benefits and from the employee data and asset data furnished by the system, the actuary determines the contribution rates to support the benefits, by means of ***an actuarial valuation.***

An actuarial valuation has a number of ingredients such as: the rate of investment return which plan assets will earn; the rates of withdrawal of active members who leave covered employment; the rates of mortality; the rates of disability; the rates of pay increases and the assumed age or ages at actual retirement.

In an actuarial valuation the actuary must assume what the above rates will be, for the next year and for decades in the future. Only the subsequent actual experience of the plan can indicate the degree of accuracy of the assumptions.

***Reconciling Differences Between Assumed Experience and Actual Experience.*** Once actual experience has occurred and has been observed, it will not coincide exactly with assumed experience, regardless of the skill of the actuary and the many calculations made. Most retirement systems cope with such differences by having annual actuarial valuations. Each actuarial valuation is a complete recalculation of assumed future experience, taking into account all past differences between assumed and actual experience. The result is ***continuing adjustments to the financial position.***

# Actuarial Valuation Process

The ***actuarial valuation*** is the mathematical process by which the contribution rate is determined, and the flow of activity constituting the valuation may be summarized as follows:

A . ***Covered people data*** furnished by plan administrator, including:

Retired lives now receiving benefits

Former employees with vested benefits not yet payable

Active employees

B . + ***Asset data*** (cash & investments), furnished by the plan administrator

C . + ***Benefit provisions*** which specify eligibility and amounts of pensions

D . + ***Assumptions concerning future experience in various risk areas,*** which are established by the Retirement Board after consulting with the actuary

E . + ***The funding method*** for employer contributions (the long-term, planned pattern for employer contributions)

F . + ***Mathematically combining the assumptions, the funding method, and the data***

G . = Determination of:

Plan Financial Position and/or

New Employer Contribution Rate

# Meaning of "Unfunded Actuarial Accrued Liabilities"

***"Actuarial accrued liabilities" are the portion of the present value of plan promises to pay benefits in the future that are not covered by future normal cost contributions.*** A liability has been established ("accrued") because the service has been rendered but the resulting monthly cash benefit may not be payable until years in the future. Actuarial accrued liabilities are the result of complex mathematical calculations, which are made by the plan's actuary.

If "actuarial accrued liabilities" exceed the plan's accrued assets (cash & investments), the difference is ***"unfunded actuarial accrued liabilities."*** This is the usual condition. If the plan's assets equaled the plan's "actuarial accrued liabilities," then the plan would be termed "fully funded." This is an unusual condition.

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Each time a plan adds a new benefit, which applies to service already rendered, an "actuarial accrued liability" is created, which is also an "unfunded actuarial accrued liability" because the plan can't print instant cash to cover the value of the new benefit promises. Payment for such unfunded actuarial accrued liabilities is spread over a period of years, commonly in the 20-30 year range.

Unfunded actuarial accrued liabilities can occur in another way: if actual plan experience is less favorable than assumed plan experience, the difference is added to unfunded actuarial accrued liabilities. In plans where benefits are directly related to an employee's pay near time of retirement, unfunded actuarial accrued liabilities rose dramatically during the 1970's. Unexpected rates of pay increase created additional actuarial accrued liabilities, which could not be matched by reasonable investment results. More recent experience has generally been more favorable with some reductions in unfunded actuarial accrued liabilities.

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***The existence of unfunded actuarial accrued liabilities is not bad, but the changes from year to year in the amount of unfunded actuarial accrued liabilities are important,*** --- "bad" or "good" or somewhere in between.

Even though unfunded actuarial accrued liabilities don't constitute a bill payable immediately, it is important that policy-makers prevent the amount from becoming unreasonably high and ***it is vital for plans to have a sound method for making payments toward them*** so that they are controlled.

# SECTION G

## SUPPLEMENTAL INFORMATION FOR COMPREHENSIVE ANNUAL FINANCIAL REPORTING

800.521.0498 | P: 248.799.9000 | www.grsconsulting.com

September 15, 2020

Retirement Board
Missouri Department of Transportation
and Highway Patrol Employees' Retirement System
1913 William Street
Jefferson City, Missouri 65102-1930

Ladies and Gentlemen:

This report was prepared at the request of the Board and is intended for use by the Retirement System and those designated or approved by the Board. This report may be provided to parties other than the System only in its entirety and only with the permission of the Board. GRS is not responsible for unauthorized use of this report. This report should not be relied on for any purpose other than the purpose described.

The basic financial objective of the Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS) is to establish and receive contributions which:

(1) when expressed in terms of percents of active member payroll, will remain approximately level from generation to generation of Missouri citizens; and

(2) when combined with present assets and future investment returns, will be sufficient to meet the present and future financial obligations of MPERS.

In order to measure progress toward this fundamental objective, MPERS has annual actuarial valuations performed. The valuations: (i) measure the present financial position, and (ii) establish contribution rates that provide for the current cost and level percent-of-payroll amortization of unfunded actuarial liabilities over a reasonable period. An actuarial valuation was performed based upon benefit conditions, data and assumptions as of June 30, 2020. This valuation indicates that contribution rates for the period beginning July 1, 2021 that are at least equal to the calculated contribution rates will meet the Board's financial objective. The calculated contribution rates are 58.00% of payroll for the 6,151 Non-Uniformed employees and 58.00% of payroll for the 1,204 Uniformed patrol employees.

The plan administrative staff provides the actuary with data for the actuarial valuation. The actuary relies on the data after reviewing it for internal and year to year consistency. Member data was not audited by the actuary. The actuary summarizes and tabulates population data in order to analyze longer term trends. We are not responsible for the accuracy or completeness of the data provided by MPERS.

