GRS

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January 31, 2017

CONFIDENTIAL

Ms. Erin Leonard
Executive Director
Minnesota State Retirement System
60 Empire Drive, Suite 300
St. Paul, MN 55103

**Re: Projection of Contributions and Funding Status – Correctional Plan**

Dear Erin:

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

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

Additionally, the proposed Allowance for Combined Service Annuity assumption change is reflected in this report. The liabilities for former vested members are increased by 17% and liabilities for former non-vested members are increased by 6% to account for the effect of some participants having eligibility for a Combined Service Annuity.

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

Note that as funding ratios decline, as they are expected to in some of the investment return scenarios shown in this letter, it will be increasingly difficult for the plan to attain the assumed investment return. Each year, a larger proportion of assets is paid out in benefits, and less capital is available to invest.

The estimates are based on the market value of assets with no smoothing of investment gains or losses. In all scenarios, the valuation interest rate used to discount liabilities was 8.0%. Payroll is assumed to increase approximately 3.5% per year over the long-term, consistent with the valuation assumption for total payroll growth.

The projection is an open group projection; meaning, active members projected to retire or otherwise terminate in the future are replaced with new active members so that the total active membership of the fund remains at 311 members. The profile of these new members is the same as new members of each fund hired between July 1, 2010 and July 1, 2015:

- Average age at hire is 34.0
- Average salary at hire is $42,600
- Approximately 45% female, 55% male

If actuarial accrued liability exceeds assets, the unfunded actuarial accrued liability is amortized through June 30, 2038 per Minnesota Statute 356.215, Subdivision 11. As directed by MSRS, the statutory amortization date is assumed to be changed to June 30, 2068 once the current period expires in 2038. Per Minnesota Statute 356.215, Subdivision 11 (l), a negative unfunded actuarial accrued liability (i.e., when assets exceed liability) is amortized over a rolling 30-year period.

**Post-Retirement Benefit Increases**

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

For the 8.0% scenario, an actuarial projection was performed to estimate if and when this plan is expected to attain the threshold required to pay a 2.5% post-retirement benefit increase. The projection indicated that if all assumptions were met, this plan is not expected to attain the accrued liability funding ratio threshold required to pay a 2.5% post-retirement benefit increase and will pay a 2.0% benefit increase indefinitely. This assumption is reflected in the 8.0% and 6.5% rate of return projection scenarios. Based on present expectations, the 6.5% scenario is the only scenario of the three that has a better than 50% chance of being achieved.

Under the 9.5% rate of return scenario, the funded status of the plan is expected to improve, as the plan experiences greater than expected investment return each year. Based on present expectations, the 9.5% rate of return scenario is a very low probability outcome. We performed a projection to estimate if and when the plan is expected to attain the threshold required to pay a 2.5% post-retirement benefit increase if future investment returns are 9.5%. This projection indicated the plan would begin paying a 2.5% benefit increase on January 1, 2036. To approximate the acceleration of the assumed 2.5% benefit increase date to 2036, we assumed the accrued liability and normal cost would increase by a proportionate amount between 2016 and 2036.

**Comments**

To the best of our knowledge and belief, the calculations were completed in accordance with the requirements of Minnesota Statutes, Section 356.215, and the requirements of the Standards for Actuarial Work established by the Legislative Commission on Pensions and Retirement.

This report should not be relied upon for any purpose other than the purpose described herein. Determinations of the financial results associated with the benefits described in this report in a manner other than the intended purpose may produce significantly different results. GRS is not responsible for the consequences of any unauthorized use.

The valuation was based upon information furnished by the Minnesota State Retirement System (MSRS), concerning benefits, financial transactions, plan provisions and active members, terminated members, retirees and beneficiaries.

Actuarial assumptions, including discount rates, mortality tables and others identified in this report, are prescribed by Minnesota Statutes Section 356.215, the Legislative Commission on Pensions and Retirement (LCPR), and the Board of Directors. These parties are responsible for selecting the plan's funding policy, actuarial valuation methods, asset valuation methods, and assumptions. The policies, methods and assumptions used in this valuation are those that have been so prescribed and are described in the Actuarial Basis of the valuation report, except as noted. MSRS is solely responsible for communicating to GRS any changes required thereto.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law.

**Professional Qualifications**

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

Bonita J. Wurst and Brian B. Murphy are Members of the American Academy of Actuaries (MAAA) and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein. In addition, Mr. Murphy meets the requirements of "approved actuary" under Minnesota Statutes Section 356.215, Subdivision 1, Paragraph (c).