Gabriel, Roeder, Smith & Company was responsible for the following schedules found in the Actuarial Section:

- Summary of Actuarial Assumptions and Methods
  - Probabilities of Separation from Active Employment
  - Individual Salary Increases
  - Joint Life Retirement Values
  - Probabilities of Retirement for Members
  - Probabilities of Disability for Members
- Summary of Member Data Included in Valuations
  - Active Members by Attained Age and Years of Service
  - Schedule of Active Member Valuation Data
- Solvency Test
- Derivation of Financial Experience
- Schedule of Retirees and Beneficiaries Added and Removed
- Summary of Plan Provisions
- Legislative Changes

Gabriel, Roeder, Smith & Company was responsible for the following schedules found in the Financial Section:

- Schedule of Changes in the Employer's Net Pension Liability
- Schedule of Employer's Net Pension Liability
- Schedule of Employer Contributions
- Schedule of the Actuarially Determined Contributions

Actuarial valuations are based upon assumptions regarding future activity in specific risk areas including the rates of investment return and payroll growth, eligibility for the various classes of benefits, and longevity among retired lives. These assumptions are adopted by the Board. The assumptions and the methods comply with the requirements of the Governmental Accounting Standards Board. Each actuarial valuation takes into account all prior differences between actual and assumed experience in each risk area and adjusts the contribution rates as needed. Actuarial methods and assumptions were adopted by the Board pursuant to the June 30, 2017 Experience Study. Gabriel, Roeder, Smith & Company has produced the following reports as of June 30, 2020:

- Annual Actuarial Valuation Report
- GASB Nos. 67 and 68 Valuation Report

In order to gain a full understanding of the condition of this plan, these reports should be read in their entirety.

To the best of our knowledge, the report is complete and accurate and was made in accordance with standards of practice promulgated by the Actuarial Standards Board. The assumptions and methods used for funding purposes meet the parameters set by Actuarial Standards of Practice. The actuarial assumptions used for the valuation produce results which, individually and in the aggregate, are reasonable.

The employer contributions determined in this report are based on Board funding policy. This policy is discussed on page 4 of the annual actuarial valuation report. We commend the Board for its aggressive monitoring and updating of the funding policy over the recent past. However, continued employer contributions at the current level do not guarantee benefit security. We therefore encourage the Board to continue to routinely monitor and update its funding policy and to continue to consider benefit security when doing so.

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.

This report has been prepared by individuals who have substantial experience valuing public employee retirement systems. Heidi G. Barry and Jamal Adora are Members of the American Academy of Actuaries (MAAA) and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

The signing individuals are independent of the plan sponsor.

**Based upon the valuation results, it is our opinion that the Missouri Department of Transportation and Highway Patrol Employees' Retirement System continues to operate in accordance with actuarial principles of level percent-of-payroll financing. It is important to the well-being of the System that it continues to receive contributions at the actuarially determined levels. It is also important to continue to monitor both the total funded status and the funded status of the retiree liabilities to ensure that the funding policy is consistent with the expected life span of the respective unfunded obligation.**

Respectfully submitted,

Heidi G. Barry, ASA, FCA, MAAA

Jamal Adora, ASA, MAAA

Kenneth G. Alberts

GRS

# Solvency Test

The MPERS funding objective is to meet long term benefit promises through contributions that remain approximately level from year-to-year as a percent of member payroll. If the contributions to the System are level in concept and soundly executed, the System will ***pay all promised benefits when due – the ultimate test of financial soundness.***

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***A solvency test*** is one means of checking a system's progress under its funding program. In a solvency test for a non-contributory plan, the plan's present assets (cash and investments) are compared with: 1) the liabilities for future benefits to present retired lives, and 2) the liabilities for service already rendered by members. In a system that has been following the discipline of level percent-of-payroll financing, the liabilities for future benefits to present retired lives (liability 1) will be fully covered by present assets (except in rare circumstances). In addition, the liabilities for service already rendered by members (liability 2) will be partially covered by the remainder of present assets. The larger the funded portion of liability 2, the stronger the condition of the system.

The schedule below illustrates the history of liability 2 of the System.

| Val. Date June 30 | (1) Member Contributions | (2) Retirees and Benef. | (3) Active and Inactive Members | Present Valuation Assets | Portion of Present Values Covered by Present Assets | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | (1) | (2) | (3) | Total |
| | ----------$ Millions---------- | | | | | | | |
| 2011 | 0 | 2,045 | 1,253 | 1,427 | 100% | 70% | 0% | 43% |
| 2012# | 0 | 2,133 | 1,173 | 1,531 | 100% | 72% | 0% | 46% |
| 2013# | 1 | 2,333 | 1,250 | 1,657 | 100% | 71% | 0% | 46% |
| 2014 | 2 | 2,384 | 1,264 | 1,795 | 100% | 75% | 0% | 49% |
| 2015 | 3 | 2,444 | 1,269 | 1,967 | 100% | 80% | 0% | 53% |
| 2016 | 5 | 2,470 | 1,287 | 2,087 | 100% | 84% | 0% | 55% |
| 2017 | 8 | 2,488 | 1,306 | 2,173 | 100% | 87% | 0% | 57% |
| 2018# | 11 | 2,598 | 1,373 | 2,274 | 100% | 87% | 0% | 57% |
| 2019 | 14 | 2,656 | 1,367 | 2,415 | 100% | 90% | 0% | 60% |
| 2020 | 18 | 2,726 | 1,348 | 2,481 | 100% | 90% | 0% | 61% |