This report has been prepared by actuaries who have substantial experience valuing public employee retirement systems. To the best of our knowledge and belief, the information contained in this report is accurate and fairly presents the actuarial position of the Correctional Employees Retirement Fund as of the valuation date and was performed in accordance with the requirements of Minnesota Statutes Section 356.215, and the requirements of the Standards for Actuarial Work established by the LCPR. All calculations have been made in conformity with generally accepted actuarial principles and practices, and with the Actuarial Standards of Practice issued by the Actuarial Standards Board and with applicable statutes.

Sincerely,

Bonita J. Wurst

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

Brian B. Murphy

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

BJW/BBM:sc
Enclosures

# Other Observations

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

Given the plan's contribution allocation procedure, if there are no changes in benefits or contributions and all actuarial assumptions are met (including the assumption of the plan earning 8.0% on the market value of assets), it is expected that:

(1) The unfunded actuarial accrued liabilities will increase and not be eliminated,
(2) The funded status of the plan will decrease, and
(3) The plan may eventually become insolvent and unable to pay benefits.

**Limitations of Funded Status Measurements**

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

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

**Limitations of Project Scope**

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

# Other Observations

## Discount Rate Assumption

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

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

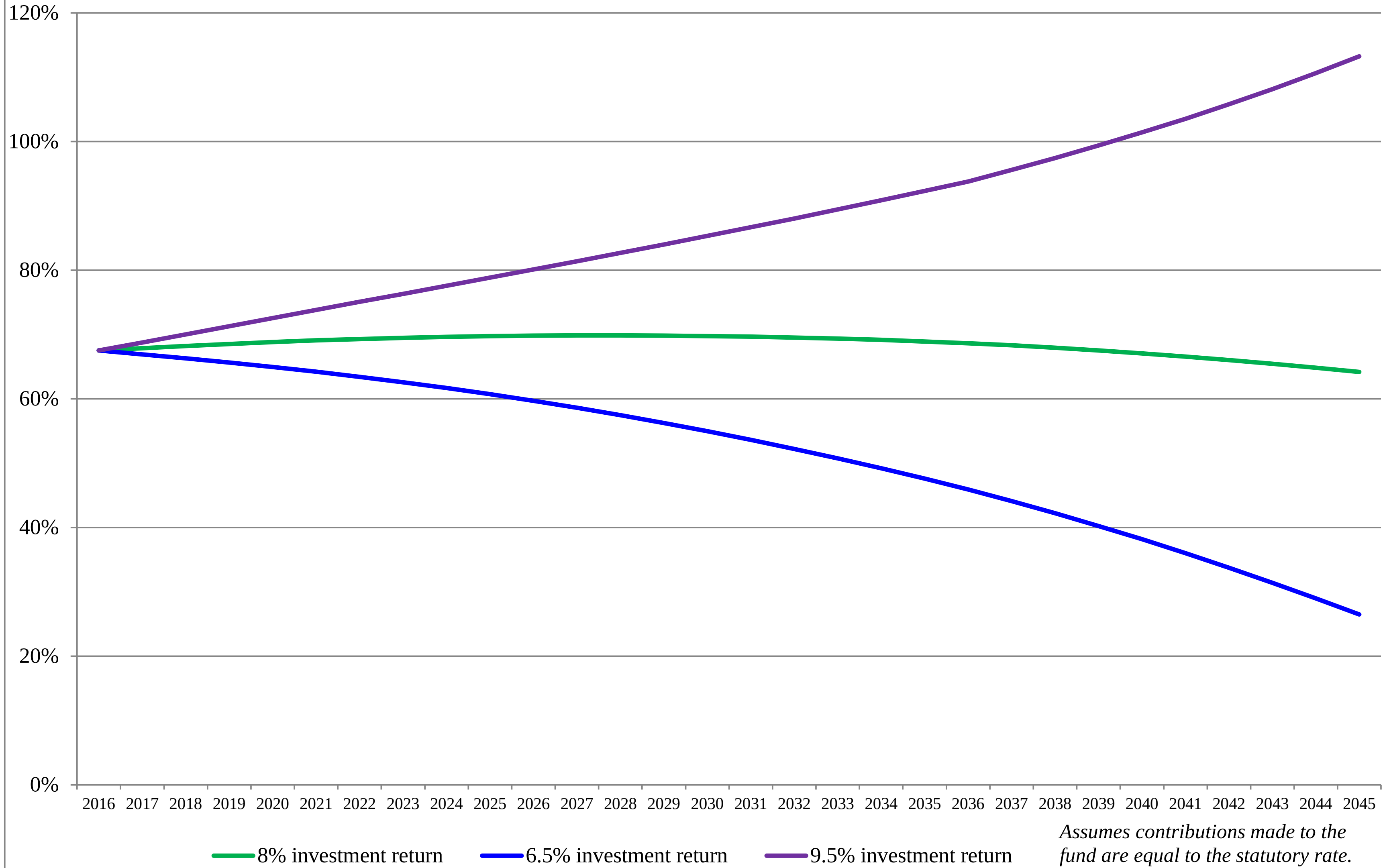
In May 2016, the Minnesota State Board of Investment (SBI) affirmed that the 8.00% return rate is attainable in the long term, while acknowledging short-term challenges. Also in May 2016, the LCPR's Actuary supported the reasonableness of the current rate by reviewing historical returns by investment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