*# New assumptions and/or methods adopted.*

# Derivation of Experience Gain/(Loss)

Actual experience will never coincide exactly with assumed experience (except by coincidence). Gains and losses may offset each other over a period of years, but sizeable year-to-year variations from assumed experience are common. Detail on the derivation of the experience gain/(loss) is shown below:

| | $ Millions |
|---|---|
| UAAL Beginning of Year (at July 1) | $ 1,622,026,277 |
| Normal Cost | 48,303,944 |
| Transfer In and Service Purchase - Liability | 5,046,936 |
| Contributions | (220,902,777) |
| Interest | 107,677,522 |
| Net Change in LTD Assets | - |
| Expected UAAL Before Any Changes | 1,562,151,902 |
| Effect of Benefit Changes | - |
| Effect of Changes in Assumptions & Methods | - |
| Effect of Adjustment | - |
| Expected UAAL After Changes | 1,562,151,902 |
| End of Year UAAL (at June 30) | $ 1,610,768,366 |
| Gain/(Loss) for Year | $ (48,616,464) |

| Valuation Date June 30 | Experience Gain/(Loss) as % of Beginning Accrued Liability |
|---|---|
| 2011 | 2.2 % |
| 2012 | 3.2 % |
| 2013 | 2.1 % |
| 2014 | 2.1 % |
| 2015 | 2.4 % |
| 2016 | 1.1 % |
| 2017 | 0.1 % |
| 2018 | 0.6 % |
| 2019 | 0.7 % |
| **2020** | **(1.2)%** |

# Summary of Actuarial Assumptions and Methods

| | |
|---|---|
| Valuation Date: | June 30, 2020 |
| Actuarial Cost Method: | Entry Age |
| Amortized Method: | Closed, level percent-of-payroll |
| Remaining Amortization Period: | 12 years# |
| Asset Valuation Method: | 3-year smoothing |
| Actuarial Assumptions: | |
| Investment Rate of Return: | 7.00% |
| Projected Salary Increase: | 3.00% to 12.45% |
| Cost-of-Living Adjustments: | 1.80% Compound |
| Includes Wage Inflation at: | 3.00% |

*# Single equivalent period.*

An actuarial valuation is based upon an actuarial cost method, an asset valuation method, and actuarial assumptions. These methods and assumptions are chosen by the Board of Trustees after consultation with the Actuary and other advisors.

The actuarial cost method is called the Entry Age Actuarial Cost Method. This method is consistent with the Board's level percent-of-payroll funding objective. With this method, the level percent-of-payroll is determined that will fund a member's retirement benefit over the member's entire working lifetime, from date of hire (Entry Age) to date of exit from the active member population. Differences in the past between assumed and actual experience become part of unfunded actuarial accrued liabilities and are amortized with level percent-of-payroll contributions. This cost method was first used in the ***June 30, 1999*** valuation.

The asset valuation method is a three-year smoothed market value method in which assumed investment return is recognized immediately each year and differences between actual and assumed investment return are phased-in over a closed three-year period. This asset valuation method is intended to give recognition to the long-term accuracy of market values while filtering out and dampening short-term market swings. This method was first used in the ***June 30, 1999*** valuation.

The actuarial assumptions used in producing the valuation fall into two broad classes: economic assumptions, and demographic assumptions. Economic assumptions refer to long-term rates of investment return, wage growth, covered population growth, and inflation. Demographic assumptions refer to retirement rates, turnover rates, disability rates, merit and seniority pay increases, and mortality rates. The current assumptions are based upon a 2012-2017 study of experience of the MPERS. The assumptions are reviewed from time to time to keep them reasonably current with expected experience. The next experience study is scheduled to follow the June 30, 2022 valuation.

## *Economic Assumptions*

***The investment return rate*** used in making the valuation was 7.00% per year, compounded annually (net after administrative expenses). This rate of return is not the assumed real rate of return. The real rate of return over wage inflation is defined to be the portion of investment return which is more than the wage inflation rate. Considering wage inflation recognition of 3.00%, the 7.00% rate translates to an assumed real rate of return over wage inflation of 4.00%. This rate was first used for the ***June 30, 2018*** valuation.

# Summary of Actuarial Assumptions and Methods (Concluded)

***Pay increase assumptions*** for individual active members are shown on Table I. Part of the assumption for each year of service is for a merit and/or seniority increase, and the other 3.00% recognizes wage inflation. These rates were first used for the **June 30, 2018** valuation.

***Price Inflation*** is assumed to be 2.25%. This results in a 1.8% annual COLA assumption. It is assumed that the 1.8% COLA will always be paid.

The Active Member Group size is assumed to remain constant at its present level.

***The active member payroll*** for all members is assumed to increase 3.00% annually.

## *Non-Economic Assumptions*

***The mortality table*** used to measure Post-Retirement Healthy Mortality Rates are from the RP-2014 Healthy Annuitant Mortality Tables projected to 2022 using projection scale MP-2017, shown in Table II. Post-Retirement Disabled Mortality Rates use the RP-2014 Disabled Retiree Annuitant Mortality Tables projected to 2022 using projection scale MP-2017, shown in Table III. Pre-Retirement Mortality Rates use the RP-2014 Employee Mortality Tables projected to 2022 using projection scale MP-2017 and multiplied by a factor of 65%, shown in Table IV. These tables were first used for the **June 30, 2018** valuation.

***The probabilities of retirement*** for members eligible to retire are shown on Table VI. The rates for full retirement were first used in the **June 30, 2018** valuation. The rates for reduced retirement were first used in the **June 30, 2018** valuation. Upon retirement, members are assumed to pick the BackDROP period that when combined with the remaining annuity produces the highest liability.

***The probabilities of disability*** for members eligible to retire are shown on Table VII. The rates for disability were first used in the **June 30, 2018** valuation.

***The probabilities of withdrawal*** from service, death-in-service and disability are shown for sample ages on Table VIII. The death-in-service and disability rates were first used in the **June 30, 2018** valuation. The withdrawal rates were first used in the **June 30, 2018** valuation.