If a discount rate of 7.50% were used in the July 1, 2016 valuation instead of 8.00%, we estimate that the unfunded liability would be approximately $80 million higher than estimated in the 2016 valuation. This estimate incorporates lower salary scale rates due to lower inflation expectations.

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

# Correctional Employees Retirement Fund
# Estimated Funded Ratio

*In all scenarios, the interest rate used to discount liabilities was 8.0%.*

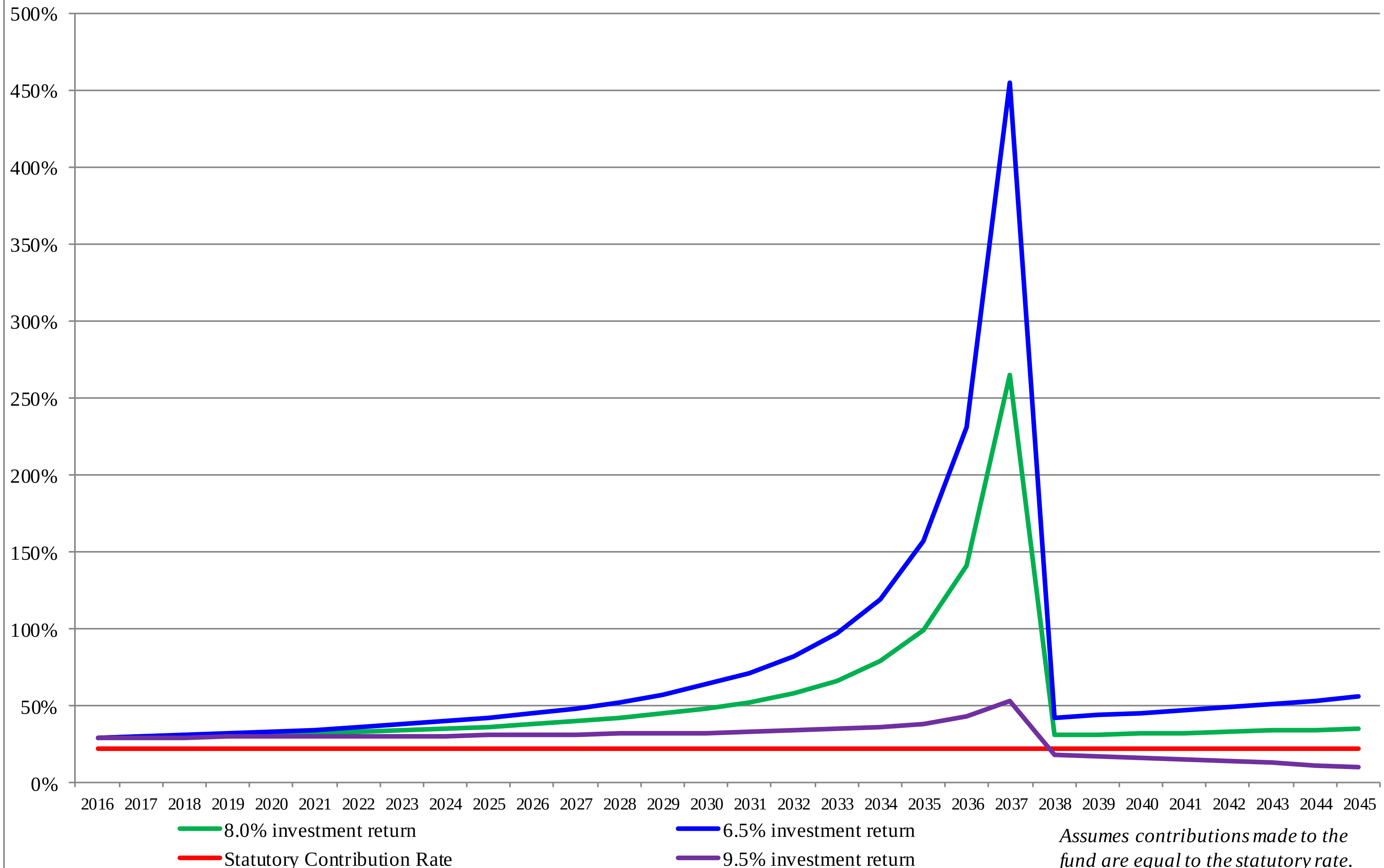



*Assumes contributions made to the fund are equal to the statutory rate.*

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

## Correctional Employees Retirement Fund
## Estimated Required Contribution Rates (% of Pay)

*In all scenarios, the interest rate used to discount liabilities was 8.0%.*




*Assumes contributions made to the fund are equal to the statutory rate.*

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

**Correctional Employees Retirement Fund**

**Scenario: 8.0% investment return for all years**

**Fiscal year beginning July 1**

| $ in Thousands | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Contributions (% of Payroll)** | | | | | | | | | | |
| Statutory - Chapter 352 | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% |
| Required - Chapter 356 (MVA) | 29.5% | 29.9% | 30.4% | 30.9% | 31.6% | 32.3% | 33.2% | 34.1% | 35.2% | 36.5% |
| Sufficiency / (Deficiency) | (7.6)% | (8.0)% | (8.4)% | (9.0)% | (9.6)% | (10.4)% | (11.2)% | (12.2)% | (13.3)% | (14.6)% |
| | | | | | | | | | | |
| **Contributions** | | | | | | | | | | |
| Statutory - Chapter 352 | 55,000 | 56,876 | 58,842 | 60,778 | 62,712 | 64,761 | 66,874 | 69,134 | 71,451 | 73,793 |
| Required - Chapter 356 (MVA) | 73,921 | 77,501 | 81,419 | 85,625 | 90,203 | 95,308 | 100,991 | 107,417 | 114,635 | 122,787 |
| Sufficiency / (Deficiency) | (18,921) | (20,625) | (22,577) | (24,847) | (27,491) | (30,547) | (34,117) | (38,283) | (43,184) | (48,994) |
| | | | | | | | | | | |
| **Funding Ratios** | | | | | | | | | | |
| Current Assets (MVA) | 899,592 | 959,191 | 1,021,448 | 1,086,527 | 1,154,494 | 1,224,697 | 1,296,878 | 1,371,126 | 1,447,375 | 1,525,641 |