***The data about persons now covered and about present assets*** was furnished by the System's administrative staff. Although examined for general reasonableness, the data was not audited by the Actuary. Data was furnished as of May 31 and assumed to be statistically equivalent to June 30.

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The actuarial valuation computations were made by or under the supervision of a Member of the American Academy of Actuaries (MAAA).

# Table I
# Service Based Salary Scale

| % Merit Increases in Salaries Next Year | | |
|---|---|---|
| **Service Index** | **Uniformed Members** | **Non-Uniformed Members** |
| 1 | 9.45% | 6.80% |
| 2 | 5.00% | 4.50% |
| 3 | 2.75% | 2.80% |
| 4 | 2.50% | 1.50% |
| 5 | 2.00% | 1.00% |
| 6 | 1.50% | 0.80% |
| 7 | 1.25% | 0.00% |
| 8 | 1.25% | 0.00% |
| 9 | 1.00% | 0.00% |
| 10 | 0.75% | 0.00% |
| 11 | 0.75% | 0.00% |
| 12 | 0.75% | 0.00% |
| 13 | 0.50% | 0.00% |
| 14 | 0.50% | 0.00% |
| 15 | 0.25% | 0.00% |
| 16 | 0.25% | 0.00% |
| 17 | 0.25% | 0.00% |
| 18 | 0.25% | 0.00% |
| 19 | 0.25% | 0.00% |
| 20 | 0.25% | 0.00% |
| 21 | 0.00% | 0.00% |
| 22 | 0.00% | 0.00% |
| 23 | 0.00% | 0.00% |
| 24 | 0.00% | 0.00% |
| 25 | 0.00% | 0.00% |

# Table II
# Post-Retirement Mortality

## Retired Lives Mortality Rates

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 20 | 0.0369% | 0.0174% |
| 21 | 0.0408% | 0.0195% |
| 22 | 0.0449% | 0.0223% |
| 23 | 0.0492% | 0.0256% |
| 24 | 0.0538% | 0.0295% |
| 25 | 0.0588% | 0.0340% |
| 26 | 0.0641% | 0.0388% |
| 27 | 0.0700% | 0.0441% |
| 28 | 0.0764% | 0.0499% |
| 29 | 0.0836% | 0.0567% |
| 30 | 0.0916% | 0.0644% |
| 31 | 0.1004% | 0.0731% |
| 32 | 0.1098% | 0.0828% |
| 33 | 0.1201% | 0.0933% |
| 34 | 0.1300% | 0.1047% |
| 35 | 0.1405% | 0.1166% |
| 36 | 0.1519% | 0.1291% |
| 37 | 0.1638% | 0.1413% |
| 38 | 0.1766% | 0.1532% |
| 39 | 0.1899% | 0.1644% |
| 40 | 0.2035% | 0.1750% |
| 41 | 0.2169% | 0.1838% |
| 42 | 0.2307% | 0.1918% |
| 43 | 0.2453% | 0.1994% |
| 44 | 0.2609% | 0.2070% |
| 45 | 0.2779% | 0.2146% |
| 46 | 0.2964% | 0.2231% |
| 47 | 0.3167% | 0.2325% |
| 48 | 0.3394% | 0.2424% |
| 49 | 0.3644% | 0.2533% |
| 50 | 0.3922% | 0.2660% |
| 51 | 0.4231% | 0.2806% |
| 52 | 0.4563% | 0.2986% |
| 53 | 0.4885% | 0.3200% |
| 54 | 0.5223% | 0.3449% |
| 55 | 0.5582% | 0.3734% |
| 56 | 0.5971% | 0.4054% |
| 57 | 0.6398% | 0.4409% |
| 58 | 0.6865% | 0.4797% |
| 59 | 0.7377% | 0.5218% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 60 | 0.7938% | 0.5667% |
| 61 | 0.8547% | 0.6147% |
| 62 | 0.9205% | 0.6657% |
| 63 | 0.9918% | 0.7196% |
| 64 | 1.0684% | 0.7773% |
| 65 | 1.1511% | 0.8398% |
| 66 | 1.2408% | 0.9085% |
| 67 | 1.3387% | 0.9850% |
| 68 | 1.4472% | 1.0710% |
| 69 | 1.5680% | 1.1678% |
| 70 | 1.7034% | 1.2770% |
| 71 | 1.8549% | 1.4005% |
| 72 | 2.0259% | 1.5392% |
| 73 | 2.2187% | 1.6965% |
| 74 | 2.4366% | 1.8727% |
| 75 | 2.6823% | 2.0723% |
| 76 | 2.9606% | 2.2975% |
| 77 | 3.2770% | 2.5540% |
| 78 | 3.6348% | 2.8455% |
| 79 | 4.0410% | 3.1769% |
| 80 | 4.5024% | 3.5553% |
| 81 | 5.0252% | 3.9869% |
| 82 | 5.6159% | 4.4782% |
| 83 | 6.2866% | 5.0381% |
| 84 | 7.0474% | 5.6722% |
| 85 | 7.9002% | 6.3897% |
| 86 | 8.8634% | 7.1988% |
| 87 | 9.9417% | 8.1051% |
| 88 | 11.1427% | 9.1109% |
| 89 | 12.4767% | 10.2194% |
| 90 | 13.9500% | 11.4522% |
| 91 | 15.4968% | 12.7799% |
| 92 | 17.0856% | 14.1857% |
| 93 | 18.6789% | 15.6544% |
| 94 | 20.2575% | 17.1685% |
| 95 | 21.8007% | 18.7264% |
| 96 | 23.6045% | 20.4458% |
| 97 | 25.4442% | 22.2335% |
| 98 | 27.3578% | 24.1013% |
| 99 | 29.3232% | 26.0345% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 100 | 31.3381% | 28.0166% |
| 101 | 33.3774% | 30.0266% |
| 102 | 35.3995% | 32.0621% |
| 103 | 37.3951% | 34.0941% |
| 104 | 39.3487% | 36.0900% |
| 105 | 41.2343% | 38.0614% |
| 106 | 43.0470% | 39.9941% |
| 107 | 44.7813% | 41.8213% |
| 108 | 46.4200% | 43.5827% |
| 109 | 47.9720% | 45.2475% |
| 110 | 49.4044% | 46.8213% |
| 111 | 49.9809% | 48.2854% |
| 112 | 49.9755% | 49.6513% |
| 113 | 49.9953% | 50.2110% |
| 114 | 49.9851% | 50.0952% |
| 115 | 50.0000% | 50.0000% |
| 116 | 50.0000% | 50.0000% |
| 117 | 50.0000% | 50.0000% |
| 118 | 50.0000% | 50.0000% |
| 119 | 50.0000% | 50.0000% |
| 120 | 100.0000% | 100.0000% |