| Actuarial Accrued Liability (AAL) | 1,332,640 | 1,413,311 | 1,497,554 | 1,585,543 | 1,677,484 | 1,772,842 | 1,871,410 | 1,973,389 | 2,078,767 | 2,187,691 |
| Unfunded AAL | 433,048 | 454,120 | 476,106 | 499,016 | 522,990 | 548,145 | 574,532 | 602,263 | 631,392 | 662,050 |
| Funding Ratio | 68% | 68% | 68% | 69% | 69% | 69% | 69% | 69% | 70% | 70% |
| | | | | | | | | | | |
| **Benefit Payments** | 65,941 | 69,813 | 73,820 | 77,952 | 82,931 | 88,443 | 94,084 | 100,092 | 106,294 | 112,783 |

*Numbers may not add due to rounding.*

*The interest rate used to discount liabilities was 8.0%.*

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

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

| **$ in Thousands** | **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Contributions (% of Payroll)** | | | | | | | | | | |
| Statutory - Chapter 352 | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% |
| Required - Chapter 356 (MVA) | 38.1% | 39.9% | 42.1% | 44.8% | 48.2% | 52.5% | 58.4% | 66.6% | 79.0% | 99.6% |
| Sufficiency / (Deficiency) | (16.1)% | (17.9)% | (20.1)% | (22.8)% | (26.2)% | (30.6)% | (36.4)% | (44.7)% | (57.0)% | (77.7)% |
| | | | | | | | | | | |
| **Contributions** | | | | | | | | | | |
| Statutory - Chapter 352 | 76,258 | 78,869 | 81,558 | 84,305 | 87,176 | 90,132 | 93,198 | 96,396 | 99,671 | 103,001 |
| Required - Chapter 356 (MVA) | 132,213 | 143,256 | 156,297 | 171,961 | 191,273 | 215,742 | 247,940 | 292,479 | 358,520 | 467,514 |
| Sufficiency / (Deficiency) | (55,955) | (64,387) | (74,739) | (87,656) | (104,097) | (125,610) | (154,742) | (196,083) | (258,849) | (364,513) |
| | | | | | | | | | | |
| **Funding Ratios** | | | | | | | | | | |
| Current Assets (MVA) | 1,605,814 | 1,687,445 | 1,770,718 | 1,855,737 | 1,942,300 | 2,030,347 | 2,119,860 | 2,210,660 | 2,302,741 | 2,395,708 |
| Actuarial Accrued Liability (AAL) | 2,300,167 | 2,415,837 | 2,535,010 | 2,657,945 | 2,784,592 | 2,915,017 | 3,049,379 | 3,187,674 | 3,330,067 | 3,476,402 |
| Unfunded AAL | 694,353 | 728,392 | 764,292 | 802,208 | 842,292 | 884,670 | 929,519 | 977,014 | 1,027,326 | 1,080,694 |
| Funding Ratio | 70% | 70% | 70% | 70% | 70% | 70% | 70% | 69% | 69% | 69% |
| | | | | | | | | | | |
| **Benefit Payments** | 119,971 | 127,237 | 134,606 | 142,362 | 150,413 | 158,682 | 167,343 | 176,239 | 185,689 | 195,948 |