# Table III
# Post-Retirement Mortality

## Disabled Retired Lives Mortality Rates

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 20 | 0.0438% | 0.0203% |
| 21 | 0.0612% | 0.0284% |
| 22 | 0.0856% | 0.0397% |
| 23 | 0.1168% | 0.0547% |
| 24 | 0.1553% | 0.0728% |
| 25 | 0.2005% | 0.0940% |
| 26 | 0.2533% | 0.1174% |
| 27 | 0.3130% | 0.1436% |
| 28 | 0.3801% | 0.1725% |
| 29 | 0.4543% | 0.2051% |
| 30 | 0.5358% | 0.2419% |
| 31 | 0.6235% | 0.2828% |
| 32 | 0.7158% | 0.3281% |
| 33 | 0.8114% | 0.3776% |
| 34 | 0.9026% | 0.4306% |
| 35 | 0.9943% | 0.4864% |
| 36 | 1.0858% | 0.5436% |
| 37 | 1.1751% | 0.6006% |
| 38 | 1.2617% | 0.6557% |
| 39 | 1.3443% | 0.7078% |
| 40 | 1.4204% | 0.7560% |
| 41 | 1.4852% | 0.7965% |
| 42 | 1.5449% | 0.8333% |
| 43 | 1.6000% | 0.8677% |
| 44 | 1.6518% | 0.9006% |
| 45 | 1.7022% | 0.9338% |
| 46 | 1.7528% | 0.9691% |
| 47 | 1.8036% | 1.0081% |
| 48 | 1.8561% | 1.0486% |
| 49 | 1.9108% | 1.0931% |
| 50 | 1.9679% | 1.1445% |
| 51 | 2.0285% | 1.2025% |
| 52 | 2.0949% | 1.2677% |
| 53 | 2.1519% | 1.3387% |
| 54 | 2.2110% | 1.4144% |
| 55 | 2.2745% | 1.4929% |
| 56 | 2.3451% | 1.5721% |
| 57 | 2.4253% | 1.6494% |
| 58 | 2.5146% | 1.7227% |
| 59 | 2.6124% | 1.7921% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 60 | 2.7176% | 1.8560% |
| 61 | 2.8283% | 1.9166% |
| 62 | 2.9435% | 1.9759% |
| 63 | 3.0631% | 2.0367% |
| 64 | 3.1849% | 2.1023% |
| 65 | 3.3118% | 2.1768% |
| 66 | 3.4447% | 2.2633% |
| 67 | 3.5855% | 2.3662% |
| 68 | 3.7399% | 2.4882% |
| 69 | 3.9098% | 2.6317% |
| 70 | 4.0984% | 2.7988% |
| 71 | 4.3081% | 2.9925% |
| 72 | 4.5436% | 3.2128% |
| 73 | 4.8065% | 3.4648% |
| 74 | 5.1008% | 3.7463% |
| 75 | 5.4281% | 4.0624% |
| 76 | 5.7929% | 4.4139% |
| 77 | 6.2011% | 4.8052% |
| 78 | 6.6529% | 5.2368% |
| 79 | 7.1550% | 5.7097% |
| 80 | 7.7133% | 6.2278% |
| 81 | 8.3320% | 6.7925% |
| 82 | 9.0153% | 7.4046% |
| 83 | 9.7759% | 8.0682% |
| 84 | 10.6221% | 8.7816% |
| 85 | 11.5504% | 9.5490% |
| 86 | 12.5809% | 10.3728% |
| 87 | 13.7130% | 11.2504% |
| 88 | 14.9503% | 12.1767% |
| 89 | 16.2983% | 13.1470% |
| 90 | 17.7578% | 14.1809% |
| 91 | 19.1980% | 15.3068% |
| 92 | 20.6246% | 16.5148% |
| 93 | 22.0177% | 17.7919% |
| 94 | 23.3675% | 19.1177% |
| 95 | 24.6544% | 20.4885% |
| 96 | 26.2066% | 22.0265% |
| 97 | 27.7603% | 23.6241% |
| 98 | 29.3541% | 25.2910% |
| 99 | 30.9669% | 27.0120% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 100 | 32.6085% | 28.7749% |
| 101 | 34.2769% | 30.5690% |
| 102 | 35.9695% | 32.4095% |
| 103 | 37.6945% | 34.2784% |
| 104 | 39.4530% | 36.1549% |
| 105 | 41.2343% | 38.0614% |
| 106 | 43.0470% | 39.9941% |
| 107 | 44.7813% | 41.8213% |
| 108 | 46.4200% | 43.5827% |
| 109 | 47.9720% | 45.2475% |
| 110 | 49.4044% | 46.8213% |
| 111 | 49.9809% | 48.2854% |
| 112 | 49.9755% | 49.6513% |
| 113 | 49.9953% | 50.2110% |
| 114 | 49.9851% | 50.0952% |
| 115 | 50.0000% | 50.0000% |
| 116 | 50.0000% | 50.0000% |
| 117 | 50.0000% | 50.0000% |
| 118 | 50.0000% | 50.0000% |
| 119 | 50.0000% | 50.0000% |
| 120 | 100.0000% | 100.0000% |