*Numbers may not add due to rounding.*

*The interest rate used to discount liabilities was 8.0%.*

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

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

| **$ in Thousands** | **2036** | **2037** | **2038** | **2039** | **2040** | **2041** | **2042** | **2043** | **2044** | **2045** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Contributions (% of Payroll)** | | | | | | | | | | |
| Statutory - Chapter 352 | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% |
| Required - Chapter 356 (MVA) | 141.0% | 265.0% | 30.8% | 31.3% | 31.9% | 32.5% | 33.2% | 33.9% | 34.7% | 35.6% |
| Sufficiency / (Deficiency) | (119.0)% | (243.1)% | (8.8)% | (9.4)% | (10.0)% | (10.6)% | (11.2)% | (12.0)% | (12.8)% | (13.6)% |
| | | | | | | | | | | |
| **Contributions** | | | | | | | | | | |
| Statutory - Chapter 352 | 106,476 | 110,136 | 113,900 | 117,778 | 121,871 | 126,084 | 130,481 | 135,047 | 139,739 | 144,625 |
| Required - Chapter 356 (MVA) | 683,933 | 1,329,772 | 159,765 | 168,083 | 177,093 | 186,779 | 197,273 | 208,647 | 220,976 | 234,439 |
| Sufficiency / (Deficiency) | (577,457) | (1,219,636) | (45,865) | (50,305) | (55,222) | (60,695) | (66,792) | (73,600) | (81,237) | (89,814) |
| | | | | | | | | | | |
| **Funding Ratios** | | | | | | | | | | |
| Current Assets (MVA) | 2,488,844 | 2,581,455 | 2,673,586 | 2,765,177 | 2,855,770 | 2,945,455 | 3,034,534 | 3,122,872 | 3,210,564 | 3,297,402 |
| Actuarial Accrued Liability (AAL) | 3,626,218 | 3,779,033 | 3,935,115 | 4,094,701 | 4,257,640 | 4,424,281 | 4,595,281 | 4,770,843 | 4,951,433 | 5,137,287 |
| Unfunded AAL | 1,137,374 | 1,197,578 | 1,261,529 | 1,329,524 | 1,401,870 | 1,478,826 | 1,560,747 | 1,647,971 | 1,740,869 | 1,839,885 |
| Funding Ratio | 69% | 68% | 68% | 68% | 67% | 67% | 66% | 65% | 65% | 64% |
| | | | | | | | | | | |
| **Benefit Payments** | 207,033 | 218,215 | 229,520 | 241,336 | 253,200 | 264,823 | 276,707 | 288,610 | 300,788 | 313,458 |

*Numbers may not add due to rounding.*

*The interest rate used to discount liabilities was 8.0%.*

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

**Correctional Employees Retirement Fund**

**Scenario: 6.5% investment return for all years**

**Fiscal year beginning July 1**

| $ in Thousands | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Contributions (% of Payroll)** | | | | | | | | | | |
| Statutory - Chapter 352 | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% |
| Required - Chapter 356 (MVA) | 29.5% | 30.3% | 31.2% | 32.2% | 33.4% | 34.8% | 36.3% | 38.1% | 40.1% | 42.5% |
| Sufficiency / (Deficiency) | (7.6)% | (8.3)% | (9.2)% | (10.3)% | (11.5)% | (12.8)% | (14.4)% | (16.1)% | (18.2)% | (20.6)% |
| | | | | | | | | | | |
| **Contributions** | | | | | | | | | | |
| Statutory - Chapter 352 | 55,000 | 56,876 | 58,842 | 60,778 | 62,712 | 64,761 | 66,874 | 69,134 | 71,451 | 73,793 |
| Required - Chapter 356 (MVA) | 73,921 | 78,487 | 83,584 | 89,199 | 95,459 | 102,574 | 110,659 | 119,965 | 130,650 | 142,996 |
| Sufficiency / (Deficiency) | (18,921) | (21,611) | (24,742) | (28,421) | (32,747) | (37,813) | (43,785) | (50,831) | (59,199) | (69,203) |
| | | | | | | | | | | |
| **Funding Ratios** | | | | | | | | | | |
| Current Assets (MVA) | 899,592 | 945,787 | 992,888 | 1,040,910 | 1,089,750 | 1,138,587 | 1,186,986 | 1,234,851 | 1,281,916 | 1,327,988 |
| Actuarial Accrued Liability (AAL) | 1,332,640 | 1,413,311 | 1,497,554 | 1,585,543 | 1,677,484 | 1,772,842 | 1,871,410 | 1,973,389 | 2,078,767 | 2,187,691 |
| Unfunded AAL | 433,048 | 467,524 | 504,666 | 544,633 | 587,734 | 634,255 | 684,424 | 738,538 | 796,851 | 859,703 |
| Funding Ratio | 68% | 67% | 66% | 66% | 65% | 64% | 63% | 63% | 62% | 61% |
| | | | | | | | | | | |
| **Benefit Payments** | 65,941 | 69,813 | 73,820 | 77,952 | 82,931 | 88,443 | 94,084 | 100,092 | 106,294 | 112,783 |

*Numbers may not add due to rounding.*

*The interest rate used to discount liabilities was 8.0%.*

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

**Correctional Employees Retirement Fund**

**Scenario: 6.5% investment return for all years**

**Fiscal year beginning July 1**

| **$ in Thousands** | **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Contributions (% of Payroll)** | | | | | | | | | | |
| Statutory - Chapter 352 | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% |
| Required - Chapter 356 (MVA) | 45.3% | 48.7% | 52.7% | 57.6% | 63.8% | 71.7% | 82.4% | 97.2% | 119.6% | 156.9% |
| Sufficiency / (Deficiency) | (23.4)% | (26.7)% | (30.7)% | (35.7)% | (41.8)% | (49.8)% | (60.4)% | (75.3)% | (97.6)% | (135.0)% |
| | | | | | | | | | | |
| **Contributions** | | | | | | | | | | |
| Statutory - Chapter 352 | 76,258 | 78,869 | 81,558 | 84,305 | 87,176 | 90,132 | 93,198 | 96,396 | 99,671 | 103,001 |
| Required - Chapter 356 (MVA) | 157,534 | 174,866 | 195,731 | 221,279 | 253,316 | 294,582 | 349,700 | 426,975 | 542,951 | 736,309 |
| Sufficiency / (Deficiency) | (81,276) | (95,997) | (114,173) | (136,974) | (166,140) | (204,450) | (256,502) | (330,579) | (443,280) | (633,308) |
| | | | | | | | | | | |
| **Funding Ratios** | | | | | | | | | | |
| Current Assets (MVA) | 1,372,731 | 1,415,462 | 1,456,117 | 1,494,535 | 1,530,230 | 1,562,844 | 1,592,040 | 1,617,301 | 1,638,266 | 1,654,158 |
| Actuarial Accrued Liability (AAL) | 2,300,167 | 2,415,837 | 2,535,010 | 2,657,945 | 2,784,592 | 2,915,017 | 3,049,379 | 3,187,674 | 3,330,067 | 3,476,402 |
| Unfunded AAL | 927,436 | 1,000,375 | 1,078,893 | 1,163,410 | 1,254,362 | 1,352,173 | 1,457,339 | 1,570,373 | 1,691,801 | 1,822,244 |
| Funding Ratio | 60% | 59% | 57% | 56% | 55% | 54% | 52% | 51% | 49% | 48% |
| | | | | | | | | | | |
| **Benefit Payments** | 119,971 | 127,237 | 134,606 | 142,362 | 150,413 | 158,682 | 167,343 | 176,239 | 185,689 | 195,948 |