# Table IV
# Pre-Retirement Mortality

## Death-in-Service Mortality Rates

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 20 | 0.0239% | 0.0106% |
| 21 | 0.0268% | 0.0108% |
| 22 | 0.0295% | 0.0109% |
| 23 | 0.0313% | 0.0112% |
| 24 | 0.0324% | 0.0116% |
| 25 | 0.0309% | 0.0119% |
| 26 | 0.0302% | 0.0122% |
| 27 | 0.0300% | 0.0127% |
| 28 | 0.0303% | 0.0133% |
| 29 | 0.0311% | 0.0140% |
| 30 | 0.0322% | 0.0150% |
| 31 | 0.0337% | 0.0161% |
| 32 | 0.0352% | 0.0174% |
| 33 | 0.0368% | 0.0187% |
| 34 | 0.0382% | 0.0200% |
| 35 | 0.0393% | 0.0214% |
| 36 | 0.0402% | 0.0227% |
| 37 | 0.0412% | 0.0242% |
| 38 | 0.0423% | 0.0258% |
| 39 | 0.0437% | 0.0276% |
| 40 | 0.0456% | 0.0296% |
| 41 | 0.0478% | 0.0317% |
| 42 | 0.0506% | 0.0340% |
| 43 | 0.0543% | 0.0367% |
| 44 | 0.0588% | 0.0398% |
| 45 | 0.0640% | 0.0434% |
| 46 | 0.0705% | 0.0474% |
| 47 | 0.0777% | 0.0521% |
| 48 | 0.0860% | 0.0571% |
| 49 | 0.0954% | 0.0626% |
| 50 | 0.1058% | 0.0688% |
| 51 | 0.1174% | 0.0757% |
| 52 | 0.1305% | 0.0835% |
| 53 | 0.1442% | 0.0922% |
| 54 | 0.1594% | 0.1017% |
| 55 | 0.1764% | 0.1121% |
| 56 | 0.1960% | 0.1233% |
| 57 | 0.2187% | 0.1351% |
| 58 | 0.2452% | 0.1474% |
| 59 | 0.2759% | 0.1602% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 60 | 0.3113% | 0.1733% |
| 61 | 0.3515% | 0.1870% |
| 62 | 0.3965% | 0.2013% |
| 63 | 0.4467% | 0.2166% |
| 64 | 0.5019% | 0.2329% |
| 65 | 0.5624% | 0.2506% |
| 66 | 0.6210% | 0.2753% |
| 67 | 0.6844% | 0.3028% |
| 68 | 0.7539% | 0.3335% |
| 69 | 0.8303% | 0.3680% |
| 70 | 0.9147% | 0.4070% |
| 71 | 1.0083% | 0.4510% |
| 72 | 1.1130% | 0.5006% |
| 73 | 1.2299% | 0.5572% |
| 74 | 1.3608% | 0.6207% |
| 75 | 1.5071% | 0.6928% |
| 76 | 1.6706% | 0.7741% |
| 77 | 1.8540% | 0.8664% |
| 78 | 2.0582% | 0.9704% |
| 79 | 2.2859% | 1.0874% |
| 80 | 2.5398% | 1.2190% |
| 81 | 2.8770% | 1.4450% |
| 82 | 3.2941% | 1.7633% |
| 83 | 3.7903% | 2.1715% |
| 84 | 4.3640% | 2.6658% |
| 85 | 5.0073% | 3.2435% |
| 86 | 5.7229% | 3.9007% |
| 87 | 6.5034% | 4.6310% |
| 88 | 7.3429% | 5.4253% |
| 89 | 8.2360% | 6.2734% |
| 90 | 9.1736% | 7.1761% |
| 91 | 10.1429% | 8.1223% |
| 92 | 11.1417% | 9.1047% |
| 93 | 12.1542% | 10.1144% |
| 94 | 13.1696% | 11.1381% |
| 95 | 14.1705% | 12.1722% |
| 96 | 15.3429% | 13.2898% |
| 97 | 16.5387% | 14.4518% |
| 98 | 17.7826% | 15.6658% |
| 99 | 19.0601% | 16.9224% |

| Age | % Dying Next Year | |
|---|---|---|
| | Male | Female |
| 100 | 20.3698% | 18.2108% |
| 101 | 21.6953% | 19.5173% |
| 102 | 23.0097% | 20.8404% |
| 103 | 24.3068% | 22.1612% |
| 104 | 25.5767% | 23.4585% |
| 105 | 26.8023% | 24.7399% |
| 106 | 27.9806% | 25.9962% |
| 107 | 29.1078% | 27.1838% |
| 108 | 30.1730% | 28.3288% |
| 109 | 31.1818% | 29.4109% |
| 110 | 32.1129% | 30.4338% |
| 111 | 32.4876% | 31.3855% |
| 112 | 32.4841% | 32.2733% |
| 113 | 32.4969% | 32.6372% |
| 114 | 32.4903% | 32.5619% |
| 115 | 32.5000% | 32.5000% |
| 116 | 32.5000% | 32.5000% |
| 117 | 32.5000% | 32.5000% |
| 118 | 32.5000% | 32.5000% |
| 119 | 32.5000% | 32.5000% |
| 120 | 100.0000% | 100.0000% |