*Numbers may not add due to rounding.*

*The interest rate used to discount liabilities was 8.0%.*

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

**Correctional Employees Retirement Fund**

**Scenario: 6.5% investment return for all years**

**Fiscal year beginning July 1**

| **$ in Thousands** | **2036** | **2037** | **2038** | **2039** | **2040** | **2041** | **2042** | **2043** | **2044** | **2045** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Contributions (% of Payroll)** | | | | | | | | | | |
| Statutory - Chapter 352 | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% |
| Required - Chapter 356 (MVA) | 231.6% | 455.2% | 42.6% | 44.1% | 45.7% | 47.5% | 49.4% | 51.4% | 53.7% | 56.1% |
| Sufficiency / (Deficiency) | (209.6)% | (433.3)% | (20.6)% | (22.1)% | (23.8)% | (25.5)% | (27.4)% | (29.5)% | (31.7)% | (34.1)% |
| | | | | | | | | | | |
| **Contributions** | | | | | | | | | | |
| Statutory - Chapter 352 | 106,476 | 110,136 | 113,900 | 117,778 | 121,871 | 126,084 | 130,481 | 135,047 | 139,739 | 144,625 |
| Required - Chapter 356 (MVA) | 1,123,207 | 2,284,061 | 220,776 | 236,575 | 253,893 | 272,813 | 293,584 | 316,416 | 341,542 | 369,328 |
| Sufficiency / (Deficiency) | (1,016,731) | (2,173,925) | (106,876) | (118,797) | (132,022) | (146,729) | (163,103) | (181,369) | (201,803) | (224,703) |
| | | | | | | | | | | |
| **Funding Ratios** | | | | | | | | | | |
| Current Assets (MVA) | 1,663,869 | 1,666,292 | 1,661,040 | 1,647,594 | 1,625,008 | 1,592,858 | 1,550,893 | 1,498,390 | 1,434,817 | 1,359,299 |
| Actuarial Accrued Liability (AAL) | 3,626,218 | 3,779,033 | 3,935,115 | 4,094,701 | 4,257,640 | 4,424,281 | 4,595,281 | 4,770,843 | 4,951,433 | 5,137,287 |
| Unfunded AAL | 1,962,349 | 2,112,741 | 2,274,075 | 2,447,107 | 2,632,632 | 2,831,423 | 3,044,388 | 3,272,453 | 3,516,616 | 3,777,988 |
| Funding Ratio | 46% | 44% | 42% | 40% | 38% | 36% | 34% | 31% | 29% | 26% |
| | | | | | | | | | | |
| **Benefit Payments** | 207,033 | 218,215 | 229,520 | 241,336 | 253,200 | 264,823 | 276,707 | 288,610 | 300,788 | 313,458 |

*Numbers may not add due to rounding.*

*The interest rate used to discount liabilities was 8.0%.*

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

**Correctional Employees Retirement Fund**

**Scenario: 9.5% investment return for all years**

**Fiscal year beginning July 1**

| $ in Thousands | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Contributions (% of Payroll)** | | | | | | | | | | |
| Statutory - Chapter 352 | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% |
| Required - Chapter 356 (MVA) | 29.5% | 29.6% | 29.7% | 29.8% | 30.0% | 30.1% | 30.3% | 30.5% | 30.7% | 31.0% |
| Sufficiency / (Deficiency) | (7.6)% | (7.6)% | (7.7)% | (7.9)% | (8.0)% | (8.2)% | (8.4)% | (8.6)% | (8.8)% | (9.0)% |
| | | | | | | | | | | |
| **Contributions** | | | | | | | | | | |
| Statutory - Chapter 352 | 55,000 | 56,876 | 58,842 | 60,778 | 62,712 | 64,761 | 66,874 | 69,134 | 71,451 | 73,793 |
| Required - Chapter 356 (MVA) | 73,921 | 76,670 | 79,576 | 82,552 | 85,635 | 88,924 | 92,398 | 96,129 | 100,048 | 104,141 |
| Sufficiency / (Deficiency) | (18,921) | (19,794) | (20,734) | (21,774) | (22,923) | (24,163) | (25,524) | (26,995) | (28,597) | (30,348) |
| | | | | | | | | | | |
| **Funding Ratios** | | | | | | | | | | |
| Current Assets (MVA) | 899,592 | 972,596 | 1,050,409 | 1,133,442 | 1,222,028 | 1,315,804 | 1,414,825 | 1,519,519 | 1,630,192 | 1,747,268 |
| Actuarial Accrued Liability (AAL) | 1,332,640 | 1,414,473 | 1,500,209 | 1,590,083 | 1,684,365 | 1,782,594 | 1,884,647 | 1,990,816 | 2,101,189 | 2,216,025 |
| Unfunded AAL | 433,048 | 441,877 | 449,800 | 456,641 | 462,337 | 466,790 | 469,822 | 471,297 | 470,997 | 468,757 |
| Funding Ratio | 68% | 69% | 70% | 71% | 73% | 74% | 75% | 76% | 78% | 79% |
| | | | | | | | | | | |
| **Benefit Payments** | 65,941 | 69,813 | 73,820 | 77,952 | 82,931 | 88,443 | 94,084 | 100,092 | 106,294 | 112,783 |