# Table V
# Joint Life Retirement Values
# (7.00% Interest)

| Sample Attained Ages | Single Life Retirement Values | | | | | |
|---|---|---|---|---|---|---|
| | Present Value of $1 Monthly for Life | | Percent Dying Next Year | | Future Life Expectancy (years) | |
| | Men | Women | Men | Women | Men | Women |
| 50 | $149.37 | $153.84 | 0.3922% | 0.2660% | 32.36 | 34.85 |
| 55 | 142.00 | 147.02 | 0.5582% | 0.3734% | 28.05 | 30.34 |
| 60 | 132.97 | 138.52 | 0.7938% | 0.5667% | 23.89 | 25.97 |
| 65 | 122.06 | 128.13 | 1.1511% | 0.8398% | 19.90 | 21.76 |
| 70 | 109.01 | 115.45 | 1.7034% | 1.2770% | 16.11 | 17.74 |
| 75 | 93.80 | 100.44 | 2.6823% | 2.0723% | 12.58 | 13.97 |
| 80 | 76.99 | 83.55 | 4.5024% | 3.5553% | 9.41 | 10.56 |

The present values shown above are for illustrative purposes only and include a 50% survivor benefit but do not include the value of future post-retirement increases. Males are assumed to be 3 years older than their spouses.

# Table VI
# Rates of Retirement

| | % of Active Participants Retiring | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Closed and Year 2000 Plans | | | | | 2011 Tier | | | |
| | Non-Uniformed Members | | | | | Non-Uniformed | | | |
| | Male | | Female | | Uniformed | Normal | | | Uniformed |
| Age | Normal | Early | Normal | Early | Normal | Age & Service | Rule of 90 | Early | Normal |
| 50 | 40% | | 25% | | 45% | | | | |
| 51 | 30% | | 20% | | 15% | | | | |
| 52 | 26% | | 20% | | 15% | | | | |
| 53 | 26% | | 20% | | 16% | | | | |
| 54 | 24% | | 24% | | 16% | | | | |
| 55 | 27% | 3% | 32% | 3% | 25% | | 30% | | 30% |
| 56 | 25% | 3% | 35% | 3% | 30% | | 30% | | 30% |
| 57 | 26% | 4% | 29% | 4% | 20% | | 30% | | 30% |
| 58 | 22% | 2% | 25% | 4% | 30% | | 30% | | 30% |
| 59 | 25% | 4% | 30% | 5% | 40% | | 30% | | 30% |
| 60 | 19% | 5% | 22% | 5% | 100% | | 30% | | 100% |
| 61 | 18% | 5% | 22% | 5% | 100% | | 30% | | 100% |
| 62 | 40% | 40% | 36% | 30% | 100% | | 30% | 10% | 100% |
| 63 | 35% | 35% | 22% | 30% | 100% | | 30% | 10% | 100% |
| 64 | 25% | 30% | 20% | 25% | 100% | | 30% | 10% | 100% |
| 65 | 35% | | 35% | | 100% | | 30% | 10% | 100% |
| 66 | 40% | | 45% | | 100% | | 30% | 10% | 100% |
| 67 | 45% | | 40% | | 100% | 50% | 30% | | 100% |
| 68 | 30% | | 40% | | 100% | 50% | 30% | | 100% |
| 69 | 30% | | 40% | | 100% | 50% | 30% | | 100% |
| 70 | 40% | | 50% | | 100% | 100% | 100% | | 100% |
| 71 | 50% | | 50% | | 100% | 100% | 100% | | 100% |
| 72 | 50% | | 100% | | 100% | 100% | 100% | | 100% |
| 73 | 50% | | 100% | | 100% | 100% | 100% | | 100% |
| 74 | 100% | | 100% | | 100% | 100% | 100% | | 100% |

# Table VII
# Rates of Disability

## All Plan Participants

| Age | % of Active Participants Becoming Disabled | | | |
|---|---|---|---|---|
| | Uniformed Members | | Non-Uniformed Members | |
| | Male | Female | Male | Female |
| 20 | 0.10% | 0.10% | 0.06% | 0.06% |
| 21 | 0.10% | 0.10% | 0.06% | 0.06% |
| 22 | 0.10% | 0.10% | 0.07% | 0.07% |
| 23 | 0.10% | 0.10% | 0.07% | 0.07% |
| 24 | 0.10% | 0.10% | 0.07% | 0.07% |
| 25 | 0.10% | 0.10% | 0.08% | 0.08% |
| 26 | 0.10% | 0.10% | 0.08% | 0.08% |
| 27 | 0.10% | 0.10% | 0.09% | 0.09% |
| 28 | 0.10% | 0.10% | 0.09% | 0.09% |
| 29 | 0.10% | 0.10% | 0.09% | 0.09% |
| 30 | 0.10% | 0.10% | 0.10% | 0.10% |
| 31 | 0.10% | 0.10% | 0.10% | 0.10% |
| 32 | 0.10% | 0.10% | 0.11% | 0.11% |
| 33 | 0.10% | 0.10% | 0.11% | 0.11% |
| 34 | 0.10% | 0.10% | 0.12% | 0.12% |
| 35 | 0.10% | 0.10% | 0.13% | 0.13% |
| 36 | 0.10% | 0.10% | 0.13% | 0.13% |
| 37 | 0.10% | 0.10% | 0.14% | 0.14% |
| 38 | 0.10% | 0.10% | 0.14% | 0.14% |
| 39 | 0.10% | 0.10% | 0.15% | 0.15% |
| 40 | 0.10% | 0.10% | 0.17% | 0.17% |
| 41 | 0.10% | 0.10% | 0.19% | 0.19% |
| 42 | 0.10% | 0.10% | 0.21% | 0.21% |
| 43 | 0.10% | 0.10% | 0.23% | 0.23% |
| 44 | 0.10% | 0.10% | 0.24% | 0.24% |
| 45 | 0.10% | 0.10% | 0.27% | 0.27% |
| 46 | 0.10% | 0.10% | 0.30% | 0.30% |
| 47 | 0.10% | 0.10% | 0.32% | 0.32% |
| 48 | 0.10% | 0.10% | 0.36% | 0.36% |
| 49 | 0.10% | 0.10% | 0.41% | 0.41% |
| 50 | 0.10% | 0.10% | 0.46% | 0.46% |
| 51 | 0.10% | 0.10% | 0.52% | 0.52% |
| 52 | 0.10% | 0.10% | 0.59% | 0.59% |
| 53 | 0.10% | 0.10% | 0.68% | 0.68% |
| 54 | 0.10% | 0.10% | 0.77% | 0.77% |
| 55 | 0.10% | 0.10% | 0.86% | 0.86% |
| 56 | 0.10% | 0.10% | 0.97% | 0.97% |
| 57 | 0.10% | 0.10% | 1.09% | 1.09% |
| 58 | 0.10% | 0.10% | 1.22% | 1.22% |
| 59 | 0.10% | 0.10% | 1.35% | 1.35% |
| 60 | 0.10% | 0.10% | 1.49% | 1.49% |
| 61 | 0.10% | 0.10% | 1.64% | 1.64% |
| 62 | 0.10% | 0.10% | 1.80% | 1.80% |
| 63 | 0.10% | 0.10% | 1.97% | 1.97% |
| 64 | 0.10% | 0.10% | 2.15% | 2.15% |
| 65 | 0.10% | 0.10% | 0.00% | 0.00% |
| 66 | 0.10% | 0.10% | 0.00% | 0.00% |
| 67 | 0.10% | 0.10% | 0.00% | 0.00% |
| 68 | 0.10% | 0.10% | 0.00% | 0.00% |
| 69 | 0.10% | 0.10% | 0.00% | 0.00% |
| 70 | 0.10% | 0.10% | 0.00% | 0.00% |
| 71 | 0.10% | 0.10% | 0.00% | 0.00% |
| 72 | 0.10% | 0.10% | 0.00% | 0.00% |

# Table VIII
# Table Rates of Separation from Active Employment

## All Plan Participants

| Age | Service | % of Active Participants Withdrawing | | | |
|---|---|---|---|---|---|
| | | Uniformed Members | | Non-Uniformed Members | |
| | | Male | Female | Male | Female |
| | 0-1 | 12.00% | 12.00% | 30.00% | 20.00% |
| | 1-2 | 6.00% | 6.00% | 16.00% | 14.00% |
| | 2-3 | 2.50% | 2.50% | 9.00% | 11.00% |
| | 3-4 | 2.50% | 2.50% | 7.00% | 9.00% |
| | 4-5 | 2.50% | 2.50% | 5.50% | 6.00% |
| 25 | 5 & Up | 1.89% | 1.89% | 5.60% | 6.00% |
| 26 | | 1.89% | 1.89% | 5.60% | 6.00% |
| 27 | | 1.89% | 1.89% | 5.60% | 6.00% |
| 28 | | 1.89% | 1.89% | 5.60% | 6.00% |
| 29 | | 1.89% | 1.89% | 5.60% | 6.00% |
| 30 | | 1.89% | 1.89% | 5.60% | 6.00% |
| 31 | | 1.89% | 1.89% | 5.53% | 6.00% |
| 32 | | 1.83% | 1.83% | 5.46% | 6.00% |
| 33 | | 1.65% | 1.65% | 5.39% | 6.00% |
| 34 | | 1.49% | 1.49% | 5.32% | 6.00% |
| 35 | | 1.34% | 1.34% | 5.25% | 6.00% |
| 36 | | 1.19% | 1.19% | 5.18% | 6.00% |
| 37 | | 1.06% | 1.06% | 5.11% | 6.00% |
| 38 | | 0.95% | 0.95% | 5.04% | 6.00% |
| 39 | | 0.86% | 0.86% | 4.97% | 5.78% |
| 40 | | 0.79% | 0.79% | 4.90% | 5.54% |
| 41 | | 0.74% | 0.74% | 4.48% | 5.29% |
| 42 | | 0.69% | 0.69% | 4.06% | 5.05% |
| 43 | | 0.64% | 0.64% | 3.64% | 4.81% |
| 44 | | 0.60% | 0.60% | 3.22% | 4.56% |
| 45 | | 0.55% | 0.55% | 2.80% | 4.32% |
| 46 | | 0.50% | 0.50% | 2.66% | 4.12% |
| 47 | | 0.46% | 0.46% | 2.52% | 3.92% |
| 48 | | 0.41% | 0.41% | 2.38% | 3.72% |
| 49 | | 0.36% | 0.36% | 2.24% | 3.36% |
| 50 | | 0.32% | 0.32% | 2.10% | 3.00% |
| 51 | | 0.27% | 0.27% | 1.96% | 3.00% |
| 52 | | 0.23% | 0.23% | 1.82% | 3.00% |
| 53 | | 0.21% | 0.21% | 1.68% | 3.00% |
| 54 | | 0.19% | 0.19% | 1.54% | 3.00% |
| 55 | | 0.16% | 0.16% | 1.40% | 3.00% |
| 56 | | 0.17% | 0.17% | 1.40% | 3.00% |
| 57 | | 0.13% | 0.13% | 1.40% | 3.00% |
| 58 | | 0.13% | 0.13% | 1.40% | 3.00% |
| 59 | | 0.13% | 0.13% | 1.40% | 3.00% |
| 60 | | 0.12% | 0.12% | 1.40% | 3.00% |