*Numbers may not add due to rounding.*

*The interest rate used to discount liabilities was 8.0%.*

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

**Correctional Employees Retirement Fund**

**Scenario: 9.5% investment return for all years**

**Fiscal year beginning July 1**

| $ in Thousands | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Contributions (% of Payroll)** | | | | | | | | | | |
| Statutory - Chapter 352 | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% |
| Required - Chapter 356 (MVA) | 31.2% | 31.5% | 31.9% | 32.3% | 32.7% | 33.3% | 34.0% | 35.0% | 36.4% | 38.6% |
| Sufficiency / (Deficiency) | (9.3)% | (9.6)% | (9.9)% | (10.3)% | (10.8)% | (11.3)% | (12.1)% | (13.0)% | (14.4)% | (16.7)% |
| | | | | | | | | | | |
| **Contributions** | | | | | | | | | | |
| Statutory - Chapter 352 | 76,258 | 78,869 | 81,558 | 84,305 | 87,176 | 90,132 | 93,198 | 96,396 | 99,671 | 103,001 |
| Required - Chapter 356 (MVA) | 108,541 | 113,307 | 118,416 | 123,915 | 129,961 | 136,691 | 144,392 | 153,558 | 165,110 | 181,265 |
| Sufficiency / (Deficiency) | (32,283) | (34,438) | (36,858) | (39,610) | (42,785) | (46,559) | (51,194) | (57,162) | (65,439) | (78,264) |
| | | | | | | | | | | |
| **Funding Ratios** | | | | | | | | | | |
| Current Assets (MVA) | 1,871,079 | 2,001,661 | 2,139,721 | 2,285,941 | 2,440,746 | 2,604,764 | 2,778,727 | 2,963,274 | 3,159,296 | 3,367,370 |
| Actuarial Accrued Liability (AAL) | 2,335,452 | 2,459,246 | 2,587,867 | 2,721,733 | 2,860,972 | 3,005,844 | 3,156,720 | 3,313,828 | 3,477,588 | 3,648,118 |
| Unfunded AAL | 464,373 | 457,585 | 448,146 | 435,792 | 420,226 | 401,080 | 377,993 | 350,554 | 318,292 | 280,748 |
| Funding Ratio | 80% | 81% | 83% | 84% | 85% | 87% | 88% | 89% | 91% | 92% |
| | | | | | | | | | | |
| **Benefit Payments** | 119,971 | 127,237 | 134,606 | 142,362 | 150,413 | 158,682 | 167,343 | 176,239 | 185,689 | 196,609 |

*Numbers may not add due to rounding.*

*The interest rate used to discount liabilities was 8.0%.*

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

**Correctional Employees Retirement Fund**
**Scenario: 9.5% investment return for all years**
**Fiscal year beginning July 1**

| **$ in Thousands** | **2036** | **2037** | **2038** | **2039** | **2040** | **2041** | **2042** | **2043** | **2044** | **2045** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Contributions (% of Payroll)** | | | | | | | | | | |
| Statutory - Chapter 352 | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% | 22.0% |
| Required - Chapter 356 (MVA) | 43.0% | 53.7% | 18.2% | 17.3% | 16.3% | 15.2% | 14.1% | 12.9% | 11.7% | 10.3% |
| Sufficiency / (Deficiency) | (21.1)% | (31.8)% | 3.7% | 4.7% | 5.7% | 6.7% | 7.8% | 9.0% | 10.3% | 11.6% |
| | | | | | | | | | | |
| **Contributions** | | | | | | | | | | |
| Statutory - Chapter 352 | 106,476 | 110,136 | 113,900 | 117,778 | 121,871 | 126,084 | 130,481 | 135,047 | 139,739 | 144,625 |
| Required - Chapter 356 (MVA) | 208,793 | 269,538 | 94,563 | 92,784 | 90,451 | 87,491 | 83,858 | 79,450 | 74,144 | 67,898 |
| Sufficiency / (Deficiency) | (102,317) | (159,402) | 19,337 | 24,994 | 31,420 | 38,593 | 46,623 | 55,597 | 65,595 | 76,727 |
| | | | | | | | | | | |
| **Funding Ratios** | | | | | | | | | | |
| Current Assets (MVA) | 3,587,348 | 3,819,193 | 4,064,058 | 4,323,101 | 4,597,191 | 4,887,873 | 5,197,042 | 5,526,319 | 5,877,716 | 6,253,126 |
| Actuarial Accrued Liability (AAL) | 3,824,770 | 3,995,969 | 4,171,012 | 4,350,126 | 4,533,155 | 4,720,437 | 4,912,625 | 5,109,922 | 5,312,789 | 5,521,461 |
| Unfunded AAL | 237,422 | 176,776 | 106,954 | 27,025 | (64,036) | (167,436) | (284,417) | (416,397) | (564,927) | (731,665) |
| Funding Ratio | 94% | 96% | 97% | 99% | 101% | 104% | 106% | 108% | 111% | 113% |
| | | | | | | | | | | |
| **Benefit Payments** | 208,645 | 220,838 | 233,210 | 246,149 | 259,190 | 272,044 | 285,207 | 298,440 | 311,996 | 326,088 |

*Numbers may not add due to rounding.*

*The interest rate used to discount liabilities was 8.0%.*